CK-12 Physics - Intermediate Quizzes and Tests

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Contents

CHAPTER 1 What is Science? Assessments

Chapter Outline

1.1 Scientific Inquiry

Lesson Quiz

Name________ Class________ Date________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Explain the role of using postulates in science.

1. Which of the following statements below is a scientific postulate?
   a. Isaac Newton was a great physicist.
   b. There are multiple universes even though scientists cannot find evidence of their existence.
   c. An atom is made up of protons, neutrons, and electrons.

Lesson Objective: Explain the role of mathematics in science.

2. Why are the laws of nature written as mathematical equations?

Lesson Objective: Explain how scientists investigate nature by ensuring their models can be proven incorrect (falsifiable) and are tested by many independent researchers.

3. Explain why the following statement is a misconception, "A scientific hypothesis is just a guess."

4. Which of the following is a valid scientific hypothesis?
   a. The flowers in my front yard are taller than the flowers in my backyard
   b. If exposure to sunlight in the front yard is increased, then the flowers in the front yard will grow taller
   c. Flowers need water
   d. None of the above

Lesson Objective: Describe the difference between a hypothesis, theory, and law.

5. Which statement below is a scientific law?
   a. The universe began with the Big Bang.
   b. Atoms are the smallest particles of matter.
   c. $V = d/t$ (Velocity equals distance divided by time)
   d. If a plant is placed in direct sunlight, then it will grow taller.

Lesson Objective: Explain that new theories explain phenomena more accurately than preexisting theories, and such theories are consistent with the correct predictions of previous theories.

6. How can a scientist guarantee that their experiment is repeatable?

Lesson Objective: Describe the scientific method.

7. Give an example of a hypothesis and describe how a scientist would try to prove the hypothesis.

Answer Key

1. C
2. The laws of nature are written as mathematical equations because they show a precise relationship between physical quantities and can be used to make predictions about future experiments.
3. A scientific hypothesis is more than just a guess, it is a prediction based on reason, evidence, and logic.
4. B
5. C
6. Every experimental step should be documented in a way that another person could follow them.
7. Answers will vary. *Sample Answer: Hypothesis - If the amount of sun is increased, then the sunflowers will grow taller. A scientist could increase the amount of sun that a group of sunflowers receives in increments of 1 hour and measure the height of the sunflowers over a period of 4 weeks. They would have to keep where the sunflowers are, the type of soil, and amount of water the sunflowers receive constant. A control group would be a group of sunflowers in the dark.*

1.2 Fundamental Units and Standard Units

Lesson Quiz

Name________ Class________ Date________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: List and use fundamental units in the study of mechanics.

1. What is the one measurement system that scientists all over the world use?
2. What are mass, length and time called?
3. Is this statement true or false: Velocity is a fundamental unit in physics. Explain the reason for your choice.

Lesson Objective: List and use standard units in the study of mechanics.

4. What is the standard unit for time?
   a. Hours
   b. Minutes
   c. Seconds
   d. Milliseconds
5. Which of the following is equal to 50 seconds?
   a. 50,000 ms
   b. 0.005 ms
   c. 0.5 s^2
   d. 5 s
6. Which of the following is equal to 700 g?
   a. 70 kg
   b. 7 kg
   c. 0.7 kg
   d. 0.007 kg

Lesson Objective: Use dimensional analysis.

7. Show how dimensional analysis can only help you determine the units of the elastic constant k using the following equation for the spring force: F_s = kx if F_s is the force in Newtons and x is the distanced stretched

in meters.

8. Dimensional analysis:
   a. is a method for scientists to write large numbers
   b. allows you to check mathematical equations and predict units
   c. is the process of determining which the digits in a number carry meaning
   d. all of the above
9. Use dimensional analysis to calculate how many seconds there are in an hour.

Answer Key

1. The International System of Units (abbreviated: SI units), based on the metric system
2. Fundamental Units
3. False - velocity (m/s) is derived from the two fundamental units of length (m) and time (s).
4. C
5. A
6. C
7. The units for the elastic constant k are N/m.

$$N = [k] \times m$$
$$\frac{N}{m} = [k] \times \frac{m}{m}$$
$$\frac{N}{m} = [k]$$

8. B
9. There are 3,600s in an hour based on the equation below:
   $1\ hr \times \frac{60\ min}{1\ hr} \times \frac{60\ s}{1\ min} = 3600\ s$

1.3 Unit Conversions

Lesson Quiz

Name________ Class________ Date________

Answer each of the questions below to show your achievement of the lesson objectives.

Perform unit conversions.

1. Which of the following are conversion factors:
   a. $a^2 + b^2 = c^2$
   b. 1 kg = 1000 g
   c. 50 s
   d. 48/12
2. Sarah worked 375 hours this summer as a lifeguard on the beach. How many seconds did she spend in the scorching sun?
3. Joe needs to pack eggs to ship across the country in a truck. The eggs should be packed in cartons of one dozen eggs each. If Joe has to pack 672 eggs, how many cartons does he need?
4. If Mark is 6 feet tall, what is his height in meters (1 ft = 0.3 m)?
5. Which of the following is correct?
   a. 100 mm = 1 cm
   b. 1 cm = 100 m
   c. 1 m = 100 cm
   d. 1 mm = 100 cm
6. Which of the following correctly expresses 5 g in kilograms?
   a. 500 kg
   b. 5000 kg
   c. 0.05 kg
   d. 0.005 kg

Properly use scientific notation.

7. What is 6300000000 in scientific notation?
   a. 0.63×10^{10}

b. 630 x 10^8
c. 6.3 x 10^9
d. 6.3 x 10^{-9}

8. Which number is written in correct scientific notation?

a. 0.478 x 10^4
b. 4.78 x 10^4
c. 47.8 x 10^4
d. 478 x 10^4

9. A 16 year-old has been alive for 504,576,000 seconds. Write this number in scientific notation.

10. When writing a number in scientific notation, how many digits should be left of the decimal?

a. One
b. Two
c. Three
d. Four

Answer Key

1. B
2. Conversion factor: 1 hour = 3600 s
$375\ hrs \times \frac{3600\ s}{1\ hr} = 1,350,000\ s$
3. Conversion factor: 1 carton=12 eggs
$672\ eggs \times \frac{1\ carton}{12\ eggs} = 56\ cartons$
4. Conversion Factor: 1 ft=0.3 m
$6\ ft \times \frac{0.3\ m}{1\ ft} = 1.8\ m$
5. C
6. D
7. C
8. F
9. 5.04576 x 10^8
10. A

1.4 Measurement and Recording Data

Lesson Quiz

Name____________________ **Class**______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives.

Describe measurement.

1. Which one of the following is a reasonable measurement for the mass of a red clay brick?
   a. 300 kg
   b. 30 kg
   c. 3 kg
   d. 0.3 kg
2. Is 200 cm greater or less than 6 m?

Explain what is meant by significant digits.

3. Significant figures are
   a. all the certain digits of a measurement
   b. all the uncertain digits of a measurement
   c. all the certain digits of a measurement plus one uncertain digit
   d. none of the above
4. What is the difference between certain digits and uncertain digits?

Determine the number of significant digits in a measurement.

5. How many significant figures are there in the measurement 6.571g?
   a. Five
   b. Four
   c. Three
   d. Two
6. How many significant figures are there in the measurement 800.0 cm?
   a. Five
   b. Four
   c. Three
   d. Two
7. How many significant figures are there in the measurement 0.00062s?
   a. Five
   b. Four
   c. Three

d. Two

Add, subtract, multiply, and divide with significant digits.

8. How many significant figures should the answer to the following multiplication problem be rounded to: 98,456 x 0.00054?
   a. One
   b. Two
   c. Three
   d. Four
9. Add the following numbers and round your answer to the correct number of significant figures: 90.0 + 80 =

Use scientific notation.

10. Solve the following problems and write your answer in scientific notation.
    a. (5.0 x 10^{-6}) x (9.3 x 10^{-4})
    b. (8.0 x 10^{4}) $\div$ (4.0 x 10^{2})
11. Change the following values into scientific notation:
    a. Diameter of the Sun: 1,392,000 km
    b. Distance to the Moon: 238,855 miles
    c. Circumference of the Earth: 40,075 km

Answer Key

1. C
2. 200 cm is less than 6 m
   $6\ m \times \frac{100\ cm}{1\ m} = 600\ cm$
3. C
4. Certain digits are known to be correct and uncertain digits are vague as a result of the measurement equipment and human error.
5. B
6. B
7. D
8. B
9. 1.7 x 10^{2}
10. a. 4.65 x 10^{-9}; b. 2.0 x 10^{2}
11. a. 1.392 x 10^{6} km; b. 2.38855 x 10^{5} miles; c. 4.0075 x 10^{4} km

1.5 Working with Error

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Describe systematic and random error.

1. What is the difference between systematic and random errors?

2. Which of the following is an example of a systematic error?
   a. Mistaking a yardstick for a meter stick and recording data in meters
   b. Measuring the length of your desk with a ruler and finding that three of your measurements are different by a factor of 0.1cm.
   c. Both AB
   d. None of the above
3. What is responsible for both random and systematic error?
   a. The measuring tool
   b. The person doing the measuring
   c. Both A B
   d. None of the above
4. Which of the following is an example of random error?
   a. Measuring water in a graduated cylinder and recording five different measurements that differ by 0.01mL
   b. Using a measuring tape that is old and stretched out to measure the area of a room
   c. Both AB
   d. None of the above

Explain precision and accuracy as they relate to error.

5. Sally measures the height of her desk and finds it to be 74cm. Is her measurement precise? Why or why not?

6. The actual mass of a boulder is 122.15 kg. Which of the following measurements is most accurate?
   a. 120 kg
   b. 122 kg
   c. 120 g
   d. 122 g
7. Which of the following data sets is most precise?
   a. 15.01 m, 15.05 m, 15.01 m, 15.03 m

b. 15 m, 17 m, 17 m, 16 m
c. 15 m, 30m, 45 m, 60 m
d. none of the above

8. A physics student mistakes a yardstick for a meter stick and records his measurements as meters. What will likely characterize his measurements?

a. high accuracy and high precision
b. high accuracy and low precision
c. low accuracy and high precision
d. low accuracy and low precision

9. If a physics student forgets to zero our their force probe, their measurements will most likely have:

a. high accuracy and high precision
b. high accuracy and low precision
c. low accuracy and high precision
d. low accuracy and low precision

10. A valid scientific explanation needs to be

a. Accurate
b. Precise
c. Both A B
d. None of the above

Answer Key

1. Systematic errors can be corrected and random errors cannot be corrected.
2. A
3. C
4. A
5. No. She only made one measurement, so it is impossible to determine precision.
6. B
7. A
8. C
9. C
10. C

1.6 What is Science? Chapter Test

Chapter Test

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives

1. A scientific theory
   a. is a guess about how or why something happens
   b. is a broad explanation of how the natural world works based on evidence
   c. can never be altered
   d. none of the above
2. Scientists use mathematical equations because they
   a. Represent physical quantities
   b. Can help make predictions
   c. Show a precise relationship between variables
   d. All of the above
3. Why is it important for a hypothesis to be testable?
4. Which statement below correctly identifies the difference between a hypothesis and a theory?
   a. A hypothesis is a prediction, while a theory is an explanation
   b. A hypothesis is an explanation, while a theory is just an opinion
   c. A hypothesis is a guess, while a theory is a fact
   d. A hypothesis is a fact, while a theory is a guess
5. Explain how scientific theories can influence the work that future scientists may do.
6. Discuss why following the scientific method will not enable scientists to answer all questions.
7. Is this statement true or false: The meter is a fundamental unit in physics. Explain the reason for your choice.
8. What is the standard unit for mass?
   a. Meters
   b. Newtons
   c. Seconds

d. Kilograms

9. Use dimensional analysis to calculate how many dozen donuts you would have to order to feed a school of 456 students.

10. Jane is a college freshmen and needs to do laundry. If it costs $1.75 to wash one load, how many quarters does Jane need to do four loads?

11. A cat has a mass of 13608 grams (30 lbs). What is the mass of the cat in kilograms, expressed in scientific notation?

12. Which one of the following is a reasonable measurement for the temperature of a refrigerator?
    a. 450°C
    b. 45°C
    c. 4.5°C
    d. 0.45°C
13. Why do we need significant figures?

14. How should a scientist record a measurement of 5000 g in two significant figures?
    a. 5000 g
    b. 5 kg
    c. 5.0×10^3 g
    d. 5.00×10^3 g
15. Multiply the following numbers and round your answer to the correct number of significant figures: 72,000 x 45

16. On average, an African elephant is 12,125 lbs. What is the mass of an African elephant in kilograms, expressed in scientific notation (1 lb = 0.4536 kg)?

17. A systematic error
    a. Occurs when a scientist uses the wrong measuring tool
    b. Can be corrected by calculation
    c. Both A B
    d. None of the above
18. A random error
    a. Cannot be avoided
    b. Cannot be corrected by calculation
    c. Both A B

d. None of the above

Refer to the following experiment to answer questions 19-20

TABLE 1.1:

Student:	Trial 1	Trial 2	Trial 3	Trial 4
Sam	30.4 N	30.1 N	29.9 N	30.2 N
Tyler	31.8 N	34.1 N	41.5 N	35.1 N
Tara	39.2 N	39.3 N	39.2 N	39.1 N

Three physics students have made multiple measurements of the force needed to stretch a rubber band 12 cm. Their results are summarized in the table below. The correct value for the force is 30 N.

19. Which student's measurements have high precision but low accuracy?
    a. Sam
    b. Tyler
    c. Tara
    d. None of the students
20. Which student's measurements are both accurate and precise?
    a. Sam
    b. Tyler
    c. Tara
    d. None of the students

Answer Key

1. B
2. D
3. Hypothesis must be testable because scientists have to be able to gather evidence to determine whether it is valid or not.
4. A
5. Past scientific theories lay a foundation for future scientific discovery by influencing research. By design, scientific explanations are subject to changes from new research.
6. The scientific method requires evidence to be collected in order to support a conclusion. For some questions, it is impossible to collect evidence and, as a result, they cannot be answered in a scientific way.
7. True - The SI unit for length is a meter and this unit is used to derive many other units in physics, such as Velocity.
8. D
9. You would need to order 38 dozen
   $456\ donuts \times \frac{1\ dozen}{12\ donuts} = 38\ dozen$
10. Conversion Factor: 1 dollar = 4 quarters, Four loads = 4 x $1.75 = $7.00
    $\$7.00 \times \frac{4\ quarters}{\$1.00} = 28\ quarters$
11. 1.3608 x 10^1
12. C
13. Significant figures help us determine how good our data is. 1000 g is not as accurate as 1000.00 g because 1000 g has 1 significant figure and 1000.00 has 6 significant figures.
14. C

15. 3.2×10^6
16. 5.4999×10^3 kg
17. A
18. C
19. C
20. A

CHAPTER 2 One-Dimensional Motion Assessments

Chapter Outline

2.1 Locating an Object: Distance and Displacement

Lesson Quiz

Name___________________ **Class**______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Define scalar and vector.

1. Which of the following is a vector?
    a. 0.007cm
    b. 7 meters
    c. 7 x 10^6 m
    d. 7 miles Northwest
2. Which of the following is a scalar?
    a. Displacement
    b. Distance
    c. Velocity
    d. None of the above
3. If Susie moves leftward 5 meters, what is true about her displacement?
    a. Her displacement is zero
    b. Her displacement is positive
    c. Her displacement is negative
    d. None of the above
4. Explain why the following statement is false: -25 m would be the correct way to represent the distance traveled by a woman moving leftward 25 meters.

Lesson Objective: Define distance and displacement.

5. The minimum distance from the Earth to Mars is 5.46 x 10^7 km. If you travel from the Earth to the Mars and back, which of the following is a correct estimation of your displacement?
    a. 0 miles
    b. 238,900 miles
    c. 477,800 miles
    d. None of the above
6. The moon is 238,900 miles from the Earth. If you travel from the Earth to the moon and back, which of the following correctly describes the distance you have traveled?
    a. 0 miles

b. 238,900 miles
c. 477,800 miles
d. None of the above

7. I drove 15 miles to the local farmer's market. Halfway back to my house I ran out of gas. What is my displacement?
   a. 22.5 miles
   b. 15 miles
   c. 7.5 miles
   d. 0 miles

Lesson Objective: Distinguish between distance and displacement.

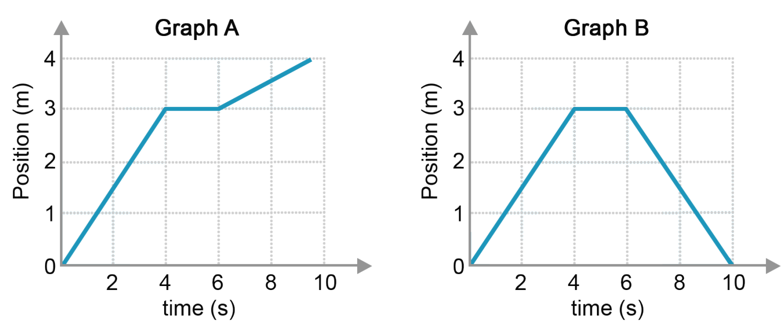
Diane is training for a marathon and goes to the track (400 m) to run every morning.

8. If Diane runs around the track eight times, what is the distance she travels?

9. If Diane runs around the track four times, what is her final displacement?

10. If there are about 1600 meters in one mile, how many miles did Diane run?

Lesson Objective: Graphically model distance and displacement.



11. Which of the following graphs represents an object that traveled a total distance of 4 meters?
    - Graph A
    - Graph B
12. Which of the following graphs represents an object that has a displacement of 0 m.
    - Graph A
    - Graph B

Answer Key

1. D

2. B
3. C
4. False, distance is a scalar quantity. Therefore, the negative sign has no meaning because direction does not matter. The woman simply traveled a distance of 25 meters
5. A
6. C
7. C
8. 400 x 8 = 3200 meters
9. Zero, her initial and final positions are the same.
10. 3200 m x 1 mile/1600 m = 2 miles
11. Graph A
12. Graph B

2.2 Speed and Velocity in One Dimension

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Define constant speed and velocity.

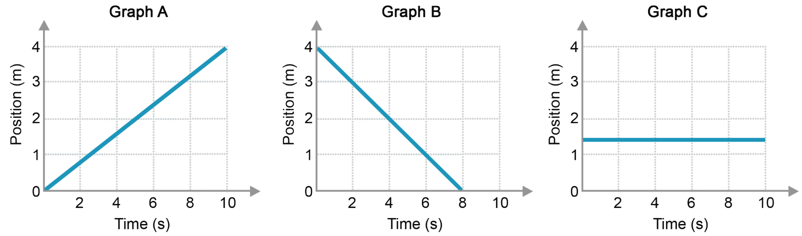
1. Which of the following objects most likely has a constant speed?
   a. A car that speeds up when the light turns green
   b. A car traveling at 65 mph on the freeway
   c. A car that slows down to a stop due to a red light
   d. A car that makes a u-turn
2. When calculating an object's velocity, you must first consider its
   a. Average speed
   b. Instantaneous speed
   c. Displacement
   d. Distance

Lesson Objective: Distinguish between speed and velocity.

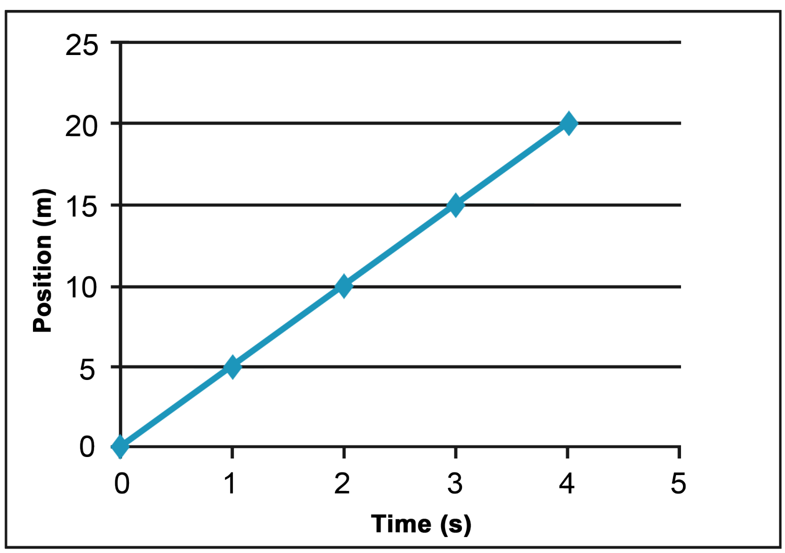
3. What is the difference between speed and velocity?
4. A cheetah runs at 93 km/hr. This describes the cheetah's
   a. Displacement
   b. Instantaneous Speed
   c. Average Speed
   d. Average Velocity
5. A snail travels 15 cm north in 30 minutes. What is the speed of the snail in m/s?
   a. 0.5 cm/min
   b. 0.5 cm/min North
   c. 8.3 x 10^{-5} m/s
   d. 8.3 x 10^{-5} North

Lesson Objective: Determine velocity from position-time graphs.

Use the following graphs to answer questions #6-8:



6. Which of the following position-time graphs describes an object moving to the left?
   a. Graph A
   b. Graph B
   c. Graph C
7. Which of the following position-time graphs describes an object moving to the right?
   a. Graph A
   b. Graph B
   c. Graph C
8. Which of the following position-time graphs describes an object that is at rest?
   a. Graph A
   b. Graph B
   c. Graph C
9. The following position-time graph depicts the motion of squirrel as it runs across a park. Use the graph to derive the squirrel's velocity.



Answer Key

1. B
2. C
3. Speed is scalar, it only has a magnitude and does not include direction. It is the total distance traveled divided by the total time. Velocity is a vector, it has both magnitude and direction. It is the change in position (displacement) divided by the change in time.

4. C
5. C
6. Graph B
7. Graph A
8. Graph C
9. The velocity of the squirrel can be derived from the slope of the position-time graph.
   $\frac{(5\ m-0\ m)}{(1\ s-0\ s)} = \frac{5\ m}{1\ s} = 5\ \frac{m}{s}$
   The slope of this line is +5 m/s, so the squirrels velocity is 5 m/s rightward.

2.3 Average Speed, Velocity, and Instantaneous velocity

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Calculate average speed for varying rates.

The data table below describes the motion of a train moving east. Use the information in the data table to answer questions #1-6

TABLE 2.1:

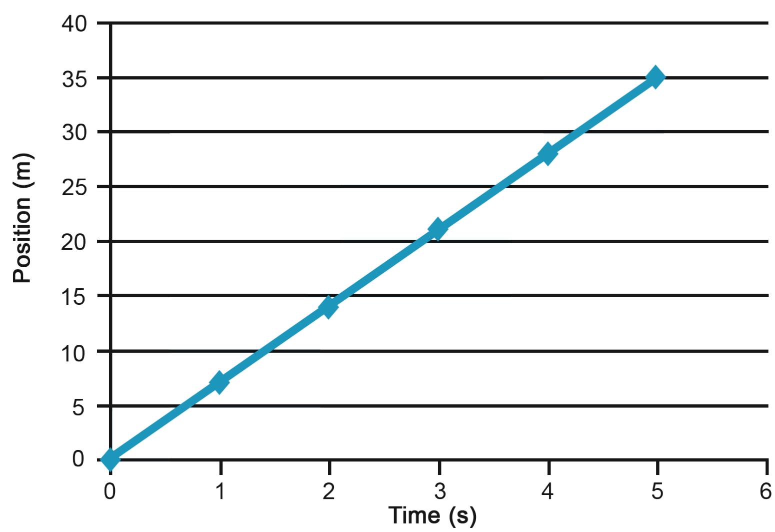
t (s)	x (m)
0	0
1	55
3	165
10	550
15	825
19	1045
23	1265
25	1375

1. What is the position of the train at t = 19 s
2. What is the displacement of the train at t = 19 s?
3. What is the average speed of the train?
4. What is the average velocity of the train?
5. Create a position-time graph of the train.

6. Create a velocity-time graph of the train.

Lesson Objective: Explain what is meant by instantaneous velocity.

Refer to the graph below to answer questions #7-11.



7. Use the graph above to complete the data chart below

TABLE 2.2:

t (s)	x (m)
0	
1	
2	
3	
4	
5	

8. What is the average velocity of the moving object depicted in the position-time graph?

9. What is the instantaneous velocity of the moving object depicted in the position-time graph at t=3s?

10. What is the difference between instantaneous velocity and instantaneous speed?

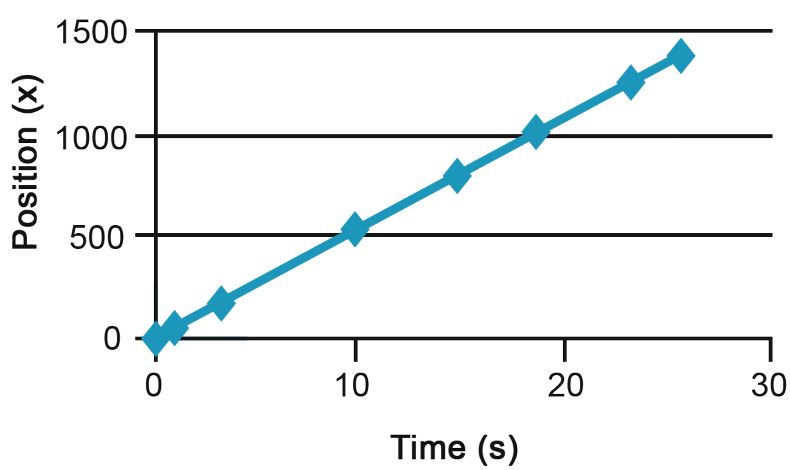
11. Which of the following is an example of instantaneous velocity?

    a. A cheetah running 93 km/hr east
    b. A dog walking at 5 mph
    c. At t=1.01 s, a runner is moving 4 m/s west
    d. At t=5 s, a softball is moving 22.35 m/s

Answer Key

1. The variable for the position of an object is x. According to the chart, at t=19s, x=1045m.
2. Displacement: $\Delta x = p_f - p_i$
   At t = 19 s, p_f = 1045 m
   1045 m - 0 m = 1045 m east
3. Average Speed = total distance/total time

   1375 m/25 s = 55 m/s
4. $\Delta v = \frac{\Delta x}{(t_f - t_i)}$; 1375 m/25 s=55 m/s east
5.



6.

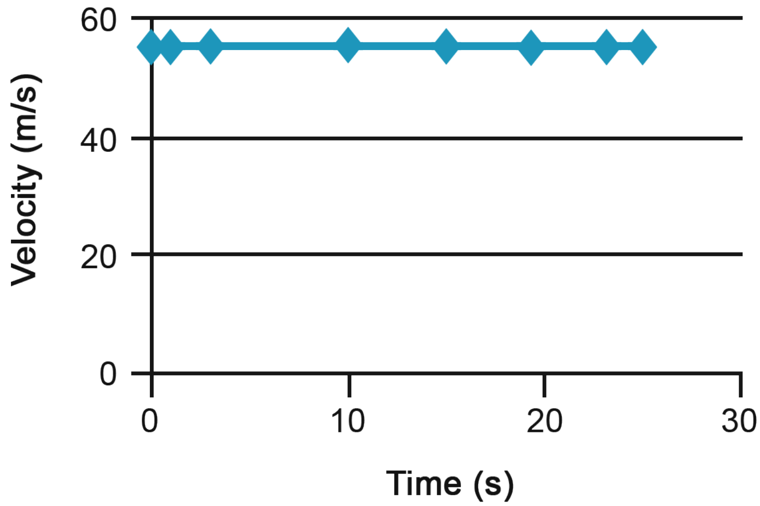


TABLE 2.3:

t (s)	x (m)
0	0
1	7
2	14
3	21
4	28
5	35

7.
8. (35-0)/(5-0) = 7 m/s rightward
9. (21-0)/(3-0) = 7 m/s rightward
10. Instantaneous velocity is a vector, so it has magnitude and direction. Instantaneous speed is a scalar, so only magnitude is included.
11. C

2.4 Uniform Acceleration

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Define and explain acceleration.

1. Explain why acceleration is a vector quantity.

2. Explain why the following statement is a misconception, "Acceleration must mean that an object is speeding up".

Circle the direction of the car's acceleration in the following scenarios described in # 3-6:

3. A car moving rightward and slowing down
   a. Left
   b. Right
4. A car moving leftward and speeding up
   a. Left
   b. Right
5. A car moving rightward and speeding up
   a. Left
   b. Right
6. A car moving leftward and slowing down
   a. Left
   b. Right
7. A Tesla Roadster can go from 0 to 60 mph in 3.9 seconds. What is the magnitude of the car's acceleration in m/s^2 during the 3.9 seconds?

Answer Key

1. Acceleration is the change in velocity over time. Velocity is a vector and direction matters, so acceleration must also be a vector in which the direction of motion matters.

2. This is a misconception because acceleration is the change in velocity over time. An object is accelerating if it speeds up, slows down, or changes direction.
3. Left
4. Left
5. Right
6. Left
7. 60 mph = 26.82 m/s; (26.82-0)/(3.9-0)=6.87 m/s^2

2.5 The Kinematic Equations

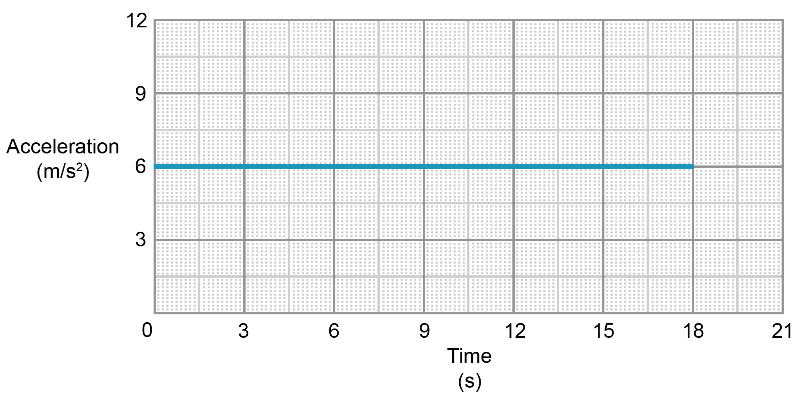
Lesson Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Interpret area in an acceleration-time graph.

Use the graph below for questions #1-5



1. Without doing any calculations, will the velocity at t=15s be positive, negative or zero?

2. Explain the reason for your answer choice in question #1.

3. Calculate the instantaneous velocity at t=15s.

4. What statement best describes the motion of the object depicted in the graph above?

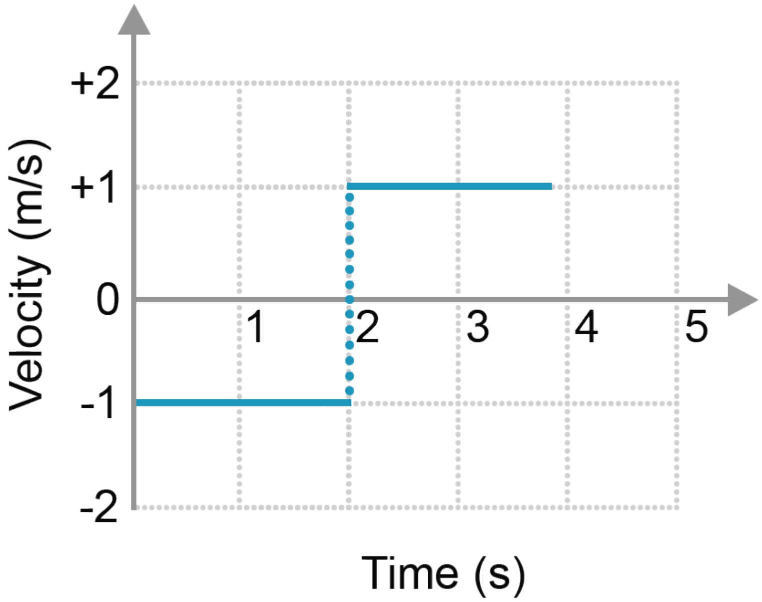
    1. The object is traveling at a constant speed
    2. The object is traveling with a constant velocity
    3. The object is traveling with a constant acceleration
    4. The object is at rest

5. Is the object depicted by the graph speeding up, slowing down, or traveling at a constant velocity? Explain the reason for your choice.

The velocity-time graphs depict a dog walking. Use the graphs in questions #6-8 to describe the motion of the dog in words.

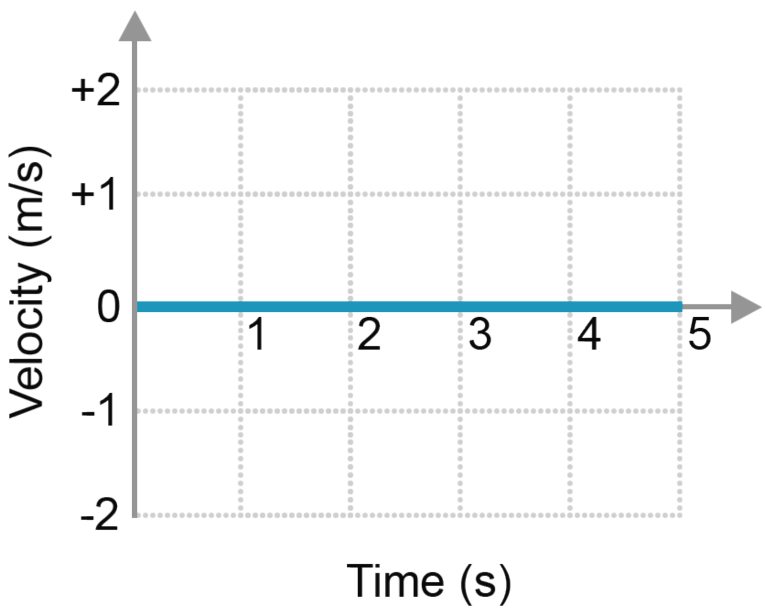
Lesson Objective: Represent motion using a velocity-time graph.

6.



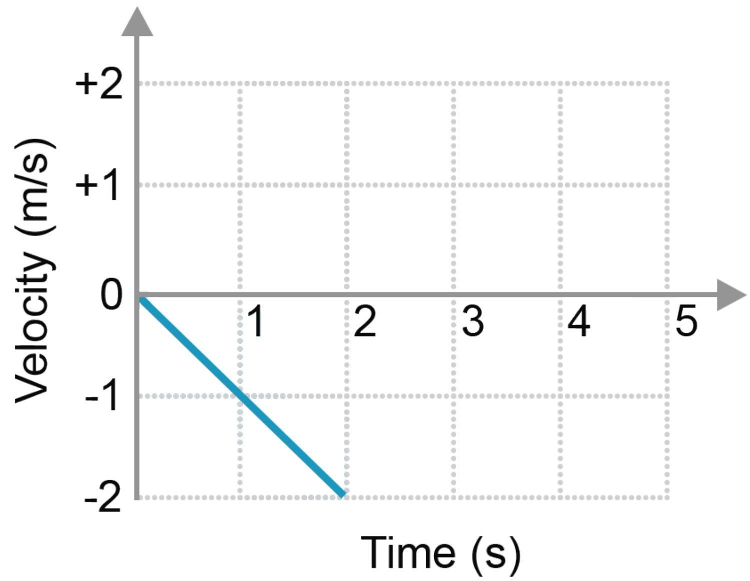
+2
+1
0
-1
-2
Velocity (m/s)
1
2
3
4
5
Time (s)

7.



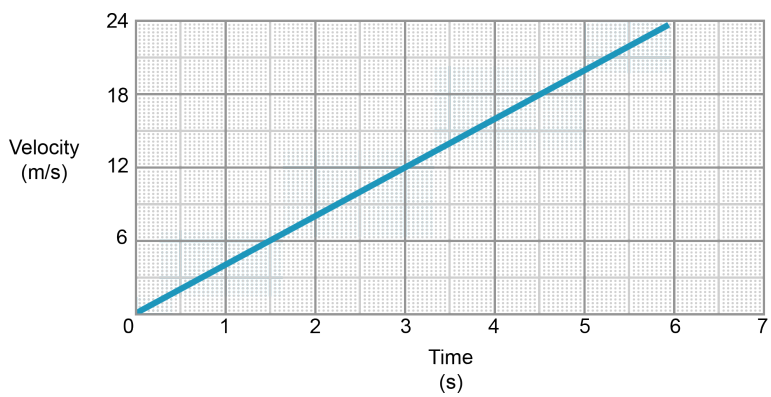
+2
+1
0
-1
-2
Velocity (m/s)
1
2
3
4
5
Time (s)

8.



Lesson Objective: Interpret slope and area in a velocity-time graph.

The graph below depicts the motion of a bowling ball. Use the graph for questions #9-10.



9. What is the acceleration of the bowling ball?
   a. 2 m/s
   b. 2 m/s^2
   c. 4 m/s
   d. 4 m/s^2
10. What is the magnitude of the displacement of the rolling ball?
    a. 12 m
    b. 24 m
    c. 48 m
    d. 72 m

Determine the sign of the displacement, velocity, and acceleration are for each of the graphs below by placing a (+), (-), or (0) in the space provided.

11.

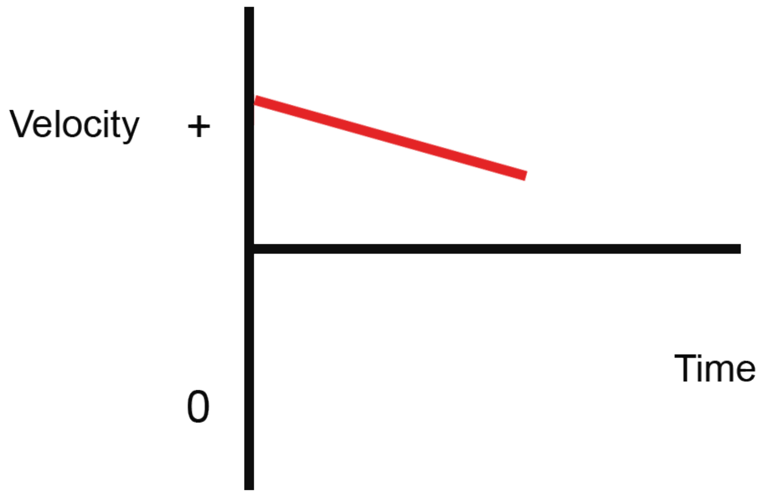


TABLE 2.4:

displacement, $\Delta \mathbf{x}$	
velocity, $\mathbf{v}$	
acceleration, $\mathbf{a}$	

12.

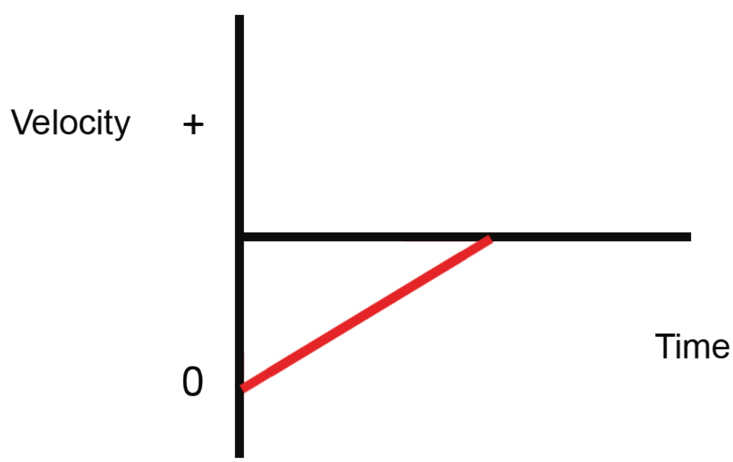


TABLE 2.5:

displacement, $\Delta \mathbf{x}$	
velocity, $\mathbf{v}$	
acceleration, $\mathbf{a}$	

Answer Key

1. Positive
2. Answers will vary. *Sample answer: the velocity can be derived from the area under a a-t graph. The area bounded by this line is in the positive quadrant.*
3. The shape of the area bounded by the line is a rectangle and the equation for the area of a triangle is $A = b \times h$. Velocity=(15)x(9)= +135 m/s rightward
4. C
5. The object is speeding up with a constant acceleration. The object has a positive acceleration and a positive velocity. If the sign if the acceleration and velocity of an object are the same, the object will speed up
6. The dog is moving to the left at a constant speed of -1 m/s for 2 seconds. Then, it suddenly turns around and travels rightward at a constant speed of +1 m/s for 2 s.
7. The dog is at rest with a velocity of 0 m/s for 5 s.
8. The dog is moving leftward and accelerating -1 m/s^2. The dog is speeding up because the direction of the velocity (negative) and acceleration (negative) are the same.
9. D
10. D

TABLE 2.6:

displacement, $\Delta\mathbf{x}$	+
velocity, **v**	+
acceleration, **a**	-

11.

12.

TABLE 2.7:

displacement, $\Delta\mathbf{x}$	-
velocity, **v**	-
acceleration, **a**	+

2.6 One Dimensional Motion Chapter Test

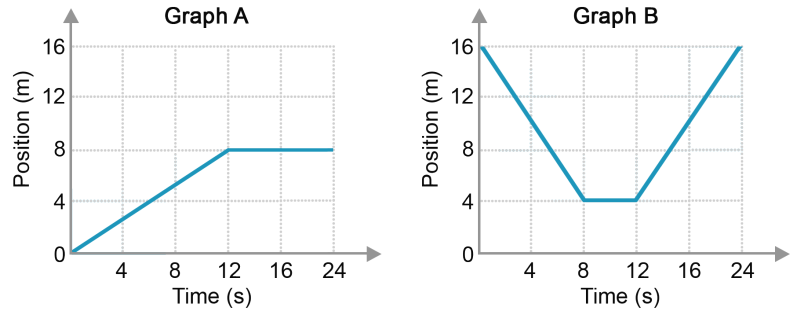
Chapter Test

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

1. If Susie moves leftward 5 meters, what is true about her displacement?
   a. Her displacement is zero
   b. Her displacement is positive
   c. Her displacement is negative
   d. None of the above
2. The Curiosity Rover landed on Mars on August 6th, 2012. Amazingly, it landed roughly 1.5 miles away from its touchdown target. Which of the following statements is correct?
   a. The displacement of the Curiosity rover from the touchdown target is 1.5 miles
   b. The distance of the Curiosity rover from the touchdown target is 1.5 miles
   c. Both A B are correct
   d. None of the above
3. Lisa takes her dog to the local dog park every morning. She walks with her dog 5 blocks north, 5 blocks west, and 5 blocks south in order to get to the park.
   a. Draw a picture of her path and label each distance.
   b. What is her total distance traveled?
   c. What is her total displacement?
   d. If each block is 55 meters, what distance did Lisa travel in meters?

Refer to Graph A and Graph B to answer questions #4-5.



4. What is the total distance traveled by the object in Graph A?
   a. 0 m
   b. 4 m
   c. 8 m
   d. 12 m
5. What is the magnitude of the displacement of the object depicted by Graph B?
   a. 0m
   b. 4m
   c. 8m
   d. 12m
6. You are flying 2586 miles from San Francisco to New York.
   1. An hour into the flight, you are 600 miles from San Francisco. What is your speed in m/s?

   2. The pilot looks at the speedometer on the plane and it reads 615 mph. This is a measure of the
      1. Average Speed
      2. Instantaneous Velocity
      3. Average Velocity
      4. Instantaneous Velocity
   3. 965.6 km/hr northeast describes the plane's
      1. Average Speed
      2. Instantaneous Velocity
      3. Average Velocity
      4. Instantaneous Velocity
7. Which of the following are vectors?
   1. Distance and speed
   2. Speed and displacement
   3. Displacement and velocity
   4. Velocity and speed
8. What direction is an object moving if the slope of its position-time graph is positive?
   1. Rightward
   2. Leftward
   3. At rest
   4. Cannot be determined
9. What direction is an object moving if the slope of its position-time graph is negative?
   1. Rightward
   2. Leftward
   3. At rest

4. Cannot be determined

10. What direction is an object moving if the slope of its position-time graph is zero?
    1. Rightward
    2. Leftward
    3. At rest
    4. Cannot be determined

```
The data table below describes the motion of a cheetah.  Use the information in the data table
to answer question #11.
```

TABLE 2.8:

t (hr)	x (km)
1	93
2	186
3	279
4	372

11. Using the information in the chart above, what is the average speed of the cheetah in m/s?
    a. 26 m/s
    b. 58 m/s
    c. 93 m/s
    d. 126 m/s

The data table below describes the motion of a jogger running east. Use the information in the data table to answer questions #12-13.

TABLE 2.9:

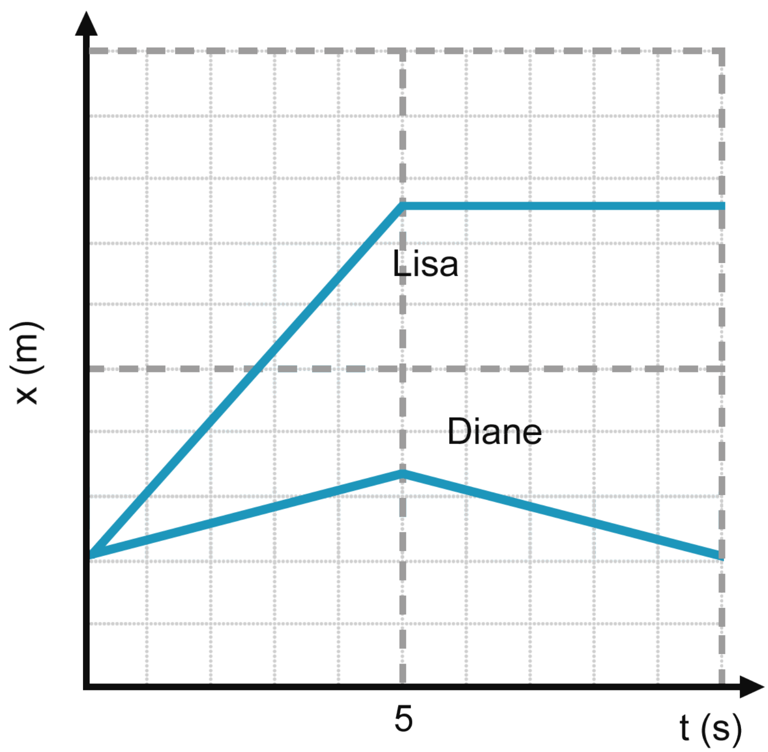
t (s)	x (m)	v (m/s)
0	0	0
3	7	2.3
10	21	2.1
15	30	2
19	39	2.1
23	44	1.9
25	48	1.9

12. What is the average velocity of the jogger?
    a. 1.75 m/s west
    b. 1.9 m/s east
    c. 1.75 m/s west
    d. 2.1 m/s east
13. What is the instantaneous velocity of the jogger at 19s?
    a. 1.75 m/s west
    b. 1.9 m/s east
    c. 1.75 m/s west

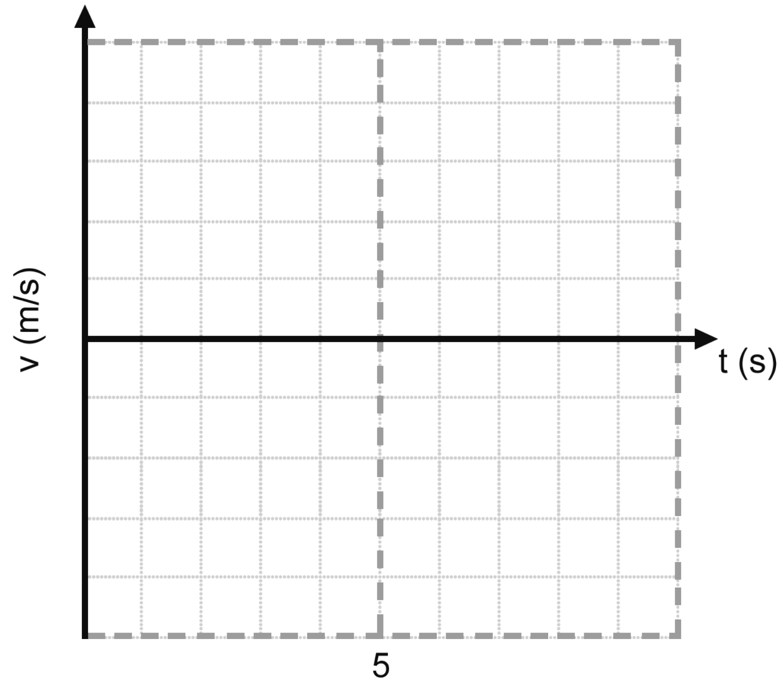
d. 2.1 m/s east

14. If a plane has a positive velocity and a positive acceleration, then it is:
    a. slowing down
    b. speeding up
    c. moving at constant velocity
    d. has zero velocity
15. A driver traveling north slows down from 35 m/s to 0 m/s in about 6 seconds. What is the magnitude of the driver's acceleration?
16. The area under an acceleration-time graph can be used to derive
    a. displacement
    b. position
    c. acceleration
    d. velocity

The position-time graph below depicts the motion of two runners, Diane and Lisa. Use the graph to answer questions #17-19.



17. Which runner is going faster during the first 5 seconds? How do you know?
18. Use the information provided in the position-time graph to plot Lisa's velocity on the velocity-time graph below.



19. Use the information provided in the position-time graph to describe Diane's velocity in words.

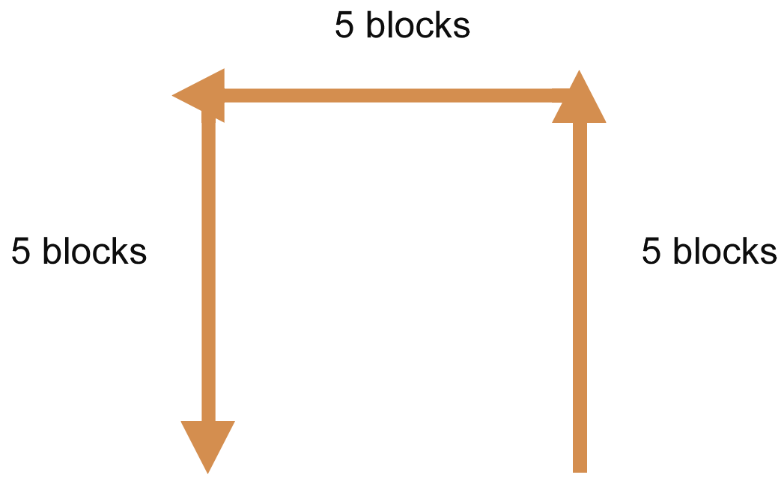
20. The slope of a velocity-time graph represents a moving object's

    a. displacement
    b. position
    c. acceleration
    d. velocity

Answer Key

1. C
2. B
3.

    1.

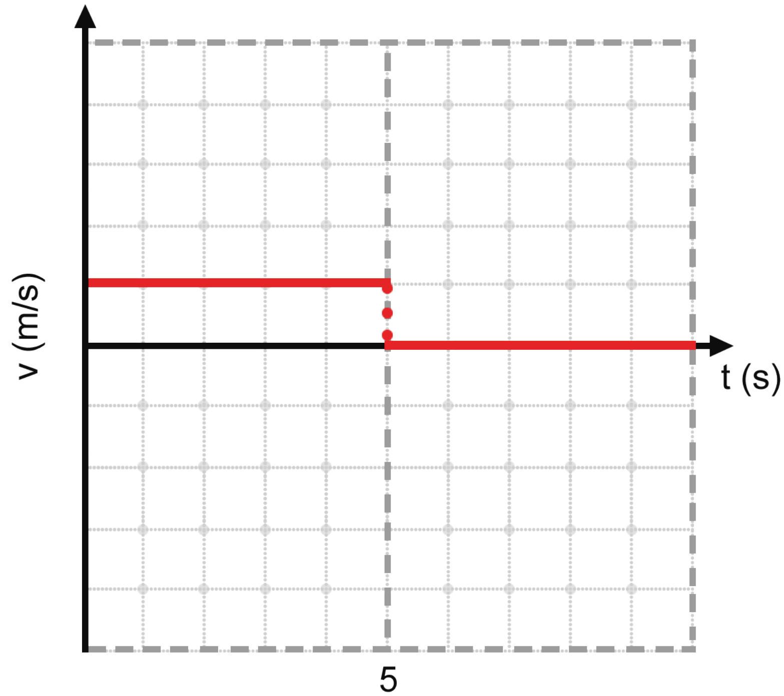


2. 15 blocks
3. 5 blocks west
4. 15 x 55 = 825 m

4. B
5. A
6.

a. $600\frac{miles}{hr} \times \frac{1600\ m}{1\ mile} \times \frac{1\ hr}{60\ min} \times \frac{1\ min}{60\ s} = 268.2\ \frac{m}{s}$
b. B
c. C

7. C
8. A
9. B
10. C
11. A
12. B
13. D
14. B
15. $(\frac{0-35\frac{m}{s}}{6-0\ s}) = \frac{-35\frac{m}{s}}{6\ s} = -5.8\ \frac{m}{s^2}$
16. D
17. Lisa is going faster because the slope of her position-time graph is steeper than Diane's. The slope of a position-time graph is velocity.
18. Based on the position-time graph, Lisa's velocity is about 1 square per second for the first five seconds. The she stops and her velocity is 0 m/s.



19. Diane moves in the positive direction at a constant speed for 5 seconds. She suddenly turns around and goes in the reverse direction for 5 more seconds at the same constant speed.
20. C

CHAPTER 3 Two-Dimensional Motion Assessments

Chapter Outline

3.1 Independence of Motion Along Each Dimension

Lesson Quiz

Name___________________ **Class**______________ **Date** ________

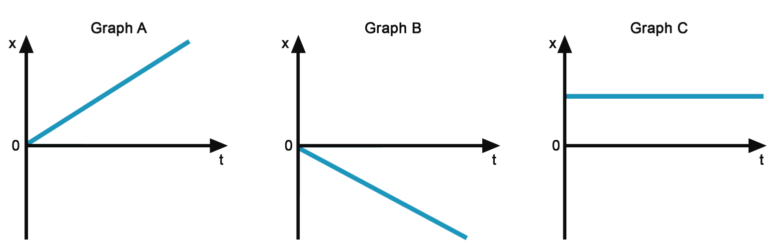
Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand how motion along each axis can be resolved independently

Use the following prompt for questions #1-5:

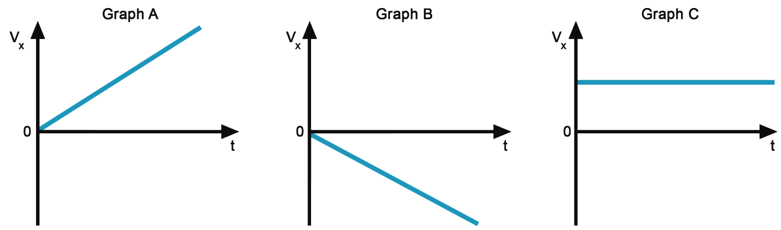
An archer shoots an arrow horizontally at +50 m/s from a height of 1.5 m.

1. How long does it take the arrow to hit the ground?
2. The archer accidentally drops an arrow from the same height (1.5m). How long does it take this arrow to hit the ground?
3. What is the final horizontal velocity of the arrow just before it hits the ground?
4. Which of the following graphs correctly depicts the arrow's horizontal position over time?



a. Graph A
b. Graph B
c. Graph C
d. None of the above

5. Which of the following graphs correctly depicts the arrow's horizontal velocity over time?



a. Graph A
b. Graph B
c. Graph C
d. None of the above

Lesson Objective: Solve problems involving objects, which are simultaneously under the influence of uniform acceleration and constant velocity along different dimensions

Use the following prompt for questions #6-15:

A soccer ball is placed at the edge of a 10 m tall cliff. At t=0s, George kicks the ball horizontally off the cliff with a velocity of +5 m/s.

6. What is the horizontal position (x) of the ball at t = 0 s?
   a. 0 m
   b. 0.5 m
   c. 5 m
   d. 10 m
7. What is the horizontal position (x) of the ball at t = 1 s?
   a. 0 m
   b. 0.5 m
   c. 5 m
   d. 10 m
8. What is the horizontal velocity (V_x) of the ball at t = 0 s?
   a. 0 m/s
   b. +5 m/s
   c. -5 m/s
   d. -10 m/s
9. What is the horizontal velocity (V_x) of the ball at t = 1 s?
   a. 0 m/s
   b. +5 m/s
   c. -5 m/s
   d. -10 m/s
10. What is the vertical position (y) of the ball at t = 0 s?
    a. 0 m
    b. 5 m
    c. 10 m
    d. 15 m
11. What is the vertical position (y) of the ball at t = 1 s?
    a. 0 m

b. 5 m
c. 10 m
d. 15 m

12. What is the vertical velocity (V_y) of the ball at t = 0 s?
    a. 0 m/s
    b. 5 m/s
    c. -5 m/s
    d. -10 m/s
13. What is the vertical velocity (V_y) of the ball at t = 1 s?
    a. 0 m/s
    b. -5 m/s
    c. -10 m/s
    d. -20 m/s
14. At what time does the soccer ball hit the ground?
    a. 1 s
    b. 1.2 s
    c. 1.4 s
    d. 2 s
15. George simply drops another soccer ball off the 10 m high cliff. How long does it take this soccer ball to hit the ground?
    a. 1 s
    b. 1.2 s
    c. 1.4 s
    d. 2 s

Answer Key

1.

$$\begin{aligned} y_f &= \frac{1}{2}gt^2 + y_i \\ 0 &= \frac{1}{2}(-10)t^2 + 1.5\ m \\ t &= 0.55\ s \end{aligned}$$

2.

$$\begin{aligned} y_f &= \frac{1}{2}gt^2 + y_i \\ 0 &= \frac{1}{2}(-10)t^2 + 1.5\ m \\ t &= 0.55\ s\text{(same as question 1)} \end{aligned}$$

3. +50 m/s (the horizontal velocity remains constant, only the vertical velocity changes)
4. A
5. C
6. A
7. C

8. B
9. B
10. C
11. B
12. A
13. C
14. C
15. C

3.2 Vector Representation

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Explain the relationship between coordinates and components.

1. Draw a vector with the coordinates (2,5).
2. What is the horizontal component of this vector?
3. What is the vertical component of this vector?

Use the following prompt for questions #4-6:

A train is traveling northwest.

4. Sketch the vector.
5. What is the horizontal component of this vector?
6. What is the vertical component of this vector?
7. What are the coordinates of a vector that has a vertical component of 15 and a horizontal component of 3?

a. (15,3)
b. (3,15)
c. (0,3)
d. (0,15)

Lesson Objective: Use vectors and vector components to add and subtract vectors.

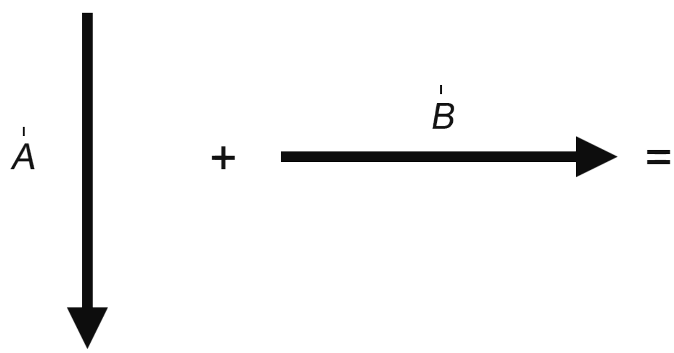
Use the following prompt for questions #8-9:

Vector $\vec{S}$ has components (5,2) and Vector $\vec{T}$ has components (10,1).

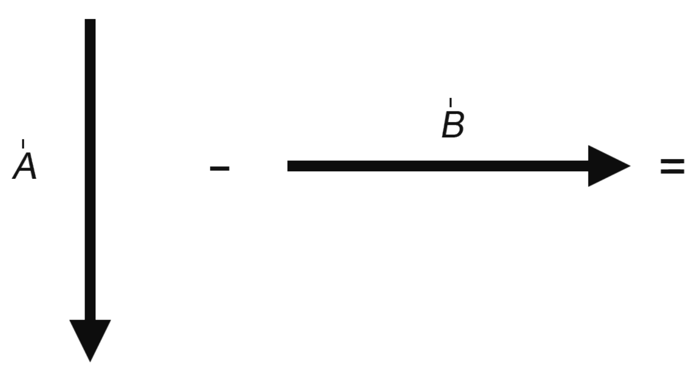
8. Find the sum of $\vec{S}$ and $\vec{T}$; call the result Vector $\vec{U}$.

9. Find the difference $\vec{S}-\vec{T}$, called the result Vector $\vec{V}$.

10. Draw the resultant vector of $(\vec{A}+\vec{B})$.

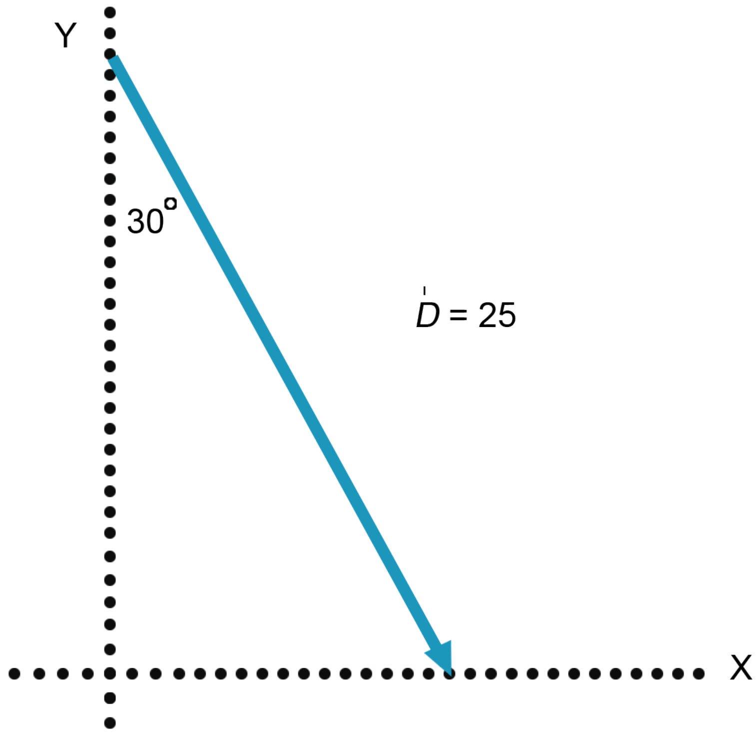


11. Draw the resultant vector of $(\vec{A}-\vec{B})$.



Lesson Objective: Use trigonometric relationships to express vector components.

Use the diagram below of Vector $\vec{D}$ to answer questions #12-15.



12. Use trigonometry to solve for the magnitude of the x-component of Vector $\vec{D}$.

13. Use trigonometry to solve for the magnitude of the y-component of Vector $\vec{D}$.

14. What is the direction of the x-component of Vector $\vec{D}$?

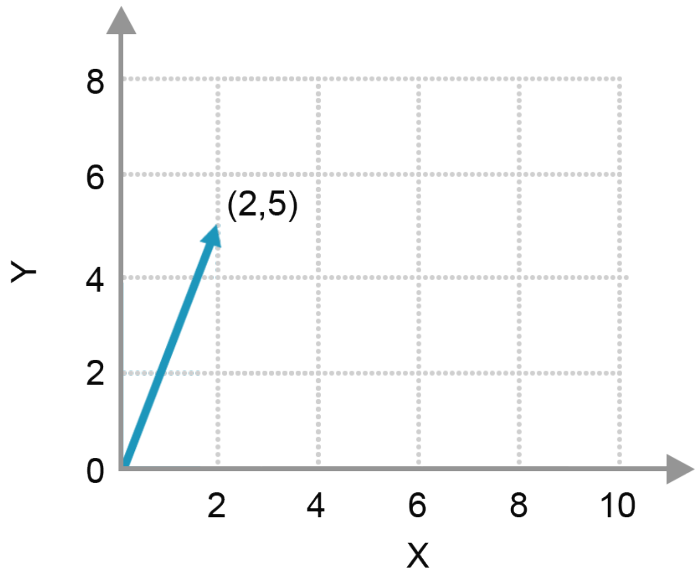
    a. North
    b. South
    c. East
    d. West

15. What is the direction of the y-component of Vector $\vec{D}$?

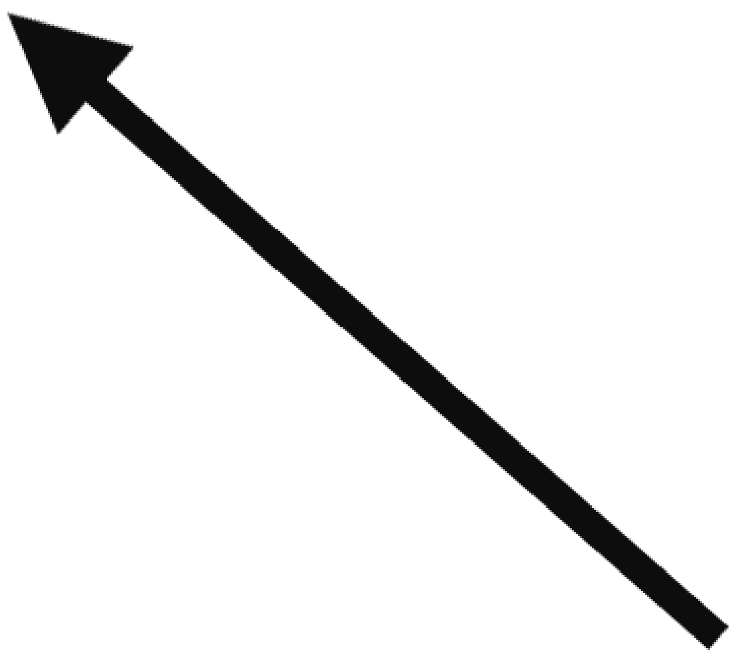
    a. North
    b. South
    c. East
    d. West

Answer Key

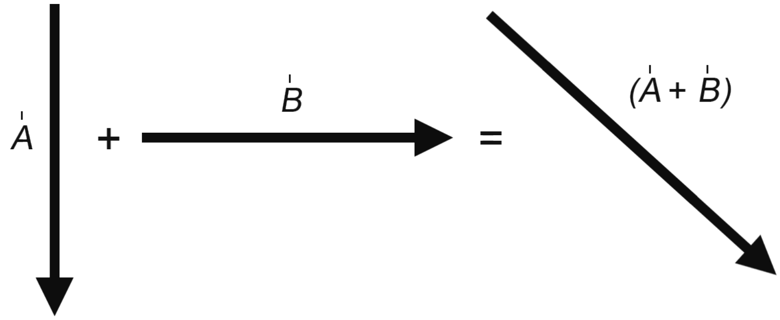
1.



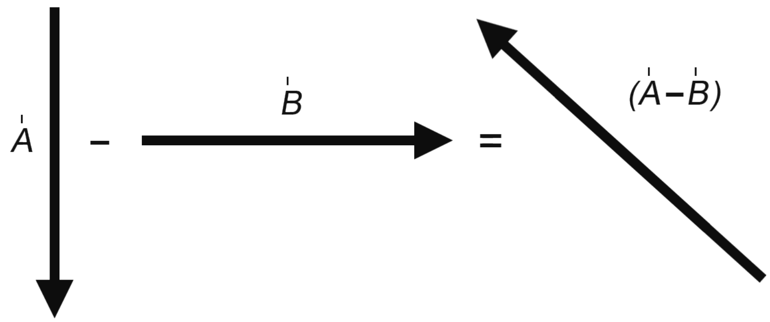
2. 2
3. 5
4.



5. West
6. North
7. B
8. $\vec{U}$ = (5+10, 2+1) = (15,3)
9. $\vec{V}$ = (5-10, 2-1) = (-5,1)
10.



11.



12. $\vec{D}_x = 25\sin 30° = 12.5$
13. $\vec{D}_y = 25\cos 30° = 21.7$
14. C
15. B

3.3 Inertial Frames and Relative Motion

Lesson Quiz

Name___________________ **Class**______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives. Lesson Objective: Explain frames of reference and inertial frames.

1. Which of the following would serve as the best frame of reference?
   a. A accelerating plane moving at 100 mph
   b. A car braking for a stop light
   c. A chair
   d. A marble in freefall
2. Explain the reason for your answer choice above.
3. Which of the following could serve as an inertial frame of reference?
   a. A train speeding up from rest to 80 mph
   b. A parked car
   c. A piece of masking tape on the ground
   d. A plane traveling at a constant velocity of 600 mph
4. Explain the reason for your answer choice above.
5. You throw a ball up into the air as you are traveling on a train, moving with a constant velocity of 65 mph. What would be the best frame of reference to use to analyze the ball's motion?

Lesson Objective: Solve problems involving relative motion in one dimension.

Use the following prompt for questions #6-8:

You are seated on a train traveling at 65 mph.

6. What is your velocity if the train is the inertial frame of reference?
   a. 0 mph
   b. 65 mph
   c. 130 mph
   d. 195 mph

7. What is your velocity if the ground is the frame of reference?
   a. 0 mph
   b. 65 mph
   c. 130 mph
   d. 195 mph
8. While sitting on the moving train, you throw a coin into the air. What is the vertical acceleration of the coin in free fall if the train is your inertial frame of reference?
   a. 0 m/s^2
   b. 10 m/s^2
   c. -10 m/s^2
   d. 65 mph

Lesson Objective: Solve problems involving relative motion in two dimensions.

Use the following prompt for questions #9-11:

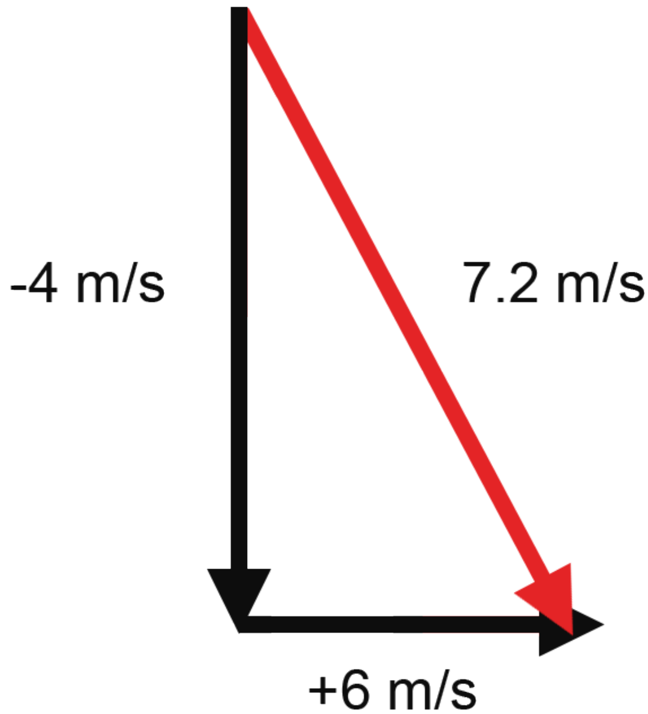
A boat is traveling on a lake with a velocity of +6 m/s east against a -4 m/s southern current.

9. What is the resultant velocity of the boat?
10. If the width of the lake is 200 meters wide, how long does it take the boat to cross the lake?
11. What distance downstream does the boat reach the opposite shore?

Answer Key

1. A chair
2. A chair is the only object that has a fixed point. All the other objects are changing motion (accelerating).
3. D
4. An inertial frame of reference is an object moving with a constant velocity. The only object moving with a constant velocity in the question above is a plane traveling at 600 mph
5. The train would be the best frame of reference. The train can serve as an inertial frame of reference because it is traveling at a constant velocity of 65 mph.
6. A
7. B
8. C
9. Pythagorean Theorem:

$$a^2 + b^2 = c^2$$
$$(-4)^2 + (6)^2 = c^2$$
$$7.2\ m/s\ sou$$



10. $t = \frac{d}{v}$; t=(200 m)/(+6 m/s) = 33.3 s
11. $d = v \cdot t$; (-4 m/s)$\cdot$ (33.3 s) = 113.2 m

3.4 Projectile Motion

Lesson Quiz

Name____________________ Class_______________ Date _________

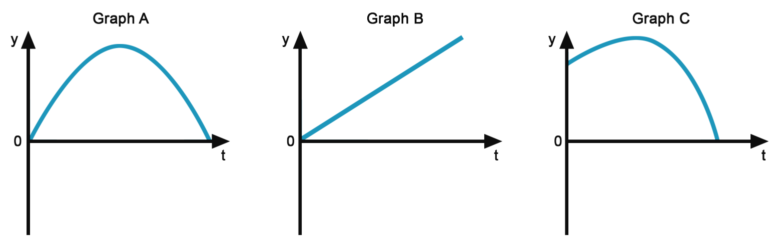
Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Draw and interpret graphs involving two-dimensional projectile motion

Use the following prompt for questions #1-2:

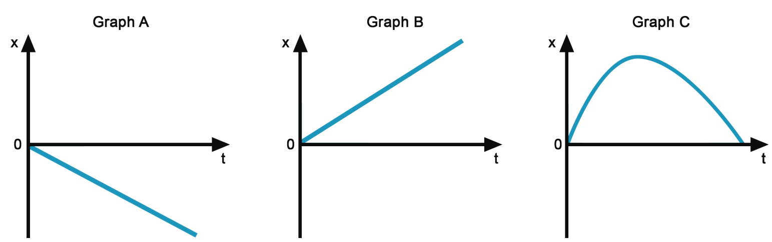
Lisa kicks a soccer ball leftward off a 2m high cliff.

1. Which of the following Y-t graphs correctly depicts the soccer ball's vertical position over time?



   a. Graph A
   b. Graph B
   c. Graph C
   d. None of the above

2. Which of the following X-t graphs correctly depicts the soccer ball's horizontal position over time?



   a. Graph A
   b. Graph B
   c. Graph C
   d. None of the above

3. Which of the following statement accurately describes the slope of the horizontal velocity (V_x) of a projectile?
   a. The slope is zero
   b. The slope is constant

c. The slope is positive
d. None of the above

4. Which of the following statements accurately describes the slope of the vertical velocity (V_y) of a projectile?
   a. The slope is zero
   b. The slope is constant
   c. The slope is positive
   d. None of the above

Lesson Objective: Solve for the instantaneous velocity of a projectile

Use the following prompt for questions #5-8:

A golf ball is hit horizontally off the edge of a 30 m high cliff and lands a distance of 25 m from the edge of the cliff.

5. What was the initial vertical velocity of the golf ball?

6. At what time did the golf ball hit the ground?

7. What was the initial horizontal velocity of the golf ball?

8. What was the final horizontal velocity of the golf ball

Lesson Objective: Predict a projectile's range

9. A cannon is fired with an initial horizontal velocity of 20 m/s and initial vertical velocity of 25 m/s. After 3s in the air, the canon hits its target. How far away was the canon from its target?

10. A football ball is kicked with an initial velocity of 10 m/s at an angle of 25°. If it hits the ground 1.5s later, how far does it travel?

11. A plane traveling at 270 m/s (about 600 mph) wants to drop a package and hit a target 90 m below. When should the plane drop the package?
    a. Before the target
    b. Exactly over the target
    c. After the target
    d. None of the above

Answer Key

1. C
2. A
3. A
4. D
5. 0 m/s (it was hit horizontally)
6.

$$y_f = (\frac{1}{2})gt^2 + (v_{y-initial})t + y_i$$
$$0 = 5t^2 + 0 + 30\ m$$
$$t = 2.45\ s$$

7.

$$x_f = (v_x)t + x_i$$
$$25\ m = v_x(2.45\ s) + 0$$
$$v_{x-initial} = 10.2\ m/s$$

8. $v_{x-initial} = V_{x-final} = 10.2\ m/s$
9.

$$x_f = v_x t + x_i$$
$$(20\ m/s)(3) + 0 = 60\ m$$

10.

$$x_f = (v \cos\theta)t + x_i$$
$$(10 \cos 25\ \frac{m}{s})(1.5\ s) = 13.6\ m$$

11. A

3.5 Two-Dimensional Motion Chapter Test

Chapter Test

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

1. Marble A is rolled off a table from a height of 1 meter at the same exact time Marble B is dropped 1 meter above the ground. Which of the following statements is correct?

   a. Marble A will hit the ground before Marble B
   b. Marble B will hit the ground before Marble A
   c. Both marbles will hit the ground at the same time
   d. Not enough information is given to answer the question

2. A soccer ball on the ground is kicked with an initial horizontal velocity of +1 m/s rightward and an initial vertical velocity of +3 m/s upward. Which of the following statements accurately describes it motion at t = 0.5 s?

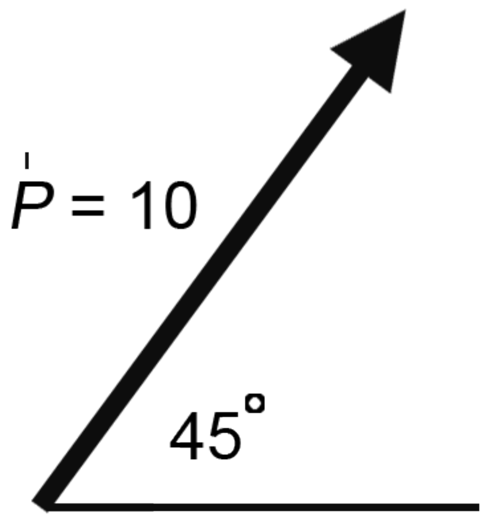
   a. x = 0.5 m, y = 0.25 m, V_x = +1 m/s, V_y = -2 m/s
   b. x = 0.5 m, y = 0.25 m, V_x = +1 m/s, V_y = +2 m/s
   c. x = 0.5 m, y = 0.25 m, V_x = -2 m/s, V_y = -2 m/s
   d. x = 0.5 m, y = 0.25 m, V_x = +2 m/s, V_y = +2 m/s

3. Which statement accurately describes the components of a vector whose coordinates are (50.5,25.6)

   a. The horizontal components is 25.6 and the vertical component is 50.5
   b. The horizontal component is 50.5 and the vertical component is 25.6
   c. There is only a vertical component of 50.5
   d. There is only a horizontal component of 50.5

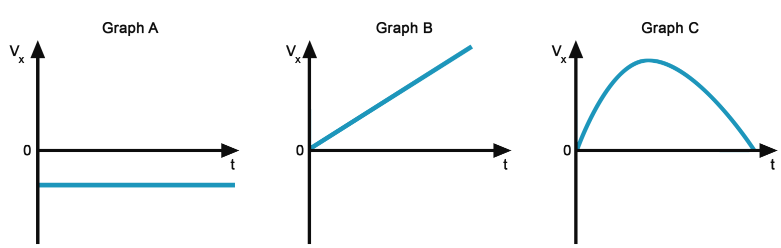
4. Vector $\vec{D}$ has components (-5,-2) and Vector $\vec{E}$ has components (3,-7). Find the sum of $\vec{D}$ and $\vec{E}$; call the result Vector $\vec{F}$.

5. Use trigonometry to solve for the magnitude of the x-component of the two-dimensional Vector $\vec{P}$ shown below.



6. You are passenger on a plane traveling at a constant velocity of 500 mph. You throw a water bottle into the air. What is the best frame of reference to use to analyze the water bottle's motion?
   a. The plane
   b. The Earth
   c. The water bottle
   d. None of the above
7. Car A is traveling 50 mph north on one side of a highway and Car B is traveling 20 mph south on the other side of the highway. What is the velocity of Car A relative to Car B?
   a. -20 mph
   b. +50 mph
   c. +70 mph
   d. -70 mph
8. A yacht traveling 2 m/s west encounters a current traveling 1.5 m/s north. What is the resultant velocity of the yacht?

9. Which of the following V_x-t graphs correctly depicts a projectile's horizontal velocity over time?



1. Graph A
2. Graph B

3. Graph C
4. None of the above

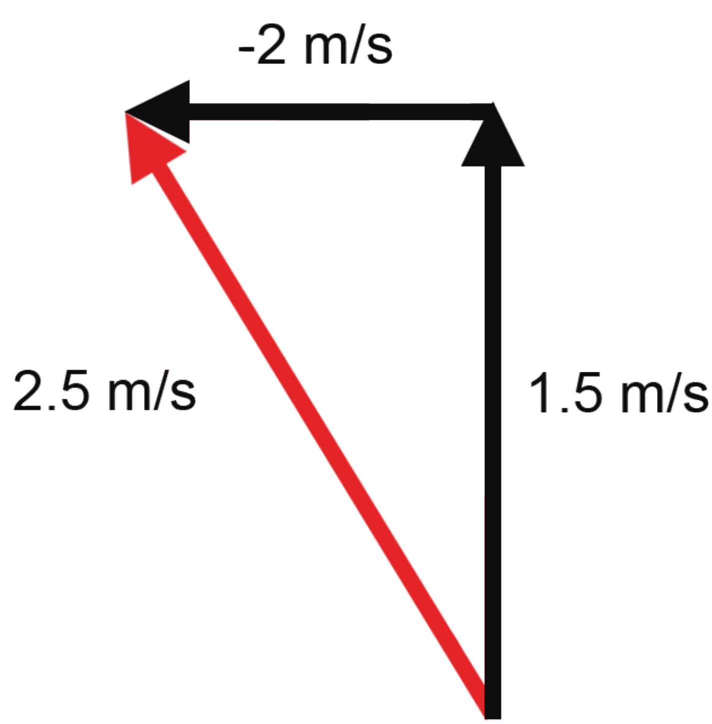
10. A high jumper leaves the ground with an initial velocity of 10 m/s rightward at an angle of 15°. What is the high jumper's initial horizontal velocity?

11. In the homecoming game, the field goal kicker attempts to make a 47 yard (43 m) field goal. He kicks with an initial velocity of 15 m/s at an angle of 60° and the ball is in the air for 6 s. Does he make the field goal?

Answer Key

1. C
2. A
3. B
4. $\vec{F}$ = (-5+3, -2+(-7)) = (2,-9)
5. $\vec{P}_x$ = 10cos45 = 7.1
6. A
7. C
8. Pythagorean Theorem:

$$a^2 + b^2 = c^2$$
$$(1.5)^2 + (-2)^2 = c^2$$
$$2.5\ m/s\ nor$$



9. A
10. 10cos15 = 9.66 m/s rightward
11. (15cos60)(6) + 0 = 45 m; yes - he makes the field goal!!

CHAPTER 4 Newton's Three Laws Assessments

Chapter Outline

4.1 Newton's First Law

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Describe what force is and different types of forces.

Use the following prompt for questions #1-4:

You hold an apple in your hand.

1. Describe all the forces acting on the apple.

2. Categorize the forces listed above as contact forces or forces acting at a distance.

3. What is the net force acting on the apple?

4. Which of the following statements correctly describes the motion of the apple according to Newton's First Law?
   a. The apple will begin to speed up if the net force is zero
   b. The apple will start to slow down if the net force is zero
   c. The apple will remain at rest if the net force is zero
   d. The apple will remain at rest if there is a net force

Lesson Objective: Understand the meaning of inertia and Newton's First Law.

Use the following prompt for questions #5-6:

At t = 0 s, a car has a velocity of 0 m/s.

5. Which statement correctly describes the forces acting on the car?
   a. the forces are balanced
   b. the forces are unbalanced
   c. there are no forces acting on the car
   d. none of the above
6. Which statement correctly describes the net force acting on the car?

a. The net force >1 N
b. The net force <1 N
c. The net force is zero
d. Not enough information is provided to answer the question

Use the following prompt for questions #7-8:

At t = 2 s, a car has a constant velocity of +12 m/s.

7. Which statement correctly describes the forces acting on the car?
   a. the forces are balanced
   b. the forces are unbalanced
   c. there are no forces acting on the car
   d. none of the above
8. Which statement correctly describes the net force acting on the car?
   a. The net force >1N
   b. The net force <1N
   c. The net force is zero
   d. Not enough information is provided to answer the question
9. Which of the following objects has a greatest inertia?
   a. Soccer ball
   b. Basketball
   c. Football
   d. Bowling ball
10. Utilize your understanding of inertia to describe how the same amount of force will affect a soccer ball compared to a bowling ball.

Answer Key

1. The force of your hand acting upward on the apple (normal force). The force of the Earth's gravity acting downward on the apple (gravitational force).
2. Contact force - the normal force of your hand on the apple. Force acting at a distance - the gravitational force of the Earth's gravity acting downward on the apple.
3. The apple is at rest, so the net force must be zero.
4. C
5. A
6. C
7. A
8. C
9. D
10. Answers will vary. *Sample answer: The inertia of an object is its resistance to a change in motion and is equal to its mass. A soccer ball has less mass than a bowling ball, and therefore less inertia. As a result, the same amount of force will have a greater effect on a soccer ball than a bowling ball.*

4.2 Newton's Second Law

Lesson Quiz

Name___________________ **Class**______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Define Newton's Second Law and net force.

Use the following prompt for question #1:

If all the forces acting on an object are unbalanced, the object will change its velocity.

1. According to Newton's Second Law, is the statement above true or false? Explain the reason for your choice.

Use the following prompt for questions #2-3:

A car is accelerating at a rate of 5 m/s2.

2. If the net force on the car is doubled, what will be the new acceleration of the car?

3. If the mass of the car is tripled, what will be the new acceleration of the car?

Lesson Objective: Calculate acceleration from force and mass.

Use the following prompt for questions #4-6:

A +100 N rightward net force is applied to a 25 kg object moving rightward.

4. What is the resulting acceleration?

5. Does the object speed up or slow down? Explain the reason for your answer.

6. If the velocity of the object at t = 0 s was +8 m/s rightward, what would the velocity be at t = 1 s?

Lesson Objective: Calculate force from acceleration and mass.

7. A scooter with a mass of 100 kg begins from rest and increases its speed to 7 m/s in 7 s. What was the net force exerted on the scooter?
   a. 1 N
   b. 42 N
   c. 100 N
   d. 700 N
8. What net force is required to produce an acceleration of 3 m/s^2 on a 60 kg object?
   a. 30 N
   b. 100 N
   c. 180 N
   d. 600 N

Lesson Objective: Calculate mass from force and acceleration.

Use the following prompt for questions #9-10:

An astronaut weighs 600 N on the Earth.

9. What is the astronaut's mass on Earth?

10. What is the astronaut's mass on moon?

Answer Key

1. True. If all of the forces acting on an object are unbalanced, then there will be a net force. According to Newton's 2^{nd} law of motion, F_{net} = ma. Therefore, the object will accelerator or change its velocity.
2. 10 m/s^2; According to Newton's Second Law, the net force and acceleration are directly proportional.
3. 3/5 or 0.6 m/s^2; According to Newton's Second Law, the mass of an object and its acceleration are inversely proportional.
4. 100 N = (25 kg)(a)
   a = +4 m/s^2 rightward
5. The object speeds up because the net force is in the same direction as its motion.
6. Acceleration is the change of velocity over time. Therefore, the object will increase its velocity (speed up) 4 m/s every second. At t = 1 s, the object will be traveling at a velocity of +12 m/s rightward.
7. C
8. C

9. W = mg
   W = 600 N; g_{Earth} = 10 N/kg
   600 N= (m)(10 N/kg)
   m = 60 kg
10. Still 60 kg because mass is simply the amount of matter in an object and remains constant throughout the universe.

4.3 Newton's Three Law

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand Newton's Third Law.

Use the following prompt for questions #1-3:

A weightlifter stands on the Earth and holds a 20 kg barbell above his head for 1 minute.

According to Newton's 3^{rd} Law of motion, identify the reaction pair to the following forces:

1. The upward normal force from the weightlifter on the barbell
   a. The downward normal force from the weightlifter on the Earth
   b. The downward normal force from the barbell on the weightlifter
   c. The downward gravitational force from the Earth on the barbell
   d. The downward gravitational force from the Earth on the weightlifter

2. The downward gravitational force from the Earth on the weightlifter
   a. The upward normal force from the weightlifter on the Earth
   b. The downward normal force from the barbell on the weightlifter
   c. The upward gravitational force from the weightlifter on the Earth
   d. The downward gravitational force from the Earth on the weightlifter

3. The upward normal force from the Earth on the weightlifter
   a. The upward normal force from the weightlifter on the Earth
   b. The downward normal force from the weightlifter on the Earth
   c. The upward gravitational force from the weightlifter on the Earth
   d. The downward gravitational force from the Earth on the weightlifter

Lesson Objective: Understand the difference between countering force and action-reaction.

Use the following prompt for questions #4-5:

A -200 N gravitational force from the Earth acts on a barbell held still by a weightlifter.

4. What is the countering force to the force described above?
   a. -200 N normal force from the weightlifter on the barbell

b. +200 N normal force from the weightlifter on the barbell
c. -200 N gravitational force from the Earth on the barbell
d. +200 N gravitational force from the barbell on the Earth

5. What is the reaction pair force according to Newton's 3^{rd} law of motion?

    a. -200 N normal force from the weightlifter on the barbell
    b. +200 N normal force from the weightlifter on the barbell
    c. -200 N gravitational force from the Earth on the barbell
    d. +200 N gravitational force from the barbell on the Earth

Use the following prompt for questions #6-7:

A +750 N normal force from the Earth acts on a weightlifter at rest.

6. What is the countering force to the force described above?

    a. -750 N normal force from the weightlifter on the Earth
    b. +750 N normal force from the weightlifter on the Earth
    c. -750 N gravitational force from the Earth on the weightlifter
    d. +750 N gravitational force from the Earth on the weightlifter

7. What is the reaction pair force according to Newton's 3rd law of motion?

    a. -750 N normal force from the weightlifter on the Earth
    b. +750 N normal force from the weightlifter on the Earth
    c. -750 N gravitational force from the Earth on the weightlifter
    d. +750 N gravitational force from the Earth on the weightlifter

Lesson Objective: Use Newton's three laws to solve problems in one dimension.

For questions #8-10, solve for the net force in each of the following situations:

8. A 20 kg barbell is being held at rest by a weightlifter.

    a. The net force is 0 N
    b. The net force is +20 N
    c. The net force is +4 N
    d. The net force is +40 N

9. A 20 kg barbell is moving upward with a constant velocity of 2 m/s.

    a. The net force is 0 N
    b. The net force is +20 N
    c. The net force is +4 N
    d. The net force is +40 N

10. A 20 kg barbell is moving upward with a constant acceleration of 2 m/s^2.

    a. The net force is 0 N
    b. The net force is +20 N
    c. The net force is +4 N
    d. The net force is +40 N

Answer Key

1. B
2. C
3. B
4. B
5. D
6. C
7. A
8. A
9. A
10. D

4.4 Newton's Three Laws Chapter Test

Chapter Test

Name___________________ **Class**______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives.

Use the following prompt for questions #1-4:

A book rests on a table.

1. Which of the following describes a contact force acting on the book?
   a. The force of Earth's gravity acting downward on the book
   b. The normal force of the table acting upward on the book
   c. The force of air resistance acting on the book
   d. The force of friction acting on the book
2. Which of the following describes a force acting from a distance on the book?
   a. The force of Earth's gravity acting downward on the book
   b. The normal force of the table acting upward on the book
   c. The electrical force acting on the book
   d. The magnetic force acting on the book
3. What is the net force acting on the book?
   a. The net force is zero
   b. The net force >1 N
   c. The net force <1 N
   d. Not enough information is provided to answer the question
4. Which of the following statements correctly describes the motion of the book according to Newton's First Law?
   a. The book will begin to speed up if the net force is zero
   b. The book will start to slow down if the net force is zero
   c. The book will remain at rest if there is a net force
   d. The book will remain at rest if the net force is zero

Use the following prompt for questions #5-6:

A 7 lb bowling ball accelerates at a rate of 7 m/s2.

5. If the net force on the bowling ball is tripled, what will be its new acceleration?
   a. 2.3 m/s^2
   b. 7 m/s^2
   c. 14 m/s^2

d. 21 m/s^2

6. If the mass of the bowling ball is doubled, what will be its new acceleration?
   a. 2.3 m/s^2
   b. 3.5 m/s^2
   c. 7 m/s^2
   d. 14 m/s^2

Use the following prompt for questions #7-9:

A +10 N rightward net force is applied to a 5kg object moving leftward.

7. What is the resulting acceleration?

8. Does the object speed up or slow down? Explain the reason for your answer.

9. If the velocity of the object at t = 0 s was -20 m/s leftward, what would the velocity be at t = 1 s?

10. What net force is required to accelerate a 100 kg object from 3 m/s to 6 m/s in 1.5 s?
    a. 80 N
    b. 180 N
    c. 200 N
    d. 450 N
11. What is the net force on a 400 kg car that is stopping at a red light if it goes from 12 m/s to 0 m/s in 2 s?
    a. 6000 N
    b. 4800 N
    c. 3600 N
    d. 2400 N
12. A sled is pulled with a net force of 60 N, causing it to increase its velocity 3 m/s in 7 s. What is the mass of the sled?

13. The acceleration due to gravity on the moon is 1.6 m/s^2. If an astronaut weighs 96 N on the moon, what is the astronaut's mass on Earth?

Use the following prompt for questions #14-15:

A book is resting on a table.

For each of the following forces acting on the book, identify the properties of the reaction force pair according to Newton's third law of motion.

14. Action: A downward gravitational force from the Earth acting on the book.

15. Action: An upward normal force from the table acting on the book.

Use the following prompt for questions #16-17:

A normal force of +10 N from a table acts on a book.

16. What is the countering force to the force described above?
    a. -10 N normal force from the book on the table
    b. +10 N normal force from the book on the table
    c. -10 N gravitational force from the Earth on the book
    d. +10 N gravitational force from the Earth on the book
17. What is the reaction pair force according to Newton's 3rd law of motion?
    a. -10 N normal force from the book on the table
    b. +10 N normal force from the book on the table
    c. -10 N gravitational force from the Earth on the book
    d. +10 N gravitational force from the Earth on the book

For question #18-20, solve for the net force in each of the following situations:

18. A 0.1 kg book is resting on a table.
    a. The net force is 0 N
    b. The net force is +1 N
    c. The net force is +10 N
    d. The net force is +100 N
19. A 0.1kg book is sliding rightward on a table with a constant acceleration of $2 m/s^2$.
    a. The net force is 0 N
    b. The net force is +0.2 N
    c. The net force is +2 N
    d. The net force is +20 N
20. What is the reaction force to the downward gravitational force on the book from the Earth?
    a. The upward gravitational force from the book on the Earth
    b. The downward gravitational force on the book from the Earth
    c. The upward normal force on the book from the table
    d. The downward normal force on the table from the book

Answer Key

1. B
2. A
3. A
4. D
5. D
6. B
7. +10 N = (5 kg)(a)
   a = +2 m/s^2 rightward
8. The object slows down because the net force is in the opposite direction of its motion.
9. Acceleration is the change of velocity over time. Therefore, the object will decrease its velocity (slow down) 2 m/s every second. At t = 1 s, the object will be traveling at a velocity of -18 m/s leftward.
10. C
11. D
12. First, solve for the acceleration: $a = \frac{\Delta v}{\Delta t} = \frac{3\frac{m}{s}}{7\ s} = 0.43\frac{m}{s^2}$
    Then, use F_{net} = ma to solve for the mass.
    60 N = (m)(0.43 m/s^2)
    m = 140 kg
13. W = mg
    W=96 N; g_{Moon}=1.6 N/kg
    96 N = (m)(1.6 N/kg)
    m=60 kg (the mass on the Moon and Earth are the same).
14. Reaction Pair: A upward gravitational force from the book acting on the Earth
15. Reaction Pair: A downward normal force from the book acting on the table
16. C
17. A
18. A
19. B
20. A

CHAPTER 5 Forces in Two Dimensions Assessments

Chapter Outline

5.1 Normal Forces and Friction Forces

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand how to solve problems involving the normal force.

Use the following prompt for questions #1-5.

A box with a mass of 10kg is resting on the floor.

1. Draw a free-body diagram to illustrate all the forces acting on the box.
2. What is the magnitude and direction of the force due to Earth's gravity acting on the box?
3. What is the magnitude and direction of the normal force acting on the box?
4. What is the magnitude and direction of the net force acting on the box?
5. In your own words, explain how the forces acting on the box are responsible for its motion according to Newton's laws.

Lesson Objective: Understand how to solve problems involving friction.

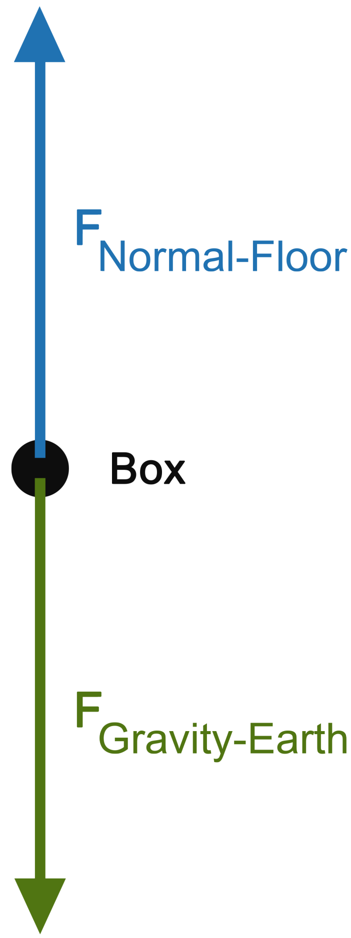
Use the following prompt for questions #6-10.

A suitcase with a mass of 15kg is being pushed rightward on the airport floor. The coefficient of static friction is 0.8 and the coefficient of kinetic friction is 0.4.

6. What is the weight of the suitcase?
7. What is the normal force acting on the suitcase?
8. How much force did it take to get the suitcase to start moving?
9. How much force does it take to keep the suitcase moving?
10. Which of the following would help decrease the force of kinetic friction on the suitcase?
    a. Pushing down on the suitcase

b. Placing a box on top of the suitcase
c. Lifting up on the suitcase off the floor a little
d. Sliding the suitcase on a carpeted floor (with a coefficient of kinetic friction of 0.8)

Answer Key

1. 

2. W=mg
(10 kg)(10 N/kg)=-100 N downward
3. The box is at rest, so according to Newton's first law of motion, all of the forces acting on the box must be balanced. In this situation, the normal force is countering the force due to gravity and must be +100 N upward.
4. F_{net}=ma=0 N
(10kg)(0 m/s^2)=0 N
The box is at rest
5. Answers will vary. *Sample Answer: The force due to Earth's gravity is acting from a distance on the box and is constant on Earth. The normal force is due to the box's contact with the floor. The box is at rest, so according to Newton's first law of motion, all the forces acting on the box must be balanced. Therefore, the force due to gravity and the normal forces are countering each other, requiring them to be equal in magnitude and opposite in direction.*
6. W=mg=(15 kg)(-10 N/kg)=-150 N downward

7. FN counters the force due to gravity, or the chew toy's weight
   W=mg=(15 kg)(-10 N/kg)=-150 N downward
   FN=+ 150N upwards
8. $F_s = \mu_s F_n$
   F_s=(0.8)(150 N)=-120 N leftward
   F_A >+120 N rightward
9. $F_k = \mu_k F_n$
   F_k=(0.4)(150 N)=-60 N leftward
   F_A=+60 N rightward
10. C

5.2 Inclined Planes

Lesson Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand how to analyze and work with forces on inclined planes.

Use the following prompt for questions #1-4:

A 78kg skateboarder is skating down a hill with an incline of 60 degrees.

1. What is the weight of the skateboarder?
2. What is the horizontal (x) component of the weight of the skateboarder?
3. What is the vertical (y) component of the weight of the skateboarder?
4. What is the normal force on the skateboarder?

Lesson Objective: Understand how to apply Newton's Second Law to the inclined plane problems.

Use the following prompt for questions #5-6:

A 78kg skateboarder is skating down a hill with an incline of 60 degrees.

5. If the skateboarder is sliding at a constant speed, what is the force of kinetic friction on the skateboarder?
6. If the skateboarder is accelerating at -3 m/s^2, want is the force of kinetic friction on the skateboarder?

For questions #7-9, determine the acceleration of the following boxes if they slide down a frictionless inclined plane with an angle of 30 degrees.

7. 5 kg box

8. 50kg box

9. 500kg box

10. Write a sentence describing your observations regarding the effect of the mass of the box on the acceleration down a 30 degree inclined plane.

Answer Key

1. F_g=mg=-780 N
2. F_{g-x}=mg sinθ=-676 N
3. F_{g-x}=mg cosθ=-390 N
4. F_N=mg cosθ=+390 N
5. F_{Net-X}=0 N
   0 N=F_{g-x}+F_f
   F_f=-F_{g-x}
   F_f=mg sinθ=+676 N
6. F_{Net-X}=-234 N
   -234 N=-676 N+F_f
   F_f=+442 N
7. a=g sinθ
   10sin(30°)=5 m/s^2
8. a=g sinθ
   10sin(30°)=5 m/s^2
9. a=g sinθ
   10sin(30°)=5 m/s^2
10. Answers will vary. *Sample Answer: The mass of the box does not affect the acceleration of the box down a frictionless inclined plane, if the incline remains constant.*

5.3 Circular Motion

Lesson Quiz

Name____________________ Class_______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand that in circular motion there is always an acceleration (and hence a force) that points to the center of the circle defined by the objects motion. This force changes the direction of the velocity vector of the object but not the speed.

1. Dispel the following misconception, "Centripetal force is a new type of force."

Use the following prompt for questions #2-5:

A tetherball moves in a circle.

2. The centripetal force on the tetherball is due to
   a. The force of gravity
   b. The force of kinetic friction
   c. The force of static friction
   d. The tension force of the rope
3. The direction of the centripetal force on the tetherball is
   a. Downward
   b. Upward
   c. Clockwise
   d. Toward the center of the circle
4. The direction of the tetherball's acceleration in the horizontal (x) dimension is
   a. Downward
   b. Upward
   c. Clockwise
   d. Toward the center of the circle
5. In your own words, explain how the tetherball can move in a circle at a constant speed and still be accelerating?

Lesson Objective: Understand how to calculate that speed using the period of motion and the distance of its path (circumference of the circle it traces out).

Calculate the magnitude and direction of the centripetal acceleration of the following objects moving in a circle:

6. A 1000kg truck drives along a circular round-a-bout with a radius of 40 m at a constant speed of 15 m/s.

7. A 0.05 kg golf ball moves in a circle with a radius of 0.05 m at a constant speed of 1 m/s.

8. A 60 kg skateboarder travels around a circular ramp with a radius of 10 m at a constant speed of 4.2 m/s.

Calculate the speed of the following objects moving in a circle:

9. A 3000 kg truck drives along a circular path with a radius of 45 m with an acceleration of 5 m/s^2.

10. A 75 kg Olympic sprinter runs around a track with a radius of 36.8 m with an acceleration of 7 m/s^2.

Answer Key

1. Answers will vary. *Sample Answer: Centripetal force is not a type of force, it simply describes the direction of a force (toward the center of the circle). For example, the force of gravity is the centripetal force for satellites and friction is the centripetal force for cars moving around a racetrack.*
2. D
3. D
4. D
5. Answers will vary. *Sample Answer: The tether ball experiences a net force in the horizontal (x) dimension toward the center of the circle. According to Newton's Second Law, it must also be accelerating toward the center of the circle. Acceleration is a change in velocity over time. Velocity is a vector, with both magnitude and direction. Although the magnitude of the tether ball's velocity is constant (constant speed), the direction of the tether ball's velocity is always changing as it travels along the circle.*
6. $a_c = \frac{v^2}{r}$
   a_c=(225/40)=5.6 m/s^2 toward the center of the circle
7. $a_c = \frac{v^2}{r}$
   a_c=(1/0.05)=20 m/s^2 toward the center of the circle
8. $a_c = \frac{v^2}{r}$
   a_c=(100/20)= 1.8 m/s^2 toward the center of the circle
9. $a_c = \frac{v^2}{r}$
   5m/s^2=(v^2/45)=15 m/s
10. $a_c = \frac{v^2}{r}$
    7 m/s^2=(v^2/36.8)=16 m/s

5.4 Forces in Translational Equilibrium-Statics

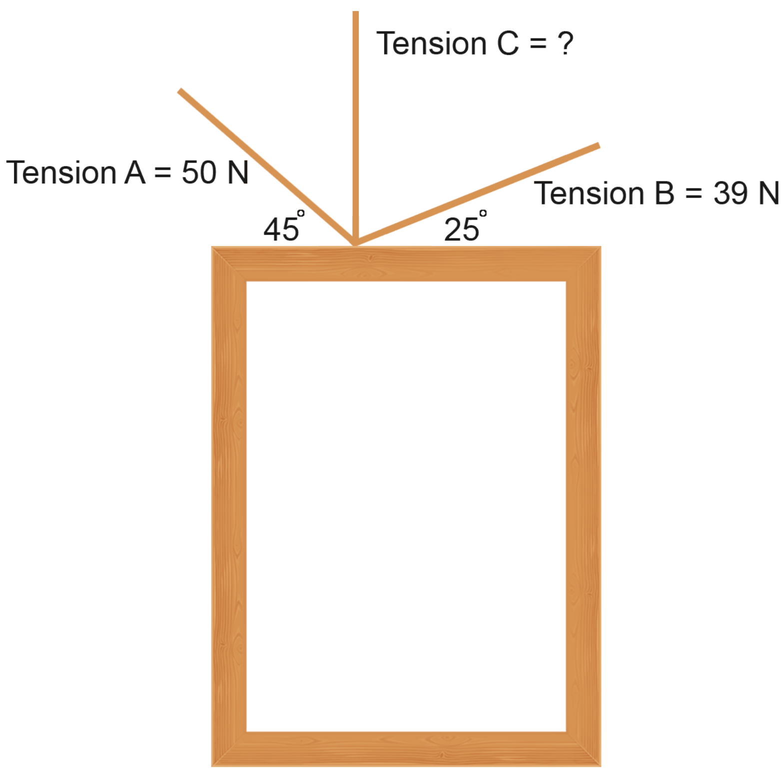
Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand how to apply Newton's Second Law under equilibrium conditions in two dimensions.

A 8kg picture is hanging on a wall by three wires as depicted below.:::



Determine the force of Tension C needed to keep the picture hanging in static equilibrium. Use the chart to help you organize your work.

TABLE 5.1:

Force	Horizontal (x) Component	Vertical (y) Component
Weight		
Tension A		
Tension B		

TABLE 5.1: (continued)

Force	Horizontal (x) Component	Vertical (y) Component
Tension C		
Net Force		

Answer Key

TABLE 5.2:

Force	Horizontal (x) Component	Vertical (y) Component
Weight	0N	-80N
Tension A	50cos45=-35.4N	50sin45=+35.4N
Tension B	39cos25=+35.4N	39sin25=+16.5N
Tension C	0N	+28.1N
Net Force	0N	0N

Tension C must apply 28.1N upward for the picture to remain in static equilibrium.

5.5 Forces in Two Dimensions Chapter Test

Chapter Test

Name___________________ **Class**______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives.

Use the following prompt for questions #1-5.

Diane picks up a 10 kg box with an upward acceleration of +2 m/s2.:::

1. Draw a free body diagram to illustrate all the forces acting on the box.
2. What is the magnitude and direction of the force due to Earth's gravity acting on the box?
   a. -10 N downward
   b. +20 N upward
   c. -100 N downward
   d. +120 N upward
3. What is the magnitude and direction of the normal force acting on the box?
   a. -10 N downward
   b. +20 N upward
   c. -100 N downward
   d. +120 N upward
4. In your own words, explain how the forces acting on the box are responsible for its motion according to Newton's laws.

Use the following prompt for questions #6-7:

A man (105 kg) pulls on a stuck drawer (0.5 kg). The force of static friction on the drawer is 3.5 N and the force of kinetic friction on the drawer is 2.6 N.:::

6. What is the coefficient of static friction on the drawer?
7. What is the coefficient of kinetic friction on the drawer?

Use the following prompt for questions #8-10:

A 14lb (6.35kg) bowling ball is sliding down a 5 meter frictionless ramp with an incline of 25 degrees at a constant speed.:::

8. What is the weight of the bowling ball?
   a. 14 lbs
   b. 6.35 kg
   c. -26.8 N
   d. -63.5 N
9. What is the normal force on the bowling ball?
   a. -26.8 N
   b. +26.8 N
   c. -63.5 N
   d. +63.5N
10. What is the acceleration of the bowling ball?
   a. 0 m/s^2
   b. 6.35 m/s^2
   c. 26.8 m/s^2
   d. 63.5 m/s^2

Use the following prompt for questions #11-13:

An Olympic skier of mass 80 kg skies down a slope of 25 degrees with an acceleration of 4.1 m/s2.:::

11. What is the weight of the skier?
   a. 80 kg
   b. -80 N
   c. 800 kg
   d. -800N
12. What is the normal force on the skier?
   a. +72.5 N
   b. +725 N
   c. +80 N
   d. +800 N
13. What is the force of friction on the skis?
   a. +5 N
   b. +10 N
   c. +15 N
   d. +25 N

Use the following prompt for questions #14-16:

A car is driving around a race track.:::

14. The centripetal force on the car is due to

a. The force of gravity
b. The force of friction
c. The normal force
d. The tension force of a rope

15. The direction of the centripetal force on the car is

a. Downward
b. Upward
c. Clockwise
d. Toward the center of the circular track

16. The direction of the car's acceleration is

a. Downward
b. Upward
c. Clockwise
d. Toward the center of the circle

17. Clark Griswold travels in a 1000kg car with his family and can't get off the round-a-bout, traveling at a constant speed of 11 m/s in a circle with a radius of 35m. Calculate the magnitude and direction of the centripetal acceleration.

Use the following prompt for questions #18-20.

Spiderman (mass=77.3 kg) hangs at rest from two strings of a web. String A has a tension force of 400N and an angle of 45 degrees. String B has a tension force of 565.6N at an angle of 60 degrees.:::

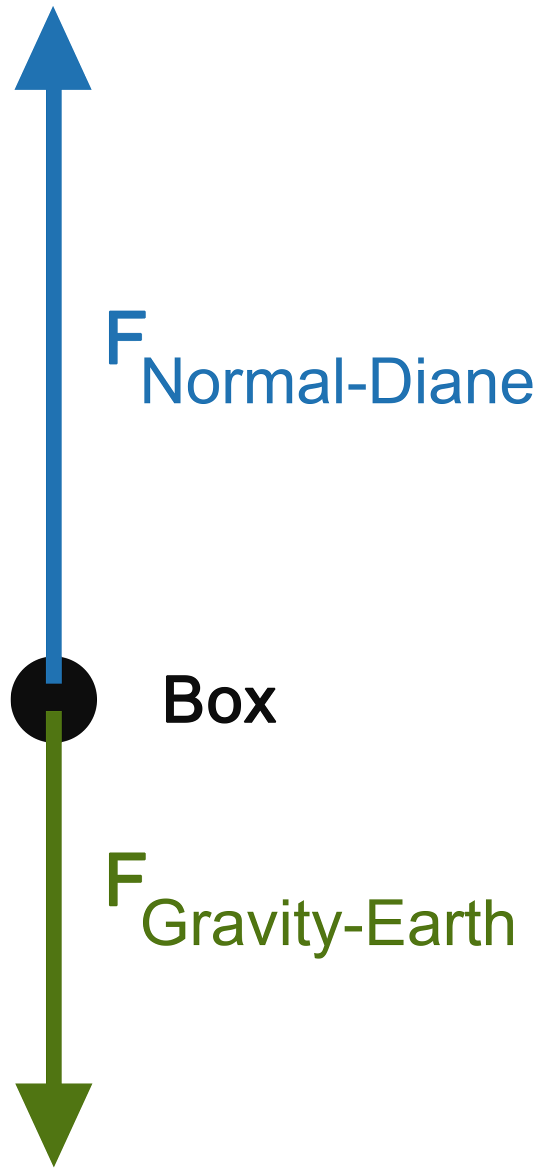
18. Draw a free body diagram illustrating all the forces acting on Spiderman.

19. Use your understanding of Newton's 2nd Law to prove that the net force in the horizontal (x) dimension is zero.

20. Use your understanding of Newton's 2nd Law to prove that the net force in the vertical (y) dimension is zero.

Answer Key

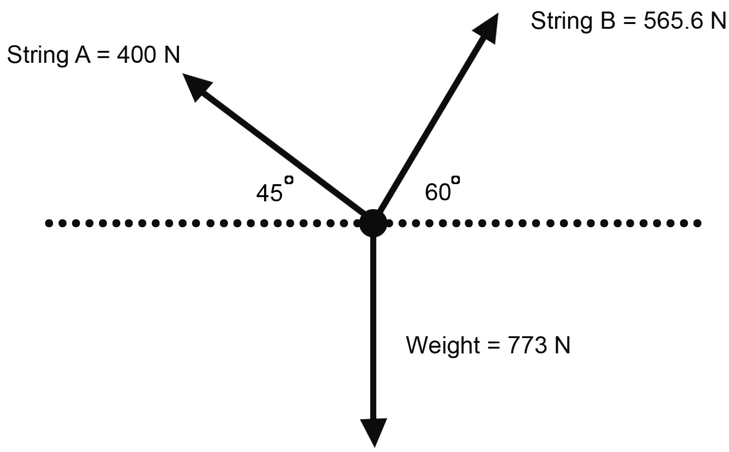
1.



2. C
3. B
4. D
5. Answers will vary. *Sample Answer: The force due to Earth's gravity is acting from a distance on the box and is constant on Earth. The normal force is due to Diane's contact with the box. The normal force is greater than the force due to gravity, creating a net force of +20 N upward. According to Newton's 2nd law of motion, an unbalanced (net) force of +20 N will cause the box to accelerate upwards at +2 m/s*^{2} *(*F_{net}*=ma).*
6. W=mg; W=-5 N
   F_N=+5 N
   $F_s=\mu_s F_n$
   3.5N=μ_s(5N)=0.7
   μ_s=0.7
7. W=mg; W=-5 N
   F_N=+5 N
   $F_k=\mu_k F_n$

2.6 N=μ_k(5 N)=0.52
μ_k=0.52

8. D
9. B
10. A
11. D
12. B
13. D
14. B
15. D
16. D
17. $a_c = \frac{v^2}{r}$
18.



19. Using Newton's Second Law, $F = ma$, we know that if an object is not accelerating there are no forces acting on it. Since it is specified that Spiderman is at rest, he must not be accelerating, and so has no net force on him.
20. Using Newton's Second Law, $F = ma$, we know that if an object is not accelerating there are no forces acting on it. Since it is specified that Spiderman is at rest, he must not be accelerating, and so has no net force on him.

CHAPTER 6 Work and Energy Assessments

Chapter Outline

6.1 Work Quiz

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand how work is defined in physics.

1. Work and energy are measured in
    a. Newtons
    b. Kilograms
    c. Watts
    d. Joules
2. Explain how a waiter does 50 J of work when lifting a 20 lb (100 N) tray 0.5 m off the kitchen counter.
3. Explain how a waiter does 0J of work when carrying a 20 lb (100 N) tray from the kitchen to a table.
4. A 150 lb (667 N) diver needs to get to the top of a 10 m high diving board. Which method of getting to the top would require the most amount of work?
    a. Walking up a 30 m long ramp
    b. Climbing a 10 m ladder
    c. Running up a 40 m inclined plane
    d. All of the choices require the same amount of work
5. Explain your choice above.

Lesson Objective: Be able to solve problems involving work.

Use the prompt below for questions #6-10.

<u>You are moving furniture into a moving truck that is 1 meter above the ground. You have two identical chairs, weighing 70 lbs (31.8 kg) each, which need to be moved into the truck.</u>

6. How much force does it require to lift the first chair into the truck?
    a. 31.8 N
    b. 31.8 J
    c. 318 N

d. 318 J

7. How much work does it require to lift the first chair into the truck?
   a. 31.8 N
   b. 31.8 J
   c. 318 N
   d. 318 J
8. Suddenly you realize there is a 3 m ramp. How much force does it require to push the second chair up the ramp into the truck?
   a. 318 N
   b. 318 J
   c. 106 N
   d. 106 J
9. How much work does it require to push the second chair up the 3m ramp into the truck?
   a. 318 N
   b. 318 J
   c. 106 N
   d. 106 J
10. Using your understanding of work and the relationship between force and distance in a simple machine, explain why using the ramp made moving the chair so much "easier" than simply lifting it into the truck.

Answer Key

1. D
2. Whenever a force is applied to move an object a distance, work is done. Work is the product of force and distance (W=fd). In this case, W=(100 N)(0.5 m)=50 J
3. In order for work to be done, the force cannot be perpendicular to the direction of motion. In this case, the tray is moving rightward and the force is upward. Therefore, the force is perpendicular to the motion and no work is being done.
4. D
5. Explanations will vary. *Sample Answer: To move a massive object a certain distance requires the same amount of work, despite the path taken. It will take 6,667 J of work to get the 667 N diver to the top of the 10 m diving board, no matter what path the diver takes. Simple machines make our lives easier by decreasing the amount of force needed by increasing the distance over which the force is applied, but the overall work stays the same. So, the amount of force would decrease by using a 30 m ramp or 40 m inclined plane, but the work would still be 6,667 J.*
6. C
7. D
8. C
9. B
10. Answers will vary. *Sample Answer: The ramp decreased the amount of force needed to move the chair by increasing the distance over which I had to apply the force. Using the ramp, I only had to apply 106 N of force but I had to apply it over 3 m. When I simply lifted the chair, I had to apply 318 N of force over a shorter distance of 1 m. The work done in both situations remained the same, or 318 J.*

6.2 Energy Quiz

Lesson Quiz

Name____________________ **Class**_______________ **Date** _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand the relationship between work and energy.

Use the following prompt for questions #1-3:

You eat a 140-Calorie snack and then go to the gym to "work it off" by lifting a 25 lb (11 kg) barbell.

1. How many Joules did you consume by eating the 140-Calorie snack?
2. How much work do you do when you lift the barbell 1 meter?
3. How many times do you have to lift the barbell 1 meter to work off the calories you consumed?

Lesson Objective: Be able to distinguish between kinetic and potential energy.

Use the following prompt for questions #4-6:

A weightlifter lifts a 45 kg barbell from the floor to a height of 2 m above the ground.

4. How much work did the weightlifter do?
   a. 45 N
   b. 450 J
   c. 900 N
   d. 900 J
5. How much potential energy does the barbell have when it is 2m above the ground?
   a. 45 N
   b. 450 J
   c. 900 N
   d. 900 J
6. If he drops the weight, what type of energy does the system have halfway down?
   a. Potential Energy

b. Kinetic Energy
c. Potential Spring Energy
d. Both A B

Lesson Objective: Understand the role of friction as it pertains to work and energy.

Use the following prompt for questions #7-8:

A student applies a 50 N force to push a book across a 2 meter library table at a constant speed.

7. How much work was done by the student on the book?
   a. 50 N
   b. -50 J
   c. +100 J
   d. -100 J
8. How much work was done by friction on the book?
   a. 50 N
   b. -50 J
   c. +100 J
   d. -100 J

Lesson Objective: Be able to solve problems involving kinetic and potential energy and friction.

Use the following prompt for questions #9-10:

A 0.43kg soccer ball rolls on the ground with a velocity of 6 m/s.

9. Calculate the soccer ball's kinetic energy.

10. Calculate the soccer ball's potential energy.

Answer Key

1. $140\ cal * (\frac{4200\ J}{1\ cal}) = 588,000\ J$
2. $W = Fd = (110\ N)(1\ m) = 110\ J$
3. $\frac{588,000\ J}{110\ J} = 5,345\ times$ (this does not include the energy your body uses as chemical energy)
4. D
5. D
6. D
7. C
8. D
9. $KE = \frac{1}{2}mv^2$, so $(\frac{1}{2})(0.43\ kg)(6\ m/s)^2 = 7.74\ J$
10. $PE = mgh$, so $(0.43\ kg)(10\ N/kg)(0\ m) = 0\ J$

6.3 Energy Conservation Quiz

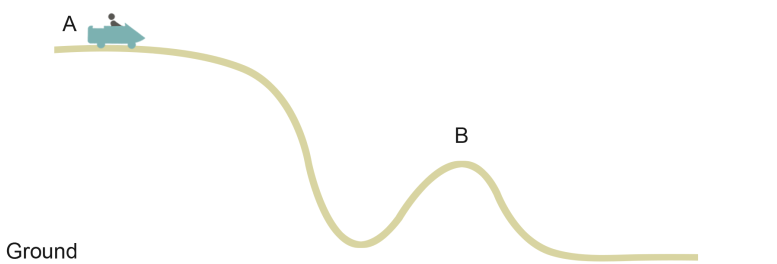
Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand the meaning of energy conservation.

The mass of the roller coaster cart below is 80 kg. It starts from rest at a height of 30 m and reaches a speed of 20 m/s at Point B. Assume no energy is lost due to dissipative forces such as friction.



1. What is the total mechanical energy of the roller coaster cart at Point A?
   a. 800 J
   b. 2400 J
   c. 24,000 J
   d. Not enough information to determine
2. What is the total mechanical energy of the roller coaster cart at Point B?
   a. 800 J
   b. 2400 J
   c. 24,000 J
   d. Not enough information to determine
3. What is the amount of potential energy at Point A?
   a. 0 J
   b. 800 J
   c. 2400 J
   d. 24,000 J
4. What is the amount of kinetic energy at Point A?
   a. 0 J
   b. 8000 J
   c. 16,000 J
   d. 24,000 J
5. What is the amount of potential energy at Point B?

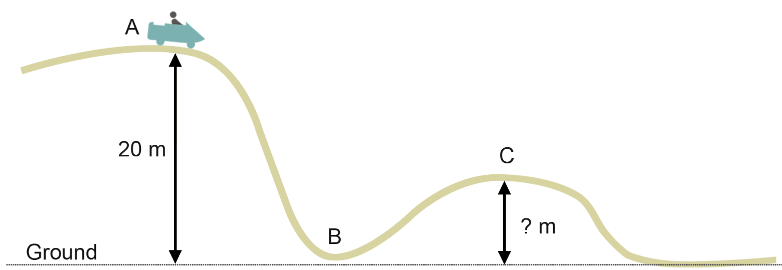
a. 0 J
b. 8000 J
c. 16,000 J
d. 24,000 J

6. What is the amount of kinetic energy at Point B?

a. 0 J
b. 8000 J
c. 16,000 J
d. 24,000 J

Lesson Objective: Be able to use energy conservation in solving problems.

The total mechanical energy of the roller coaster cart below at Point A is 180,000 J. The speed of the cart at Point B is +20 m/s. Assume no energy is lost due to dissipative forces such as friction.



7. What is the mass of the roller coaster cart?

8. What is the potential energy at Point A?

9. What is the kinetic energy at Point A?

10. The velocity of the roller coaster cart is +16 m/s at Point C. What is the height of the roller coaster at Point C?

Answer Key

1. C
2. C
3. D
4. A
5. B
6. C

7. At Point B, we know all the energy is kinetic. Therefore 180,000 J=1/2(m)(20 m/s)^2 m=900 kg
8. PE=mgh=(900 kg)(10 N/kg)(20 m)=180,000 J
9. TE=PE+KE
   180,000 J=180,000 J + KE
   KE=0 J
10. TE=PE + KE
    180,000 J = (900 kg)(10 N/kg)(? m) + $\frac{1}{2}$(900 kg)(16 m/s)^2
    64,800=(9000 N)(? m)
    height=7.2m

6.4 Power Quiz

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand how power is defined in physics.

1. In physics, what does power depend on?
   a. The amount of work done
   b. The rate work is done
   c. The amount of energy consumed
   d. The amount of energy transferred
2. Power is measured in
   a. Watts
   b. Kilowatts
   c. Horsepower
   d. All of the above
3. If the time it takes to do a certain amount of work increases, then the power
   a. Increases
   b. Decreases
   c. Stays the same
   d. None of the above
4. If the time it takes to do a certain amount of work decreases, then the power
   a. Increases
   b. Decreases
   c. Stays the same
   d. None of the above
5. In general, power companies charge you for
   a. Work done
   b. Energy consumed over time
   c. Force over time
   d. None of the above

Lesson Objective: Be able to solve problems involving power.

Use the following prompt for questions #6-8:

George drags his suitcase with a constant force of 36 N over a distance of 100 m in 3 minutes.

6. How much power does George use in Watts?

a. 0.02 W
b. 2 W
c. 20 W
d. 200 W

7. How much power does George use in kilowatts?

a. 0.02 kW
b. 2 kW
c. 20 kW
d. 200 kW

8. How much power does George use in horsepower?

a. 0.026 hp
b. 2.6 hp
c. 26 hp
d. 260 hp

Use the following prompt for questions #9-10:

Diane drags her suitcase with the same force (36 N) over a distance of 50 m in 3 minutes.

9. Who does the most work, George or Diane? Explain.

10. Who expends the most power, George or Diane? Explain.

Answer Key

1. B
2. D
3. B
4. A
5. B
6. C
7. A
8. A
9. George, because he applied 36N of force over a greater distance than Diane.
10. Diane: P=100 W = (1800 J/180 s) =100 W
    George: P=20 W = (3600 J/180 s) = 20 W

6.5 Work and Energy Chapter Test

Chapter Test

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

1. In physics, work is
   a. Decreased by using a simple machine
   b. Measured in Newtons
   c. The product of force and distance
   d. Both A B
2. A Joule is a unit of measurement for which of the following
   a. Energy
   b. Work
   c. Force
   d. Both A B

Use the following prompt to answer questions #3-4:

You are working at a local grocery store stocking shelves. You have ten 15kg boxes to lift onto a shelf 3m above the ground.

3. How much work will you need to perform?

4. You use a 6 m inclined plane to help you lift the boxes to the shelf. Now how much work will you need to perform?

Use the following prompt for questions #5-6:

A 2500 kg boulder rests at the top of a mountain, 200 m above the ground.

5. How much Potential Energy does the boulder have at the top of the mountain?

6. How much work did it take to roll the boulder to the top of the mountain?

Use the following prompt for questions #7-8:

Two dogs, Spot and Fluffy, are in their backyard. Spot has a mass of 30 kg and is resting on a 1 m high bench. Fluffy is 24 kg and is chasing after a ball at 5 m/s rolling on the ground.

7. Which dog has more kinetic energy?
   a. Spot
   b. Fluffy
   c. Both have the same amount of kinetic energy
   d. Neither of the dogs have kinetic energy
8. Which dog has more potential energy?
   a. Spot
   b. Fluffy
   c. Both have the same amount of potential energy
   d. Neither of the dogs have potential energy
9. A mover applies a 300N force to push a box at a constant speed 4 meters across a carpeted floor. What is the work done by friction on the box?
   a. -300 N
   b. +300 N
   c. +1200 J
   d. -1200 J

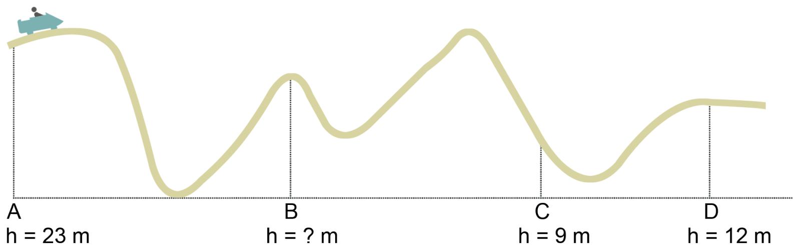
Use the following prompt for questions #10-11:

A car with a mass of 1670 kg travels on the highway at a velocity of 30 m/s.

10. Calculate the car's kinetic energy.
11. Calculate the car's potential energy.

Use the following prompt for questions #12-16:

The roller coaster cart depicted below begins from rest at Point A with a total mechanical energy of 41,400 J and ends at Point D. Assume no energy is lost due to dissipative forces such as friction.



12. What is the mass of the cart?
    a. 23 kg
    b. 41.4 kg
    c. 180 kg
    d. not enough information to determine
13. What is the total mechanical energy at Point B?
    a. 23,000 J
    b. 41,400 J
    c. 180,000 J
    d. not enough information to determine
14. If the velocity at Point B is +10 m/s, what is the height of the roller coaster at Point B?
    a. 18 m
    b. 180 m
    c. 1800 m
    d. not enough information to determine
15. What is the total mechanical energy at Point C?
    a. 23,000 J
    b. 41,400 J
    c. 180,000 J
    d. not enough information to determine
16. What is the velocity of the roller coaster at Point C?
    a. +3.3 m/s
    b. +7.5 m/s
    c. +16.7 m/s
    d. not enough information to determine
17. How much work is needed to keep a 60-Watt light bulb lit each second?
    a. 6 J
    b. 60 J
    c. 600 J
    d. 6000 J
18. How much energy is needed to keep a 60-Watt light bulb lit each second?
    a. 6 J
    b. 60 J
    c. 600 J
    d. 6000 J

Use the following prompt for questions #19-20

Susie (m=60 kg) and Jan (m=60 kg) climb three flights of stairs (18 m) to attend their physics class. Susie arrives in 60 seconds and Jan arrives in 30 seconds.

19. Which person does the most work, Susie or Jan? Explain.

20. Which person uses the most power, Susie or Jan? Explain.

Answer Key

1. C
2. D
3. F=mg=150 N
   W=Fd=(150 N)(3 m)=450 J x 10 boxes = 4,500 J
4. Still 4,500 J - work always remains the same. To move a massive object a certain distance requires the same amount of work, despite the path taken. It will take 4,500 J of work to get the ten 15 kg boxes to the shelf 3 m above the ground no matter how they get there. Simple machines make our lives easier by decreasing the amount of force needed by increasing the distance over which the force is applied, but the overall work stays the same. So, the amount of would decrease by using a 6 m ramp, but the work would still be 4,500 J.
5. PE=mgh=(2500 kg)(10 N/kg)(200 m)=5,000,000 J
6. 5,000,000 J; That is where the Potential Energy came from.
7. B
8. A
9. D
10. $KE=\frac{1}{2}mv^2$
    $\frac{1}{2}$(1670 kg)(30 m/s)^2=751,500 J
11. PE=mgh
    (1670 kg)(10 N/kg)(0 m)=0 J
12. C
13. B
14. A
15. B
16. C
17. C
18. C
19. They both do the same amount of work because they both apply the same amount of force over the same amount of distance.
20. Jan uses more power because she does the same amount of work as Susie in half the time.
    Susie:(P=1080 J/60 s=180 W)
    Jan: (P=1080 J/30 s=360 W)

CHAPTER 7 Momentum Assessments

Chapter Outline

7.1 Understanding Momentum

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Know how momentum is defined.

1. The momentum of an object depends on the
   a. mass of the object
   b. velocity of the object
   c. force of gravity on the object
   d. Both A B
2. The following bowling balls are all traveling at 6 m/s. Which bowling ball has the greatest momentum?
   a. 6 lb bowling ball
   b. 10 lb bowling ball
   c. 12 lb bowling ball
   d. 14 lb bowling ball
3. What would be the best way to increase the momentum of a 15kg wagon?
   a. increase the mass of the wagon
   b. increase the acceleration of the wagon
   c. increase the displacement of the wagon
   d. all of the above
4. At what velocity would a 5 kg object have to travel to have the same momentum as a 50kg object traveling at 1 m/s?
   a. 1 m/s
   b. 10 m/s
   c. 100 m/s
   d. not enough information to determine
5. If the velocity of a soccer ball is doubled, then its momentum will
   a. Double
   b. Triple
   c. Be halved
   d. Stay the same

Lesson Objective: Be able to solve problems using momentum.

6. Calculate the momentum of a 4500 kg helicopter moving north at +100 m/s.

7. Calculate the momentum of a 5700 kg plane moving south at -250 m/s.

8. What is the momentum of a 0.4 kg soccer ball kicked +14 m/s north?
   a. 0.4 kg•m/s north
   b. 5.6 kg•m/s north
   c. 14 kg•m/s north
   d. 560 kg•m/s north
9. What is the velocity of a 900 kg car with a momentum of 16,200 kg•m/s east?
   a. 6 m/s east
   b. 18 m/s east
   c. 90 m/s east
   d. 162 m/s east
10. What is the mass of a tennis ball traveling with a velocity of 3 m/s and a momentum of 0.25 m/s?
   a. 0.08 kg
   b. 0.5 kg
   c. 9 kg
   d. 18 kg

Answer Key

1. D
2. D
3. A
4. B
5. A
6. p=mv=(4500kg)(+100 m/s)=+450,000 kg•m/s north
7. p=mv=(5700kg)(-250 m/s)=-1,425,000 kg•m/s south
8. B
9. B
10. A

7.2 Impulse

Lesson Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Learn the meaning of impulse force and how to calculate both impulse and impulse force in various situations.

Use the following prompt for questions #1-5:

A baseball (mass=0.145kg) traveling rightward at 30 m/s collides with a bat (mass=0.935 kg) traveling leftward at -55 m/s.

Determine if the following statements are true or false by circling the correct answer.

1. (True/False) The ball experiences the same change in momentum as the bat, just in the opposite direction.
2. (True/False) The ball experiences the same impulse as the bat, just in the opposite direction.
3. (True/False) The ball experiences the same force as the bat, just in the opposite direction.
4. (True/False) The ball experiences the same acceleration as the bat, just in the opposite direction.
5. (True/False) The ball experiences the same change in velocity as the bat, just in the opposite direction.

Use the following prompt for questions #6-10:

A red car collides with a blue car over a time interval of 0.2 s. The momentum of the red car before the collision is +0.25 kg•m/s and after the collision is -1.5 kg•m/s. The momentum of the blue car before the collision is -1.5 kg•m/s and after the collision is +0.25 kg•m/s.

6. Calculate the impulse of the red car.
7. Calculate the impulse of the blue car.
8. What is the magnitude and direction of the collision force experienced by the red car?

9. What is the magnitude and direction of the collision force experience by the blue car?

10. Which of the following terms best describes the collision force between the red and blue car?
    a. Normal force
    b. Action-reaction pairs
    c. Gravitational force
    d. Both A B

Answer Key

1. True
2. True
3. True
4. False
5. False
6. Δp=p_f-p_i
   (-1.5 kg•m/s - 0.25 kg•m/s) = -1.75 kg•m/s
7. Δp=p_f-p_i
   +0.25 kg•m/s - (-1.5 kg•m/s)] = +1.75 kg•m/s
8. Δp=FΔt
   -1.75 kg•m/s=F(0.2 s)
   F=-8.75 N
9. Δp=FΔt
   +1.75 kg•m/s=F(0.2 s)
   F=+8.75 N
10. D

7.3 Conservation of Momentum and Center of Mass

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand conservation of momentum.

The momentum of a bowling ball and a pin before and after their collision are described in the chart below. Use your understanding of conservation of momentum to complete the chart.

Based on the information in the chart above, answer the following questions:

1. Are the bowling ball and the pin moving in the same direction after the collision? Explain.

2. Do the bowling ball and the pin travel at different speeds after the collision? Explain.

Lesson Objective: Be able to solve problems using the conservation of momentum.

Use the following prompt for questions #3-7:

A 75kg soccer player runs rightward with a velocity of +1.5 m/s toward a 0.43 kg soccer ball at rest on the grass.

3. What is the initial momentum of the soccer player?
   a. 0 kg•m/s
   b. +1.5 kg•m/s
   c. +75 kg•m/s
   d. +112.5 kg•m/s
4. What is the initial momentum of the soccer ball?
   a. 0 kg•m/s
   b. +1.5 kg•m/s
   c. +75 kg•m/s
   d. +112.5 kg•m/s
5. What is the initial total momentum of the system?
   a. 0 kg•m/s
   b. +1.5 kg•m/s
   c. +75 kg•m/s
   d. +112.5 kg•m/s

6. What is the final total momentum of the system?
   a. 0 kg•m/s
   b. +1.5 kg•m/s
   c. +75 kg•m/s
   d. +112.5 kg•m/s
7. If the final speed of the soccer ball is +15 m/s, what is the final speed of the soccer player?
   a. 0 m/s
   b. +1.4 m/s
   c. +7 m/s
   d. +112.5 m/s

Answer Key

1. Yes. They both have a positive momentum, meaning they are moving in the same direction.
2. Yes. They each have a final momentum of +9kgm/s. However, the bowling ball has a greater mass than the pin, so it will have a smaller speed.
3. D
4. A
5. D
6. D
7. B

7.4 Collisions and Conservation Principles

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand the difference between elastic and inelastic collisions.

Categorize each of the following collisions in questions #1-5 as elastic or inelastic by circling the correct answer choice.

1. A baseball hits a bat and both move in opposite directions after the collision.
   a. Elastic Collision
   b. Inelastic Collision
2. A softball player catches a fly ball in their glove.
   a. Elastic Collision
   b. Inelastic Collision
3. Two cars collide and stick together while moving rightward.
   a. Elastic Collision
   b. Inelastic Collision
4. A bowling ball hits all the pins down for a strike.
   a. Elastic Collision
   b. Inelastic Collision
5. A skier collides with a tree and comes to a halt.
   a. Elastic Collision
   b. Inelastic Collision

Lesson Objective: Be able to solve problems using both energy and momentum conservation.

Use the following prompt for questions #6-10:

A red toy car, with a rightward momentum of +0.75 kg•m/s, collides with a blue toy car, moving leftward with a momentum of -0.75 kg•m/s. The two cars stick together and come to a complete stop after the collision.

6. If the mass of the red car was 0.25kg, what was the velocity of the toy car before the collision?
   a. +0.75 m/s

b. +1 m/s
c. +2 m/s
d. +3 m/s

7. If the mass of the blue car was also 0.25 kg, what was the total energy of the system before the collision?
   a. 0 J
   b. 1.13 J
   c. 1.5 J
   d. 2.25 J
8. What was the total energy of the system after the collision?
   a. 0 J
   b. 1.13
   c. 1.5 J
   d. 2.25 J
9. What type of collision is this?
   a. Elastic
   b. Inelastic
   c. Perfectly elastic
   d. None of the above
10. What is the speed of the blue car after the collision?
    a. 0 m/s
    b. 7.5 m/s
    c. 10 m/s
    d. not enough information to determine

Answer Key

1. A
2. B
3. B
4. A
5. B
6. D
7. D
8. A
9. B
10. A

7.5 Momentum Chapter Test

Chapter Test

Name___________________ **Class**______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives.

1. If the mass of an object is doubled, then its momentum will
   a. Double
   b. Triple
   c. Be halved
   d. Stay the same
2. If the velocity of an object is halved, then its momentum will
   a. Double
   b. Triple
   c. Be halved
   d. Stay the same
3. For a 25 kg object to have the same momentum as a 5kg object, the 25kg object must have
   a. a greater velocity than the 5kg object
   b. a smaller velocity than the 5kg object
   c. the same velocity as the 5kg object
   d. Not enough information to determine
4. What is the momentum of a 0.5 kg football thrown -5 m/s to the left?
   a. -0.5 kg•m/s
   b. -2.5 kg•m/s
   c. 15 kg•m/s
   d. 30 kg•m/s
5. What is the velocity of a 2000 kg truck with a momentum of 48,000 kg•m/s ?
   a. 0.2 m/s
   b. 3 m/s
   c. 24 m/s
   d. 43 m/s
6. What is the mass of a baseball with a velocity of 30 m/s and a momentum of 6 kg•m/s ?
   a. 0.2 m/s
   b. 3 m/s
   c. 8 m/s
   d. 16 m/s

Use the following prompt for question #7-10:

A 0.5 kg bowl falls with an initial velocity of -1.5 m/s and lands on the hard wood floor. The same type of bowl falls with the same initial velocity and lands on the carpet.

7. Which bowl experiences a greater change in **momentum**?
   a. The bowl that lands on the hard wood floor
   b. The bowl that lands on the carpet
   c. They both experience the same change in momentum
   d. Not enough information is provided
8. Which bowl experiences a greater **impulse**?
   a. The bowl that lands on the hard wood floor
   b. The bowl that lands on the carpet
   c. They both experience the same impulse
   d. Not enough information is provided
9. Which bowl experiences a greater contact **force** with the floor?
   a. The bowl that lands on the hard wood floor
   b. The bowl that lands on the carpet
   c. They both experience the same magnitude of contact force with the floor
   d. Not enough information is provided
10. Which collision occurs over the longest **time** interval?
    a. The bowl that collided with the hard wood floor
    b. The bowl that collided with the carpet
    c. They both experience the same collision time
    d. Not enough information is provided

Use the following prompt for questions #11-12:

<u>A toy dart gun shoots a dart.</u>

11. What is the initial total momentum of the system?
    a. 0 kg•m/s
    b. +2 kg•m/s
    c. +3 kg•m/s
    d. not enough information to determine
12. What is the final total momentum of the system?
    a. 0 kg•m/s
    b. +2 kg•m/s
    c. +3 kg•m/s
    d. not enough information to determine
13. If the initial total momentum of a tennis ball and tennis racket is +10 kg•m/s, then the final total momentum of the system after the racket hits the ball must be
    a. -5 kg•m/s
    b. +5 kg•m/s
    c. -10 kg•m/s
    d. +10 kg•m/s
14. The total initial momentum of a bat and ball is +80 kg•m/s before they collide. If the ball's final momentum after the collision is +72 kg•m/s, determine the bat's final momentum.

15. If two objects collide and stick together, the collision can be categorized as
    a. Elastic
    b. Inelastic
    c. Perfectly elastic
    d. None of the above
16. The kinetic energy of a system is conserved in which type of collision?
    a. Elastic
    b. Inelastic
    c. Perfectly inelastic
    d. None of the above

Use the following prompt for questions # 17-20:

A clay ball (mass=0.25kg) has a rightward momentum of +1.75 kg•m/s. A second clay ball (mass =0.25 kg) has a leftward momentum of -1.75 kg•m/s. The two collide, stick together, and come to a complete stop after the collision.

17. What was the total energy of the system before the collision?
    a. 0 J
    b. 6.13 J
    c. 12.25 J
    d. Not enough information to determine
18. What was the total energy of the system after the collision?
    a. 0 J
    b. 6.13 J
    c. 12.25 J
    d. Not enough information to determine
19. What was the total momentum before the collision?
    a. 0 kg•m/s
    b. 6.13 kg•m/s
    c. 12.25 kg•m/s
    d. Not enough information to determine
20. What was the total momentum after the collision?
    a. 0 kg•m/s
    b. 6.13 kg•m/s
    c. 12.25 kg•m/s
    d. Not enough information to determine

Answer Key

1. A
2. C
3. B
4. B
5. C

6. A
7. C
8. C
9. C
10. B
11. A
12. A
13. D

14. Total initial momentum = total final momentum
    +80 kg•m/s = +80 kg•m/s
    +80 kg•m/s = +72 kg•m/s + p_{bat}
    p_{bat}=+8 kg•m/s
15. B
16. A
17. C
18. A
19. A
20. A

CHAPTER 8 Statics Assessments

Chapter Outline

8.1 Angular Momentum

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand what angular momentum is and how to use it in solving problems.

1. Rotational inertia is
   a. the rate of rotation
   b. how quickly an object is rotating
   c. a rotating object's tendency to keep rotating
   d. always conserved
2. Angular velocity is
   a. a vector
   b. the rate of rotation
   c. always conserved
   d. both A B
3. Which of the following statements is consistent with the conservation of angular momentum?
   a. The rotational inertia of a rotating object always remains the same
   b. The angular velocity of a rotating object always remains the same
   c. The angular momentum of a systems always remains the same
   d. None of the above
4. What happens to the **rotational inertia** of a rotating object when the center of mass is moved farther away from its axis of rotation?
   a. It decrease
   b. It increases
   c. It remains the same
   d. None of the above
5. What happens to the **angular velocity** of a rotating object when the center of mass is moved farther away from its axis of rotation?
   a. It decreases
   b. It increases
   c. It remains the same
   d. None of the above
6. What happens to the total **angular momentum** of a system when the center of mass of a rotating object is moved farther away from its axis of rotation?
   a. It decreases
   b. It increases
   c. It remains the same
   d. None of the above

7. How can the speed of a rotating object be changed?
    a. Increase the rotational inertia
    b. Decrease the rotational inertia
    c. Both A B
    d. None of the above
8. Which of the following would double the angular velocity of a rotating object?
    a. Decreasing the rotational inertia by 50%
    b. Increasing the rotational inertia by 50%
    c. Decreasing the angular momentum by 50%
    d. None of the above
9. What is the angular momentum of a 67kg trapeze artist at rest on a platform 10m above the ground?
    a. 0 kg•m^2/s
    b. 10 kg•m^2/s
    c. 100 kg•m^2/s
    d. 1000 kg•m^2/s
10. What is the angular momentum of a trapeze artist that has an angular velocity of 5 rad/s and a rotational inertia of 20 kg•m^2?
    a. 0 kg•m^2/s
    b. 10 kg•m^2/s
    c. 100 kg•m^2/s
    d. 1000 kg•m^2/s

Answer Key

1. C
2. D
3. C
4. B
5. A
6. C
7. C
8. A
9. A
10. C

8.2 Torque

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand what torque is and how to use it in solving problems.

1. Torque is
   a. a force
   b. the tendency for an object to keep rotating
   c. the rate an object spins
   d. required to produce a rotation
2. Is the following statement true or false, "Where the force is applied determines whether or not there is a torque."
   a. True
   b. False
3. How much perpendicular force must be applied to a 0.86m lever to produce a torque of 860 N•m?
   a. 1 N•m
   b. 10 N•m
   c. 100 N•m
   d. 1000 N•m

Calculate the torque produced by the following wrenches:

4. A 0.05 m wrench with a 40 N perpendicular force
   a. 0.05 N•m
   b. 0.5 N•m
   c. 1 N•m
   d. 2 N•m
5. A 0.09 m wrench with a 22.2 N perpendicular force
   a. 0.05 N•m
   b. 0.5 N•m
   c. 1 N•m
   d. 2 N•m

6. A 0.2m wrench with a 10 N perpendicular force
   a. 0.05 N•m
   b. 0.5 N•m
   c. 1 N•m
   d. 2 N•m

7. Which of the wrenches above (in questions #4-6) would you want to use? Explain the reason for your choice.

8. The entrance to the mall has a rotating glass door that requires 30 N•m of torque to spin. How much force must you apply if you stand 1.3 meters from the center axis?
   a. 1.3 N
   b. 3 N
   c. 23 N
   d. 30 N
9. A construction worker applies a 70 N force, at an angle of 90°, to a wrench a distance of 0.5 m from a nut to get it to rotate. What is the magnitude of the torque applied to the nut?

10. How could the construction worker in Question #9 use his knowledge of physics to decrease the force he needs to apply to the wrench by 50% (48.5 N)?

Answer Key

1. D
2. A
3. D
4. D
5. D
6. D
7. Wrench in #6 because it requires the least amount of applied force.
8. C
9.

$$\begin{aligned}\tau &= rF\sin\theta\\ \tau &= (0.5\ m)(70\ N)(\sin 90^\circ)\\ \tau &= 35N\cdot m\end{aligned}$$

10.

$$\begin{aligned}\tau &= rF\sin\theta\\ 35\ N &= r(48.5\ N)\\ r &= 0.72\ m\end{aligned}$$

He would need to increase the lever arm of the wrench so that it is 0.72m from the nut.

8.3 Two Conditions of Equilibrium

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand the necessity for two conditions of equilibrium to ensure static equilibrium.

1. If an object has **zero net force**, it has achieved which of the following?
   a. Translational equilibrium
   b. Rotational equilibrium
   c. Static equilibrium
   d. All of the above

2. If an object has **zero net torque**, it has achieved which of the following?
   a. Translational equilibrium
   b. Rotational equilibrium
   c. Static equilibrium
   d. All of the above

3. In order for a system to achieve complete **static equilibrium** it must have
   a. Translational equilibrium
   b. Rotational equilibrium
   c. A net torque of zero
   d. All of the above

Use the following prompt for questions #4-6:

A 6.35 kg bowling ball is stable and at rest on a shelf in a bowling alley.

4. What is the **net force** on the bowling ball?
   a. -63.5 N downward due to the force of gravity
   b. +63.5 N upward due to the normal force
   c. 0 N
   d. not enough information to determine

5. What is the **net torque** on the bowling ball?
   a. -63.5 N•m clockwise
   b. +63.5 N•m counter clockwise
   c. 0 N•m

   d. not enough information

6. This bowling ball has achieved
   a. Translational equilibrium
   b. Rotational equilibrium
   c. Static equilibrium
   d. All of the above

Answer Key

1. A
2. B
3. D
4. C
5. C
6. D

8.4 Applications of Equilibrium Conditions

Lesson Quiz

Name____________________ **Class**_______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Use the conditions of equilibrium to solve problems.

Use the following prompt for questions #1-8

A window washer (mass = 60 kg) is standing 1.7 m from the left end of a 5.5m board (mass = 10 kg) suspended by two vertical ropes, Rope A and Rope B. The board is stable and at rest.

1. Draw a sketch of the scenario above and be sure to include force vectors.

2. Is the following statement true or false, "The board is in static equilibrium."
   a. True
   b. False
3. What is the net torque on the board?
   a. 0 N•m
   b. 100 N•m
   c. -600 N•m
   d. -1020 N•m
4. What is the net force on the board?
   a. 0 N
   b. -100 N
   c. -600 N
   d. -1020 N
5. What is the weight of the window washer?
   a. 0 N
   b. -100 N
   c. -600 N
   d. -1020 N
6. What is the weight of the board?

a. 0 N
b. -100 N
c. -600 N
d. -1020 N

7. Calculate the tension of Rope B.

8. Calculate the tension of Rope A.

Lesson 8.4 Quiz Answer Key

1. Sketches will vary.
2. A
3. A
4. A
5. C
6. B
7. $\sum T = 0N * m$

   $T_{window-washer} + T_{board} + T_{ropeB} = 0N * m$
   (-600N)(1.7m) + (-100N)(2.75) + (F$_{Tension\ Rope\ B}$) (5.5m)= 0N•m
   -1020N•m - 275 N•m + 5.5m(F$_{Tension\ Rope\ B}$) = 0 N•m
   5.5m (F$_{Tension\ Rope\ B}$) = 1295 N•m
   F$_{Tension\ Rope\ B}$=+235.5N upward

8. $\sum F_{net} = 0N$
   F$_{g-window\ washer}$ + F$_{g\ board}$ + F$_{Tension\ Rope\ A}$ + F$_{Tension\ Rope\ B}$ = 0N
   -600N - 100N + F$_{Tension\ Rope\ A}$ + 235.5N = 0N
   F$_{Tension\ Rope\ A}$ = +464.5N upward

8.5 Statics Chapter Test

Chapter Test

Name___________________ **Class**______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives.

1. The rotational inertia of a rotating object depends on
   a. Mass
   b. Mass distribution
   c. Rate of rotation
   d. Both A B
2. What happens to the **angular velocity** of a rotating object when the center of mass is moved closer to its axis of rotation?
   a. It decrease
   b. It increases
   c. It remains the same
   d. None of the above
3. A gyroscope has a
   a. high rotational inertia
   b. low rotational inertia
   c. no rotational inertia
   d. none of the above
4. What is the angular momentum of a 3 kg ball rolling down a hill with an angular velocity of 4 rad/s and a rotational inertia of 15 kg•m^2?
   a. 3 kg•m^2/s
   b. 12 kg•m^2/s
   c. 45 kg•m^2/s
   d. 60 kg•m^2/s
5. A diver rotates twice each second and reduces her rotational inertia by a factor of three, what is her resulting angular velocity.
   a. 2 rev/s
   b. 3 rev/s
   c. 6 rev/s
   d. 18 rev/s
6. Which of the following are basic requirements for torque
   a. Force
   b. Lever arm
   c. Both A B
   d. None of the above
7. What length lever arm will produce a torque of 6000 N•m by applying a perpendicular force of 300N to it?

a. 2 m
b. 20 m
c. 200 m
d. 2000 m

8. Which of the wrenches below produces the greatest torque if 100N of perpendicular force is applied?

a. a wrench with a 0.05 m lever arm
b. a wrench with a 0.5 m lever arm
c. a wrench with a 1 m lever arm
d. all the wrenches above have produce the same torque

9. An object is rotating at a constant angular velocity of 25 rev/s. What is the net torque on the object?

a. 0 N•m
b. 10 N•m
c. 100 N•m
d. not enough information to determine

10. Calculate the torque produced by a 120 N force applied perpendicular to a 0.5 m lever arm.

11. If an object has **zero net force** and **zero net torque**, it has achieved which of the following?

a. Translational equilibrium
b. Rotational equilibrium
c. Static equilibrium
d. All of the above

12. **Translational equilibrium** requires

a. A net force
b. A net torque
c. A net force of zero
d. A net torque of zero

13. **Rotational equilibrium** requires

a. A net force
b. A net torque
c. A net force of zero
d. A net torque of zero

14. A system in **static equilibrium** is

a. at rest
b. stable
c. both B C
d. none of the above

15. Sonia and Jeff are playing at the local park. Sonia has a mass of 40 kg and sits 1.2 m from the center axis of a seesaw. Jeff has a mass of 55 kg and comes over to the seesaw. Where should Jeff sit in order for the seesaw to be in rotational equilibrium?

Answer Key

1. D
2. B
3. A
4. C
5. A
6. C
7. B
8. C
9. A
10.

$$\tau = rF\sin\theta$$
$$\tau = (0.5\ m)(120\ N)$$
$$\tau = 60\ N\cdot m$$

11. D
12. A
13. B
14. C
15.

$$\Sigma\tau = 0\ N\cdot m$$
$$\tau_{jeff} + \tau_{sonia} = 0\ N\cdot m$$
$$\tau_{jeff} + (-440\ N)(1.2\ m) = 0\ N\cdot m$$
$$(550\ N)(?) + (-528\ N\cdot m) = 0\ N\cdot m$$
$$550\ N(?) = 528\ N\cdot m$$
$$r = 0.96\ m$$

Jeff should sit 0.96m from the center axis of the seesaw.

CHAPTER 9

Newton's Universal Law of Gravity Assessments

Chapter Outline

9.1 Kepler's Laws

Lesson Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand Kepler's Laws.

1. Circle each statement below that is consistent with Kepler's Three Laws of Planetary Motion:
   a. The orbit of each planet about the sun is a circle with a set of all points that are equal distance from a single point
   b. The orbit of each planet about the sun is an ellipse with the sun at one of the foci
   c. A planet will move at a slower speed when positioned closer to the sun
   d. A planet will move at a faster speed when positioned closer to the sun
   e. A planet will move at a constant speed during its orbit around the sun
   f. The cube of the time for one orbital period of a planet about the sun is proportional to the square of the average distance between the sun and the planet
   g. The time for one orbital period of a planet about the sun is proportional to the cube of the average distance between the sun and the planet
   h. The square of the time for one orbital period of a planet about the sun is proportional to the cube of the average distance between the sun and the planet

   Lesson Objective: Use Kepler's Third Law to solve problems. Use Kepler's Third Law of Motion to solve questions #2-6:
2. The time, in years, it takes the Earth to orbit the sun if the distance of the Earth to the sun is 1 AU.
3. The distance of Jupiter to the sun, in AU, if the period of Jupiter's orbit around the sun is 11.8 years.
4. The distance of Venus to the sun, in AU, if it takes Venus 0.615 years to orbit the sun.
5. The period of Saturn, in years, if the distance from Saturn to the sun is 9.5 AU.
6. The amount of years it takes Neptune to orbit the sun if the distance from Neptune to the sun is 30.06 AU

Answer Key

1. B,D,H should be circled
2. T^2=kr^3
   T=1 year
3. T^2=kr^3
   $(11.8)^2$=$(r)^3$
   $r = \sqrt[3]{139.24}$
   r=5.18 AU
4. T^2=kr^3
   $(0.615)^2$=$(r)^3$
   $r = \sqrt[3]{0.378}$
   r=0.72 AU
5. T^2=kr^3
   T^2=$(9.5)^3$
   T= $\sqrt{}\{857\}$

T=29.3 years

6. T^2=kr^3
   T^2=$(30.06)^3$
   $T = \sqrt{27162}$
   T=164.8 years

9.2 Newton's Universal Law of Gravity

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand Newton's Universal Law of Gravity.

1. Which of the following objects are in free fall?
   a. The Earth as it orbits the sun
   b. The moon as it orbits the Earth
   c. An apple as it falls from a tree
   d. All of the above
2. Which of the following objects only has a force due to gravity acting on it?
   a. The Earth as it orbits the sun
   b. The moon as it orbits the Earth
   c. An apple as it falls from a tree
   d. All of the above
3. Which of the following objects can be categorized as a projectile?
   a. The Earth as it orbits the sun
   b. The moon as it orbits the Earth
   c. An apple as it falls from a tree
   d. All of the above
4. Newton's Universal Law of Gravity is described as an inverse-squared law because
   a. The force of gravity increases as distance increases
   b. The force of gravity and the distance between two massive objects is directly proportional
   c. The force of gravity is inversely proportional to the square of the distance
   d. All of the above
5. Which of the following statements is consistent with Newton's Universal Law of Gravity?
   a. The greater the masses, the greater the force of gravity
   b. The greater the distance, the smaller the force of gravity
   c. Every massive object exerts a force of gravity on every other massive object in the universe
   d. All of the above

Lesson Objective: Use Newton's Universal Law to solve problems.

6. The force of gravity between two objects is initially 100 N. What is the new force of gravity if the distance between the two objects is suddenly reduced by a third?
   a. 100 N
   b. 300 N
   c. 900 N

d. 1800 N

7. The force of gravity between two objects is initially 800 N. What is the new force of gravity if the distance between the two objects is increased by a factor of two?
   a. 200 N
   b. 400 N
   c. 600 N
   d. 800 N
8. The force of gravity between two objects is initially 500 N. What is the force of gravity if the mass of one object suddenly doubles?
   a. 500 N
   b. 1000 N
   c. 5,000 N
   d. 10,000 N
9. The force of gravity between two objects is initially 700 N. What is the force of gravity if each massive object suddenly doubles?
   a. 700 N
   b. 1400 N
   c. 2800 N
   d. 50,000 N
10. The force of gravity between two objects is initially 1000 N. What is the force of gravity if each massive object suddenly doubles and the distance is halved?
   a. 200 N
   b. 500 N
   c. 700 N
   d. 1000 N

Answer Key

1. D
2. D
3. D
4. C
5. D
6. C
7. A
8. B
9. C
10. D

9.3 Circular Orbits

Lesson Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Use Newton's Universal Law of Gravity and Kepler's Third Law to solve problems.

1. Which of the following correctly describes the shape of the orbital path of a satellite around the Earth?
   a. A circle
   b. An ellipse
   c. Both A B
   d. None of the above
2. What is the distance from the center of the Earth of a satellite orbiting at a distance double the Earth's radius (2_{Re})?
   a. $\frac{1}{2}$ R_e
   b. R_e
   c. 2 R_e
   d. 3 R_e
3. Which of the following equations represents the force due to gravity acting on a satellite orbiting at a distance double the Earth's radius (2R_e)?
   a. $F = \frac{Gm_1m_2}{4R_e^2}$
   b. $F = \frac{Gm_1m_2}{3R_e^2}$
   c. $F = \frac{Gm_1m_2}{2R_e^2}$
   d. none of the above
4. What is the acceleration of a satellite orbiting at a distance double the Earth's radius (2R_e)?
   a. 1 m/s^2
   b. 2 m/s^2
   c. 5 m/s^2
   d. 10 m/s^2
5. Calculate the velocity of a satellite orbiting at a distance double the Earth's radius (2R_e)?

Answer Key

1. A
2. D
3. B

4. A
5. $a = \frac{v^2}{r}; v = \sqrt{ar}$
   $v = \sqrt{(3\ m/s^2)(6.37 * 10^6\ M)}$
   v=4372 m/s

9.4 Newton's Universal Law of Gravity Chapter Test

Chapter Test

Name___________________ **Class**______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives.

1. According to Kepler's First Law of Motion, which of the following correctly describes the shape of the orbital path of a planet around the sun?
    a. A circle with the set of all points that are equal distant from a single point
    b. A circle with the sun at one of the foci
    c. An ellipse with the sun at one of the foci
    d. An ellipse with the set of all points that are equal distant from a single point
2. Which of the following statements is consistent with Kepler's Second Law of Motion?
    a. A planet will move at a slower speed when positioned closer to the sun
    b. A planet will move at a faster speed when positioned closer to the sun
    c. A planet will move at a constant speed during its orbit around the sun
    d. None of the above
3. Kepler's third law relates the radius of an orbit to
    a. the time it takes to complete one orbit
    b. the period of an orbit
    c. Both A B
    d. None of the above
4. One Astronomical Unit is equal to
    a. the average distance from the Earth to the sun
    b. the average distance from the Earth to Mars
    c. one light year
    d. none of the above
5. According to Kepler's Third Law of Motion, the period of a planet around the sun is related to
    a. The planet's distance from the sun
    b. The planet's mass
    c. Both A B
    d. None of the above
6. Which of the following equations accurately depicts Kepler's Third Law of Motion?
    a. F_{Net}=ma
    b. PE=mgh
    c. T^2=kr^3
    d. y=mx+b
7. According to Kepler's Third Law of Motion, if the period of the Earth around the sun is one year, then
    a. Kepler's constant "k" must be equal to one

b. The distance of the Earth to the sun must be one astronomical unit
c. Both A B
d. None of the above

8. Use Kepler's Third Law of Motion to solve for the period of Mercury around the sun, in years, if the distance from Mercury to the sun is 0.39 AU.

9. According to Newton's Universal Law of Gravity, the force acting on an apple as it falls from a tree
   a. is the same force acting on the moon
   b. is the force due to gravity
   c. is equal to the mass of the apple multiplied by the gravitational constant on Earth (g)
   d. all of the above
10. Which of the following describes the moon's orbit around the Earth according to the Universal Law of Gravity?
   a. The moon is falling around the Earth
   b. The moon's tangential velocity is large enough to keep it moving around the Earth
   c. The moon is traveling at a constant speed around the Earth
   d. All of the above
11. If the Earth were twice as massive, then the force of gravity between you and the Earth would
   a. Double
   b. Quadruple
   c. Decrease by 1/2
   d. Decrease by 1/4
12. If you were twice as far from the center of the Earth as you are now, then the force of gravity between you and the Earth would
   a. Double
   b. Quadruple
   c. Decrease by 1/2
   d. Decrease by 1/4
13. Which of the following statements correctly describes the force of gravity between the Earth and a desk?
   a. The Earth pulls down on the desk with a force due to gravity
   b. The desk pulls up on the Earth with a force due to gravity
   c. The magnitude of the force due to gravity on the Earth and desk are equal
   d. All of the above
14. What is the distance from the center of the Earth of a satellite orbiting at a distance a third of the Earth's radius (Re)?
   a. 0.3 R_e
   b. R_e
   c. 1.3 R_e
   d. 3 R_e
15. What is the acceleration of a satellite orbiting at a distance a third of the Earth's radius (R_e)?
   a. 1 m/s^2
   b. 2 m/s^2
   c. 4 m/s^2
   d. 6 m/s^2

Answer Key

1. C
2. B
3. C
4. A
5. A
6. C
7. C
8. $T^2 = kr^3$
   $T^2 = (0.39)^3$
   $T = \sqrt{0.059}$
   T=0.24 years
9. D
10. D
11. A
12. D
13. D
14. C
15. D

CHAPTER 10 Periodic Motion Assessments

Chapter Outline

10.1 Simple Harmonic Motion

Lesson Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

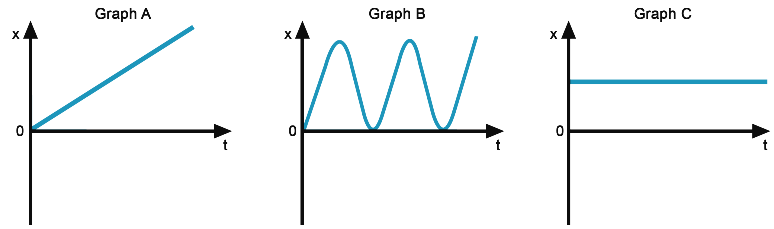
Lesson Objective: Understand periodic motion.

1. What is periodic motion?

2. Provide an example of an object that exhibits periodic motion.

Lesson Objective: Understand simple harmonic motion.

3. Which of the following factors is necessary for periodic motion to be simple harmonic motion?
   a. Back and forth motion
   b. Restoring force directly proportional to displacement
   c. Move through a point of equilibrium
   d. All of the above
4. Which of the following factors are necessary for both uniform circular motion and simple harmonic motion?
   a. Force and displacement are oppositely directed
   b. Force and displacement are directly proportional
   c. Both A B
   d. None of the above
5. Simple harmonic motion is produced by
   a. A restorative force inversely proportional to an object's displacement
   b. Viewing uniform circular motion in one dimension
   c. An object with a linear position-time (x-t) graph
   d. None of the above
6. Which of the following objects exhibit simple harmonic motion?
   a. A mass-spring system
   b. A simple pendulum
   c. A vibrating violin string
   d. All of the above
7. Which of the following graphs below depicts an object with simple harmonic motion?



a. Graph A
b. Graph B
c. Graph C
d. None of the above

Answer Key

1. Answers will vary. *Sample Answer: Periodic motion repeats the same path at regular intervals.*
2. Answers will vary. *Sample Answer: The Earth rotating around the sun.*
3. D
4. C
5. B
6. D
7. B

10.2 Mass on a Spring

Lesson Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Solve problems dealing with Simple Harmonic Motion.

Use the following prompt for questions #1-10:

A mass of 5kg is attached to a spring with a spring constant, k, of 150 N/m. The spring is stretched 2 cm from its resting position.

1. What is magnitude of the restoring force on the mass-spring system?
   a. 3 N
   b. 5 N
   c. 50N
   d. 150 N
2. What is the direction of the restoring force if the displacement of this mass-spring system is leftward?
   a. Leftward
   b. Rightward
   c. Upward
   d. Downward
3. If the displacement doubles, the restoring force of this mass-spring system will
   a. halve
   b. double
   c. triple
   d. stay the same
4. What is the period (T) of the mass-spring system?
   a. 0.36 s
   b. 0.88 s
   c. 1.14 s
   d. 5.2 s
5. What is the frequency (f) of the mass spring system?
   a. 0.36 Hz
   b. 0.88 Hz
   c. 1.14 Hz
   d. 5.2 Hz
6. How many times does the mass-spring system pass through the point of equilibrium if it vibrates for 12 seconds?
   a. 2 times

b. 12 times
c. 21 times
d. 24 times

7. If the spring is stretched twice as much, the period (T) of the mass-spring system will
   a. increase
   b. decrease
   c. stay the same
   d. not enough information to determine
8. If the spring constant is halved, the period (T) of the mass-spring system will
   a. increase
   b. decrease
   c. stay the same
   d. not enough information to determine
9. If the amount of mass attached to the spring is doubled, what will happen to the period (T) of the mass-spring system?
   a. Increase
   b. Decrease
   c. Stay the same
   d. Not enough information to determine
10. The shape of the position-time (x-t) graph for this mass-spring system will be
    a. Parabola
    b. Sinusoidal curve
    c. Line
    d. None of the above

Answer Key

1. A
2. B
3. B
4. C
5. B
6. C
7. C
8. B
9. A
10. B

10.3 Simple Pendulum

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand a simple pendulum.

1. If the mass of the pendulum bob is doubled, the period of a simple pendulum will
   a. Increase
   b. Decrease
   c. Stay the same
2. If the length of the string is increased, the period of a simple pendulum will
   a. Increase
   b. Decrease
   c. Stay the same
3. If the amplitude is decreased, the period of a simple pendulum will
   a. Increase
   b. Decrease
   c. Stay the same
4. If an astronaut takes a pendulum to the moon (g=1.6N/kg), the period compared to that on Earth will
   a. Increase
   b. Decrease
   c. Stay the same
5. If a spaceship takes the pendulum to Saturn (g=11.2 N/kg), the period compared to that on Earth
   a. Increase
   b. Decrease
   c. Stay the same

Lesson Objective: Solve problems involving a simple pendulum.

6. What is the period of a pendulum whose length is 0.3 m on the Earth (g=10 N/kg)?
   a. 0.03 s
   b. 0.17 s
   c. 0.54 s
   d. 1.09 s
7. What is the period of a pendulum whose length is 0.3m on the moon (g=1.6 N/kg)?
   a. 0.19 s
   b. 0.43 s
   c. 1.40 s

d. 2.72 s

8. What is the length of a simple pendulum whose period is 5 s and bob is 4 kg?
   a. 6.34 m
   b. 1.67 m
   c. 0.63 m
   d. 0.79 m
9. What is the length of a simple pendulum whose period is 5s and bob is 10 kg?
   a. 6.34 m
   b. 1.67 m
   c. 0.63 m
   d. 0.79 m
10. The period of a simple pendulum is 2 s. If you want to double the period (4s), what length string will you need?
    a. 1 m
    b. 2 m
    c. 3 m
    d. 4 m

Answer Key

1. C
2. A
3. C
4. A
5. B
6. D
7. D
8. A
9. A
10. D

10.4 Waves and Wave Properties

Lesson Quiz

Name____________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Be able to distinguish between types of waves.

Classify the following waves in questions #1-5 as longitudinal or transverse. Then, explain the reason for your choice.

1. Sound wave
   - Longitudinal
   - Transverse

   Explain:

2. Light wave
   - Longitudinal
   - Transverse

   Explain:

3. P wave
   - Longitudinal
   - Transverse

   Explain:

4. S wave
   - Longitudinal
   - Transverse

   Explain:

5. Water wave
   - Longitudinal
   - Transverse

Explain:

Lesson Objective: Be able to recognize the behavior of waves.

6. Light bouncing off a mirror is an example of wave
   a. reflection
   b. refraction
   c. diffraction
   d. none of the above
7. You can hear the sound of your friend's voice down the hall due to wave
   a. reflection
   b. refraction
   c. diffraction
   d. none of the above
8. Eye glasses improve vision as a result of light wave
   a. reflection
   b. refraction
   c. diffraction
   d. none of the above
9. The ability of water waves to spread out through openings exemplifies wave
   a. reflection
   b. refraction
   c. diffraction
   d. none of the above
10. The sound of your voice echoing in a large tunnel is an example of wave
    a. reflection
    b. refraction
    c. diffraction
    d. none of the above

Answer Key

1. Longitudinal. Explanations will vary. *Sample Explanation: The air molecules vibrate parallel to the direction the wave energy travels*
2. Transverse. Explanations will vary. *Sample Explanation: The electromagnetic spectrum vibrates perpendicular to the direction the wave energy travels.*
3. Longitudinal. Explanations will vary. *Sample Explanation: The ground moves parallel to the direction the wave energy travels.*
4. Transverse. Explanations will vary. *Sample Explanation: The ground moves perpendicular to the direction the wave energy travels.*
5. Transverse. Explanations will vary. *Sample Explanation: The molecules of water move perpendicular to the direction the wave energy travels.*
6. A
7. C

8. B
9. C
10. A

10.5 Periodic Motion Chapter Test

Chapter Test

Name___________________ **Class**______________ **Date** ________

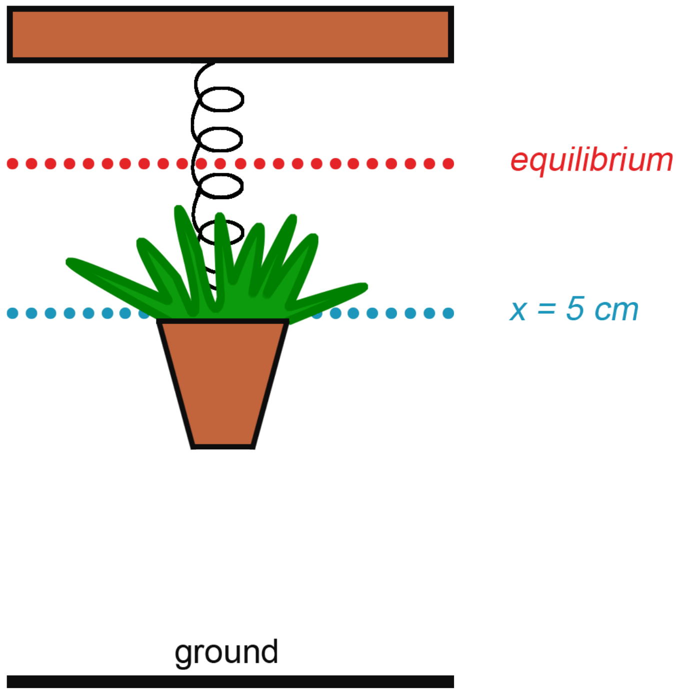
Answer each of the questions below to show your achievement of the lesson objectives.

1. Which of the following exhibit periodic motion?
    a. heart beat
    b. rocking chair
    c. a vibrating tuning fork
    d. all of the above
2. The Earth's orbit around the sun can be described as .
    a. Periodic motion
    b. Simple harmonic motion
    c. Both A B
    d. None of the above
3. The restorative force on an object exhibiting simple harmonic motion is always
    a. In the opposite direction of the object's displacement
    b. Directly proportional to the object's displacement
    c. Inversely proportional to the object's displacement
    d. Both A B
4. The restorative force causes an object in simple harmonic motion to
    a. Move towards the point of equilibrium
    b. Move away from the point of equilibrium
    c. Remain at rest
    d. None of the above
5. What is the shape of a position-time (x-t) graph for an object in simple harmonic motion?
    a. Parabola
    b. Sinusoidal curve
    c. Line
    d. None of the above
6. Which of the following objects does not exhibit simple harmonic motion?
    a. A mass on a spring
    b. A simple pendulum
    c. The Earth rotating around the sun
    d. Both A B
7. Which of the following variables affect the period (T) of a mass-spring system?
    a. the mass
    b. the spring constant

c. the distance the spring is stretch
d. A and B only

Use the following prompt for questions #8-12:

A 7 kg plant is hung from a spring hook and causes the spring to stretch 5 cm as illustrated in the diagram below.



8. What is magnitude of the restoring force on this plant-spring system?
   a. 0.05 N
   b. 7 N
   c. 70 N
   d. 1400 N
9. What is the direction of the restoring force on this plant-spring system?
   a. Upward
   b. Downward
   c. Leftward
   d. Rightward
10. What is the spring constant (k) of the spring?
   a. 0.05 N/m
   b. 7 N/m
   c. 70 N/m
   d. 1400 N/m
11. What is the period (T) of the plant-spring system?
   a. 0.07 s
   b. 0.2 s
   c. 0.4 s
   d. 2.5 s

12. What is the frequency (f) of the plant spring system?
    a. 0.07 s
    b. 0.2 s
    c. 0.4 s
    d. 2.5 s
13. Which of the following variables affect the period (T) of a simple pendulum?
    a. the mass of the pendulum bob
    b. the length of the string
    c. the displacement of the pendulum bob
    d. none of the above
14. The shape of the position-time (x-t) graph for a simple pendulum will be
    a. Parabola
    b. Sinusoidal curve
    c. Line
    d. None of the above
15. Which of the following simple pendulums has the greatest period?
    a. A 5 kg mass attached to a 0.5 m long string
    b. A 5 kg mass attached to a 1 m long string
    c. A 10 kg mass attached to a 1.5 m long string
    d. A 10 kg mass attached to a 2 m long string
16. Which of the following simple pendulums has the highest frequency?
    a. A 5 kg mass attached to a 0.5 m long string
    b. A 5 kg mass attached to a 1 m long string
    c. A 10 kg mass attached to a 1.5 m long string
    d. A 10 kg mass attached to a 2 m long string
17. Which of the following is transferred by a wave?
    a. Particles
    b. Mass
    c. Energy
    d. A medium
18. A light wave is a
    a. Longitudinal wave
    b. Transverse wave
    c. Stationary wave
    d. None of the above
19. A sound wave is a
    a. Longitudinal wave
    b. Transverse wave
    c. Stationary wave
    d. None of the above
20. Echoes are produced as a result of sound wave
    a. Reflection
    b. Refraction
    c. Diffraction
    d. None of the above

Answer Key

1. D
2. A
3. D
4. A
5. B
6. C
7. D
8. C
9. A
10. D
11. C
12. D
13. B
14. B
15. D
16. A
17. C
18. B
19. A
20. A

CHAPTER 11 Vibrations and Sound Assessments

Chapter Outline

11.1 Transmission of Sound

Lesson Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Describe how mechanical waves are transmitted.

1. Which of the following are necessary conditions for a sound wave to be transmitted?
   a. A medium
   b. Empty space
   c. Particles that can be displaced
   d. All of the above
2. A sound wave is a
   a. transverse wave
   b. longitudinal wave
   c. light wave
   d. all of the above
3. Mechanical waves, such as sound, are transmitted by
   a. an original source that causes vibrations in nearby particles
   b. particle interactions
   c. traveling through empty space
   d. both A B
4. Which of the following statements below correctly describes a sound wave?
   a. Sound waves are classified as mechanical waves because they require a medium in which to travel through
   b. Sound waves are classified as mechanical waves because they can travel through empty space
   c. Sound waves are classified as transverse waves because they cause particles to vibrate perpendicular to the direction the wave travels
   d. Sound waves are classified as transverse waves because they cause particles to vibrate parallel to the direction the wave travels

Lesson Objective: Explain what is meant by the superposition of waves and interference.

5. According to the principle of superposition, the amplitudes of two interfering waves should
   a. be added together
   b. combine to create a wave with a smaller resultant amplitude
   c. combine to create a wave with a larger resultant amplitude
   d. never be combined
6. As a result of constructive interference, the combined amplitude of two waves in phase will be
   a. smaller than the minimum amplitude of each wave

b. smaller than the maximum amplitude of each wave
c. equal to the sum of the maximum amplitudes of each wave
d. equal to the difference of the maximum amplitudes of each wave

7. Two sound waves interfere to create a quieter sound wave due to
   a. A decrease in the resultant amplitude
   b. Destructive interference
   c. Both A B
   d. None of the above

Use the following prompt to answer questions #8-10:

Two sound waves have different amplitudes but the same wavelength and period. The first wave has an amplitude of 1.5 m and the second wave has an amplitude of 1.2 m.

8. What is the maximum resultant amplitude that could be created by these two waves?
   a. 0.3 m
   b. 1.5 m
   c. 2.7 m
   d. 3 m
9. What type of interference would cause a resultant amplitude of 0.3 m?
   a. Constructive interference
   b. Destructive interference
   c. Complete constructive interference
   d. Complete destructive interference
10. What is the beat frequency created by two sounds waves with frequencies of 500 Hz and 498 Hz?
    a. 2 Hz
    b. 996 Hz
    c. 998 Hz
    d. 1000 Hz

Answer Key

1. A
2. B
3. D
4. A
5. A
6. C
7. C
8. C
9. B
10. A

11.2 Wave Speed

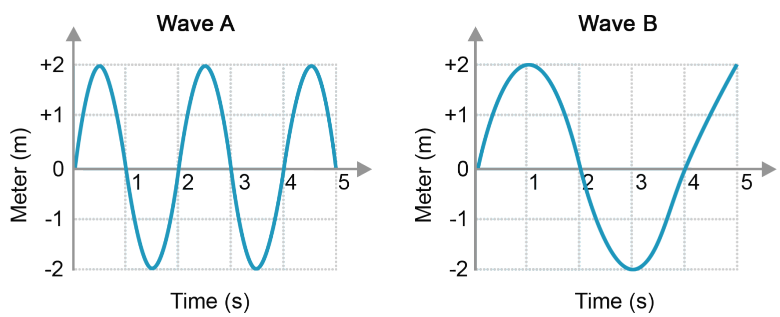
Lesson Quiz

Name____________________ **Class**_______________ **Date** _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Solve problems involving wavelength, wave speed, and frequency.

Compare the images of Wave A and Wave B below to answer questions #1-5:



1. Which wave has a higher **frequency**?
   a. Wave A
   b. Wave B
   c. They are equal
   d. Not enough information to determine
2. Which wave has a longer **period**?
   a. Wave A
   b. Wave B
   c. They are equal
   d. Not enough information to determine
3. Which wave has a greater **amplitude**?
   a. Wave A
   b. Wave B
   c. They are equal
   d. Not enough information to determine
4. Which wave has a higher **pitch**?
   a. Wave A
   b. Wave B
   c. They are equal
   d. Not enough information to determine
5. Which wave is **louder**?

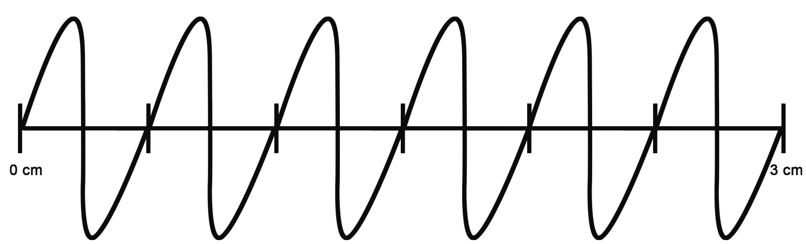
a. Wave A
b. Wave B
c. They are equal
d. Not enough information to determine

Use the following prompt to answer questions #6-7:

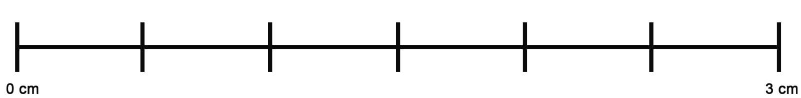
A musician plucks a guitar string, causing a sound wave to travel from the guitar string, through the air, into your ear.

6. What property of the sound wave changes as it goes from the string, through the air, to your ear?
   a. speed
   b. frequency
   c. wavelength
   d. Both A C
7. What property of the sound wave remains constant as it goes from the string, to the air, to your ear?
   a. speed
   b. frequency
   c. wavelength
   d. Both A C

Use the image below of a wave on a string fixed at both ends to answer questions # 8-10:

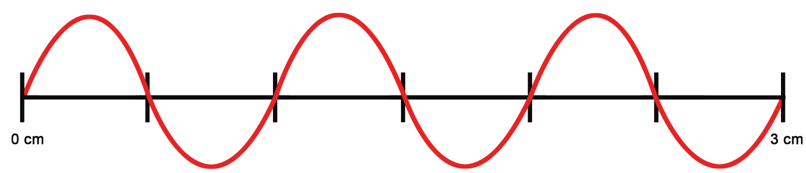


8. What is the wavelength of this wave on a string?
9. If the frequency is 800 Hz, what is the speed of the wave on the string?
10. If the frequency is decreased to 400 Hz, draw what the new wave on the 3 cm string would look like in the space below. Be sure to show your calculations.



Answer Key

1. A
2. B
3. C
4. A
5. C
6. D
7. B
8. 0.5 cm or $5*10^{-3}$ m
9. v=fλ
   v=(800 Hz)(0.005 m)
   v=4 m/s
10.



v=fλ
4 m/s=(400 Hz)(λ)
λ=0.01 m or 1 cm

11.3 Resonance with Sound Waves

Lesson Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand the conditions for resonance.

1. When the forced vibration frequency of one object matches the natural frequency of another object, there will be a dramatic increase in
   a. Amplitude
   b. Frequency
   c. Wavelength
   d. Wave speed
2. Resonance is
   a. The natural frequency of all objects
   b. One example of wave interference
   c. Exemplified when one vibrating tuning fork causes a second tuning fork to move with sympathetic vibrations
   d. Exemplified by a car driving on a bridge

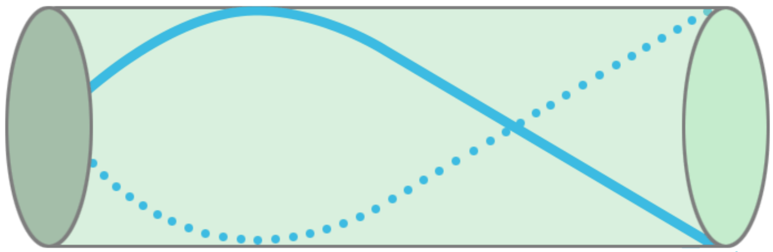
Lesson Objective: Solve problems with strings and pipes using the condition for resonance.

Use the following prompt to answer questions #3-5:

The 0.66 m guitar string has a fundamental frequency of 146.8 Hz.

3. Create a sketch of the standing wave on the guitar string at the first harmonic.
4. Calculate the speed of the wave on the guitar string at the first harmonic.
5. Calculate the wavelength of the sound wave this guitar string creates at the first harmonic. (The speed of a sound wave in air is 343 m/s).

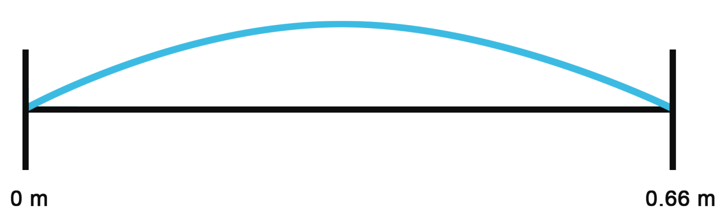
Use the image of a standing wave produced in a pipe closed at one end to answer questions #6-8:



6. How many antinodes are present in the standing wave illustrated above?
    a. Zero
    b. One
    c. Two
    d. Three
7. How many antinodes are present in the standing wave illustrated above?
    a. Zero
    b. One
    c. Two
    d. Three
8. What is the harmonic of the standing wave illustrated above?
    a. First
    b. Second
    c. Third
    d. Fourth

Answer Key

1. A
2. C
3.



4. The wavelength of the wave on this guitar string is 0.66 m x 2 = 1.32 m
   v=fλ
   v=(146.8 Hz)(1.32 m)
   193.8 m /s
5. Reminder: When a wave travels from one medium to another, the frequency remains constant.
   v=fλ
   343 m/s=(146.8 Hz)(λ)
   2.33 m
6. C
7. C
8. C

11.4 Doppler Effect

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand the Doppler effect.

Demonstrate your understanding of how the Doppler effect influences the following properties of sound waves as a result of a sound source traveling towards an observer by answering questions #1-6 below:

1. Wavelength
   a. Increases
   b. Decreases
   c. Remains constant
2. Frequency
   a. Increases
   b. Decreases
   c. Remains constant
3. Wave Speed
   a. Increases
   b. Decreases
   c. Remains constant
4. Amplitude
   a. Increases
   b. Decreases
   c. Remains constant
5. The perceived pitch increases as a result of the change in
   a. Wavelength
   b. Wave speed
   c. Frequency
   d. Amplitude
6. The perceived loudness increases as a result of the change in
   a. Wavelength
   b. Wave speed
   c. Frequency
   d. Amplitude
7. A car honks its horn with a frequency of 45 Hz as it travels towards an observer at 13.4 m/s. The frequency of the horn the observer hears is
   a. 44.9 Hz

b. 45.0 Hz
c. 46.82 Hz
d. 58.4 Hz

Answer Key

1. B
2. A
3. C
4. A
5. C
6. D
7. C

11.5 Vibrations and Sound Chapter Test

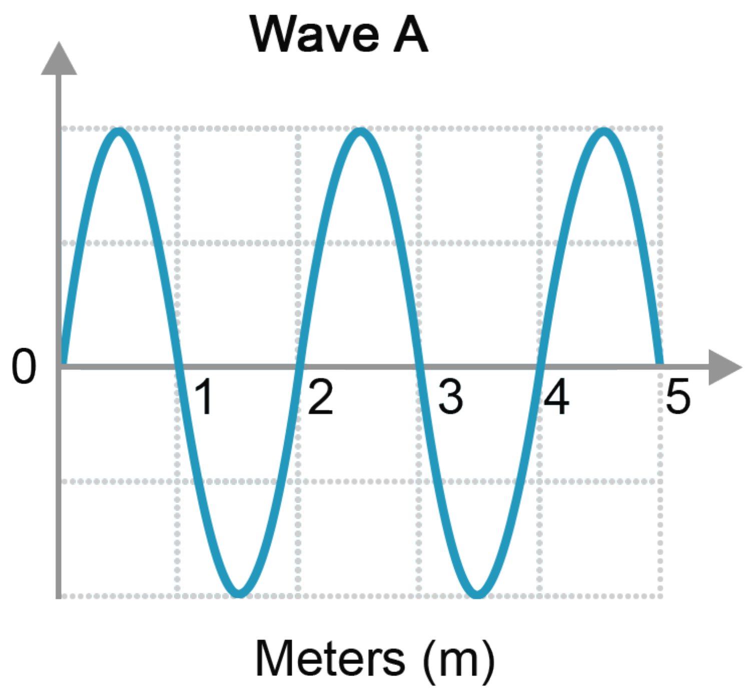
Chapter Test

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

1. A sound wave is a
    a. mechanical wave
    b. longitudinal wave
    c. transfer of energy
    d. All of the above
2. Sound waves are classified as
    a. longitudinal waves because they cause particles to vibrate perpendicular to the direction the wave travels
    b. transverse waves because they cause particles to vibrate parallel to the direction the wave travels
    c. mechanical waves because they require a medium in which to travel through
    d. electromagnetic waves because they can travel through empty space
3. Two waves with the same wavelength, period and amplitude of 15 cm constructively interfere. Calculate the resultant amplitude of their superposition.
4. Which of the following statements correctly describes sound wave interference?
    a. all sound waves are in phase
    b. all sound waves are out of phase
    c. one sound wave can cancel out another sound wave
    d. sound wave interference will always result in a louder noise

Use the image of Wave A below, which depicts a wave on a guitar string, to answer questions #5-9:



5. What is the wavelength of the Wave A?
   a. 1 m
   b. 2 m
   c. 3 m
   d. 4 m
6. If the frequency is 2000 Hz, what is the wave speed?
   a. 1000 m/s
   b. 2000 m/s
   c. 3000 m/s
   d. 4000 m/s
7. If the frequency increases to 12,000 Hz, what is the resulting wave speed?
   a. 4,000 m/s
   b. 8,000 m/s
   c. 16,000 m/s
   d. 24,000 m/s
8. If the frequency decreases to 1000 Hz, what is the resulting wavelength?
   a. 1 m
   b. 2 m
   c. 3 m
   d. 4 m
9. Which of the following statements correctly describes the affect on the wave speed, wavelength, and frequency of this wave as it travels from the guitar string, through the air, and into the guitarist's ear.
   a. The wave speed will remain the same, and the frequency will increase as the wavelength decreases.
   b. The wave speed will remain the same, and the frequency will decrease as the wavelength increases.
   c. The frequency will remain the same, and the wave speed will increase and the wavelength increases.

d. The frequency will remain the same, and the wave speed will decrease as the wavelength decreases.

10. Which of the following conditions below are necessary for resonance?
    Natural frequency
    Forced vibration frequency matching the natural frequency
    Increase in Amplitude
    a. I only
    b. I II only
    c. I, II, III
    d. None of the above
11. Which of the following examples utilizes the principle of resonance?
    a. An opera singer breaking a wine glass with only their voice
    b. One tuning fork being sent into motion by an identical vibrating tuning fork
    c. A parent pushing a child on a swing and increasing their amplitude
    d. All of the above

Use the following prompt for questions #12:

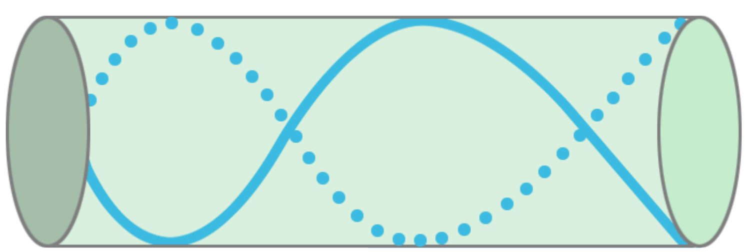
A guitar string that is 0.7 m long has fundamental frequency of 392 Hz.

12. Create a sketch of the standing wave on this guitar string in the second harmonic.

13. Calculate the speed of the wave on this guitar string in the second harmonic.

14. When this guitar string vibrates in the second harmonic, it creates a sound wave in air, traveling at 343 m/s. What is the frequency of this sound wave?
    a. 240.1 Hz
    b. 274.4 Hz
    c. 392 Hz
    d. 490 Hz

Use the image of a standing wave produced in a pipe closed at one end to answer questions #15-16:



15. How many antinodes are present in the standing wave illustrated above?
    a. Zero
    b. One
    c. Two
    d. Three
16. What is the harmonic of the standing wave illustrated above?
    a. First
    b. Third
    c. Fifth
    d. Seventh
17. When a sound source approaches an observer, the waves become compressed and result in
    a. shorter wavelengths
    b. lower frequencies
    c. slower wave speed
    d. all of the above
18. When a sound source moves away from an observer, the waves spread out and result in
    a. shorter wavelengths
    b. lower frequencies
    c. slower wave speed
    d. all of the above

Use the following prompt for questions #19-20:

An ambulance is driving at a velocity of 10 m/s with its siren blaring at 800 Hz.

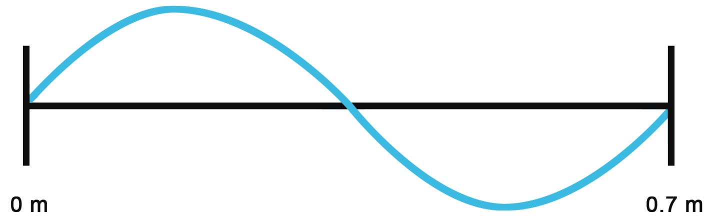
19. Calculate the frequency you hear as it drives towards you.

20. Calculate the frequency you hear as it drives away from you.

Answer Key

1. D
2. C
3. A+A=2A
   15 cm + 15 cm = 30 cm
4. C
5. B
6. D
7. A
8. D
9. D
10. C

11. D
12.



13. v=fλ
    v=(392 Hz)(0.7m)
    v=274.4 m/s
14. C
15. D
16. C
17. A
18. B
19. $f' = \frac{v+v_r}{v+v_s}$
    $800\ Hz(\frac{343\ m/s}{343\ m/s-10\ m/s}) = 824\ Hz$
20. $f' = \frac{v+v_r}{v+v_s}$
    $800\ Hz(\frac{343\ m/s}{343\ m/s+10\ m/s}) = 777\ Hz$

CHAPTER 12 Fluid Mechanics Assessments

Chapter Outline

12.1 Pressure in Fluids

Lesson Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand density and be able to solve problems with density.

Use the following prompt for questions #1-3:

Sphere A has a mass of 0.1 kg and radius of 0.04 meters. Sphere B has a mass of 0.1 kg and a radius of 0.02 meters. Both spheres are dropped into a pool of water, with a density of 1000 kg/m3.

1. Which of the following spheres has the greatest weight?
   a. Sphere A
   b. Sphere B
   c. They have the same weight
   d. There is not enough information to determine
2. If the volume of a sphere is $V_{sphere} = \frac{4}{3}\pi r^3$, which of the following spheres has the greatest volume?
   a. Sphere A
   b. Sphere B
   c. They have the same volume
   d. There is not enough information to determine
3. If the density if a sphere is $\rho = \frac{m}{v}$, which of the following spheres has the greatest density?
   a. Sphere A
   b. Sphere B
   c. They have the same volume
   d. There is not enough information to determine

Use the following prompt for questions #4-6:

A block of granite has a mass of 2.6 g and a volume of 1 cm3.

4. What is the density of this block of granite?
   a. 2.6 kg/m3
   b. 26 kg/m3
   c. 260 kg/m3
   d. 2600 kg/m3
5. What is the specific gravity of the block of granite compared to water (1000kg/m3)?
   a. 2.6
   b. 26

c. 260
d. 2600

6. Based on your calculations above, will the block of granite sink of float when placed in a pool of water? Explain.

Lesson Objective: Understand pressure and be able to solve problems with pressure.

7. Is the following statement true or false: "Pressure is the same as force."
   a. True
   b. False
8. Explain your choice above.

9. Which of the following fluids at rest exerts the greatest pressure?
   a. A 6ft pool of fresh water
   b. A 8ft pool of fresh water
   c. A 6ft pool of salt water
   d. A 8ft pool of salt water
10. Explain your choice above.

11. When you open your hand (area = 0.0081 m^2), your palm experiences a force of 818 N from the atmosphere. Calculate the amount of pressure exerted by the atmosphere on the palm of your hand.

Answer Key

1. A
2. A
3. B
4. D
5. A
6. The block of granite will float because its density is greater than the density of water, as shown by its specific gravity being greater than 1.
7. B
8. Pressure is the amount of force exerted over a specific area. Two objects can exert the same force, but if exerted over different areas, the pressure will differ.
9. D
10. Pressure increases with depth and density. Salt water is denser than freshwater and a pool 8ft deep with exert more pressure than a 6ft pool.
11. $P = \frac{F}{A}$
    818 N/0.0081 m^2 = 100,988 Pa (which is about atmospheric pressure = 101,000 Pa)

12.2 Measuring Pressure

Lesson Quiz

Name____________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand how atmospheric pressure is measured.

1. The pressure exerted by the weight of air molecules over an area is
    a. Atmospheric pressure
    b. Gauge pressure
    c. Total pressure
    d. Absolute pressure
2. Suction works as a result of
    a. A vacuum force pulling up
    b. Atmospheric pressure pushing down
    c. Both A B
    d. None
3. Explain why you do not feel atmospheric pressure.
4. Describe the change in atmospheric pressure on you as you drive from a mountain cabin back to sea level.

Lesson Objective: Understand how gauge pressure is defined.

5. Gauge pressure is equal to
    a. Atmospheric pressure
    b. Total pressure
    c. The pressure above atmospheric pressure
    d. None of the above
6. What is the gauge pressure of a tire with a total pressure of 2.5 atm?
    a. 1 atm
    b. 1.5 atm
    c. 2.5 atm
    d. 3 atm

Answer Key

1. A
2. B
3. Answers will vary. *Sample Answer: The pressure inside our bodies is equal to the atmospheric pressure, creating an overall zero net pressure on us.*
4. Answers will vary. *Sample Answer: Atmospheric pressure will increase because air density increases as you approach sea level.*
5. C
6. B

12.3 Pascal's Law

Lesson Quiz

Name___________________ **Class**______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand and be able to solve problems using Pascal's Principle.

Use the following prompt for questions #1-5:

A car mechanic uses a hydraulic lift to raise a car off the ground. The mechanic applies a force, F1, to piston 1 with an area A1 = 0.5 m2, which is connected to piston 2 with an area, A2 = 5 m2, that applies a force, F2, on a 950 kg car.

1. What force, F_2, must be applied to the larger piston to move the car upward at constant speed?
2. What force, F_1, must be applied to the smaller piston to move the car upward at a constant speed?
3. What is the pressure of the fluid located in piston 1?
4. What is the pressure of the fluid located in piston 2?
5. Explain how the hydraulic lift above exemplifies Pascal's Law.

Answer Key

1. To lift a 950 kg vehicle at a constant speed, the upward force must be equal to the downward force of gravity (or the vehicle's weight).
   $F_2 = mg = (950 \text{ kg})(10 \text{ N/kg}) = 9{,}500 \text{ N}$.
2. $F_1/A_1 = F_2/A_2$
   $F_2 = 9{,}500 \text{ N}$; $A_2 = 5\text{m}^2$

F_1=?; A_1=0.5 m^2
x/0.5 m^2 = 9,500 N/5 m^2
F_1 = 950 N

3. P = F/A = 950 N/0.5 m^2 = 1900 N/m^2
4. P = F/A = 9500 N/5 m^2 = 1900N/m^2
5. Answers will vary. *Sample Answer: Pascal's Law states that increasing the pressure in a fluid anywhere increases the pressure in the fluid everywhere. As the pressure increases on Piston 1 it is transferred directly to piston 2.*

12.4 Archimedes' Law

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand buoyancy and how it applies to Archimedes' Law.

1. Archimedes' Law states that an object submerged in a liquid will
   a. Displace a volume of water equal to the volume of the object
   b. Displace a weight of water equal to the weight of the object
   c. Float if the weight of the water displaced is equal to the weight of the object
   d. Both A C

2. If the volume of an object increases, the buoyant force on the object will
   a. Increase
   b. Decrease
   c. Stay the same
   d. Not enough information to determine

3. If the volume of an object increases, the amount of fluid displaced by the object
   a. Increase
   b. Decrease
   c. Stay the same
   d. Not enough information to determine

4. An object will sink (move downward in a fluid) if
   a. The gravitational force is equal to the buoyant force
   b. The gravitational force is greater than the buoyant force
   c. The gravitational force is less than the buoyant force
   d. An object is weightless due to the upward buoyant force
5. An object will float (remain at rest on top of a fluid) if
   a. The gravitational force is equal to the buoyant force
   b. The gravitational force is greater than the buoyant force
   c. The gravitational force is less than the buoyant force
   d. An object is weightless due to the upward buoyant force
6. An object will surface (move upward in a fluid) if
   a. The gravitational force is equal to the buoyant force
   b. The gravitational force is greater than the buoyant force
   c. The gravitational force is less than the buoyant force
   d. An object is weightless due to the upward buoyant force

Lesson Objective: Be able to solve problems using Archimedes' Law.

Use the following prompt for questions #7-12:

A block of lead, 0.5 meters on all sides, has a density of 1350 kg/m3 and sinks in water with a density of 1000 kg/m3.

7. Calculate the volume of the lead block.
8. Calculate the weight of the lead block.
9. Calculate the buoyant force on the lead block when it is fully submerged in the water.
10. According to Archimedes' Law, what is the weight of the water the lead block displaces?
    a. 1000 N
    b. 1250 N
    c. 1350 N
    d. 1687 N
11. Which of the statements below correctly explains why the lead block sinks?
    a. The force of gravity of the lead block is greater than the buoyant force.
    b. The force of gravity of the lead block is less than the buoyant force.
    c. The density of the lead block is less than the density of water.
    d. The weight of the water displaced by the lead block is less than the weight of the lead block.
12. Which of the following alterations could me made to the lead block to make it float?
    a. Add more lead, so that the density of the lead block increased
    b. Add more lead, so that the weight of the lead block increased
    c. Change the shape of the lead block, so that its volume increased
    d. Change the shape of the lead block, so that its volume decreased

Answer Key

1. D
2. A
3. A
4. B
5. A
6. C
7. V = $(0.5\text{ m})^3 = 0.125\text{ m}^3$
8. Solve for the mass of the cube using the equation for density ($\rho = \frac{m}{v}$);
   $\frac{1350\ kg}{m^3} = \frac{x}{0.125\ m^3} = 168.7\ kg$
   Then, use this mass to solve for the weight (force due to gravity);
   $F_{gravity}$ = mg = (168.7 kg)(10 N/kg) = 1687 N

9. $F_b = \rho$; $F_b = (1000 \text{ kg/m}^3)(0.125 \text{ m}^3)(10 \text{ N/kg}) = 1250 \text{ N}$
10. B
11. A
12. C

12.5 Bernoulli's Law

Lesson Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand Bernoulli's principle and be able to discuss its implications.

1. Which of the following statements correctly describes the relationship between the rate of fluid flow and pressure according to Bernoulli's principle?
   a. Fast moving fluid exerts less pressure than slow moving fluid
   b. Fast moving fluid exerts more pressure than slow moving fluid
   c. Slow moving fluid exerts less pressure than fast moving fluid
   d. The rate of fluid flow does not affect pressure
2. The shape of an airplane wing allows the plane to lift up because it causes
   a. the speed of the air to increase and the pressure to decrease below the wing
   b. the speed of the air to increase and the pressure to decrease above the wing
   c. the speed of the air to increase and the pressure to increase above the wing
   d. the speed of the air to decrease and the pressure to decrease above the wing

Explain the physics behind each of the following examples, with reference to Bernoulli's principle.

3. A piece of paper goes up when you blow air over it
4. A hurricane causes the roof of a house to pop off
5. Shower curtain goes inward when you turn on the hot water

Answer Key

1. A
2. B
3. The velocity of the air above the paper is greater than the velocity of the air below the paper. As a result, the pressure below the paper will be greater than the pressure above the paper and push the paper up.

4. The velocity of the air above the roof is greater than the velocity of the air below the roof. As a result, the pressure below the roof will be greater than the pressure above the roof and push the roof off.
5. The velocity of the air in the shower is greater than the velocity of the air outside of the shower. As a result, the pressure outside of the shower will be greater than the pressure inside the shower and push the shower curtain inward.

12.6 Fluid Mechanics Chapter Test

Chapter Test

Name___________________ **Class**______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives.

1. What is the density of a piece of silver with a mass of 31.5 grams and a volume of 3 cm^3?
    a. 10.5 kg/m^3
    b. 105 kg/m^3
    c. 1,050 kg/m^3
    d. 10,500 kg/m^3
2. An object that is less dense than water will
    a. float
    b. have a specific gravity less than one
    c. sink
    d. Both A B
3. Pressure is the same as
    a. Force
    b. Force divided by area
    c. Weight
    d. The sum of the density of a liquid and the depth
4. The pressure of a liquid increases with
    a. Density
    b. Depth
    c. Volume
    d. Both A B
5. Which of the following liquids at rest exerts the greatest pressure?
    a. A small bowl of freshwater 10 cm deep
    b. A large tub of freshwater 15 cm deep
    c. A small glass of freshwater 25 cm deep
    d. A large puddle of freshwater 5 cm deep
6. The Earth's atmosphere
    a. Exerts a pressure
    b. Has a weight
    c. Increases density as it approaches sea level
    d. All of the above
7. A barometer can be used to measure
    a. Atmospheric pressure
    b. Gauge pressure

   c. Total pressure
   d. Absolute pressure

8. Which of the following statements accurately describes how atmospheric pressure allows a person to drink through a straw?
   a. There is a sucking force greater than atmospheric pressure that pulls up on the liquid in a straw
   b. The atmospheric pressure pushes down on the liquid around the straw
   c. A straw has a vacuum force that pulls up on the liquid
   d. None of the above
9. As the number of air molecules above you decreases, the atmospheric pressure
   a. Increase
   b. Decreases
   c. Stays the same
   d. Not enough information to determine
10. To pump up a tire, you must rely on
    a. Atmospheric pressure
    b. Gauge pressure
    c. Both A B
    d. None of the above
11. What is the total pressure of a tire with a gauge pressure of 151, 685 N/m^2
    a. 1.01 x 10^5 N/m^2
    b. 2.53 x 10^5 N/m^2
    c. 5.10 x 10^5 N/m^2
    d. 7.32 x 10^5 N/m^2
12. Hydraulic machines rely on the principle that
    a. atmospheric pressure is always 101,325 Pa
    b. pressure in a fluid increases equally in all areas
    c. a submerged object experiences an upward buoyant force
    d. the pressure of a liquid increases with density
13. A car crusher pushes down with a force of 5000 N on a 3 m^2 input piston, producing a force of 50,000 N to crush an old car. What is the area of the output piston?

Use the following prompt for questions #14-16:

An 0.7 m3 iron sphere with a density of 7870 kg/m3 is about to be dropped into a large pool of water with a density of 1000 kg/m3.

14. Calculate the buoyant force on the sphere when it is fully submerged in the water.

15. According to Archimedes' Law, the weight of water the sphere displaces when it is fully submerged is
    a. 5,509 N
    b. 7000 N
    c. 7870 N

d. 55,090 N

16. Will the iron sphere sink or float when it is dropped into the pool? Provide evidence for your answer.

17. According to Bernoulli's principle, an increase in the speed of a fluid results in

a. An increase in pressure
b. A decrease in pressure
c. Increase in density
d. Decrease in density

18. A tornado causes the roof of a house to pop off because

a. The velocity of the air above the roof is greater than the velocity of the air below the roof
b. The velocity of the air above the roof is less than the velocity of the air below the roof
c. The pressure of the air above the roof is greater than the pressure of the air below the roof
d. None of the above

Answer Key

1. D
2. D
3. B
4. D
5. C
6. D
7. A
8. B
9. B
10. B
11. B
12. B
13. $F_1/A_1=F_2/A_2$
F_1 = 5,000 N; A_1 = 3 m^2
F^2 = 50,000 N; A_2 = ? m^2
5,000 N/3 m^2 = 50,000 N/? m^2
A_2 = 30 m^2
14. $F_b = \rho\ Vg$
F_b = (1000 kg/m^3)(0.7 m^3)(10 N/kg) = 7000 N
15. B
16. The iron sphere will sink. *Sample Reasons: The aluminum sphere will sink because the gravitational force on the sphere (55,090N) is greater than the buoyant force (7000 N). As a result, there is a net force downward and a downward acceleration. Also, the weight of water the sphere displaces (7,000 N) is less than its own weight (55,090 N). Lastly, the density of the sphere (7870 kg/m^3) is greater than the density of water (1000 kg/m^3).*
17. B
18. A

CHAPTER 13 Heat Assessments

Chapter Outline

13.1 Temperature

Lesson Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Explain what is meant by temperature.

Label the following statements as true or false. Then, explain the reason for your choice.

1. All matter expands when the temperature increases.
   True
   False
   Explain:

2. The atoms in a solid object are motionless.
   True
   False
   Explain:

3. Temperature is a quantity that determines how hot or cold something is based on a feeling.
   True
   False
   Explain:

Lesson Objective: Use the centigrade (Celsius) and Kelvin temperature scales.

4. At which of the following temperatures does water freeze?
   a. 98.7°F
   b. 0°C
   c. 293 K
   d. 100°C

5. At which of the following temperatures does water boil?
   a. 98.7°F
   b. 0°C
   c. 373 K
   d. 10°F

6. Convert the 293 Kelvin to the centigrade (Celsius) scale.

7. Which of the following would most likely be at a temperature of 293 Kelvin?
   a. Water Boiling
   b. Snow Falling
   c. Room Temperature
   d. Sahara Desert
8. Convert the 36.7 °C to the Kelvin scale.

9. Which of the following would most likely be at a temperature of 36.7°C?
   a. Water Boiling
   b. Body Temperature
   c. Water Freezing
   d. Snow falling
10. Which of the following scales of temperature is most often used by scientists and based on the motion of the atoms in an object?
    a. The Centigrade Scale (Celsius)
    b. The Fahrenheit Scale
    c. The Kelvin Scale
    d. The Joule Scale

Answer Key

1. True. Answers will vary. *Sample Answer: All solids, liquids, and gases expand when the temperature increases due to the increase in the kinetic energy of their atoms.*
2. False. Answers will vary. *Sample Answer: The atoms of every object, including solids, vibrate continuously.*
3. False. Answers will vary. *Sample Answer: We do not measure temperature using our senses, because they are relative. We measure temperature based on a standard scale (using a calibrated thermometer).*
4. B
5. C
6. 293 K-273=20°C
7. C
8. 36.7°C + 273 = 309.7 K
9. B
10. C

13.2 Kinetic Theory of Temperature

Lesson Quiz

Name__________________ Class_____________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Describe the relationship between temperature and kinetic energy.

1. When the temperature of a solid object increases, the atoms that make up the solid object
   a. move faster
   b. slow down
   c. decrease their kinetic energy
   d. remain motionless
2. When the atoms in a liquid move faster, the liquid
   a. contracts
   b. gets warmer
   c. cools down
   d. remains at the same temperature
3. The atoms of a gas
   a. vibrate back and forth in place
   b. can move freely in any direction
   c. experience a decrease in kinetic energy when heated
   d. experience an increase in kinetic energy when cooled

Label the following statements as true or false. Then, explain the reason for your choice.

4. Temperature is really a measure of the speed of the atoms in an object.
   True
   False
   Explain:

5. Temperature is a measure of the total kinetic energy of all the atoms in an object.
   True
   False
   Explain:

6. Only the atoms in liquids and gases have kinetic energy; the atoms in a solid object remain motionless.
   True

False
Explain:

7. As temperature increases, the average kinetic energy of the atoms in an object decreases.
True
False
Explain:

8. The internal energy of a substance is only dependent on the temperature.
True
False
Explain:

9. A cup of water at room temperature and a tub full of water at room temperature both have the same average kinetic energy.
True
False
Explain:

10. A cup of water at room temperature and a tub full of water at room temperature both have the same internal energy.
True
False
Explain:

Answer Key

1. A
2. B
3. B
4. True. Temperature is the measure of the average kinetic energy of the atoms of an object and kinetic energy has to do with speed (KE=1/2mv2).
5. False. Temperature is not a measure of the total kinetic energy of the atoms in an object. It is a measure of the average kinetic energy of the atoms in an object.
6. False. The atoms in solid vibrate back and forth in place.
7. False. As temperature increases, the average kinetic energy of the atoms in an object increases.
8. False. The internal energy of a substance is directly proportional to both the temperature and the number of individual atoms in a substance.
9. True. The temperature of a substance is a measure of the average kinetic energy of the atoms in a substance.

10. False. The internal energy of a substance is directly proportional to both the temperature and the number of individual atoms. As a result, the tub of water at room temperature has more internal energy than the cup of water because it contains more individual atoms.

13.3 Heat

Chapter Test

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

1. When liquid is heated it always
   a. contracts
   b. expands
   c. evaporates
   d. sublimates
2. The atoms in your desk
   a. are motionless
   b. are vibrating back and forth in place
   c. are free to move around each other
   d. move freely in any direction
3. Temperature is
   a. only used to determine the amount of heat in a liquid
   b. inversely proportional to the average kinetic energy of the atoms in an object
   c. the energy transferred between two objects
   d. the measurement that describes how hot or cold an object is
4. Convert the 271.9 Kelvin to the centigrade (Celsius) scale.
5. Which of the following would most likely be at a temperature of 271.9 K?
   a. Water Boiling
   b. Body Temperature
   c. Room Temperature
   d. Snow falling
6. Which of the following statements correctly describes the relationship between temperature and kinetic energy?
   a. Temperature is the measure of the total kinetic energy of all the atoms in an object.
   b. Temperature is the measure of the average kinetic energy of the atoms in an object.
   c. As the temperature of an object increases, the kinetic energy of the atoms in an object decreases.
   d. Temperature is independent of the kinetic energy of the atoms in an object.

Use the following prompt to answer questions #7-9:

A large bucket of water and a small cup of water are both at 20°C.

7. The temperature of the large bucket of water is
    a. higher than the temperature of the small cup of water
    b. lower than the temperature of the small cup of water
    c. the same as the temperature of the small cup of water
    d. not enough information to determine
8. The average kinetic energy of the atoms in the large bucket of water is
    a. higher than the average kinetic energy of the small cup of water
    b. lower than the average kinetic energy of the small cup of water
    c. the same as the average kinetic energy of the small cup of water
    d. not enough information to determine
9. The internal energy of the large bucket of water is
    a. higher than the internal energy of the small cup of water
    b. lower than the internal energy of the small cup of water
    c. the same as the internal energy of the small cup of water
    d. not enough information to determine
10. When an object heats up it gains,
    a. Mass
    b. Atoms
    c. Force
    d. Energy
11. An object can contain
    a. Heat
    b. Internal energy
    c. Work
    d. All of the above

Use the following prompt to answer questions #12-13:

You hold a mug filled with hot chocolate.

12. Describe the heat transfer between the mug and your hands.

13. Which of the following objects contains the most heat?
    a. The mug
    b. The hot chocolate
    c. Your hands
    d. Heat cannot be contained
14. What is the SI unit for heat?
    a. Calorie
    b. Joule
    c. Degrees Celsius
    d. Degrees Fahrenheit
15. A group of skiers sit near a fireplace in a ski lodge to get warm through the process of
    a. Conduction

b. Convection
c. Radiation
d. None of the above

16. The second floor of a house is warmer than the basement due to
    a. Conduction
    b. Convection
    c. Radiation
    d. None of the above
17. A hot seat belt burns your hand as you put it on as a result of
    a. Conduction
    b. Convection
    c. Radiation
    d. None of the above
18. The greater the specific heat value,
    a. the more heat energy is needed to produce a temperature increase.
    b. the less heat energy is needed to produce a temperature increase.
    c. the faster an object will experience a rise in temperature.
    d. the warmer the object.

Answer Key

1. B
2. B
3. D
4. 271.9 K-273=-1.1°C
5. D
6. B
7. C
8. C
9. A
10. D
11. B
12. Heat is transferred from the hot mug to your hands (from the object of higher temperature to the object of lower temperature).
13. D
14. A
15. C
16. B
17. A
18. A

13.4 Heat Transfer

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Describe how energy is transported through the processes of conduction, convection, and radiation.

Circle the correct method of heat transfer in each example. Then, explain the reason for your choice.

1. Sitting around a campfire to stay warm
   Conduction
   Convection
   Radiation
   Explain:

2. Touching a hot plate
   Conduction
   Convection
   Radiation
   Explain:

3. Standing in direct sunlight to get warm
   Conduction
   Convection
   Radiation
   Explain:

4. Ventilation ducts used to cool a house
   Conduction
   Convection
   Radiation
   Explain:

5. The circulation of air in the Earth's atmosphere
   Conduction

Convection
Radiation
Explain:

Answer Key

1. Radiation. A campfire emits electromagnetic waves to transfer heat.
2. Conduction. The energy from the hot plate is transferred to your hand by contact.
3. Radiation. The energy from the sun is transferred by electromagnetic waves through space.
4. Convection. Warmer air rises and leaves the house through the ducts.
5. Convection. Warmer air rises and cooler air falls, creating convection cells in the Earth's atmosphere.

13.5 Specific Heat

Lesson Quiz

Name____________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Solve problems involving specific heat.

The table below includes the specific heat values of four common materials:

1. Which of the following materials has the highest specific heat?
    a. Glass
    b. Aluminum
    c. Wood
    d. Water
2. Which of the following materials requires the most energy to experience a temperature rise?
    a. Glass
    b. Aluminum
    c. Wood
    d. Water
3. If 1 g of each of the materials above were exposed to 400 J of energy at room temperature, which substance will experience an increase in temperature first?
    a. Glass
    b. Aluminum
    c. Wood
    d. Water
4. Which of the following statements below is correct?
    a. It will take about four times as much heat to raise the temperature of aluminum than water.
    b. It will take about four times as much heat to raise the temperature of water than aluminum.
    c. Aluminum will absorb more energy from the sun than water will if left outside for two hours.
    d. Water will absorb more energy from the sun than aluminum will if left outside for two hours.
5. Calculate the amount of joules required to raise the temperature of 10 g of aluminum from 20°C to 30°C using the equation $\Delta Q = mc\Delta T$.

Answer Key

1. D
2. D

3. A
4. B
5. (10 g)(0.982 J/g°C)(10°C)=98.2 J

13.6 Heat Chapter Test

Chapter 13 Test

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

1. When liquid is heated it always
    1. contracts
    2. expands
    3. evaporates
    4. sublimates
2. The atoms in your desk

3.
    1. are motionless
    2. are vibrating back and forth in place
    3. are free to move around each other
    4. move freely in any direction
4. Temperature is

4.
    1. only used to determine the amount of heat in a liquid
    2. inversely proportional to the average kinetic energy of the atoms in an object
    3. the energy transferred between two objects
    4. the measurement that describes how hot or cold an object is
5. Convert the 271.9 Kelvin to the centigrade (Celsius) scale.

6. Which of the following would most likely be at a temperature of 271.9K?

6.
    1. Water Boiling
    2. Body Temperature
    3. Room Temperature
    4. Snow falling
7. Which of the following statements correctly describes the relationship between temperature and kinetic energy?

1. Temperature is the measure of the total kinetic energy of all the atoms in an object
2. Temperature is the measure of the average kinetic energy of the atoms in an object
3. As the temperature of an object increases, the kinetic energy of the atoms in an object decreases.
4. Temperature is independent of the kinetic energy of the atoms in an object

Use the following prompt to answer questions #7-9:

A large bucket of water and a small cup of water are both at 20°C.

7. The temperature of the large bucket of water is

1. higher than the temperature of the small cup of water
2. lower than the temperature of the small cup of water
3. the same as the temperature of the small cup of water
4. not enough information to determine

8. The average kinetic energy of the atoms in the large bucket of water is

9. 1. higher than the average kinetic energy of the small cup of water
   2. lower than the average kinetic energy of the small cup of water
   3. the same as the average kinetic energy of the small cup of water
   4. not enough information to determine
10. The internal energy of the large bucket of water is
    1. higher than the internal energy of the small cup of water
    2. lower than the internal energy of the small cup of water
    3. the same as the internal energy of the small cup of water
    4. not enough information to determine
11. When an object heats up it gains,

11. 1. Mass
    2. Atoms
    3. Force
    4. Energy
12. An object can contain
    1. Heat
    2. Internal energy
    3. Work
    4. All of the above

Use the following prompt to answer questions #12-13:

You hold a mug filled with hot chocolate.

12. Describe the heat transfer between the mug and your hands.

13. Which of the following objects contains the most heat?

    1. The mug
    2. The hot chocolate
    3. Your hands
    4. Heat cannot be contained

14. What is the SI unit for heat?

15. 1. Calorie
    2. Joule
    3. Degrees Celsius
    4. Degrees Fahrenheit

16. A group of skiers sit near a fireplace in a ski lodge to get warm through the process of

16. 1. Conduction
    2. Convection
    3. Radiation
    4. None of the above
17. The second floor of a house is warmer than the basement due to
    1. Conduction
    2. Convection
    3. Radiation
    4. None of the above
18. A hot seat belt burns your hand as you put it on as a result of
    1. Conduction
    2. Convection
    3. Radiation
    4. of the above
19. The greater the specific heat value,

1. the more heat energy is needed to produce a temperature increase.
2. the less heat energy is needed to produce a temperature increase.
3. the faster an object will experience a rise in temperature.
4. the warmer the object.

Chapter 13 Test Answer Key

1. B
2. B
3. D
4. 271.9K-273=-1.1°C
5. D
6. B
7. C
8. C
9. A
10. D
11. B
12. Heat is transferred from the hot mug to your hands (from the object of higher temperature to the object of lower temperature).
13. D
14. A
15. C
16. B
17. A
18. A

CHAPTER 14 Thermodynamics Assessments

Chapter Outline

14.1 The Ideal Gas Law

Lesson Quiz

Name___________________ **Class**______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Explain the Ideal Gas Law.

1. An ideal gas
   a. does not actually exist
   b. is an approximation of how a gas would act under certain conditions
   c. Both A B
   d. None of the above
2. Under what conditions do gases act most ideal?
   a. High temperature; low pressure
   b. High temperature; high pressure
   c. Low temperature, low pressure
   d. Low pressure; high temperature
3. Under what conditions do gases act least ideal?
   a. High temperature; low pressure
   b. High temperature; high pressure
   c. Low temperature, low pressure
   d. Low temperature, high pressure
4. Which of the following substances will act least ideal under the same conditions?
   a. N_2
   b. O_2
   c. H_2
   d. H_2O
5. According to the Ideal Gas Law, what happens to the volume of a gas as temperature increases and the pressure is held constant?
   a. Increases
   b. Decreases
   c. Remains the same
   d. Not enough information to determine

Lesson Objective: Solve problems using the Ideal Gas Law.

6. What is the temperature of 4 moles of an ideal gas at a pressure of 6.5 atm and a volume of 10 liters?
   a. 198 K
   b. 273 K
   c. 289 K

   d. 373 K

7. What is the volume of 2.3 moles of an ideal gas at 0.9 atm and 45°C?
   a. 9.4 L
   b. 15.6 L
   c. 66.7 L
   d. 98.2 L
8. What is the volume of 1 mole of an ideal gas at standard temperature (273 K) and pressure (1 atm)?

Use the following prompt for questions #9-10:

An ideal gas with a volume of 2 L and a pressure of 0.67 atm is at room temperature (20 °C).

9. How many moles of the gas are present?

10. How many individual atoms of the gas are present?

Answer Key

1. C
2. A
3. D
4. D
5. A
6. A
7. C
8. PV=nRT
   (1 atm)(? L)=(1)(0.0821 L*atm/mol*K)(273 K)
   V=22.4 L
9. PV=nRT
   (0.67 atm)(2 L)=(n)(0.0821 L*atm/mol*K)(293 K)
   n=0.06 moles
10. $0.06\ mol \times \frac{6.022 \times 10^{23}\ atoms}{1\ mol} = 3.61 \times 10^{22}\ atoms$

14.2 First Law of Thermodynamics

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Describe the First Law of Thermodynamics.

1. Thermodynamics is the process in which energy is transferred by
   a. Heat
   b. Work
   c. Both A B
   d. None of the above
2. A thermodynamic process that takes place at constant volume is called a
   a. Isobaric process
   b. Isochoric process
   c. Isothermal process
   d. Adiabatic process
3. A thermodynamic process in which no heat enters or leaves the system is called a
   a. Isobaric process
   b. Isochoric process
   c. Isothermal process
   d. Adiabatic process
4. A system in which mass and energy cannot enter or leave is a(n)
   a. Isolated system
   b. Closed system
   c. Open system
   d. None of the above
5. The change in internal energy of a system is dependent on
   a. Heat
   b. Work
   c. Both A B
   d. None of the above
6. The transfer of energy by applying a force over a distance is referred to as
   a. Heat
   b. Work
   c. Both A B
   d. None of the above

Use the following prompt to answer questions #7-10:

The First Law of Thermodynamics can be represented by the equation: $\Delta U = Q + W$, where U represents the internal energy of the system, Q represents the heat, and W represents the work.

7. When heat flows into the system, the variable Q will be
    a. Positive
    b. Negative
    c. Zero
    d. Not enough information to determine
8. When heat flows out of the system, the variable Q will be
    a. Positive
    b. Negative
    c. Zero
    d. Not enough information to determine
9. When work is done on the system, the variable W will be
    a. Positive
    b. Negative
    c. Zero
    d. Not enough information to determine
10. When work is done by the system, the variable W will be
    a. Positive
    b. Negative
    c. Zero
    d. Not enough information to determine

Lesson Objective: Solve problems using the First Law of Thermodynamics.

11. Calculate the change in the internal energy of a system that does 1000 J of work as a heat reservoir transfers 500 J of energy into the system.
12. Calculate the change in the internal energy of a system that does 200 J of work on the environment.

Answer Key

1. C
2. B
3. D

4. A
5. C
6. B
7. A
8. B
9. A
10. B
11. $\Delta U = +Q - W$
    $\Delta U = +500\ J - 1000\ J = -500\ J$
12. $\Delta U = -W$
    $\Delta U = -200\ J$

14.3 Second Law of Thermodynamics

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand the second law of thermodynamics.

1. Which of the following violates the second law?
   a. An ice cube melting in a glass of water
   b. A cup of room temperature water spontaneously freezing
   c. Water boiling at 373 Kelvin
   d. Water freezing at 273 Kelvin

Lesson Objective: Understand how to calculate the efficiency of a heat engine.

2. Which of the following statements correctly describe a heat engine?
   a. Heat engines transform heat into work
   b. Heat engines transform work into heat
   c. All heat engines are 100% efficient
   d. Heat engines transfer no heat to the environment
3. Calculate the efficiency of a heat engine whose ignition transfers $5.75*10^4$ J into the system and exhaust transfers $3.24*10^4$ J out of the system.

Lesson Objective: Understand how a Carnot engine operates.

4. A Carnot engine
   a. Is a hypothetical heat engine
   b. Operates on a reversible cycle
   c. Transforms heat energy into mechanical energy
   d. All of the above

Lesson Objective: Understand that entropy is a measure of disorder.

5. Entropy is the measure of
   a. Disorder
   b. Work done
   c. Heat transferred
   d. Energy transferred

Answer Key

1. B
2. A
3. $e = (1 - \frac{Q_L}{Q_H}) \times 100$
   $e = (1 - \frac{3.24 \times 10^4}{5.75 \times 10^4} \times 100$
   $e = 44\%$
4. D
5. A

14.4 Thermodynamics Chapter Test

Chapter Test

Name___________________ **Class**______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives.

1. Which of the following statements correctly describes the Ideal Gas Law?
    a. No gas exactly follows the Ideal Gas Law
    b. Temperature in the Ideal Gas Law must be expressed in Kelvin
    c. One mole of an ideal gas at standard temperature and pressure occupies 22.4 liters
    d. All of the above
2. The Ideal Gas Law is applicable at
    a. High temperature; low pressure
    b. High temperature; high pressure
    c. Low temperature, low pressure
    d. Low temperature, high pressure
3. According to the Ideal Gas Law, what happens to the volume of a gas as pressure increases and the temperature is held constant?
    a. It Increases
    b. It Decreases
    c. It remains the same
    d. Not enough information to determine
4. What would be the temperature of 1.2 moles of an ideal gas if it had a pressure of 1.25 atm in a 20 L tank?
    a. -19°C
    b. 0°C
    c. 273 K
    d. 293 K
5. The first law of thermodynamics states that the total internal energy of a system is dependent on
    a. Heat and work
    b. A Heat reservoir
    c. Pressure inside a cylinder
    d. None of the above
6. A thermodynamic process that takes place at constant temperature is called a
    a. Isobaric process
    b. Isochoric process
    c. Isothermal process
    d. Adiabatic process
7. A system in which both mass and energy may enter or leave is a(n)
    a. Isolated system

   b. Closed system
   c. Open system
   d. None of the above

8. The transfer of energy due to a temperature difference is referred to as
   a. Heat
   b. Work
   c. Both A B
   d. None of the above
9. The internal energy of a system will increase when
   a. Heat flows out of the system
   b. Work is done on the system
   c. The system does work on the environment
   d. None of the above
10. Which of the following equations correctly represents the change in internal energy when heat flows into a system?
    a. $\Delta U = +Q$
    b. $\Delta U = -Q$
    c. $\Delta U = -Q - W$
    d. $\Delta U = 0$
11. Which of the following equations correctly represents the change in internal energy when work is done by a system?
    a. $\Delta U = +W$
    b. $\Delta U = -W$
    c. $\Delta U = -Q - W$
    d. $\Delta U = 0$
12. A heat reservoir can be used to maintain the system at constant
    a. Temperature
    b. Pressure
    c. Volume
    d. All of the above
13. Calculate the change in the internal energy of a system that does 650 J of work as a heat reservoir transfers 250 J of energy into the system.
14. Second law of thermodynamics is based on
    a. Heat flow from cold to hot
    b. Heat flow from high temperatures to low temperatures
    c. Heat flow from low temperatures to high temperatures
    d. The fact that all natural processes are reversible
15. Heat engines
    a. Supply heat to an engine from a hot reservoir (substance at a higher temperature)
    b. Transfer some heat into work
    c. Transfer some heat to a cold reservoir (some substance at lower temperature)
    d. All of the above
16. What is the efficiency of a heat engine whose ignition transfers $3.25 * 10^3$ J into the system and exhaust transfers $2.32 * 10^3$ J out of the system?

a. 10%
b. 12%
c. 29%
d. 43%

17. The Carnot engine shows that the efficiency of a heat engine is related to

a. The volume of a fuel tank in an engine
b. The amount of coal a steam engine can burn
c. The high and low temperatures under which the engine operates
d. All of the above

18. In all natural processes, the total entropy of a system will always

a. Increase
b. Decrease
c. Stay the same
d. Not enough information to determine

Answer Key

1. D
2. A
3. B
4. A
5. A
6. C
7. C
8. A
9. B
10. A
11. B
12. A
13. $\Delta U = +Q - W$
$\Delta U = +250\text{ J} - 650\text{ J} = -350\text{ J}$
14. B
15. D
16. C
17. C
18. A

CHAPTER 15 Electrostatics Assessments

Chapter Outline

15.1 Static Electricity

Lesson Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand how an imbalance of electric charge is produced.

1. Which of the following causes an imbalance of charge without contact?
   a. Friction
   b. Conduction
   c. Induction
   d. Both A B
2. When an imbalance of charge is produced, one material will lose electrons. This material will have an overall
   a. Positive charge
   b. Negative charge
   c. Neutral charge
   d. Cannot be determine

Lesson Objective: Understand that there are two different kinds of electric charge.

Match each of the following fundamental properties of matter listed in questions #3-12 with their correct description. There can be more than one correct answer for each question.

A. Electron
B. Proton
C. Neutron

3. ________A particle that carries positive charge
4. ________A particle that carries negative charge
5. ________A neutral particle with no electric charge
6. ________Attracts electrons
7. ________Attracts protons
8. ________Repels electrons
9. ________Repels protons
10. ________In motion around the nucleus
11. ________Resides in the nucleus
12. ________Resides in an atom

Lesson Objective: Understand that electric charge is conserved.

13. A positively charged object
    a. Contains no electrons

b. Has lost electrons
c. Has gained electrons
d. Has gained protons

14. Which of the following statements correctly describes the ratio of electrons to protons to neutrons in a **negatively** charged object?

a. # electrons = # protons = # neutrons
b. # electrons >\# protons = # neutrons
c. # electrons <\# protons = # neutrons
d. # electrons = # protons >\# neutrons

Lesson Objective: Understand that electric charges hold atoms together.

15. Which of the forces below attract and repel?

a. Gravitational force
b. Electrostatic force
c. Both A B
d. None of the above

16. An electrostatic force exists between

a. A proton and an electron
b. Two protons
c. Two electrons
d. All of the above

Lesson Objective: Understand the difference between conductors and insulators.

Classify the following materials listed in questions #17-20 as insulators or conductors by circling the correct answer choice.

17. Rubber

a. Insulator
b. Conductor

18. Metal

a. Insulator
b. Conductor

19. Glass

a. Insulator
b. Conductor

20. Aluminum Foil

a. Insulator
b. Conductor

Answer Key

1. C
2. A

3. B
4. A
5. C
6. B
7. A
8. A
9. B
10. A
11. B C
12. A, B, C
13. B
14. B
15. B
16. D
17. A
18. B
19. A
20. B

15.2 Coulomb's Law

Lesson Quiz

Name____________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand Coulomb's Law.

1. Coulomb's law describes
   a. The gravitational force
   b. The electrostatic force
   c. Both A B
   d. None of the above
2. According to Coulomb's law, as the product of two charges increases, the force between the two charges
   a. Increases
   b. Decreases
   c. Stays the same
   d. Not enough information to determine
3. If the distance between two electrons is cut in half, the force between the two charges
   a. Double
   b. Triples
   c. Quadruples
   d. Not enough information to determine

Lesson Objective: Understand how to solve problems using Coulomb's Law.

Calculate the magnitude of the electrostatic force between the following charged particles described in questions #4-6:

4. Two electrons 1 meter apart

5. Two electrons 2 meters apart

6. Two electrons 0.5 meters apart

Answer Key

1. B
2. A
3. C
4.

$$F = k\frac{q_1 q_2}{r^2}$$

$$F = (8.99 \times 10^9 \frac{N \cdot m^2}{C^2})\frac{(1.6 \times 10^{-19}C)(1.6 \times 10^{-19}C)}{(1\ m)^2}$$

$$F = 2.3 \times 10^{-28}\ N$$

5. Without doing calculations, the distance has doubled from question #1, so the force should be reduced by a factor of four.
6. Without doing calculations, the distance in question #1 has been cut in half, so the force should be double.

15.3 Electrostatic Fields

Lesson Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand what an electric field is.

Match each of the following force fields with their correct description in questions #1-5. There can be more than one correct answer for each question.

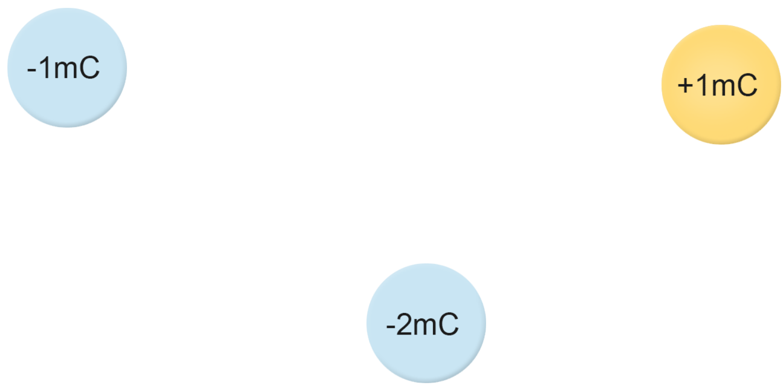
A. Gravitational Field (g)
B. Electric Field (E)

1. ________The force field that surrounds a massive object.
2. ________The force field that surrounds a charged particle.
3. ________The force field that holds an electron in orbit around the nucleus.
4. ________The force field that holds the moon in orbit around the Earth.
5. ________A vector quantity, with both magnitude and direction.

Lesson Objective: Understand how to solve electrostatic field problems.

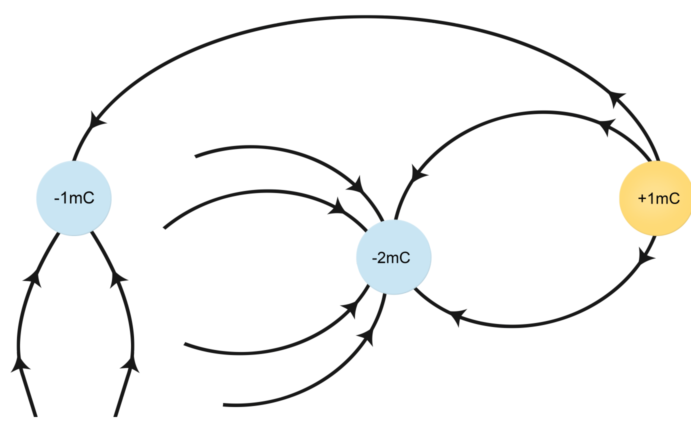
6. Electric field lines
   a. never cross each other
   b. cross each other sometimes
   c. always cross each other
   d. none of the above
7. Electric field lines illustrate the direction of the electrostatic force that would act on a
   a. neutral test charge
   b. positive test charge
   c. negative test charge
   d. none of the above
8. Which of the following statements correctly describes the ratio of the electric field lines surrounding a +2C charge compared to a +1C charge.
   a. A +2 C charge should have half the amount of electric field lines as a +1 C charge.
   b. A +2 C charge should have the same amount of electric field lines as a +1 C charge.
   c. A +2 C charge should have double the amount of electric field lines as a +1 C charge.
   d. A +2 C charge should have triple the amount of electric field lines as a +1 C charge.
9. A 6 mC charge is placed in an electric field at a point where the magnitude of the electric field is 2.67 x 10^7N/C. Calculate the magnitude of the electrostatic force acting on the charge.

10. Draw the electric field lines surrounding the charged particles below.



Answer Key

1. A
2. B
3. B
4. A
5. A B
6. A
7. B
8. C
9. First, convert 6 mC to Coulombs: $6.0 \text{ x } 10^{-3}$C
   F = qE
   F = $(6.0 \text{ x } 10^{-3}\text{C})(2.67 \text{ x } 10^{7}\text{N/C}) = 1.6 \text{ x } 10^{5}\text{N}$
10.



15.4 Electrostatics Chapter Test

Chapter Test

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

1. Which of the following produces an imbalance of charge?
   a. Rubbing two objects together
   b. Friction
   c. The ground
   d. Both A B
2. Which of the following statements correctly describes an electron?
   a. A particle that carries positive charge
   b. Repels negatively charged particles
   c. Repels positively charged particles
   d. Resides in the nucleus of an atom
3. A negatively charged object
   a. Contains no electrons
   b. Has lost electrons
   c. Has gained electrons
   d. Has lost protons
4. A typical atom is
   a. Neutral
   b. Positively charged
   c. Negatively charged
   d. not enough information to determine
5. Electrostatic Force is
   a. Attractive
   b. Repulsive
   c. Both A B
   d. None of the above
6. Which of the following materials would serve as a good insulator?
   a. Rubber
   b. Glass
   c. Metal
   d. Both A B
7. According to Coulomb's Law, the electrostatic force is directly proportional to the
   a. Product of two charges
   b. The square of the distance between two charges

c. Both A B
d. None of the above

8. Calculate the magnitude of the electrostatic force between a 4.0μC charged particle and a 2.0μC charged particle separated by 0.5 meters.

9. The force field that surrounds a charged particle is a(n)

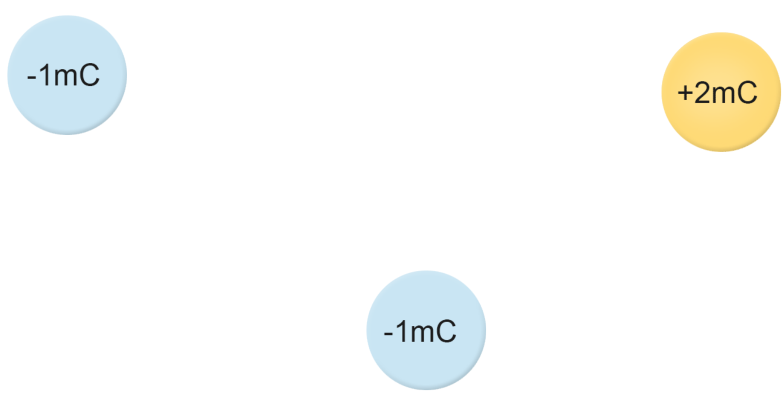
a. Gravitational field (g)
b. Electric field (E)
c. Magnetic field (B)
d. None of the above

10. If the electric field lines point toward a charge, the charge must be

a. Negative
b. Positive
c. Neutral
d. Not enough information to determine

11. A charge is placed in an electric field at a point where the magnitude of the electric field is 7.63 x 10^7N/C. Calculate the magnitude of the electrostatic force acting on the charge.

12. Draw the electric field lines surrounding the charged particles below.

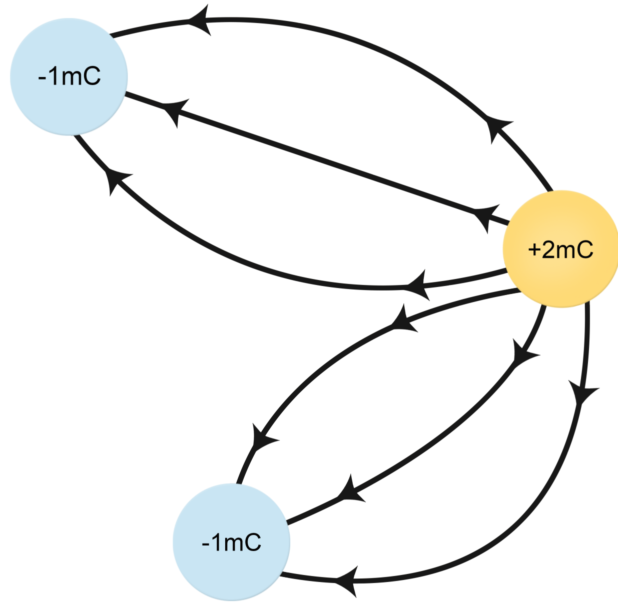


Answer Key

1. D
2. B
3. C
4. A
5. C
6. D
7. A

8.
$$F = k\frac{q_1 q_2}{r^2}$$
$$F = (8.99 \times 10^9 \frac{N \cdot m^2}{C^2})\frac{(2 \times 10^{-6} C)(4.0 \times 10^{-6} C)}{(0.5\ m)^2}$$
$$F = 0.29\ N$$

9. B
10. A
11. First, convert 2.0μC to Coulombs: 2.0 x 10^{-6}C
F = qE
F = (2.0 x 10^{-6}C)(7.63 x 10^{7}N/C) = 153 N
12.



CHAPTER 16 Electric Potential Assessments

Chapter Outline

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16.1 Reviewing Gravitational Potential Energy

Lesson Quiz

Name___________________ **Class**______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Review and understand gravitational potential energy.

1. Which of the following variables will affect the gravitational potential energy of an object?
   a. Velocity (v)
   b. Spring constant (k)
   c. Height above the Earth (h)
   d. Voltage (V)

Use the following prompt for questions # 2-3:

Santa climbs a ladder to the top of a roof. Then, Santa stands on the roof, next to the chimney. Finally, Santa goes down the chimney.

2. At which of the following points does Santa do work?
   a. When Santa climbs the ladder
   b. When Santa stands on the roof, next to the chimney
   c. When Santa slides down the chimney
   d. None of the above
3. At which of the following points does Santa have the most gravitational potential energy?
   a. When Santa climbs the ladder
   b. When Santa stands on the roof, next to the chimney
   c. When Santa slides down the chimney
   d. None of the above

Use the following prompt for questions #4-5:

A mother lifts her 9 kg baby from the floor to a height of 2 m above the ground.

4. How much work did the mother do?
   a. 9 N
   b. 90 J
   c. 180 N
   d. 180 J
5. How much gravitational potential energy does the baby have when it is 2 m above the ground?
   a. 9 N
   b. 90 J
   c. 180 N
   d. 180 J

Answer Key

1. C
2. A
3. B
4. D
5. D

16.2 Electric Potential

Lesson Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand how to solve problems using electric potential energy.

1. Electric potential energy is a
    1. Vector quantity
    2. Scalar quantity
    3. Type of Force
    4. None of the above
2. The electric potential energy of a charged particle can be calculated by multiplying its charge by
    1. The electrostatic force on the charged particle
    2. The electric field strength at the point where it is located
    3. Its distance from another charge
    4. All of the above
3. If a charged particle experiences an increase in voltage, its electric potential energy will

4.
    1. Increase
    2. Decrease
    3. Stay the same
    4. Not enough information to determine
5. Calculate the electric potential energy of an object with 6 nC of charge and a potential difference of a 5.6V.

Lesson Objective: Understand how to solve problems using voltage differences.

5. Voltage is a measure of
    1. Electric potential energy
    2. Electric potential
    3. Electric field strength
    4. Electrostatic force
6. The voltage in electric potential energy is similar to the in gravitational potential energy.

    1. height (h)
    2. mass (m)
    3. gravitational constant (g)
    4. none of the above
7. 500 Volts is equivalent to

8.
    1. 2000 joules of energy per 4 coulombs of charge

   2. 1000 joules of energy per 2 coulombs of charge
   3. 500 joules of energy per 1 coulomb charge
   4. All of the above
9. Calculate the potential difference created by a battery exerting 10 joules of energy to move 5 coulombs of charge.

Lesson Objective: Understand how to solve problems in a uniform electric field.

9. What variable would you need to determine the electric field of two objects separated by 300 V?
   1. The charges of one particles
   2. The charges of both particles
   3. The distance between the two objects
   4. All of the above
10. The electric potential energy of a charged particle can be increased

1. By allowing it to move freely in the same direction as the electric field
2. By applying a force to move it a distance against the electric field
3. By decreasing the voltage
4. None of the above

11. As a positive charge moves in the direction of a uniform electric field, its electric potential energy
    1. Decreases
    2. Increases
    3. Stays the same
    4. Not enough information to determine
12. Calculate the change in voltage due to an electric field doing 100 J of work on a 0.25 C charge.

Answer Key

1. B
2. B
3. A
4. $U=qV=(6x10^{-9}C)(5.6V)=3.36x\ 10^{-8}J$
5. B
6. A
7. D
8. 10J/5C=2V
9. C
10. B
11. A
12. V=W/q=100J/0.25C=400V

16.3 Capacitance

Lesson Quiz

Name___________________ **Class**______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand capacitance.

1. Any material able to store charge has
   a. Energy
   b. Capacitance
   c. Insulation
   d. work
2. The net charge on a capacitor is always
   a. Positive
   b. Negative
   c. Zero
   d. Not enough information to determine
3. The amount of charge gained by a capacitor is directly proportional to the
   a. gravitational potential energy
   b. electrostatic force
   c. electric field
   d. voltage source
4. The amount of electric potential energy stored in a parallel plate capacitor will increase if
   a. the distance between the two plates increases
   b. the distance between the two plates decreases
   c. the area of the two plates decreases
   d. the voltage decreases
5. A charged capacitor has an _____________ between its two parallel plates.
   a. electric field
   b. electric potential
   c. Both A B
   d. None of the above

Lesson Objective: Understand how to solve problems involving capacitance.

6. What is the electric potential difference of a 0.3 farad capacitor with 0.3 coulombs of charge?
   a. 0.3 V
   b. 0 V
   c. 1 V
   d. 3 V

7. Calculate the amount of charge that flows from a 9V battery when it is connected to a 3 microfarad capacitor.

8. Calculate the capacitance of a capacitor that has two plates, with the dimensions 2 mm by 1 mm, separated by a distance of 0.5 mm.

Answer Key

1. B
2. C
3. D
4. B
5. C
6. C
7. Q = CV
   Q = (3.0 x 10^{-6} F)(9 V)
   Q = 2.7 x 10^{-5}C
8.

$$C = \varepsilon_0 \frac{A}{d}$$
$$C = (8.85 \times 10^{-12} \frac{C^2}{N \cdot m^2}) \frac{(2.0 \times 10^{-3}\ m)(1.0 \times 10^{-3}\ m)}{5.0 \times 10^{-4}\ m}$$
$$C = 3.54 \times 10^{-14}\ F$$

16.4 Dielectrics

Lesson Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand what a dielectric is and how it affects the capacitance of a capacitor.

1. A key feature to a dielectric is its ability to be
   a. Polarized
   b. Energized
   c. Conductive
   d. All of the above
2. A dielectric ______________ the overall electric field of a capacitor.
   a. Increases
   b. Decreases
   c. maintains
   d. Has no affect on
3. Dielectric material is usually a(n)
   a. Insulator
   b. Conductor
   c. Semiconductor
   d. None of the above
4. As a result of using a dielectric, a capacitor is able to
   a. Store more charge
   b. Exert more electrostatic force
   c. Do more work
   d. All of the above

Lesson Objective: Solve problems involving capacitors with dielectrics.

5. A capacitor has a capacitance of 6pF. Determine the new capacitance as a result of placing a glass dielectric between the metal plates (k=5.2).
   a. 6 pF
   b. 15 pF
   c. 31.2 pF
   d. 331 pF

Answer Key

1. A

2. B
3. A
4. A
5. C

16.5 Electrical Energy Storage

Lesson Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand how energy is stored in a capacitor.

1. The electric potential energy stored in a capacitor is equivalent to
   a. The work done by a battery on electric charges
   b. The force needed to stretch a spring
   c. The work needed to lift a massive object above the Earth
   d. All of the above
2. The electric potential energy stored by a capacitor
   a. Becomes available when the capacitor is discharged
   b. Becomes available when the capacitor gains more charge
   c. Becomes available when the electric field strength increases
   d. Is never released
3. Which of the following statements below correctly describes the role of a battery in a capacitor system?
   a. A battery provides the charges in a capacitor system
   b. A battery does work on the charges in a capacitor system
   c. A battery provides the electric field to the capacitor system
   d. A battery is recharged by a capacitor system

Lesson Objective: Solve problems involving energy stored in capacitors.

4. Calculate the voltage between the two plates of a capacitor with 4 microfarads of capacitance storing 2 microjoules of electric potential energy.

5. Calculate the amount of electric potential energy stored by the capacitor that carries 1 C of charge and is connected to a 240 V voltage source.

Answer Key

1. A
2. A

3. B
4.

$$
\begin{aligned}
PE_{cap} &= \frac{1}{2}CV^2 \\
2.0\times 10^{-6}\ J &= \frac{1}{2}(4.0\times 10^{-6}\ F)(V^2) \\
V &= 1\ V
\end{aligned}
$$

5.

$$
\begin{aligned}
PE_{cap} &= \frac{1}{2}QV_f \\
PE_{cap} &= \frac{1}{2}(1\ C)(240\ V) = 120\ J
\end{aligned}
$$

16.6 Electric Potential Chapter Test

Chapter Test

Name___________________ **Class**______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives.

1. Which of the following statements correctly describes how a massive object gains gravitational potential energy.
   a. A massive object must have a velocity.
   b. A massive object must be placed at a height above the Earth.
   c. Work must be done on the massive object.
   d. Both B C.
2. As a charged object moves with the electric field, its electric potential energy will
   a. Increase
   b. Decrease
   c. Convert to kinetic energy
   d. Both B C
3. The electric potential energy of a charged particle will increase if
   a. The amount of charge increases
   b. The amount of voltage increase
   c. The electric potential increases
   d. All of the above
4. The unit for electric potential is the
   a. Volt (V)
   b. Joule (J)
   c. Coulomb (C)
   d. Newtons/Coulomb (N/C)
5. A mass at a height above the Earth has gravitational potential energy just as
   a. A charge has electric potential energy
   b. A voltage has electric potential energy
   c. A charge on a voltage has electric potential energy
   d. None of the above
6. A 1.5 V battery has
   a. 0.75 joules per every 1 coulomb of charge
   b. 1.5 joules per every 1 coulomb of charge
   c. 3 joules per every 1 coulomb of charge
   d. not enough information to determine
7. What is the voltage of 2 nC with an electric potential energy of 5 nJ?
   a. 1 V

b. 1.5 V
c. 2 V
d. 2.5 V

8. The electric potential energy of a charged particle depends on
   a. The gravitational force
   b. The spring constant (k)
   c. Its location in an electric field
   d. The mass of the particle
9. In order to increase the electric potential energy of a charged object in an electric field
   a. work must be done on the charge to move it with the electric field
   b. work must be done on the charge to move it against the electric field
   c. work must be done by the charge on the electric field
   d. no work must be done
10. A material with capacitance has the ability to
    a. do work
    b. store charge
    c. store energy
    d. All of the above
11. An instrument used in many electronic devices to store electric potential energy is
    a. A conductor
    b. An insulator
    c. A capacitor
    d. A dielectric
12. The capacitance of a parallel plate capacitor is directly proportional to the
    a. Area of the conducting plates
    b. Distance between the conducting plates
    c. The voltage source
    d. Both A C
13. A 4 farad capacitor with 2 coulombs of charge has an electric potential difference of
    a. 0.5 V
    b. 1 V
    c. 2 V
    d. 4 V
14. Insulating materials with high polarizability are referred to as
    a. Dielectrics
    b. Insulators
    c. Conductors
    d. Capacitors
15. A parallel plate capacitor is able to store 7pC of charge. How much charge would it be able to store with a paper dielectric (k=3.3) inserted between its two plates?
    a. 7 pC
    b. 17 pC
    c. 23.1 pC
    d. 56.7 pC
16. The potential energy stored within the capacitor is the same as

a. the electric potential
b. the electrostatic force
c. the work done by a battery
d. the work done by the electric field

17. What is the electric potential difference between the two plates of a 1 nanofarad capacitor storing 1 nanojoule of charge?

a. 1 V
b. 1.2 V
c. 1.4 V
d. 10 V

Answer Key

1. D
2. D
3. D
4. A
5. C
6. B
7. D
8. C
9. B
10. B
11. C
12. D
13. A
14. A
15. C
16. C
17. C

CHAPTER 17 Circuits Assessments

Chapter Outline

17.1 Electric Current

Lesson Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand how electric current is defined.

1. The charged particles that move through a wire in a circuit are
   a. Electrons
   b. Protons
   c. Neutrons
   d. All of the above
2. A high current means
   a. Charges are moving at the speed of light
   b. Charges are moving far distances
   c. Many charges pass by a point on a wire
   d. A few charges pass by a point on a wire
3. The current in a simple circuit
   a. Decreases as it travels around the circuit
   b. Increases as it travels around the circuit
   c. Is the same at all points along the circuit
   d. Is zero at the end of the circuit
4. In order for current to flow, there must be
   a. An electric potential difference
   b. A source of energy creating a voltage
   c. A loop of wire or other conducting material
   d. All of the above
5. As a result of current, charge flows
   a. Into a circuit
   b. Through a circuit
   c. On top of a circuit
   d. Below a circuit
6. The charges that flow in a current originate from
   a. The wire
   b. The battery
   c. The wall outlet
   d. The voltage source

Lesson Objective: Solve problems involving electric current.

7. When 9 C of charge passes a point along a wire in 1 minute, the current is
   a. 0.67 A
   b. 0.15 A
   c. 6.7 A
   d. 9 A
8. What is the current produced when 0.4 C of charge passes through a 3 mm cross-section of wire in 2 seconds?
   a. 0.2 A
   b. 0.6 A
   c. 1.2 A
   d. 1.5 A

Answer Key

1. A
2. C
3. C
4. D
5. B
6. A
7. B
8. A

17.2 Ohm's Law

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand how conventional current is defined.

1. In a battery, conventional current flows
   a. From the negative terminal to the positive terminal of the battery
   b. From the positive terminal to the negative terminal of the battery
   c. From the positive terminal of one battery to the positive terminal of another battery
   d. From the negative terminal of one battery to the negative terminal of another battery

Lesson Objective: Understand electrical resistance.

2. Which of the following provide electrical resistance in a simple circuit?
   a. A battery
   b. A wall outlet
   c. A voltage source
   d. A light bulb

Lesson Objective: Understand how to solve problems using Ohm's law.

Use the following prompt for questions #3-5:

A circuit consists of a 9 V battery, a 50 ohm resistor and some connecting wire.

3. What is the current through the wire?

4. What will happen to the current if you replace the battery with a 1.5 V battery?
   a. The current will increase
   b. The current will decrease
   c. The current will stay the same
   d. Not enough information to determine
5. What will happen to the current if you keep the 9 V battery and add a light bulb with an electrical resistance of 100 ohms?
   a. The current will increase
   b. The current will decrease
   c. The current will stay the same
   d. Not enough information to determine

Answer Key

1. B
2. D
3. V = IR
   9 V = (I)(50 Ω) = 0.18 A
4. B
5. B

17.3 Resistivity

Lesson Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand how to solve problems involving resistivity.

1. As the conductivity of a wire increases,
   a. Its resistivity decreases
   b. Its gauge number decreases
   c. Its length decreases
   d. All of the above
2. As the length of a wire increases,
   a. Its resistivity increases
   b. Its gauge number increases
   c. Its thickness increases
   d. All of the above
3. A 10-gauge wire is _________ than a 16-gauge wire.
   a. Wider
   b. Thinner
   c. More resistive
   d. Less conductive
4. A 26-gauge wire is _________ than a 16-gauge wire.
   a. Wider
   b. Thicker
   c. More resistive
   d. More conductive
5. Under identical conditions, a silver wire conducts more current than an aluminum wire. Which of the following statements correctly compares the resistivity between silver and aluminum?
   a. The resistivity of aluminum is greater than silver
   b. The resistivity of silver is greater than aluminum
   c. Silver and aluminum have equal resistivity
   d. Not enough information to determine
6. A 5 m wire made of gold ($\rho_{gold} = 2.4 \text{ x } 10^{-8}$) has a cross-sectional area of 2 mm. Calculate the voltage if a 32 A current runs through the wire.

Lesson Objective: Understand how to read the resistor code.

7. The fourth band on a four-band resistor indicates the _________ according to a color code.
   a. Percent of resistance
   b. Measure of accuracy
   c. Tolerance
   d. Both B C

Use the chart below to answer question # 8:

8. What is the resistance of a resistor with a band color sequence of Orange, Brown, Yellow, Gold?

Answer Key

1. D
2. A
3. A
4. C
5. A
6. First, calculate the resistance. Then, calculate the current using Ohm's law. (V = IR).
   ρ_{gold} = 2.4 x 10^{-8}; L = 5 m; A = 0.002 m^2
   $R = (2.4 \times 10^{-8})(\frac{5\ m}{0.002 m^2})$
   R = 6.0 x 10^{-5}
   V = IR = (32 A)(6.0 x 10^{-5})
   V = 0.002 V
7. D
8. Orange - 3
   Brown-1
   Yellow- x10,000
   Gold-$\pm$5%
   R = 310,000$\pm$5% or 3.1 x 10^5 $\pm$5%

17.4 Resistors in Series and Parallel

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Be able to distinguish between a series and parallel circuit.

1. Two resistors in this type of circuit will experience the same drop in voltage.
   a. Series
   b. Parallel
   c. Both A B
   d. None of the above
2. Two resistors in this type of circuit will experience the same current.
   a. Series
   b. Parallel
   c. Both A B
   d. None of the above
3. If one light bulb is removed from this type of circuit, the rest of the light bulbs in the circuit will go out.
   a. Series
   b. Parallel
   c. Both A B
   d. None of the above
4. When one light bulb is added to this type of circuit, all the other light bulbs get dimmer.
   a. Series
   b. Parallel
   c. Both A B
   d. None of the above
5. Each of the electrons only goes through one resistor in this type of circuit.
   a. Series
   b. Parallel
   c. Both A B
   d. None of the above
6. Car headlights are connected in this type of circuit so that if one light goes out, the other lights will remain working.
   a. Series
   b. Parallel
   c. Both A B
   d. None of the above
7. The equivalent resistance of this type of circuit is always greater than the resistance of any one resistor in the circuit.

a. Series
b. Parallel
c. Both A B
d. None of the above

Lesson Objective: Solve problems involving circuits with resistors.

Use the diagrams of circuit A & B below to complete the chart. Show your work clearly in the space below the chart.

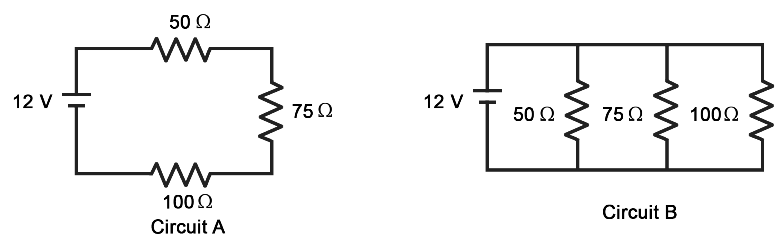


TABLE 17.1:

	Circuit A	Circuit B
Equivalent resistance of the entire circuit		
The current through the 100Ω **resistor**		
The current through the 75Ω **resistor**		
The voltage drop across the 75Ω **resistor**		
The voltage drop across the 50Ω **resistor**		

Answer Key

1. B
2. A
3. A
4. A
5. B
6. B
7. A

Circuit A

R_{eq-A} = 50 Ω + 75 Ω + 100 Ω

R_{eq-A} = 225 Ω

$I_{100} = I_{tot}$

$V_{tot} = I_{tot} * R_{eq-A}$

12 V = I_{tot} 225 Ω

I_{tot} = 0.053 A

I_{100} = 0.053 A

The resistors are in series, so the current through each resistor is equal to the total current, 0.053A

$V_{75} = I_{75}\ 75\ \Omega$

$I_{75} = I_{tot}$ = 0.053 A

V_{75} = (0.053 A) (75 Ω)

V_{75} = 3.975 V

V_{50} = (0.053 A)(50 Ω)

V_{50} = 2.65 V

Circuit B

1/ R_{eq-B} = 1 / 50#937; + 1 / 75 #937; + 1 / 100 #937;

R_{eq-B} = 23 #937;

$V_{100} = I_{100}$ (100 #937;)

12 V = I_{100} (100 #937;)

I_{100} = 0.12 A

$V_{75} = I_{75}$ (75 #937;)

12 V = I_{100} (75 #937;)

I_{100} = 0.16 A

The resistors are in parallel, so the voltage drop across each one is equal to the total voltage, **12 V**

17.5 Measuring Current and Voltage

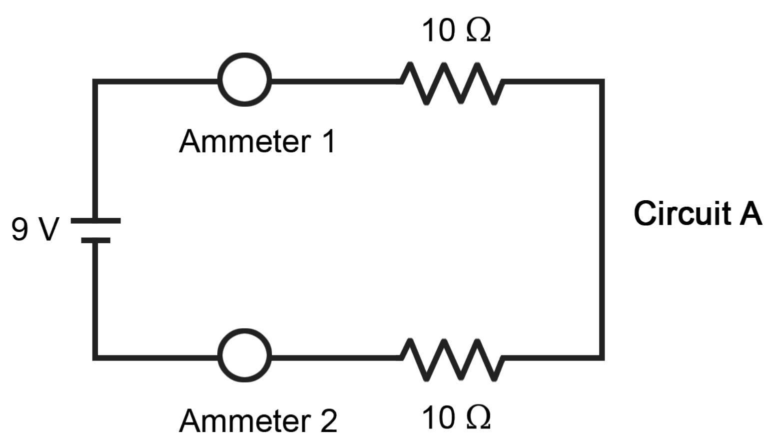
Lesson Quiz

Name____________________ Class_______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand how an ammeter is used.

Use the diagram of circuit A below to answer questions #1-2:



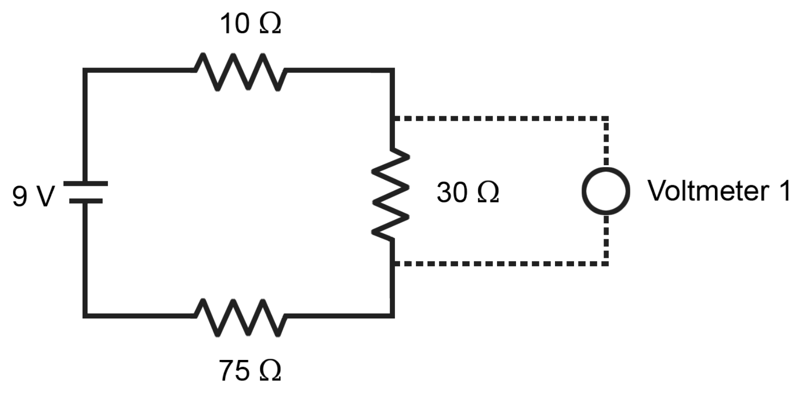
1. What does ammeter 1 read?

2. What does ammeter 2 read?

Lesson Objective: Understand how a voltmeter is used.

3. A voltmeter
   a. Should always be connected in parallel to electronic resistors
   b. Measures the potential difference across a resistor
   c. Measures the voltage drop across a resistor
   d. All of the above

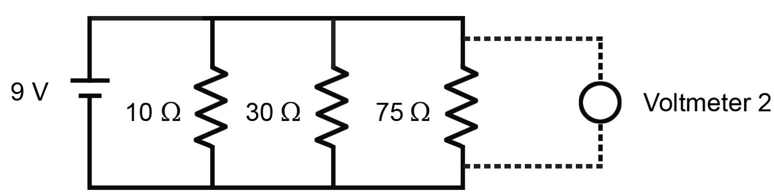
Use the diagram of circuit B below to answer question #4:



Circuit B

4. What should voltmeter 1 read?

Use the diagram of circuit C below to answer question #5:



Circuit C

5. What should voltmeter 2 read?

Answer Key

1. First, calculate the equivalent resistance of this circuit in series.
   $R_{series-equivalent} = R_1 + R_2 + ...$
   $R_{eq-A} = 10\Omega + 10\Omega = 20\Omega$
   Then, calculate the total current running through this circuit in series.
   $V = IR_{eq}$
   $9\ V = (I)(20\ \Omega) = 0.45\ A$
2. 0.45 A, because the current running through a series circuit is the same across each resistor.
3. D
4. First, calculate the equivalent resistance of this circuit in series.
   $R_{series-equivalent} = R_1 + R_2 + ...$

R_{eq-B} = 10Ω+30Ω+75Ω = 115Ω
Then, calculate the total current running through this circuit in series.
V = IR_{eq}
9 V =(I)(115 Ω) = 0.08 A
Using the total current, calculate the voltage drop across the 30Ω resistor.
V = (0.08 A)(30Ω) = 2.4 V

5. The voltage drop across all resistors in parallel is equal to the total voltage of 9 V.

17.6 Circuits Chapter Test

Chapter Test

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

1. Current is the rate at which charges
   a. Move a certain distance along a wire
   b. Pass a point on a wire
   c. Are used up by a resistor
   d. Transform electric potential energy
2. Current is the flow of
   a. Protons
   b. Electrons
   c. Neutrons
   d. All of the above
3. What causes current to flow?
   a. An energy source creating an electric potential difference
   b. A loop of conducting material that allows charges to flow freely
   c. Both A B
   d. None of the above
4. When 0.4C of charge passes a point along a wire in 2.5 minutes, the current is
   a. 0.15 A
   b. 1 A
   c. 60 A
   d. 240 A
5. Conventional current describes the flow of
   a. Charge in a battery
   b. Electrons along a wire
   c. Positive charge
   d. Negative charge
6. Electric resistance is measured in
   a. Amperes
   b. Volts
   c. Ohms
   d. Coulombs/Second
7. Electrical resistors
   a. Promote the flow of charge in a circuit
   b. Hinder the flow of charge in a circuit

c. Stop the flow of charge in a circuit
d. Do not affect the flow of charge in a circuit

8. If the voltage in a circuit decreases, the current will

a. Increase
b. Decrease
c. Stay the same
d. Not enough information to determine

9. What is the resistance of a light bulb that carries 0.12A when connected to a 1.5V battery?

a. 0.18 ohms
b. 1 ohms
c. 10 ohms
d. 12.5 ohms

10. As the resistivity of a material increases, its conductivity

a. Decrease
b. Increases
c. Stays the same
d. Not enough information to determine.

11. The resistivity of a wire increases as its ____________ increases.

a. Diameter
b. Length
c. Cross-sectional area
d. All of the above

12. A 24-gauge wire is ___________ than an 18-gauge wire.

a. Wider
b. Thicker
c. More resistive
d. More conductive

13. A 12-gauge wire allows a

a. larger current than a 14-gauge wire
b. larger current than a 10-gauge wire
c. smaller current than a 18-gauge wire
d. smaller current than a 24-gauge wire

14. What is the length of a 10-gauge ($5.26 mm^2$) aluminum wire ($\rho_{aluminum}$ = $2.7 x 10^{-8}$) with a resistance of 4.0 x $10^{-5}\Omega$?

a. 2 x 10^{-10} m
b. 8 m
c. 1457 m
d. 7692 m

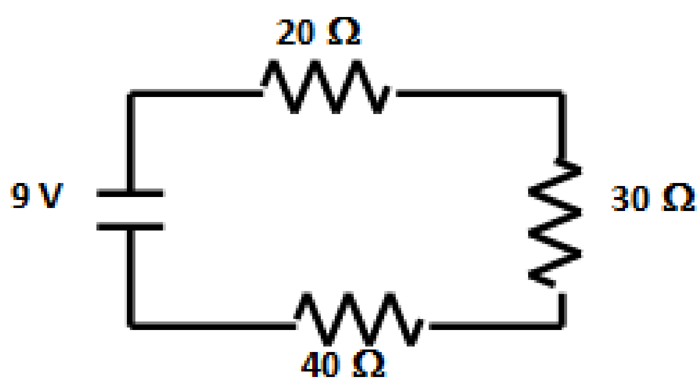
Use the chart below to answer question # 15:

15. What is the tolerance of a resistor with a band color sequence of Black, Brown. Brown, Gold?

a. 0
b. 1
c. 10 Ω
d. 5%

16. Three bulbs are connected in series. What happens if one bulb burns out?
    a. Only one bulb will go out
    b. Only two bulbs will go out
    c. All three bulbs will burn out
    d. Not enough information to determine
17. The equivalent resistance of this type of circuit is always less than the resistance of any one resistor in the circuit.
    a. Series
    b. Parallel
    c. Both A B
    d. None of the above
18. Two resistors in parallel will always experience the same
    a. Current
    b. Voltage drop
    c. Resistance
    d. Capacitance

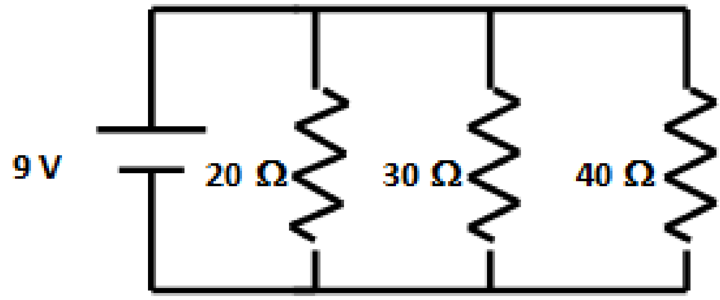
Refer to the diagram of circuit X below to answer questions #19-21:



Circuit X

19. Calculate the equivalent resistance of circuit X.
20. Calculate the current through the 20Ω resistor in circuit X.
21. Calculate the voltage drop across the 30Ω resistor in circuit X.

Refer to the diagram of circuit Y below to answer questions #22-24:



Circuit Y

22. Calculate the equivalent resistance of circuit Y.

23. Calculate the current through the 20Ω resistor in circuit Y.

24. Calculate the voltage drop across the 30Ω resistor in circuit Y.

25. What would a voltmeter read if it were placed in parallel with the 40Ω resistor in circuit Y?

Answer Key

1. B
2. B
3. C
4. C
5. C
6. C
7. B
8. B
9. D
10. B
11. B
12. C
13. A
14. B
15. D
16. C
17. B

18. B
19. $R_{series-equivalent} = R_1 + R_2 + ...$
    $R_{eq-X} = 20\Omega + 30\Omega + 40\Omega = 90\Omega$
20. The current running through each resistor in a series circuit is the same as the total current.
    V = IR = 9 V = (I)(90Ω) = 0.1 A
21. V = (0.1 A)(20 Ω) = 2 V
22.

$$R_{parallel-equivalent} = \frac{R_1 R_2}{R_1 + R_2}$$
$$R_{eq} = (\frac{20\Omega \times 30\Omega}{20\Omega + 30\Omega}) = (\frac{600\Omega}{50\Omega}) = 12\Omega$$
$$(\frac{12\Omega \times 40\Omega}{12\Omega + 40\Omega}) = 9.23\Omega$$
$$R_{eq-Y} = 9.23\Omega$$

23. The voltage drop through each resistor in a parallel circuit is the same as the voltage source (9V). The current through each resistor in a parallel circuit is different.
    V = IR
    9 V =(I)(20Ω) = 0.45 A
24. The voltage drop through each resistor in a parallel circuit is the same as the voltage source (9 V).
25. 9 V, because the voltage drop through each resistor in a parallel circuit is the same as the voltage source (9 V).

CHAPTER 18 Magnetism Assessments

Chapter Outline

18.1 Magnetic Fields

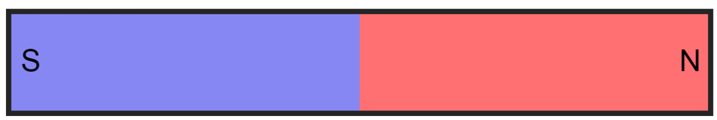
Lesson Quiz

Name____________________ Class_______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Know how to determine the direction of a permanent magnetic field.

1. Draw the magnetic field lines around the permanent bar magnet made of nickel in the space below:



Lesson Objective: Know that a current-carrying wire creates a magnetic field.

2. Which of the following is the source of the magnetic field in a current-carrying wire?
   a. The voltage source
   b. The current
   c. The resistor
   d. The magnetic force
3. Which of the following would increase the magnetic field around a current-carrying wire?
   a. Looping the wire into a coil
   b. Decreasing the current
   c. Both A B
   d. None of the above

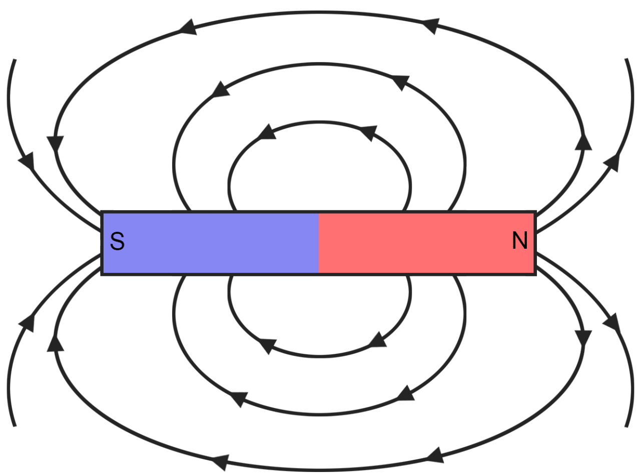
Lesson Objective: Know how to determine the direction of the magnetic field produced by a current-carrying wire.

Use the image of the current-carrying wire to answer questions #4-5 below:

4. The direction of the magnetic field at **point A** (above the wire) is
   a. Leftward
   b. Rightward
   c. Into the page
   d. Out of the page
5. The direction of the magnetic field at **point B** (below the wire) is
   a. Leftward
   b. Rightward
   c. Into the page
   d. Out of the page

Answer Key

1.



2. B
3. A
4. C
5. D

18.2 The Magnetic Force acting on a Current-Carrying Wire

Lesson Quiz

Name____________________ **Class**_______________ **Date** _________

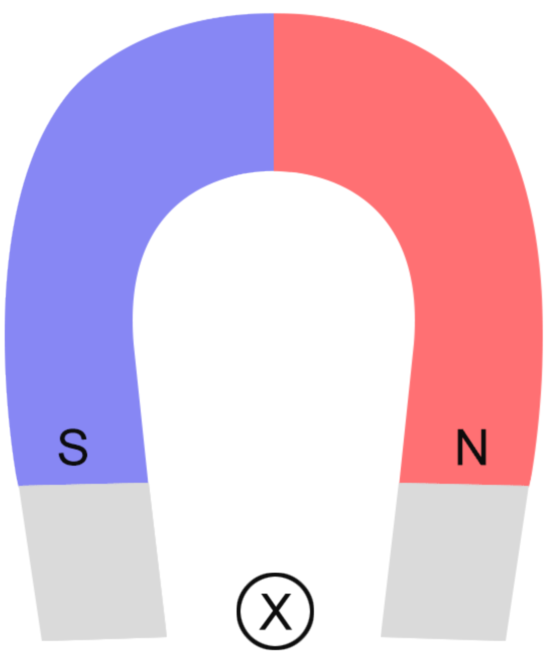
Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Know under which conditions a current-carrying wire experiences a force when placed in a magnetic field.

1. According to Newton's Third Law, if a current-carrying wire exerts a force on a magnet, then the
   a. magnet must exert a force on the current-carrying wire, equal in magnitude and pointing in the same direction
   b. magnet must exert a force on the current-carrying wire, equal in magnitude but opposite in direction
   c. Earth must exert a force on the magnet, equal in magnitude but opposite in direction
   d. Earth must exert a force on the current-carrying wire, equal in magnitude but opposite in direction.

Lesson Objective: Use the right-hand rule to determine the force on a current-carrying wire in a magnetic field.

The image below depicts a horseshoe magnet with a wire between its north and south poles running along the z-axis. The wire has a current going into the page (along the -z-axis). Use this image to answer questions #2-3 below.



2. When using the second Right-Hand Rule to determine the direction of the force on the current-carrying wire in the magnetic field above, your thumb should point
   a. Rightward (toward the south pole)
   b. Leftward (toward the north pole)
   c. Upward
   d. Downward
3. What is the direction of the force on the wire due to the magnetic field?
   a. Rightward (toward the south pole)
   b. Leftward (toward the north pole)
   c. Upward
   d. Downward

Lesson Objective: Solve problems involving the force on a current-carrying wire in a magnetic field.

4. A wire of length 0.2 m carrying a current of 1.5 A is placed at a 90° angle from a uniform magnetic field and experiences a force of 9.72 N. What is the magnitude of the uniform magnetic field?
   a. 0 N
   b. 1.95 N
   c. 2.92 N
   d. 14.58 N
5. A 2.3 m wire with a current of 2 A lies in a magnetic field of strength 5 T. If the wire and the magnetic field are running parallel to each other, what is the magnitude of the magnetic force on the wire?
   a. 0 N
   b. 1.95 N
   c. 2.92 N
   d. 14.58 N

Answer Key

1. B
2. C
3. C
4. C
5. A

18.3 Magnetic Force on Moving Electric Charges

Lesson Quiz

Name___________________ **Class**______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives.

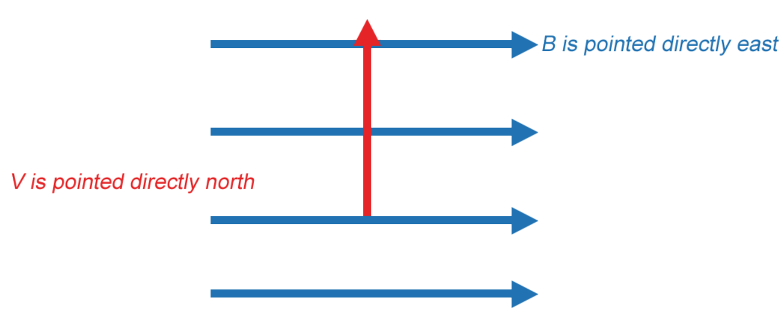
Lesson Objective: Know under which conditions a moving electric charge experiences a force when placed in a magnetic field.

1. Which of the conditions below is necessary for an electric charge to experience a force in a magnetic field?
   a. The electric charge must be at rest
   b. The velocity vector of the electric charge must be parallel to the magnetic field vector.
   c. The velocity vector of the electric charge must make an angle greater than 0° with the magnetic field vector.
   d. None of the above

Lesson Objective: Use the right-hand rule in order to determine the force on a moving electric charge in a magnetic field.

Use the prompt below to answer questions #2-3. The magnetic field (B) is illustrated in blue and the velocity vector of the moving electric charge (V) is illustrated in red.

An electric charge moves directly north into a magnetic field that is pointed directly east as depicted by the image below.



2. If the electric charge is a proton, what is the direction of the magnetic force?
   a. West
   b. South
   c. Into the page (along the -z-axis)
   d. Out of the page (along the +z-axis)
3. If the electric charge is an electron, what is the direction of the magnetic force?

a. West
b. South
c. Into the page (along the -z-axis)
d. Out of the page (along the +z-axis)

Lesson Objective: Solve problems involving the force acting on a moving electric charge in a magnetic field.

4. A particle with an overall charge of 35 μC is at rest relative to a magnetic field with strength 2 T. What is the magnitude of the magnetic force acting on this particle?
   a. 1.6 x 10^{-19}N
   b. 4.0 x 10^{-16}N
   c. 7.0 x 10^{-5}N
   d. 0 N
5. An electron from the Sun hits the Earth's magnetic field (50 μT) at a 30° angle with a speed of 1 x 10^8 m/s. What is the magnitude of the force on the electron?
   a. 1.6 x 10^{-19}N
   b. 4.0 x 10^{-16}N
   c. 7.0 x 10^{-5}N
   d. 0 N

Answer Key

1. C
2. C
3. D
4. D
5. B

18.4 A Practical Application of Magnetic Fields

Lesson Quiz

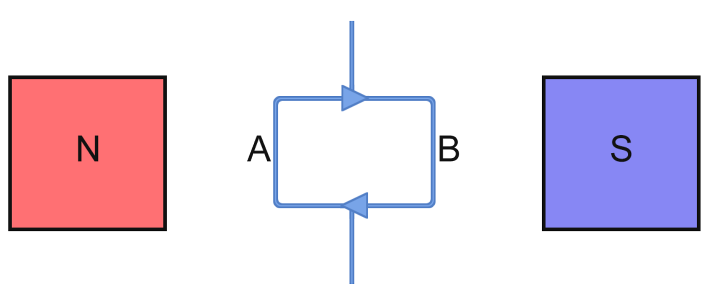
Name____________________ Class_______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand the basic operation of an electric motor.

1. An electric motor works because
   a. The electrons in a magnet are attracted to the electrons in a wire
   b. The electrons in a magnet are repelled by the electrons in a wire
   c. A magnetic field exerts a force on the moving charges in a wire
   d. A magnetic field exerts a force on charges as rest in a wire
2. The current-carrying wire in a simple electric motor is looped many times into a coil in order to
   a. Increase the magnetic field of the current-carrying wire
   b. Decrease the magnetic field of the current-carrying wire
   c. Increase the magnetic field of the bar magnet
   d. Decrease the magnetic field of the bar magnet
3. When current flows through the coil of wire in a simple electric motor, it
   a. Generates a magnetic field
   b. Experiences a force from the magnetic field of the bar magnet
   c. Both A B
   d. None of the above
4. A simple electric motor transforms
   a. Gravitational potential energy into kinetic energy
   b. Electric potential energy into kinetic energy
   c. Kinetic energy into electric potential energy
   d. Elastic potential energy into kinetic energy

A loop of current-carrying wire (with a clockwise current) is place in between the north pole of one bar magnet and the south pole of another bar magnet to generate a simple electric motor. Use the image below of this simple electric motor to answer question #5.



5. Which of the following statements correctly describes the direction of the motor's spin?
    a. Point A will move out of the page and point B will move into the page
    b. Point A will move into the page and point B will move out of the page
    c. Point A will move upwards and point B will move downward
    d. Point A will move downward and point B will move upward

Answer Key

1. C
2. A
3. C
4. B
5. A

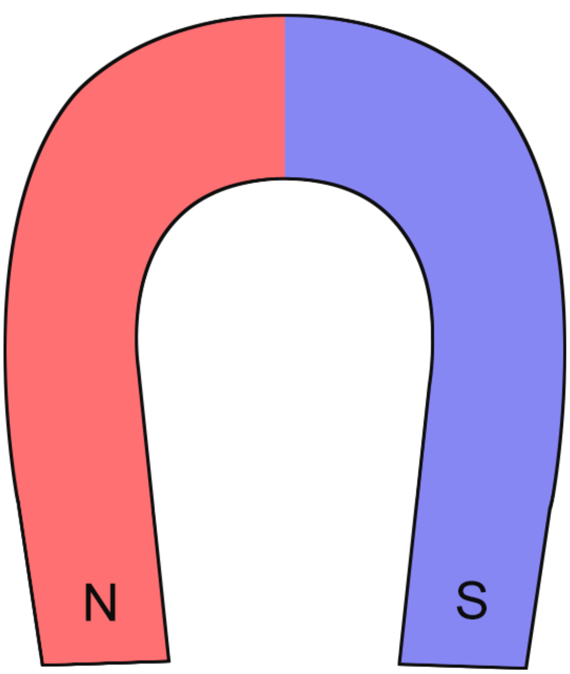
18.5 Magnetism Chapter Test

Chapter Test

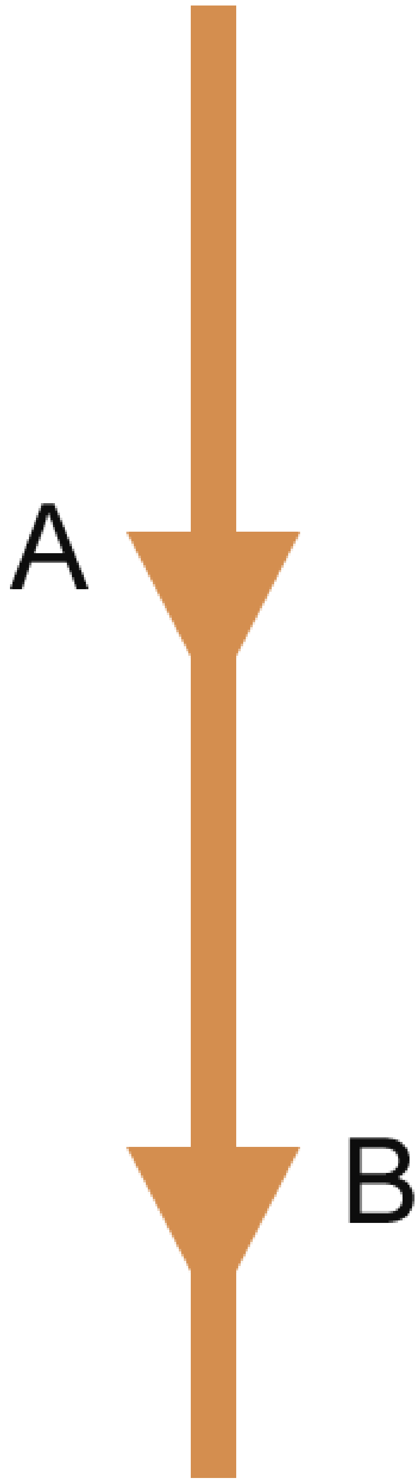
Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

1. Draw the magnetic field lines around the permanent horseshoe magnet made of iron in the space below:



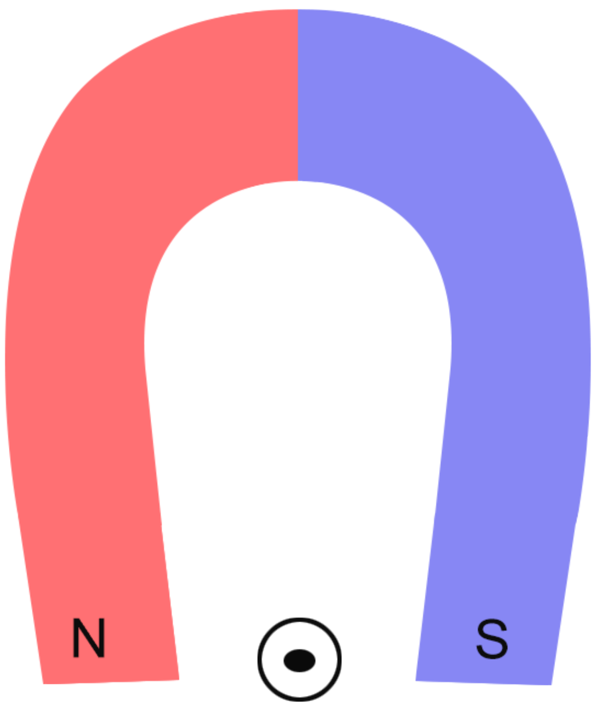
Use the image of the current-carrying wire to answer questions #2-3 below:



2. The direction of the magnetic field at **point A** is
    a. Leftward
    b. Rightward
    c. Into the page
    d. Out of the page

3. The direction of the magnetic field at **point B** is
   a. Leftward
   b. Rightward
   c. Into the page
   d. Out of the page
4. Which statement correctly explains why a current-carrying wire experiences a force when placed in a magnetic field?
   a. The electrons in the current-carrying wire are repelled by the electrons in the magnet
   b. The electrons in the current-carrying wire are attracted to the protons in the magnet
   c. The magnetic field exerts a force on the moving charges in the current-carrying wire
   d. The magnetic field exerts a force on the stationary charges in the current-carrying wire

The image below depicts a horseshoe magnet with a wire between its north and south poles running along the z-axis. The wire has a current coming out of the page (along the +z-axis). Use this image to answer question #5 below.



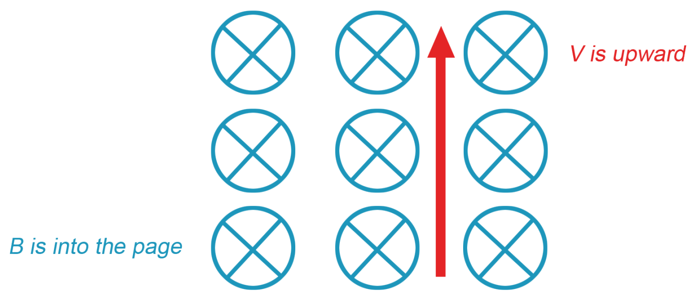
5. What is the direction of the force on the wire due to the magnetic field?
   a. Rightward (toward the south pole)
   b. Leftward (toward the north pole)
   c. Upward
   d. Downward
6. A magnetic field of 1.3 T points in the +x-direction. A 2 m piece of a wire with a current of 4 A is lying along the +z-axis in the magnetic field. What is the magnitude and direction of the force exerted by the magnetic field on the wire?

7. Which of the charges below experiences a force in a magnetic field?

   a. A neutron moving at an angle toward a magnetic field
   b. A proton moving parallel to a magnetic field
   c. An electron moving perpendicular to a magnetic field
   d. An electron at rest in a magnetic field

Use the prompt below to answer question #8. The magnetic field (B) is illustrated in blue and the velocity vector of the moving electric charge (V) is illustrated in red.

An electron moves upward into a magnetic field that is traveling into the page (along the -z-axis).



8. According to the second Right-Hand Rule, what is the direction of the force (F) on the moving electron depicted in the magnetic field above? Explain the reason for your choice.

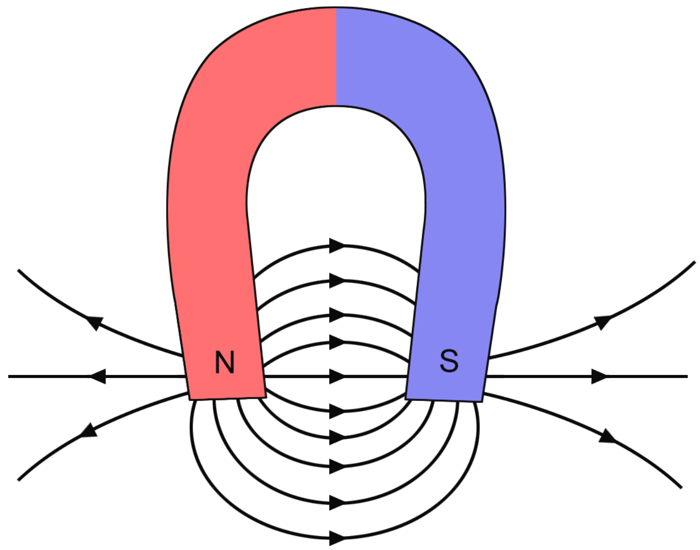
9. An proton hits the Earth's magnetic field (50 μT) at a 25° angle with a speed of 1.2 x 10^7 m/s. Calculate the magnitude of the force from the magnetic field on the proton.

10. An electric motor relies on the understanding that

   a. A magnetic field exerts a force on electric charges at rest.
   b. A magnetic field exerts a force on a current-carrying wire.
   c. A current-carrying wire generates an electric field.
   d. All of the above.

Answer Key

1.



2. C
3. D
4. C
5. C
6. F = ILB sin θ
   F = (4 A)(2 m)(1.3 T)(sin 90°) = 10.4 N upward
7. C
8. The direction of the force on the moving electron is rightward. *Sample explanation: When using the second Right-Hand Rule, you should place fingers upward, turn your hand so it curls into the page, and the thumb will point leftward. However, this is a NEGATIVELY charged particle, so the direction of the force will be reversed.*
9. F = qvB sin θ
   F = (1.6 x 10^{-19}C)(1.2 x 10^{7}m/s)(50 x 10^{-6}T)(sin 25°) = 4.04 x 10^{-17}N
10. B

CHAPTER 19 Electromagnetism Worksheets

Chapter Outline

19.1 Electromagnetic Induction

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand magnetic flux.

1. Magnetic flux is a measurement of the
   a. Magnitude of the magnetic field going through a coil of wire
   b. Induced voltage produced by moving a magnet near a coil of wire
   c. Induced current produced by moving a magnet near a coil of wire
   d. Magnetic force acting on a current-carrying wire
2. When the plane of a coil of wire is placed perpendicular to a magnetic field,
   a. the angle θ between the magnetic field vector and area vector will be zero
   b. a maximum magnetic flux is generated
   c. no magnetic flux is generated
   d. Both A B
3. The plane of a coil of wire (A=0.02 m^2) is aligned parallel to a magnetic field (0.7 T). What is the total magnetic flux through the coil?
   a. 0 Wb
   b. 0.001 Wb
   c. 0.01 Wb
   d. 0.1 Wb

Lesson Objective: Understand Faraday's law of induction.

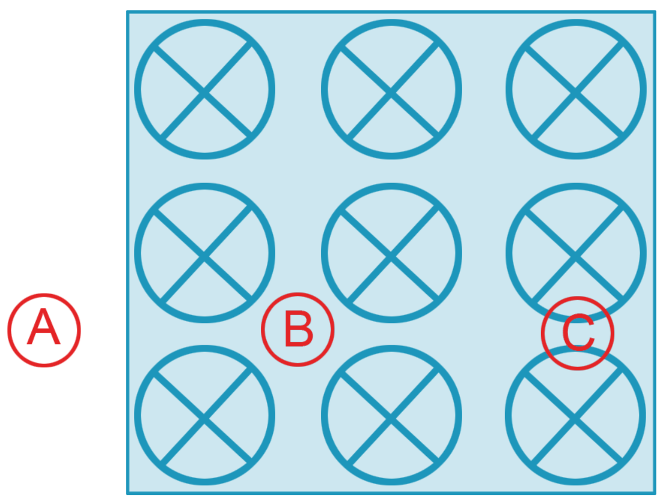
4. A changing magnetic flux induces a _____ which induces a _____.
   a. Current; voltage
   b. Voltage; current
   c. Magnetic field; magnetic force
   d. Magnetic force; magnetic field
5. The magnetic flux changes when
   a. the magnetic field changes
   b. the cross-sectional area of a coil of wire changes
   c. the orientation of the cross-sectional area of a coil relative to a magnetic field changes
   d. all of the above
6. As the rate of change in a magnetic flux increases
   a. the induced voltage decrease
   b. the induced voltage increases
   c. the current decreases

d. none of the above

Lesson Objective: Understand Lenz's law.

7. According to Lenz's Law, the direction of the induced current is such that the induced magnetic field
   a. decreases a change in the magnetic flux
   b. increases a change in the magnetic flux
   c. increases the induced voltage
   d. increases the induced current

Use the diagram below to answer questions #8-10, illustrating a coil moving rightward through a magnetic field that is directed into of the page (along the -z-axis).



8. What is the direction of the induced current at Point A?
   a. Clockwise
   b. Counter Clockwise
   c. There is no induced current because the magnetic flux is not changing at this point
   d. Not enough information to determine
9. What is the direction of the induced current at Point B?
   a. Clockwise
   b. Counter Clockwise
   c. There is no induced current because the magnetic flux is not changing at this point
   d. Not enough information to determine
10. What is the direction of the induced current at Point C?
    a. Clockwise
    b. Counter Clockwise
    c. There is no induced current because the magnetic flux is not changing at this point
    d. Not enough information to determine

Answer Key

1. A
2. D
3. A
4. B
5. D
6. A
7. A
8. C
9. C
10. A

19.2 The Electric Generator

Lesson Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand how a generator produces an electric current.

A hydroelectric dam produces power for a city. Demonstrate your understanding of how a generator produces electric current by putting the following steps in the correct chronological order by numbering them from 1-6.

_____The falling water hits the fan of a turbine, causing large magnets to spin.

_____The water stores gravitational potential energy due to its height above the ground.

_____A current is induced through the wires near the turbine, generating electricity.

_____Work is done to place water at a height above the ground behind a dam.

_____The water is allowed to flow downward, releasing potential energy as it falls.

_____The moving magnets in the turbine induce a voltage.

Answer Key

4. The falling water hits the fan of a turbine, causing large magnets to spin.

2. The water stores gravitational potential energy due to its height.

6. A current is induced through the wires near the turbine, generating electricity.

1. Work is done to place water at a height above the ground in a dam.

3. The water is allowed to flow downward, releasing potential energy as it falls.

5. The moving magnets in the turbine induce a voltage.

19.3 Electrical Power Transfer

Lesson Quiz

Name___________________ **Class**______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand how transformers operate.

1. The main role of a transformer is to change
   a. Voltage
   b. Current
   c. Capacitance
   d. Resistance
2. In a step-up transformer, the number of loops in the secondary coil is _____ the number of loops in the primary coil.
   a. Less than
   b. Greater than
   c. The same as
   d. Not enough information to decide
3. The power into the primary coil is always _____ the power out of secondary coil in a step-down transformer.
   a. Greater than
   b. Less than
   c. The same as
   d. Not enough information to decide
4. A step-down transformer converts 120 V to 5 V in a phone charger. If the primary coil has 600 turns, how many turns are in the secondary coil?
5. A primary coil of a transformer in a toy electric car has 300 turns and the secondary coil has 30 turns. How many volts will be induced when the primary coil is connected to a 9 V battery?

Answer Key

1. A
2. B
3. C

4. $\frac{V_p}{N_p} = \frac{V_s}{N_s}$
   $\frac{120\ V}{600} = \frac{5\ V}{N_s}$
   $N_s = 25\ turns$
5. $\frac{V_p}{N_p} = \frac{V_s}{N_s}$
   $\frac{9\ V}{600} = \frac{V_s}{30}$
   $V = 0.9\ V$

19.4 The Electromagnetic Spectrum

Lesson Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand what the electromagnetic spectrum is.

1. Electromagnetic waves are produced by vibrating
   a. Strings
   b. Electric charges
   c. Magnets
   d. All of the above
2. Electromagnetic waves transfer _____ through electric and magnetic fields.
   a. Energy
   b. Matter
   c. Both A B
   d. None of the above
3. What type of electromagnetic wave has the highest frequency?
   a. Radio waves
   b. Gamma rays
   c. Ultraviolet Waves
   d. All EM waves have the same frequency
4. What type of electromagnetic wave has the longest wavelength?
   a. Radio waves
   b. Gamma rays
   c. Ultraviolet Waves
   d. All EM waves have the same wavelength
5. What type of electromagnetic wave has the lowest energy?
   a. Radio waves
   b. Gamma rays
   c. Ultraviolet Waves
   d. All EM waves have the same energy
6. What type of electromagnetic wave has the highest speed?
   a. Radio waves
   b. Gamma rays
   c. Ultraviolet Waves
   d. All EM waves have the same speed
7. What is the frequency of an X-ray that has a wavelength of $1*10^{-10}$ m?
   a. $1.0*10^{-10}$ Hz

b. $1.0*10^{18}$ Hz
c. $3.0*10^{-19}$ Hz
d. $3.0*10^{18}$ Hz

Answer Key

1. B
2. A
3. B
4. A
5. A
6. D
7. D

19.5 Electromagnetism Chapter Test

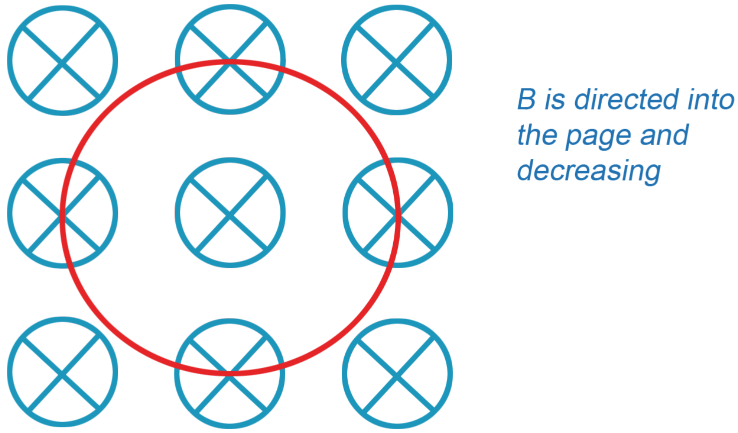
Chapter Test

Name____________________ Class_______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

1. Magnetic flux is the product of the magnitude of the average magnetic field and
   a. the perpendicular area that it goes through
   b. the parallel area that it goes through
   c. the number of loops in the coil of wire
   d. the induced voltage
2. A magnetic field of 0.5 T passes through a coil of wire with a cross-sectional area of 0.02m2 at a 10° angle to the area vector. What is the total magnetic flux through the coil?
   a. 0 Wb
   b. 0.001 Wb
   c. 0.01 Wb
   d. 0.1 Wb
3. As a coil of wire rotates in a magnetic field
   a. The magnetic flux changes
   b. The magnetic flux remains constant
   c. A voltage is induced
   d. Both A C
4. When a magnet moves through a coil of wire that has half as many loops as another,
   a. half as much voltage is induced
   b. the same amount of voltage is induced
   c. twice as much voltage is induced
   d. not enough information to determine

Use the diagram below of a stationary coil of wire (illustrated in red) in a decreasing magnetic field (illustrated in blue) directed into the page (along the -z-axis) to answer questions #5-6:



5. According to Lenz's law, if the flux into the page is decreasing, then the induced current will
    a. Create a magnetic flux into the page
    b. Create a magnetic flux out of the page
    c. There will be no induced current because there is no change in magnetic flux
    d. Not enough information to determine
6. According to Lenz's law, if the flux into the page is decreasing, then the induced current will be
    a. Clockwise
    b. Counter Clockwise
    c. There will be no induced current because there is no change in magnetic flux
    d. Not enough information to determine
7. Which of the following are electric generators?
    a. A windmill
    b. A coal power plant
    c. A hydroelectric dam
    d. All of the above

Use the following prompt to answer questions #8-9:

A transformer has 200 turns in its primary coil and 600 turns in its secondary coil.

8. What type of transformer is this?
    a. A step-up transformer
    b. A step-down transformer
    c. A direct transformer
    d. An alternating transformer
9. If 60 V is put across the primary coil, the resulting voltage output of the secondary coil will
    a. Be cut in half
    b. Double
    c. Triple
    d. Quadruple
10. A light wave
    a. Is created by a stationary or moving electric charge
    b. Consists of all the waves on the electromagnetic spectrum
    c. Requires a medium to travel through
    d. All of the above

Answer Key

1. A
2. C
3. D
4. A
5. A
6. A
7. D
8. A
9. C
10. B

CHAPTER 20 Geometric Optics Assessments

Chapter Outline

20.1 Light as a Ray and the Law of Reflection

Lesson Quiz

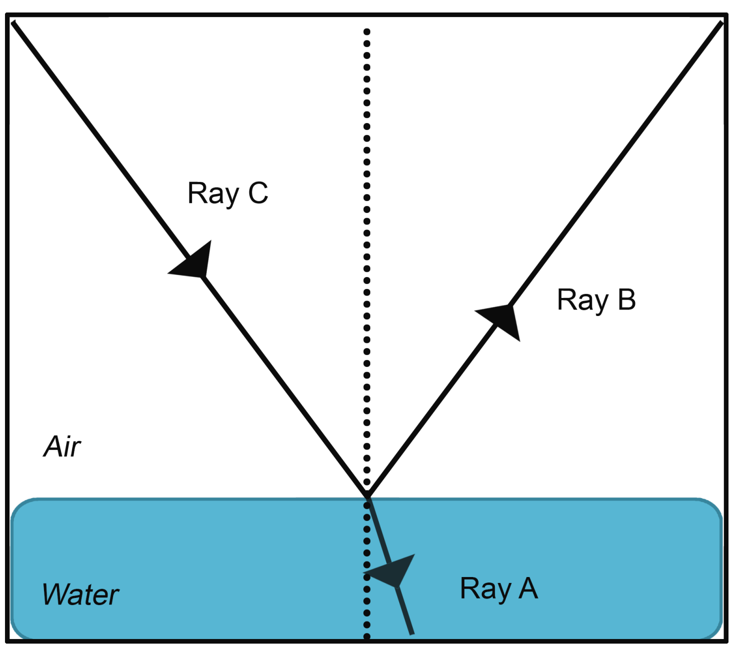
Name___________________ **Class**______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Explain the ray model of light.

1. Light is
    a. A transverse electromagnetic wave
    b. Created by the periodic motion of an electron
    c. Perceived by our eyes as a ray
    d. All of the above
2. Describing light as a ray aids in our understanding of
    a. Reflection
    b. Refraction
    c. Both A B
    d. None of the above

Use the image below to answer questions #3-5:



3. The incident ray is

a. Ray A
b. Ray B
c. Ray C
d. Not enough to determine

4. The reflected ray is

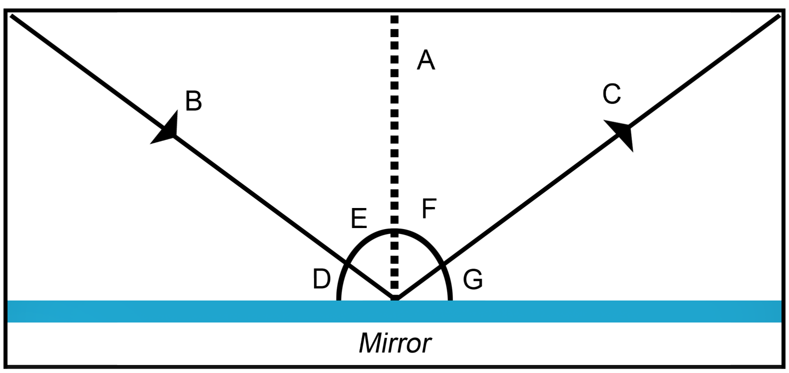
a. Ray A
b. Ray B
c. Ray C
d. Not enough to determine

5. The refracted ray is

a. Ray A
b. Ray B
c. Ray C
d. Not enough to determine

Lesson Objective: Describe the Law of Reflection.

Use the image below to answer questions #6-9:



6. Which of the following is the **normal line** in the image above?

a. A
b. B
c. C
d. Not enough to determine

7. Which of the following is the **angle of incidence** (θ_i) in the image above?

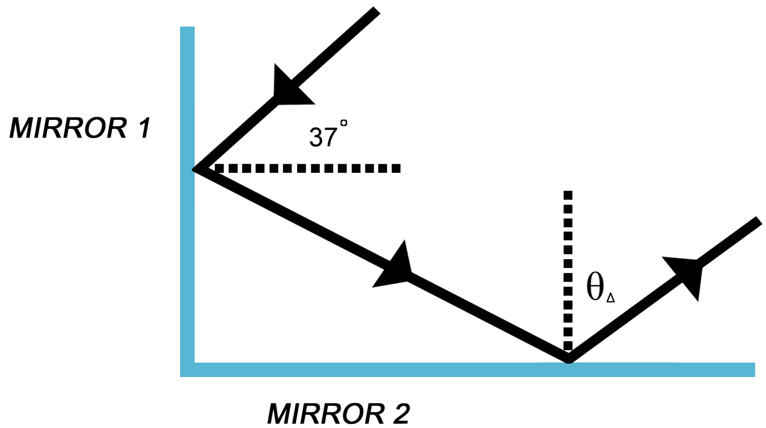
a. Angle D
b. Angle E
c. Angle F
d. Angle G

8. Which of the following is **the angle of reflection** (θ_r) in the image above?

a. Angle D
b. Angle E
c. Angle F
d. Angle G

9. With reference to the image above, the law of reflection states that
    a. A = B
    b. A = C
    c. Angle D = Angle G
    d. Angle E = Angle F

Use the image below to answer question #10:



10. Use the law of reflection to determine the angle of θ_A.

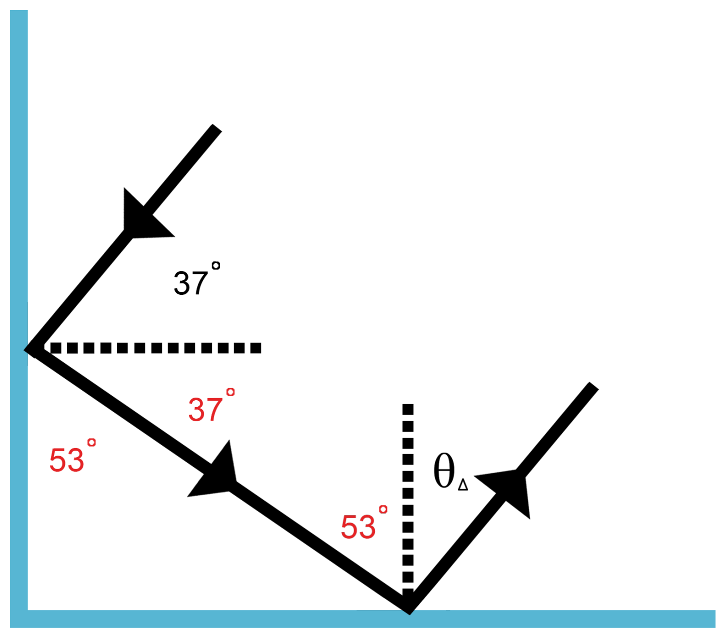
Lesson Objective: Explain how images are formed from flat mirrors.

11. The image size of an object formed in a flat mirror will be _____________ the actual size of the object.
    a. smaller than
    b. larger than
    c. the same size as
    d. not enough information to determine
12. The image formed in a flat mirror will always be
    a. Virtual
    b. Real
    c. In front of the mirror
    d. magnified

Answer Key

1. D
2. C
3. C
4. B

5. A
6. A
7. B
8. C
9. D
10. According to the law of reflection, the angle of θ_A is 53°.



11. C
12. A

20.2 Concave and Convex Mirrors

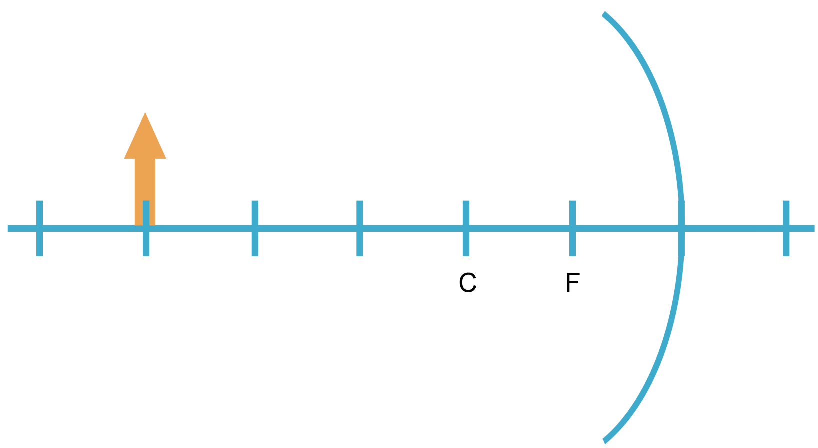
Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand how to draw ray diagrams for concave mirrors.

1. Draw a ray diagram to illustrate the image of the arrow in the **concave mirror** below:



2. Describe the image of the arrow in question #1 by circling the correct answer choices below:

   UPRIGHT / INVERTED

   Type of image:

   REAL / VIRTUAL

   Relative size of the image:

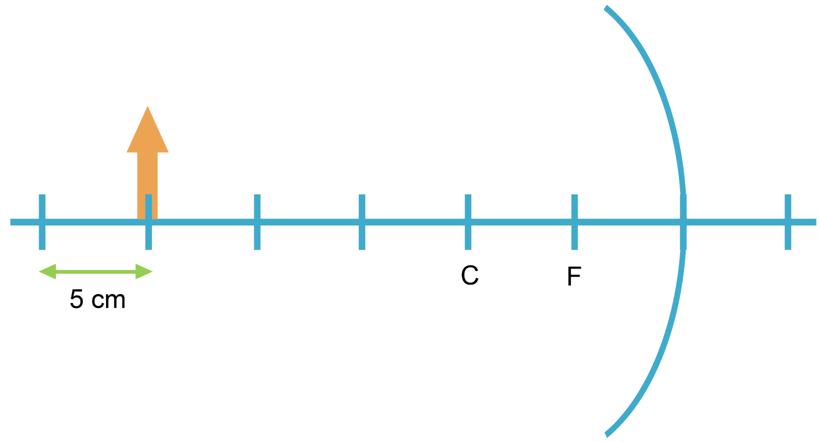
   BIGGER / SMALLER

   Image location:

   IN FRONT OF MIRROR / BEHIND MIRROR

Lesson Objective: Understand how to solve problems involving concave mirrors.

Use the diagram below of the arrow beyond the focal point of a concave mirror to answer questions #3-6:



3. At what distance from the mirror will the image of the arrow form?
   a. 0.16 cm
   b. -0.16 cm
   c. 6.25 cm
   d. -6.25 cm
4. The magnification of the image of the arrow will be
   a. 0.006
   b. -0.006
   c. 0.25
   d. -0.25
5. Based in your calculations, describe the image of the arrow in the concave mirror by circling the correct answer choices below and explain the reason for your choice:

   UPRIGHT / INVERTED

   Type of image:

   REAL / VIRTUAL

   Relative size of the image:

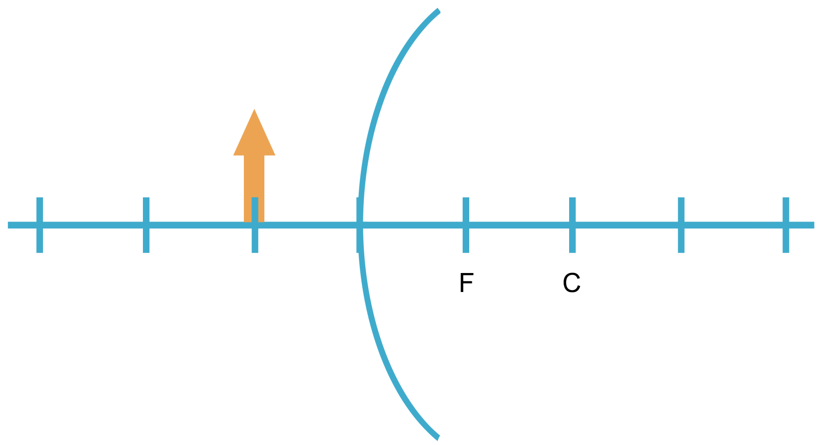
   BIGGER / SMALLER

   Image location:

   IN FRONT OF MIRROR / BEHIND MIRROR
6. Do your mathematical answers and description above match the image formed by your ray diagram in question #1?

Lesson Objective: Understand how to draw ray diagrams for convex mirrors.

7. Draw a ray diagram to illustrate the image of the arrow in the convex mirror below:



8. Describe the image of the arrow in question #7 by circling the correct answer choices below:

UPRIGHT / INVERTED

Type of image:

REAL / VIRTUAL

Relative size of the image:

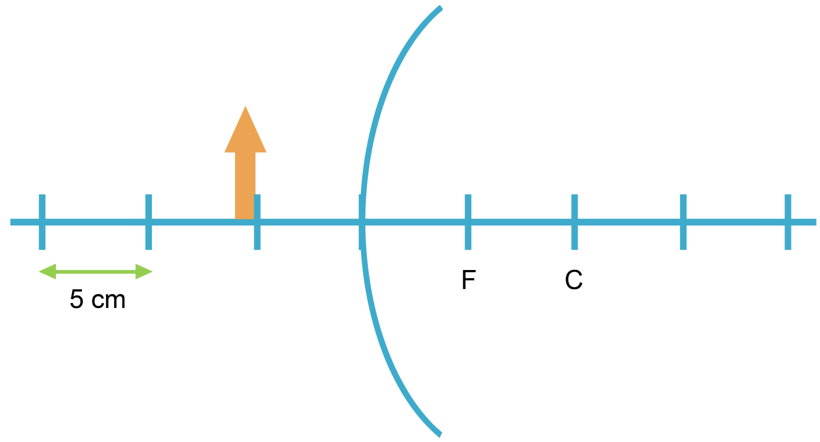
BIGGER / SMALLER

Image location:

IN FRONT OF MIRROR / BEHIND MIRROR

Lesson Objective: Understand how to solve problems involving convex mirrors.

Use the diagram below of the arrow **beyond the focal point of a convex mirror** to answer questions #9-12:



9. At what distance from the mirror will the image of the arrow form?

   a. -0.32 cm
   b. 0.32 cm
   c. 3.13 cm
   d. -3.13 cm

10. The magnification of the image of the arrow will be

    a. 0.25
    b. -0.25
    c. 0.63
    d. -0.63

11. Based in your calculations, describe the image of the arrow in the convex mirror by circling the correct answer choices below and explain the reason for your choice:

    UPRIGHT / INVERTED

    Type of image:

    REAL / VIRTUAL

    Relative size of the image:

    BIGGER / SMALLER

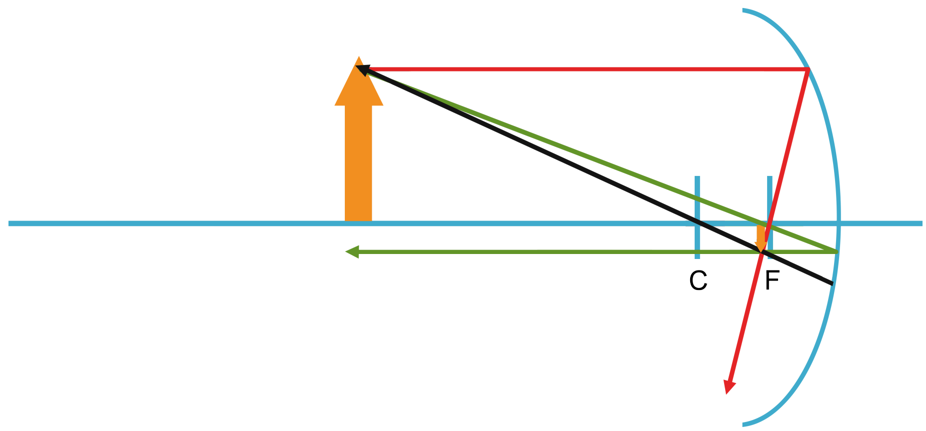
    Image location:

    IN FRONT OF MIRROR / BEHIND MIRROR

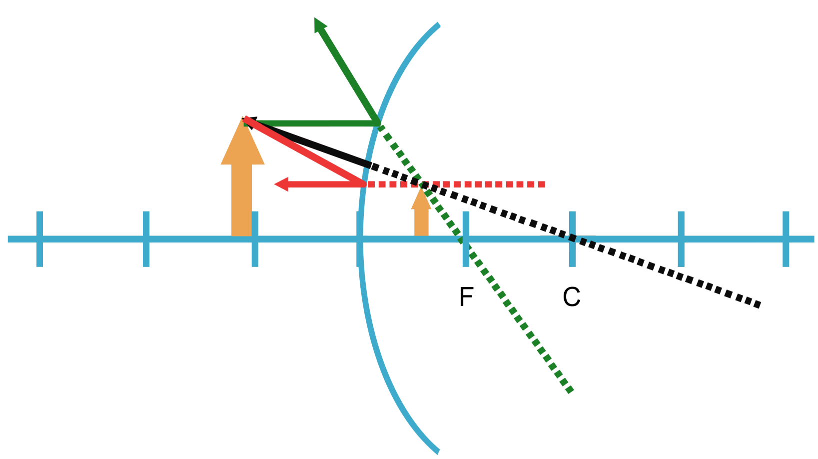
12. Do your mathematical answers and description above match the image formed by your ray diagram in question #7?

Answer Key

1.



2. Inverted, real, smaller, in front of the mirror
3. C
4. D
5. REAL *Explanation: the distance of the image (di) is positive, so the rays of light converge in front of the mirror and actually come together in real space.*
   INVERTED *Explanation: the magnification (m) is negative, so the image is inverted.*
   SMALLER *Explanation: the magnification (m) is less than one, so the image is smaller than the object.*
6. Answers will vary. *Sample answer: Yes; the image is real, inverted, smaller than the actual arrow, and forms about 6.25 cm from the mirror. (WOW!)*
7.



8. Upright, virtual, smaller, behind the mirror
9. D
10. C

11. VIRTUAL *Explanation: the distance of the image (d_i) is negative, so the rays of light converge behind the mirror and only converge in our minds.*
    UPRIGHT *Explanation: the magnification (m) is positive, so the image is upright.*
    SMALLER *Explanation: the magnification (m) is less than one, so the image is smaller than the object.*
12. Answers will vary. *Sample answer: Yes; the image is real, upright, smaller than the actual arrow, and forms about -3.13cm behind the mirror. (WOW!)*

20.3 Index of Refraction

Lesson Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand how the index of refraction is defined.

1. The speed of all light waves in a vacuum is
   a. Indicated by the index of refraction
   b. 3.0 x 10^8m/s
   c. the universal speed limit (maximum speed at which any matter can travel)
   d. Both B C
2. Refraction describes how light
   a. Bounces off the surface of a material
   b. Bends as it travels from one material to another
   c. Spreads out depending on its various wavelengths
   d. All of the above
3. The index of refraction for any material
   a. will be greater than or equal to one
   b. is a ratio comparing its speed in the material to the speed of light
   c. can be used to calculate the angle of refraction
   d. all of the above
4. Which statement below correctly compares the speed of light in air (n=1) to the speed of light in water (n=1.33) based on their indices of refraction?
   a. The speed of light in air must be greater than the speed of light in a vacuum.
   b. The speed of light in water must be greater than the speed of light in a vacuum.
   c. The speed of light in air must be greater than the speed of light in water.
   d. The speed of light in water must be greater than the speed of light in air.

Lesson Objective: Solve problems involving the index of refraction.

Refer to the following chart for questions #5-6:

5. In which of the following materials will light have the slowest speed?
   a. Air
   b. Water
   c. Oil
   d. Light always travels at the same speed (3.0 x 10^8 m/s)
6. Justify your answer choice above with calculations using the equation n=c/v.

Lesson Objective: Understand Snell's Law.

Use the image below to answer questions #7-8:

7. Which of the following statements correctly describes the change in the speed of light in the image above?
   a. Light will slow down as it travels from air to water
   b. Light will speed up as it travels from air to water
   c. The speed of light will remain constant (3.0 x 10^8 m/s) as it travels from air to water
   d. There is not enough information to determine how the speed of light will change
8. Which of the following correctly describes the bending of light in the image above, with reference to Snell's law?
   a. The angle of incidence ($\theta_1$will be greater than the angle of refraction (θ_2
   b. The angle of incidence ($\theta_1$will be less than the angle of refraction (θ_2
   c. The angle of incidence ($\theta_1$will be equal to the angle of refraction (θ_2
   d. There is not enough information to determine how the light will bend

Lesson Objective: Solve problems involving Snell's Law.

Use the image below to answer questions #9-10:

9. If $\theta_2$is 30°, calculate the measurements of the θ_1 using Snell's law in the space below.

   θ_1=

10. Does your mathematical answer match the your answers to question #8 above?

Answer Key

1. D
2. B
3. D
4. C
5. C
6. Air: 1.00 = (3.0 x 10^8m/s / v); v=3.0 x 10^8m/s
   Water: 1.33 = (3.0 x 10^8m/s / v); v=2.26 x 10^8m/s
   Oil: 1.48 =(3.0 x 10^8m/s / v); v=2.0 x 10^8m/s **slowest speed
7. A
8. A
9. n_{air} = 1.00; n_{water} = 1.33; Snell's Law: $n_1 \sin\theta_1 = n_2 \sin\theta_2$
   $(1)\sin\theta_1 = (1.33)(\sin 30°)$
   $\theta_1 = 41.7°$
10. Answers will vary. *Sample answer: Yes; When a light ray travels from air to water, it slows down and bends toward the normal line. As a result, the angle of incidence (θ_1 = 47°) is greater than the angle of refraction (θ_2 = 30°).*

20.4 Thin Lenses

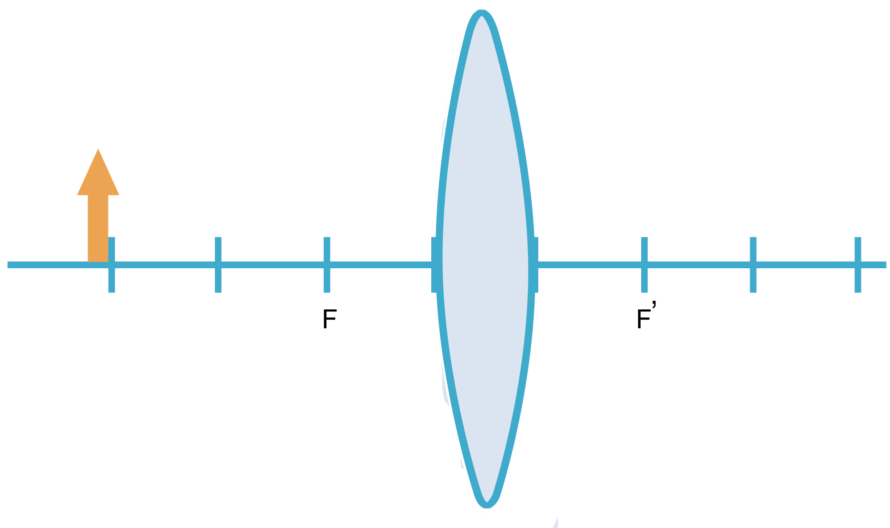
Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand how to draw ray diagrams for convex (converging) lenses.

1. Draw a ray diagram to illustrate the image of **an arrow beyond the focal point of a convex lens** below:



2. Describe the image of the arrow in question #1 by circling the correct answer choices below:
   Image orientation:

   UPRIGHT / INVERTED

   Type of image:

   REAL / VIRTUAL

   Relative size of the image:

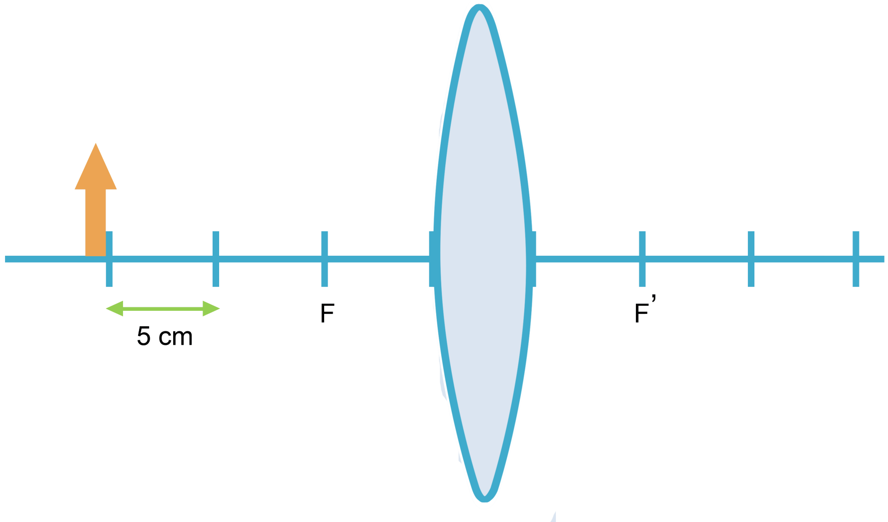
   BIGGER / SMALLER

   Image location:

   SAME SIDE / OPPOSITE SIDE

Lesson Objective: Understand how to solve problems involving convex (converging) lenses.

Use the diagram below of **an arrow beyond the focal point of a convex lens** to answer questions #3-5:



3. Use the lens equation ($\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$) to solve for the image distance (d_i) in the illustration above.

4. Use the magnification equation ($m = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$) to solve for the magnification of the image (m) in the illustration above.

5. Based in your calculations, describe the image of the arrow formed by the convex lens by circling the correct answer choices below:
   Image orientation:

   UPRIGHT / INVERTED

   Type of image:

   REAL / VIRTUAL

   Relative size of the image:

   BIGGER / SMALLER

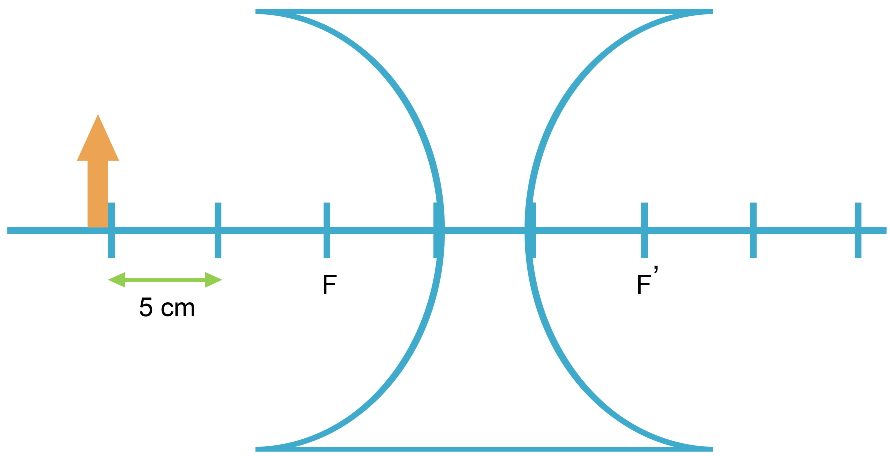
   Image location:

   SAME SIDE / OPPOSITE SIDE

6. Do your mathematical calculations and description above match your ray diagram in question #1?

Lesson Objective: Understand how to draw ray diagrams for concave (diverging) lenses.

7. Draw a ray diagram to illustrate the image of the arrow formed by the **concave lens** below:



8. Describe the image of the arrow in question #7 by circling the correct answer choices below:
Image orientation:

UPRIGHT / INVERTED

Type of image:

REAL / VIRTUAL

Relative size of the image:

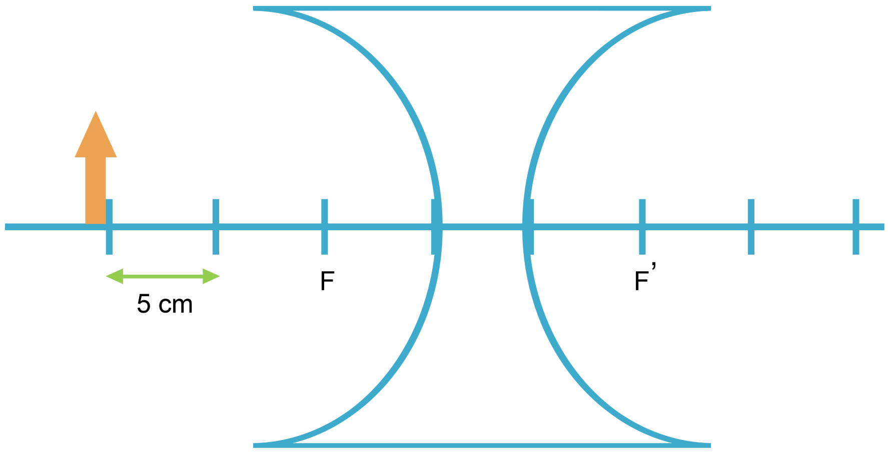
BIGGER / SMALLER

Image location:

SAME SIDE / OPPOSITE SIDE

Lesson Objective: Understand how to solve problems involving concave (diverging) lenses.

Use the diagram below of an arrow **beyond the focal point of a concave lens** to answer questions #9-12:



9. Use the lens equation ($\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$) to solve for the image distance (d_i) in the illustration above.

10. Use the magnification equation ($m = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$) to solve for the magnification of the image (m) in the illustration above.

11. Based in your calculations, describe the image of the arrow in the concave lens by circling the correct answer choices below:
Image orientation:

UPRIGHT / INVERTED

Type of image:

REAL / VIRTUAL

Relative size of the image:

BIGGER / SMALLER

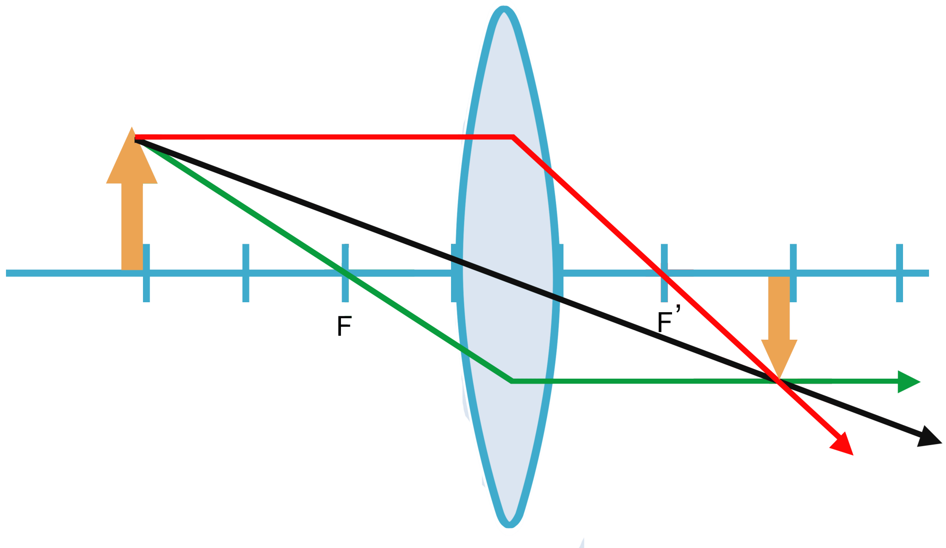
Image location:

SAME SIDE / OPPOSITE SIDE

12. Do your mathematical calculations and description above match the image formed by your ray diagram in question #7?

Answer Key

1.



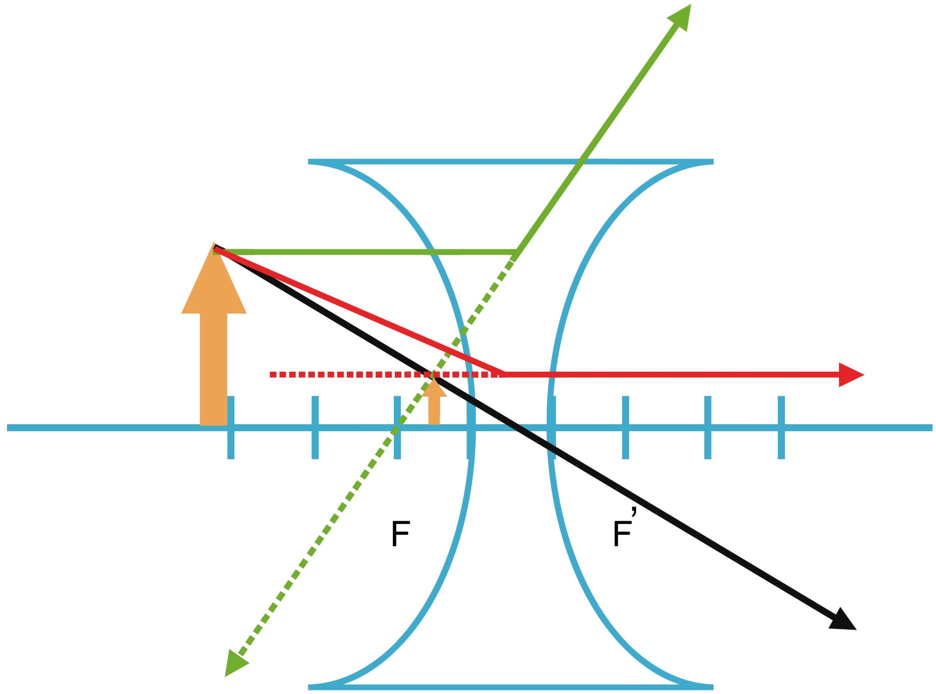
2. INVERTED, REAL, SMALLER, OPPOSITE SIDE
3. Based on the given scale, d_o=15 cm and f = 5 cm.

$$\frac{1}{d_o}+\frac{1}{d_i}=\frac{1}{f}$$
$$\frac{1}{15cm}+\frac{1}{d_i}=\frac{1}{5cm}$$
$$\frac{1}{d_i}=\frac{1}{5\ m}-\frac{1}{15cm}$$
$$\frac{1}{d_i}+\frac{(15-5)}{(75)}=0.13$$
$$d_i=+7.7\ m$$

4.

$$m=\frac{h_i}{h_o}=-\frac{d_i}{d_o}$$
$$m=-\frac{7.7\ m}{15\ m}=-0.51$$

5. REAL Explanation: the distance of the image (d_i) is positive, so the image is real and located on the opposite side of the lens as the object.
INVERTED Explanation: the magnification (m) is negative, so the image is inverted.
SMALLER Explanation: the magnification (m) is less than one, so the image is smaller than the object.
6. Answers will vary. *Sample answer: Yes; the image is real, inverted, smaller than the actual arrow, and forms about +7.7cm on the opposite side of the lens. (WOW!)*
7.



8. UPRIGHT, VIRTUAL, SMALLER, SAME SIDE
9. Based on the given scale, d_o = 15 cm and f = 5 cm.

$$\frac{1}{d_o}+\frac{1}{d_i}=\frac{1}{f}$$
$$\frac{1}{15m}+\frac{1}{d_i}=\frac{1}{-5cm}$$
$$\frac{1}{d_i}=-\frac{1}{5\ cm}-\frac{1}{15cm}$$
$$\frac{1}{d_i}+\frac{(-15-5)}{(75)}=-0.26$$
$$d_i=-3.9\ cm$$

10.

$$m=\frac{h_i}{h_o}=-\frac{d_i}{d_o}$$
$$m=-\frac{-3.9\ m}{15\ m}=0.26$$

11. REAL Explanation: the distance of the image (di) is negative, so the image is virtual and located on the same side of the lens as the object.
INVERTED Explanation: the magnification (m) is positive, so the image is upright.
SMALLER Explanation: the magnification (m) is less than one, so the image is smaller than the object.
12. Answers will vary. *Sample answer: Yes, the image is virtual, upright, smaller than the actual arrow, and forms about 3.9 cm on the same side of the lens. (WOW!)*

20.5 Geometric Optics Chapter Test

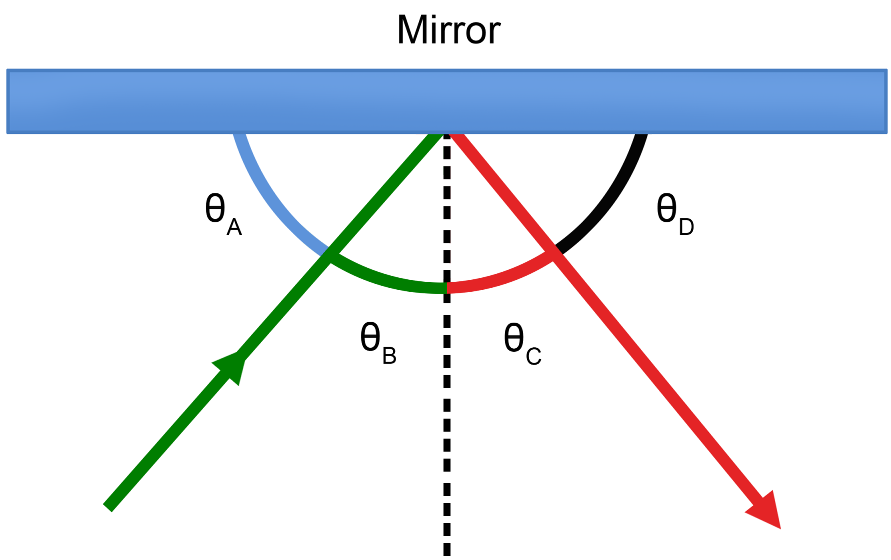
Chapter Test

Name____________________ **Class**_______________ **Date** _________

Answer each of the questions below to show your achievement of the lesson objectives

1. The ray model is an acceptable way to describe light because
   a. The periodic motion of the electrons producing the light is so slow
   b. The wavelengths of visible light are so small
   c. Light is actually a row of electrons, similar to a current-carrying wire
   d. All of the above

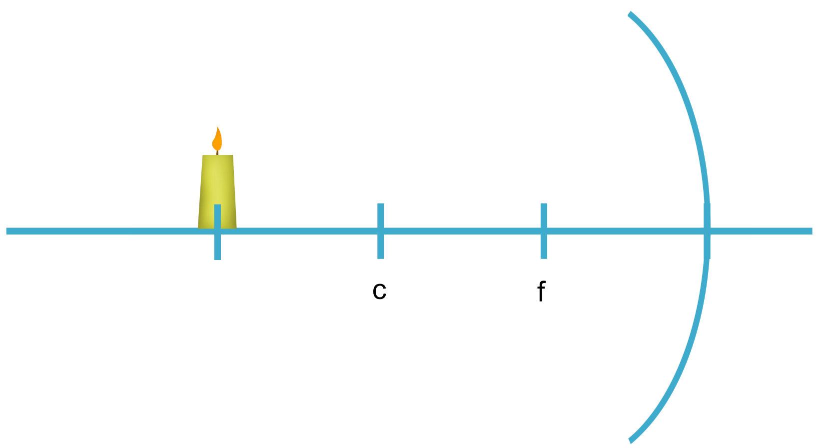
Use the image below of a ray of light reflecting off a mirror to answer questions #2-3:



2. If the angle of incidence in the image above is 47 degrees, then which of the following is correct?
   a. $\theta_A = 47^\circ$
   b. $\theta_B = 47^\circ$
   c. Both A B
   d. None of the above
3. According to the law of reflection, which of the following is correct?
   a. $\theta_A = \theta_B$
   b. $\theta_B = \theta_C$
   c. $\theta_C = \theta_D$
   d. $\theta_A = \theta_D$

4. Which of the following statements correctly describes an image formed in a flat mirror?
   a. The image is real
   b. The image will appear closer to the mirror than the actual object
   c. The image will be the same size as the object
   d. All of the above

Refer to the diagram of a candle **beyond the focal point of a concave mirror** below to answer question #5:



5. Describe the image of the candle by circling the correct answer choices below:
   Image orientation:

   UPRIGHT / INVERTED

   Type of image:

   REAL / VIRTUAL

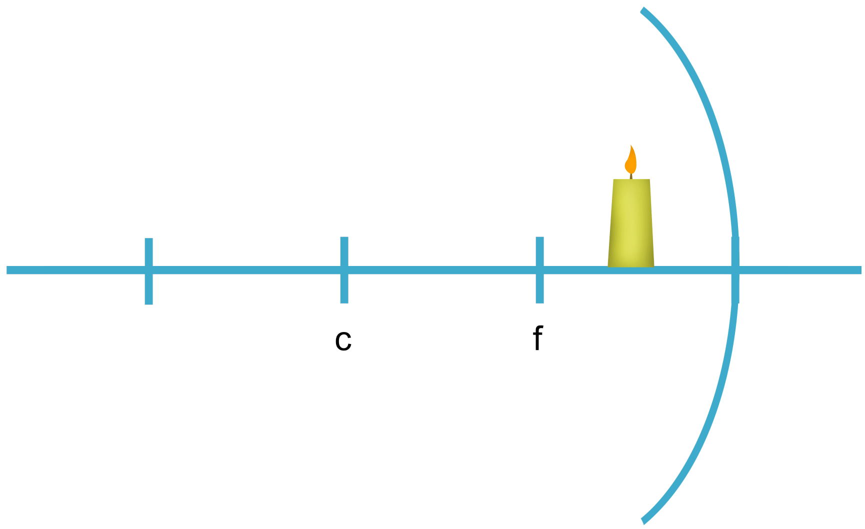
   Relative size of the image:

   BIGGER / SMALLER

   Image location:

   IN FRONT OF MIRROR / BEHIND MIRROR

Refer to the diagram of a candle **closer to the concave mirror than its focal point** below to answer question #6:



6. Describe the image of the candle by circling the correct answer choices below:
   Image orientation:

   UPRIGHT / INVERTED

   Type of image:

   REAL / VIRTUAL

   Relative size of the image:

   BIGGER / SMALLER

   Image location:

   IN FRONT OF MIRROR / BEHIND MIRROR

Use the following prompt for questions #7-10: A pencil of height 8 cm is positioned 5 cm from a concave mirror with a focal length 10 cm.

7. What is the image position (d_i) of the pencil?
   a. 0.1 cm
   b. -0.1 cm
   c. 10 cm
   d. -10 cm
8. The image of the pencil will be
   a. Real
   b. Virtual
   c. Inverted
   d. In front of the mirror

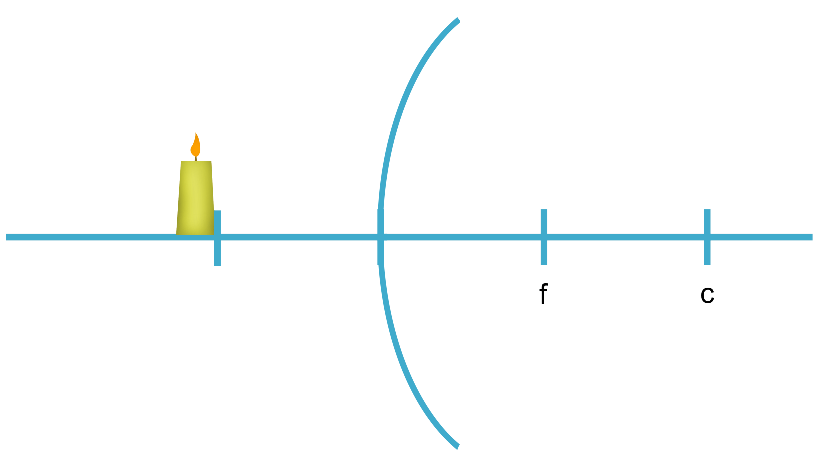
9. What is the magnification of the pencil's image?
   a. 0.02
   b. -0.02
   c. 2
   d. -2
10. The height of the pencil image is
    a. 4 cm
    b. 8 cm
    c. 16 cm
    d. not enough information to determine

Use the following prompt for questions #11-12:

A person stands in front of a **concave mirror** and sees an image with a magnification of -0.25.

11. Based on the information above, the image of the person must be
    a. Upright
    b. Inverted
    c. Virtual
    d. Behind the mirror
12. Based on the information above, if the person is 1.65 meters tall (5 ft, 5 inches), what is the height of their image in the mirror?
    a. 0.413 m
    b. 6.6 m
    c. 1.65 meters
    d. not enough information to determine

Refer to the diagram of a candle in front of a convex mirror to answer question #13:



13. Describe the image of the candle by circling the correct answer choices below:
    Image orientation:

UPRIGHT / INVERTED

Type of image:

REAL / VIRTUAL

Relative size of the image:

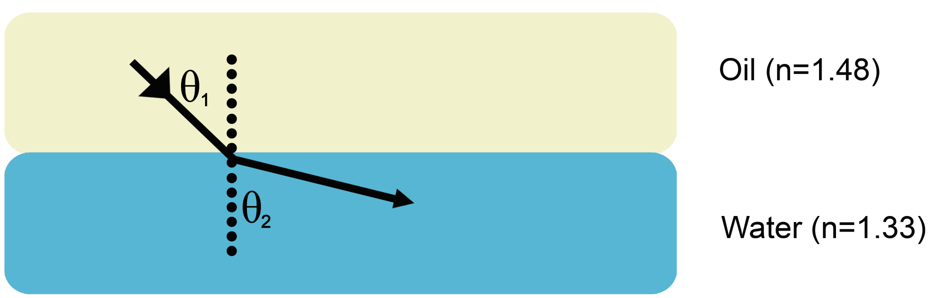
BIGGER / SMALLER

Image location:

IN FRONT OF MIRROR / BEHIND MIRROR

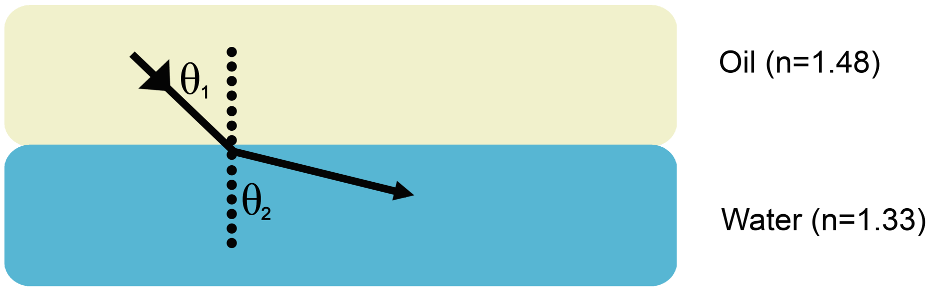
14. The ratio of the speed of light in a vacuum to the speed of light in a given material is
    a. Referred to as the index of refraction
    b. Always less than one
    c. Used to calculate the angle of reflection
    d. All of the above
15. If the speed of light in a diamond is about 1.24 x 108 m/s, the index of refraction for a diamond must be
    a. 1
    b. 1.52
    c. 1.33
    d. 2.41

Use the image below to answer questions #16-17:



16. Which of the following statements correctly describes the change in the speed of light in the image above?
    a. Light will slow down as it travels from oil to water
    b. Light will speed up as it travels from oil to water
    c. The speed of light will remain constant (3.0 x 10^8 m/s) as it travels from air to water
    d. There is not enough information to determine how the speed of light will change
17. Which of the following correctly describes the bending of light in the image above, with reference to Snell's law?
    a. The angle of incidence (θ_1 will be greater than the angle of refraction (θ_2)
    b. The angle of incidence (θ_1 will be less than the angle of refraction (θ_2)
    c. The angle of incidence (θ_1 will be equal to the angle of refraction (θ_2)
    d. There is not enough information to determine how the light will bend

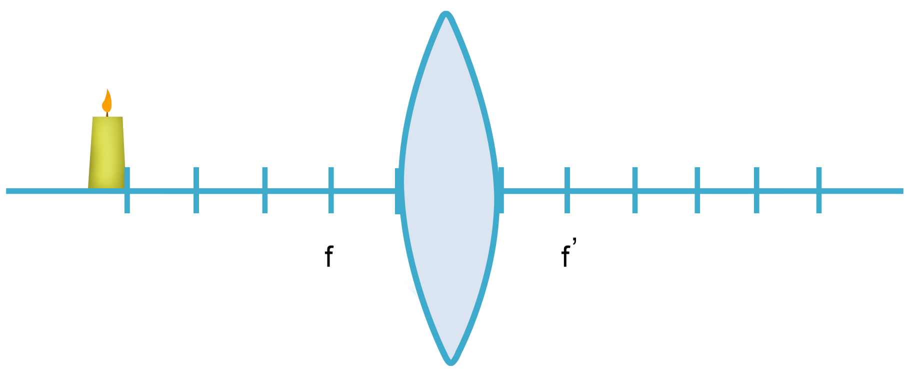
Use the image below to answer questions #18-19:



18. If θ_1 is 17°, calculate the measurements of the θ_2 using Snell's law in the space below.

19. Do your mathematical answers match the your answers to question #17 above?

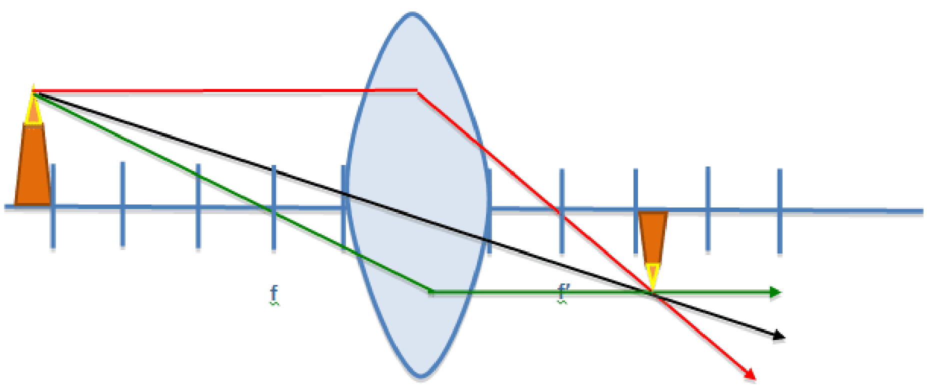
20. Draw a ray diagram to illustrate the image of the candle in the lens below:



Answer Key

1. B
2. B
3. B
4. C
5. INVERTED, REAL, SMALLER, IN FRONT OF THE MIRROR
6. UPRIGHT, VIRTUAL, BIGGER, BEHIND MIRROR
7. D
8. B
9. C
10. C
11. B

12. A
13. UPRIGHT, VIRTUAL, SMALLER, BEHIND THE MIRROR
14. A
15. D
16. B
17. B
18. n_{oil} = 1.48; n_{water} = 1.33; Snell's Law: $n_1 \sin \theta_1 = n_2 \sin \theta_2$
    (1.48) sin(17°)=1.33 sin θ_2)
    $\theta_2 = 19.3°$
19. Answers will vary. *Sample answer: Yes; when a light ray travels from oil to water, it speeds up and bends away from the normal line. As a result, the angle of incidence (sin* θ_1 *= 17°) is greater than the angle of refraction (sin* θ_2 *= 19.3°).*
20.



CHAPTER 21 Physical Optics Assessments

Chapter Outline

21.1 Dispersion

Lesson Quiz

Name___________________ **Class**______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand the causes of dispersion through a glass prism.

1. The color of a light wave in the visible spectrum is determined by its
   a. Speed
   b. Frequency
   c. Index of refraction
   d. Angle of refraction
2. As the frequency of a light wave increases, its **velocity** through a glass prism
   a. Increases
   b. Decreases
   c. Stays the same
   d. Not enough information to determine
3. As the frequency of a light wave increases, its **index of refraction** in a glass prism
   a. Increases
   b. Decreases
   c. Stays the same
   d. Not enough information to determine
4. Violet Light has the highest
   a. Frequency of all the colors in the visible spectrum
   b. Velocity through a glass prism
   c. Index of refraction in a glass prism
   d. Both A C
5. The dispersion of white light is the basis for our understanding of
   a. Reflection
   b. Refraction
   c. Rainbows
   d. A mirage

Quiz Answer Key

1. B
2. B
3. A

4. D
5. C

21.2 The Double-Slit Experiment

Lesson Quiz

Name___________________ **Class**______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand the Double-Slit Experiment.

1. When Thomas Young directed a source of light through a screen with two small openings,
   a. He provided the necessary evidence to prove that light behaved as a wave
   b. It produced a pattern of light and dark bands
   c. There were regions of constructive and destructive interference
   d. All of the above
2. In order for light to interfere after passing through two small slits, the source of light must be
   a. Monochromatic
   b. The same frequency
   c. The same color
   d. All of the above
3. In order for light to interfere after passing through two small slits, the distance between the two slits must be ____________ than the wavelength of the light.
   a. Smaller
   b. Larger
   c. Equal to
   d. Not enough information to determine

Lesson Objective: Solve problems involving the Double-slit Experiment.

Use the following prompt for questions #4-5:

In a Double-Slit Experiment, a screen with two slits spaced 0.05 mm apart produces a bright first order fringe that appears at an angle of 0.8°.

4. What is the wavelength of light directed at the two slits?
   a. 456 nm
   b. 555 nm
   c. 652 nm
   d. 698 nm
5. What type of interference produced the first order fringe described above?
   a. Constructive
   b. Destructive
   c. Dispersion
   d. Refraction

Quiz Answer Key

1. D
2. D
3. B
4. D
5. A

21.3 Thin Films

Lesson Quiz

Name____________________ Class_______________ Date _________

Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand how thin films recreate constructive and destructive interference.

1. The reason why soap bubbles often show colorful patterns is due to
    a. Light wave interference
    b. Light waves reflecting off the top surface of a film
    c. Light waves reflecting from the bottom surface of a film
    d. All of the above
2. What factor is important to consider when determining the type of wave interference in a thin film
    a. The index of refraction
    b. The frequency of the light
    c. The speed of the light
    d. None of the above
3. Thin film interference is most likely to occur when the thickness of the film is similar to the
    a. Frequency of the light wave reflected
    b. Wavelength of light wave reflected
    c. Index of refraction
    d. Angle of incidence
4. When does light undergo a phase shift as it travels through a soap bubble (n = 1.38)?
    a. As it travels from air to the soap
    b. As it travels from the soap to the air
    c. Both A B
    d. None of the above
5. What is the wavelength of blue light (475 nm) as it travels through a thin film of oil, n = 1.48?
    a. 320 nm
    b. 351 nm
    c. 475 nm
    d. 703 nm

Quiz Answer Key

1. D
2. A
3. B

4. A
5. A

21.4 Polarization

Lesson Quiz

Name___________________ Class______________ Date ________

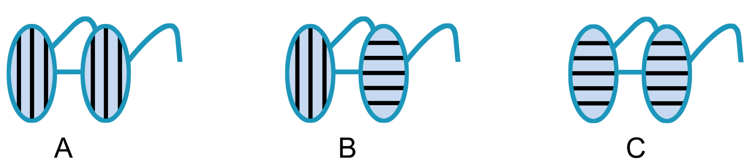
Answer each of the questions below to show your achievement of the lesson objectives.

Lesson Objective: Understand the meaning of polarization and its mechanism.

1. A single vibrating _________ creates a wave in the electromagnetic field that is ____________.
   a. Ray of light; polarized
   b. Ray of light; non-polarized
   c. Electron; polarized
   d. Electron; non-polarized
2. Polarization provides evidence for the acceptance of light as a
   a. Transverse wave
   b. Longitudinal wave
   c. Ray
   d. Particle
3. Which of the following light sources produces polarized light?
   a. Incandescent Light Bulb
   b. Candle Flame
   c. Sun
   d. None of the above

Lesson Objective: Understand polarization by transmission and reflection.

Use the image of the glasses with various axes of polarization to answer questions #4-7 below.



4. Which of the following illustrates the axis of polarization for Polaroid sunglasses?
   a. A
   b. B
   c. C
   d. None of the above

5. Explain the reason for your choice in question #4 above.

6. Which of the following illustrates the axis of polarization for a pair of 3D glasses?
   a. A
   b. B
   c. C
   d. None of the above
7. Explain the reason for your choice in question #6 above.

Quiz Answer Key

1. C
2. A
3. D
4. A
5. Answers will vary. *Sample answer: Polarized sunglasses should have a vertical axis of polarization in order to block the horizontally polarized light from the reflection off non-metallic surfaces such as the glass, water, and pavement (which we perceive as glare).*
6. B
7. Answers will vary. *Sample answer: 3D glasses allow vertically polarized light to reach one eye and horizontally polarized light to reach another eye, creating depth in the image.*

21.5 Physical Optics Chapter Test

Chapter Test

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives

1. Physical optics depends on describing light as a
   a. Ray
   b. Wave
   c. Particle
   d. All of the above
2. When a light wave travels from one medium to another, the ___________ remains the same.
   a. Frequency
   b. Wavelength
   c. Speed
   d. All of the above
3. The spreading of white light into all the colors of the rainbow is described as
   a. Diffraction
   b. Dispersion
   c. Total internal reflection
   d. Refraction
4. Red Light has the highest
   a. Frequency of all the colors of the visible spectrum
   b. Velocity through a glass prism
   c. Index of refraction in a glass prism
   d. Both A C
5. The Double-Slit Experiment proved that light
   a. Is a wave
   b. Diffracts through small openings
   c. Interferes with other waves that are in phase
   d. All of the above
6. The optical properties of a thin film result from
   a. Reflection
   b. Refraction
   c. Interference
   d. Both A C
7. Light waves experience a phase shift when traveling from
   a. air to oil
   b. soap to air

c. oil to air
d. none of the above

8. Sunlight is
   a. A longitudinal wave
   b. Polarized
   c. Non-polarized
   d. Produced by electrons vibrating in the same direction
9. 3D glasses polarization light by
   a. Transmission
   b. Reflection
   c. Refraction
   d. Diffraction
10. Polaroid sunglasses block light polarized by
   a. Transmission
   b. Reflection
   c. Refraction
   d. Diffraction

Answer Key

1. B
2. A
3. B
4. B
5. D
6. D
7. A
8. C
9. A
10. B

CHAPTER 22 The Special Theory of Relativity

Chapter Outline

22.1 Special Theory of Relativity Quiz

Chapter 22 Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Galilean Relativity

1. Which of the following could be considered inertial frames of reference?
    1. A train at rest
    2. A train speeding up to 54 m/s
    3. A train traveling with a constant velocity of 54 m/s
    4. Both A & C
2. Galilean relativity failed to provide the correct results when applied to

1. Sound
2. Light
3. Heat
4. Fluids

Time Dilation and Length Contraction

3. Distance and time must change relative to each other in order to ensure that
    1. Space-time exists
    2. We can travel through time
    3. The speed of light remains constant
    4. All of the above
4. When traveling at speeds close to the speed of light, time will noticeably

5. 1. Slow down
    2. Speed up
    3. Remain the same
    4. Not enough information to determine
6. When traveling at speeds close to the speed of light, an object's length will noticeably
    1. Increase in the direction perpendicular to the object's motion
    2. Contract in the same direction of the object's motion
    3. Remain the same size
    4. Not enough information to determine

Simultaneity

6. Simultaneity is a thought experiment used to illustrate the relative nature of
    1. Time
    2. The Speed of light

3. The Motion of the observer
4. All of the above

Mass-Energy Equivalence

7. Energy is stored in all stationary matter as
   1. Gravitational potential energy
   2. Rest energy
   3. Kinetic energy
   4. Elastic potential energy
8. In a nuclear reaction, a Uranium-235 atom divides into two lighter elements. One result of the mass of the Uranium-235 atom decreasing is that
   1. Energy is consumed
   2. Energy is released
   3. Matter is created
   4. Matter is destroyed

General Theory of Relativity

9. The theory of general relativity applies to frames of reference that are
   1. At rest
   2. In constant motion
   3. Accelerating
   4. All of the above
10. Einstein proposed that gravity was a
    1. Force between two massive objects
    2. Curvature in space-time produced by a massive object
    3. Force that acts at a distance
    4. None of the above

Chapter 22 Quiz Answer Key

***Note to Teachers: The questions contained in the Chapter 22 Quiz have been consolidated to include one quiz for the entire chapter, as opposed to previous chapters that are composed of one quiz per individual lesson. The Chapter 22 quiz has a set of problems for every lesson in the chapter, rather than every objective. The conceptual questions included are meant to provide an efficient assessment of student understanding regarding special and general relativity appropriate for the high school level.*

1. D
2. B
3. C
4. A
5. B
6. A
7. B
8. B
9. C
10. B

22.2 The Special Theory of Relativity Chapter Test

Chapter Test

Name___________________ **Class**______________ **Date** ________

Answer each of the questions below to show your achievement of the lesson objectives.

1. Einstein contradicted classical Galilean relativity when he proposed that the speed of light in a vacuum
   a. Depends on the relative motion of the observer
   b. Is the same for all observers in any inertial frame of reference
   c. Can be determined by adding the velocity vectors of light and the motion of the observer
   d. Slows down as an observer moves away from the light source
2. An astronaut aboard the International Space Station (travelling at 7.66 km/s) conducts an experiment to measure the speed of a beam of light passing the space station. According to the special theory of relativity, the astronaut's measurement should equal
   a. $2.0*10^7$ m/s
   b. $1.8*10^8$ m/s
   c. $3.0*10^8$ m/s
   d. not enough information to determine
3. According to special relativity, if the speed of light is constant, then the ratio of distance to time must
   a. Increase
   b. Decrease
   c. Also remain constant
   d. Not enough information to determine
4. According to Einstein, the simultaneity of two events is
   a. Absolute
   b. Relative
   c. Constant
   d. None of the above
5. In the distant future, an astronaut embarks on a long journey into space in which she travels on spaceship at very high speeds, close to the speed of light. Which of the following statements correctly describes a possible affect of time dilation upon her return to Earth.
   a. She could return to Earth older than her parents
   b. She could return to Earth before she was born
   c. She could return to Earth younger than her twin sister
   d. She could return to Earth the same age as her twin sister
6. One of the most important derivations Einstein made from the special theory of relativity was that
   a. Heat is a form of energy
   b. Mass is a form of energy
   c. Energy is conserved
   d. Momentum is conserved

7. General relativity is a theory regarding
   a. Space
   b. Time
   c. Force
   d. Gravity
8. According to Einstein's general theory of relativity, an experiment conducted on a spaceship accelerating at -9.8 m/s2 would produce the same results as the same experiment conducted stationary on
   a. Mars
   b. The moon
   c. The Earth
   d. Anywhere in the universe (all of the above)

Essay Questions

Apply your understanding of special and general relativity to answer the following questions using a combination of words, pictures, and equations.

9. Discuss the major differences between Galilean relativity and special relativity.

10. Compare and contrast Newton and Einstein's description of gravity.

Answer Key

1. B
2. C
3. C
4. B
5. C
6. B
7. D
8. C
9. Answers will vary. *Correct answers should include the following: Galileo thought space and time were universal and absolute. In Galilean relativity, motion is relative. Einstein proposed in his theory of special relativity that time and space were relative and the speed of light was constant.*
10. Answers will vary. *Correct answers should include the following: Newton's description of gravity was a centripetal force exerted by one massive object on another massive object over at distance. Einstein described gravity as a curvature in space-time, produced by a massive object.*

CHAPTER 23 Quantum Physics Assessments

Chapter Outline

The CK-12 Physics Intermediate Quizzes and Tests complement the Physics Intermediate FlexBook® resource and contain one objective-based quiz per lesson and one chapter test

23.1 Quantum Physics Quiz

Chapter 23 Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Blackbody Radiation and Planck's Quantum Hypothesis

1. Which of the following is an example of a quantum?
   1. Frequency of light
   2. Wavelength of light
   3. Photon of light
   4. All of the above
2. Planck's constant relates the energy of a quantum of light and its
   1. Wavelength
   2. Frequency
   3. Color
   4. All of the above
3. A blackbody is an idealized body that

4.
   1. Absorbs all electromagnetic waves
   2. Reflects all light
   3. Allows light to travel through it (is transparent)
   4. Emits all wavelengths of light
5. What is the energy of a photon of yellow light (wavelength = 590nm)?

1. 3.37 x 10^{-19}J
2. 3.91 x 10 $^{-40}$J
3. 1.12 x 10^{-27}J
4. 6.626 x 10^{-34}J

Photons and the Photoelectric Effect

5. Which color of visible light contains more energy per photon?
   1. Violet Light
   2. Yellow Light
   3. Red Light
   4. All light contains the same energy per photon
6. Explain the reason for your choice in question #5 above.
7. Which of the following will most likely eject the most electrons from a photosensitive surface?
   1. Bright light with a frequency of 450 nm
   2. Dim light with a frequency of 450 nm
   3. They both will eject the same amount of electrons

    4. Neither will result in the ejection of electrons

8. Explain the reason for your choice in question # 7 above.

9. Which beam of light contains the greater number of photons?
    1. Red light with an energy of 2.5eV
    2. Orange light with an energy fo 2.5 eV
    3. Yellow light with an energy of 2.5 eV
    4. Blue light with an energy of 2.5 eV
10. Explain the reason for your choice in question #9 above.

Wave-Particle Duality

For questions #11-14 below, determine if the following statements are true or false and circle the correct answer.

11. Einstein proposed that light was composed of quanta of electromagnetic energy called photons.
    1. True
    2. False
12. Interference and diffraction support the wave theory of light.
    1. True
    2. False
13. Einstein was the first scientist to propose that light behaved as particle.
    1. True
    2. False
14. Particles of matter in motion exhibit properties of waves
    1. True
    2. False

Chapter 23 Quiz Answer Key

***Note to Teachers: The questions contained in the Chapter 23 Quiz have been consolidated to include one quiz for the entire chapter, as opposed to previous chapters that are composed of one quiz per individual lesson. The Chapter 23 quiz has a set of problems for every lesson in the chapter, rather than every objective. The conceptual questions included are meant to provide an efficient assessment of student understanding regarding quantum physics appropriate for the high school level.*

1. C
2. B
3. A
4. A
5. A
6. Answers will vary. *Sample answer: Violet light has higher frequency and, as a result, a greater energy per photon.*
7. A
8. Answers will vary. *Sample answer: The bright light will have more photons than the dim light of the same frequency, resulting the more electrons being ejected from the photosensitive surface.*
9. A
10. Answers will vary. *Sample answer: The green beam of light must have more photons because its energy/photon is less than the beam of blue light.*
11. A

12. A
13. B (*This is false because other scientists, such as Issaac Newton, proposed a particle model of light prior to Einstein.)*
14. A

23.2 Quantum Physics Chapter Test

Chapter Test

Name____________________ **Class**_______________ **Date** _________

Answer each of the questions below to show your achievement of the lesson objectives.

1. A quantum relates to
   a. The wave model of light
   b. The minimum amount of electromagnetic energy that can be lost or gained
   c. A blackbody's ability to emit all wavelengths of light
   d. All of the above
2. Planck's mathematical equation describes the
   a. The frequency of light in the visible spectrum
   b. The energy of each photon in a beam of light
   c. The wave behavior of light
   d. The energy levels in an atom
3. According to Planck, a small energy change results in the
   a. Emission of low-frequency light
   b. Absorption of high-frequency light
   c. Absorption of low-frequency light
   d. Both A C
4. What is the energy of a photon of violet light with a frequency of 5.0 x 1014Hz
   a. 3.91 x 10^{-40}J
   b. 3.31 x 10^{-19}J
   c. 1.12 x 10^{-27}J
   d. 6.626 x 10^{-34}J
5. Einstein's particle model proposes that light is
   a. An electromagnetic wave
   b. Composed of quanta of electromagnetic energy
   c. Unrelated to the photoelectric effect
   d. All of the above
6. A photon is a(n)
   a. Quantum of light
   b. Discrete bundle of electromagnetic energy
   c. Blackbody radiation
   d. Both A B
7. The amount of energy in a photon is proportional to the
   a. Frequency of the electromagnetic wave
   b. Wavelength of the electromagnetic wave

c. Velocity of light
d. All of the above

8. Which of the following has the greatest photon energy?
   a. Radio wave
   b. Gamma ray
   c. Microwave
   d. X-ray
9. Einstein's explanation of the photoelectric effect helped to
   a. Disprove that light behaves like a wave
   b. Disprove that light behaves like a particle
   c. Prove that light behaves like both a particle and wave
   d. Prove that light cannot be quantized
10. Blackbody radiation provided evidence for the
   a. Particle theory of light
   b. Wave theory of light
   c. Matter has wave properties
   d. Speed of light in a vacuum is constant
11. Rainbows provide evidence for the
   a. Particle theory of light
   b. Wave theory of light
   c. Matter has wave properties
   d. Speed of light in a vacuum is constant
12. According to De Broglie, as the momentum of a particle increases
   a. The wavelength decreases
   b. The frequency increases
   c. The energy stays the same
   d. Not enough information to determine

Answer Key

1. B
2. B
3. D
4. B
5. B
6. D
7. A
8. B
9. C
10. A
11. B
12. A

CHAPTER 24 Atomic Physics Assessments

Chapter Outline

24.1 Atomic Physics Quiz

Chapter 24 Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

Modeling the Atom

In questions #1-4 below, match the atomic model with its correct description.

1. The plum pudding model
2. The nuclear model
3. The planetary model
4. The electron cloud model

1. ___ Positively charged particles deflected from gold foil provided evidence for this model.
2. ___ J.J. Thompson's experiment with cathode rays led to the development of this model.
3. ___ Rutherford developed this model to describe how electrons orbit the nucleus of an atom.
4. ___The acceptance of the wave-particle duality of an electron played a central role in the development of this model.

The Bohr Atom

5. Rutherford's atomic model failed to explain the
   1. Positive charge of protons
   2. Light emitted by atoms
   3. Location of the nucleus in the atoms
   4. All of the above
6. Which of the following influenced Bohr's model of the atom?
   1. Thompson's plum pudding model
   2. Rutherford's planetary model of the atom
   3. Einstein's quantum theory of light
   4. Both B & C
7. In the Bohr model of the atom, the electrons radiated energy when
   1. Orbiting around the nucleus
   2. Moving from one energy level to another
   3. Both A & B
   4. None of the above
8. Which of the following is a possible consequence of an electron absorbing energy according to Bohr's atomic model?

1. The electron will remain in a ground state
2. The electron will move from a ground state to an excited state
3. The electron will move from a high energy level to a low energy level
4. None of the above

Uncertainty Principle

9. The uncertainty principle applies to
    1. Atomic sized particles
    2. Everyday objects
    3. Objects will a large amount of mass, like the moon
    4. All of the above
10. According to the Heisenberg uncertainty principle, one can precisely measure the position the momentum of an electron.

1. Both; and
2. Either; or
3. Neither; nor
4. None of the above

Chapter 24 Quiz Answer Key

***Note to Teachers: The questions contained in the Chapter 24 Quiz have been consolidated to include one quiz for the entire chapter, as opposed to previous chapters that are composed of one quiz per individual lesson. The Chapter 24 quiz has a set of problems for every lesson in the chapter, rather than every objective. The conceptual questions included are meant to provide an efficient assessment of student understanding regarding atomic physics appropriate for the high school level.*

1. B
2. A
3. C
4. D
5. B
6. D
7. B
8. B
9. A
10. B

1.

24.2 Atomic Physics Chapter Test

Chapter Test

Name__________________ Class_____________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

1. Which of the following correctly describes the results of Rutherford's gold foil experiment?
   a. All of the alpha particles passed through the gold foil
   b. All of the alpha particles bounced off at random angles
   c. Most of the alpha particles passed through the gold foil, but some were deflected
   d. None of the above
2. The nuclear model of the atom consists of
   a. An extremely small nucleus that exists at the center of the atom
   b. All the positive charge and almost all of the mass of the atom located in the nucleus
   c. Most of the atom being empty space
   d. All of the above
3. Thompson's plum pudding model was
   a. Supported by the gold foil experiment
   b. Disproved by the gold foil experiment
   c. Replaced with Rutherford's nuclear model
   d. Both B C
4. Bohr's model of the atom helped to explain the
   a. Neutral charge of an atom
   b. Negative charge of an electron
   c. Reason why excited hydrogen gas emits only certain frequencies of light
   d. All of the above
5. In the Bohr model of the atom, the electrons
   a. Were organized into stepwise energy levels
   b. Existed in an electron cloud
   c. Only radiated energy when moving from one energy level to another
   d. All of the above
6. According to Bohr's model, electrons in a ground state
   a. Must absorb energy to move to lower energy levels
   b. Have the lowest possible energies
   c. Remain stationary
   d. All of the above
7. Bohr quantized the atomic model by proposing that
   a. Electrons only followed certain orbits
   b. Electrons absorbed or emitted certain amounts of energy

   c. Atoms can only exist in certain energy states
   d. All of the above

8. The energy lost when an electron moves from a higher level to a lower level is given off as a (n)
   a. Electron
   b. Photon
   c. Emission Spectrum
   d. Line Spectrum
9. The uncertainty principle applies to
   a. Newton's laws of motion
   b. Quantum measurements
   c. Simple Machines
   d. All of the above
10. As the certainty of an electron's position increases, the certainty of its
   a. Momentum decreases
   b. Momentum increases
   c. Velocity increases
   d. None of the above

Answer Key

1. C
2. D
3. D
4. C
5. D
6. B
7. D
8. B
9. B
10. A

CHAPTER 25 Nuclear Physics Assessments

Chapter Outline

25.1 Nuclear Physics Quiz

Chapter Quiz

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

The Nucleus

1. Nucleons
   a. Are made up protons and neutrons
   b. Exist only in the nucleus
   c. Experience a strong nuclear force
   d. All of the above
2. The strong nuclear force is
   a. Attractive
   b. Repulsive
   c. Short-range
   d. Both A C

Radioactive Half-life

3. Which of the following spontaneous reactions correctly describes the ***alpha decay*** of $^{2}19Ra$?
   a. $^{219}Ra \rightarrow^{219} Ra + \gamma$
   b. $^{219}Ra \rightarrow^{215}_{86} Ra + ^{4}_{2}He$
   c. $^{219}Ra \rightarrow^{219}_{89} Ra + ^{0}_{-1}e^{-} + \nu$
   d. None of the above
4. Which type of radioactive decay is most dangerous to humans?
   a. Alpha
   b. Beta
   c. Gamma
   d. None of the above
5. Beta decay results in the ejection of
   a. Photons
   b. Neutrinos
   c. Negatively charged electrons
   d. Positively charged helium ion
6. A sample of 200 grams of a radioactive isotope has a half-life of 20 years. How much of the original isotope will remain after 60 years has passed?
   a. 3.3 g
   b. 10 g
   c. 25 g

d. 48 g

Nuclear Fission and Fusion

7. Which of the following statements is true regarding the reaction below?
   a. This is an example of nuclear fission.
   b. This is an example of nuclear fusion.
   c. This reaction is how the sun gets its energy.
   d. Both B C
8. A chain reaction describes the process in which
   a. A lone neutron undergoes spontaneous radioactive decay
   b. The neutrons produced by one nuclear fission reaction cause other fission reactions to occur
   c. A proton decays into a neutron
   d. A very small amount of energy is produced
9. Nuclear Fission has the potential to be used for
   a. Explosions
   b. Power production
   c. Both A B
   d. None of the above
10. Nuclear fusion occurs naturally within the core of
   a. The Earth
   b. The moon
   c. Stars
   d. All of the above

Answer Key

∗∗Note to Teachers: The questions contained in the Chapter 25 Quiz have been consolidated to include one quiz for the entire chapter, as opposed to previous chapters that are composed of one quiz per individual lesson. The Chapter 25 quiz has a set of problems for every lesson in the chapter, rather than every objective. The conceptual questions included are meant to provide an efficient assessment of student understanding regarding nuclear physics appropriate for the high school level.

1. D
2. D
3. B
4. C
5. C
6. C
7. D
8. B
9. C
10. C

25.2 Nuclear Physics Chapter Test

Chapter Test

Name___________________ Class______________ Date ________

Answer each of the questions below to show your achievement of the lesson objectives.

1. The nucleus of an atom is composed of
   a. Protons bound to electrons by a strong nuclear force
   b. Nucleons bound together by a strong nuclear force
   c. Neutrons bound together by a weak nuclear force
   d. Electrons bound together by a weak nuclear force
2. As the number of protons in an atom's nucleus increases
   a. The more neutrons are required to stabilize the nucleus
   b. The number of electrons must increase to maintain the atom's overall neutral charge
   c. The overall stability of the atom decreases
   d. All of the above
3. Identify the type of radioactive decay in the following reaction:
   $^{219}_{88}Ra \rightarrow ^{219}_{89}Ac + ^{9}_{-1}e^{-} + v$
   a. Alpha
   b. Beta
   c. Gamma
   d. None of the above
4. Which type of radioactive decay results in the highest energy emission?
   a. Alpha
   b. Beta
   c. Gamma
   d. None of the above
5. Alpha decay results in the emission of a
   a. Photon
   b. Neutrino
   c. Negatively charged electron
   d. Positively charged helium ion
6. Iodine-131 has a half-life of 8 days. If you start with a sample of 150 grams, how much of the original isotope will remain after 30 days?
   a. 8 grams
   b. 11 grams
   c. 144 grams
   d. 150 grams
7. Nuclear energy is released when

a. Heavy nuclei split apart
b. Lighter nuclei join together
c. Due to the equivalence of mass and energy
d. All of the above

8. Which of the following statements is true regarding the reaction below?
$^{1}_{0}n +^{235}_{92} U \rightarrow^{142}_{56} Ba + 3(^{1}_{0}n$
 a. This is an example of nuclear fusion.
 b. This is an example of nuclear fission.
 c. This process can be used to create nuclear chain reactions.
 d. Both B C
9. A nuclear power plant relies on energy released by
 a. Nuclear fission
 b. Nuclear fusion
 c. Both A B
 d. None of the above
10. The sun gets it energy from
 a. Nuclear fission
 b. Nuclear fusion
 c. Both A B
 d. None of the above

Answer Key

1. B
2. D
3. B
4. C
5. D
6. B
7. D
8. D
9. A
10. A