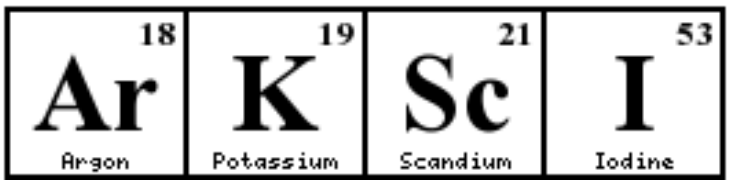


PHYSICS STUDY PACK

AQA GCSE Combined Science: Trilogy 8464
AQA GCSE Physics 8462

Paper	Exam Date
<u>Paper 1</u> 4.1 Energy 4.3 Particle Model 4.4 Atomic Structure 4.2 Electricity	23rd May 2018
<u>Paper 2</u> 4.5 Forces 4.6 Waves 4.7 Magnets and Electromagnetism 4.8 Space physics	15th June 2018

Contents Page

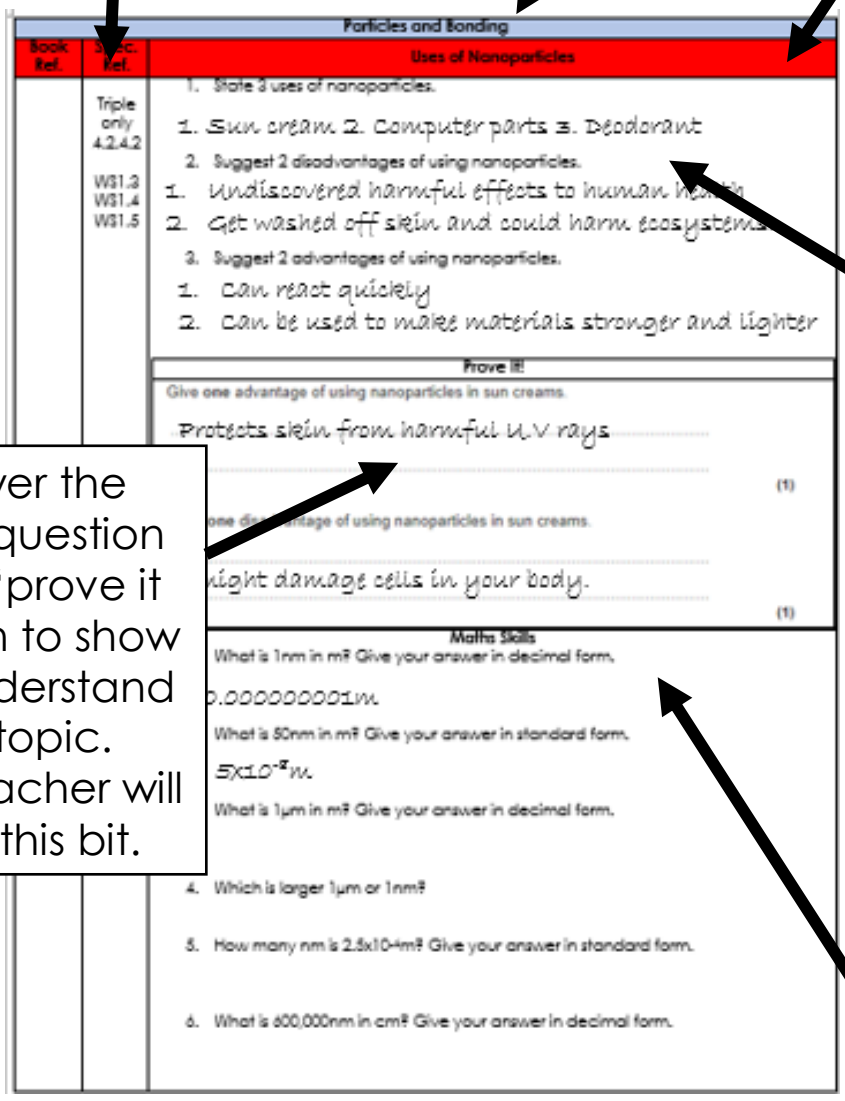
Page Number	Contents
2	How to use your study pack
3	GCSE Command Words
4	Forces Forces and Interactions Work Done and Energy Transfer Forces and Elasticity Moments, Levers and Gears Pressure Forces and Motion Momentum Space Physics
29	Electricity and Magnetism Current, Voltage and Potential Difference Series and Parallel Domestic Uses and Safety Energy Transfer Static Electricity Permanent and Induced Magnetism Motor Effect Induced Potential, Transfer and National Grid
50	Waves Waves in Air, Fluids and Solids Electromagnetic Waves Black Body Radiation
68	Energy Energy Changes in a System Conservation and Dissipation of Energy National and Global Energy Resources Changes of State and the Paticle Model Internal Energy and Energy Transfers Particle Model and Pressure Atoms and Isotopes Atoms and Nuclear Radiation Hazards and Uses of Radioactive Emissions
89	Reflections Page

How To Use Your Study Pack

This tells you which bit of the specification you are studying. If says here if it is a triple only topic.

This is the big idea this topic is part of

This is the topic you are studying



Particles and Bonding

Book Ref.	Spec. Ref.	Uses of Nanoparticles
	Triple only 4.2.4.2 WS1.3 WS1.4 WS1.5	1. State 3 uses of nanoparticles. 1. Sun cream 2. Computer parts 3. Deodorant 2. Suggest 2 disadvantages of using nanoparticles. 1. Undiscovered harmful effects to human health 2. Get washed off skin and could harm ecosystems 3. Suggest 2 advantages of using nanoparticles. 1. Can react quickly 2. Can be used to make materials stronger and lighter

Prove it!

Give one advantage of using nanoparticles in sun creams.

Protects skin from harmful U.V rays (1)

one disadvantage of using nanoparticles in sun creams.

might damage cells in your body. (1)

Maths Skills

What is 1nm in m? Give your answer in decimal form.

0.000000001m.

What is 50nm in m? Give your answer in standard form.

$5x10^{-8}$m.

What is 1μm in m? Give your answer in decimal form.

4. Which is larger 1μm or 1nm?

5. How many nm is 2.5x10-4m? Give your answer in standard form.

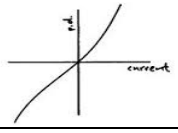
6. What is 600,000nm in cm? Give your answer in decimal form.

1. Try and answer the questions in this box.
2. Use your revision guide to check your answers and correct any you got wrong.
3. Use the revision guide to help you answer the questions you didn't know.

Answer the exam question in the 'prove it 'section to show you understand the topic. Your teacher will mark this bit.

This section will help you prepare for any questions that involve maths in the exam.

GCSE Command Words

Command Word	Definition	Example Question	Example Answer
State, give, name, write down	Short answer only and does not require an explanation.	**State** the units for acceleration.	m/s^2
Describe (not graphs or practical)	Recall facts, events or process in an accurate way.	**Describe** how quadrats should be used to estimate the number of plants in a field.	Place a large number of quadrats randomly in the field. Count the number of plants in the quadrat. Calculate the mean number in each quadrat then use the area of the quadrat and field to estimate the number of plants.
Describe (graphs)	Identify the pattern in the graph and use numbers from the graph to make this clear.	**Describe** the pattern of tooth decay in Figure 3 for water without fluoride.	The percentage of tooth decay increases with age by 4% for each age group in figure 3.
Describe (practical)/ Plan	Write the method for the practical or the results that you would expect to see.	**Plan** an experiment to test the hypothesis "the higher the temperature, the faster the rate of reaction".	Measure the rate of reaction by adding a set amount of metal to set type, volume and concentration of acid and time how long it takes to stop fizzing. Repeat the experiment at 5 different temperatures.
Determine	Use given data or information to obtain and answer.	**Determine** the half-life of a sample if it decreases from 1000g to 250g in 2.6million years.	1.3 million years
Explain	Make something clear or state the reasons for something happening. You will need to state what is happening and then say why it happens.	**Explain** why soot forms.	Soot forms during incomplete combustion when not enough oxygen is present.
Evaluate	Use the information supplied and your own knowledge to consider the evidence for and against a point. You may also be required to include a *justified conclusion*.	A company stated: 'A Life Cycle Assessment shows that using plastic bags has less environmental impact than using paper bags'. **Evaluate** this statement.	Paper bags are made from a renewable resource whereas plastic bags are made from finite resources. However paper bags are bad because they produce much more solid waste and more CO_2 is released when they are produced therefore the negative impacts of paper bags outweigh the problem of plastic coming from a finite resource.
Compare	Describe the similarities and/or differences between things. Avoid writing about just one.	**Compare** the differences between cracking and distillation.	Cracking involves a catalyst *whereas* distillation does not.
Sketch	Draw approximately.	**Sketch** a current–potential difference graph for a filament lamp.	

Forces Keywords

Add all the important keywords for this big idea in the grid below as you come across them in the study pack.

Word	Definition

Forces

Book Ref.	Spec. Ref.	Scalar/Vector and Contact/Non Contact forces
	CS 6.5.1.1 6.5.1.2 Triple 4.5.1.1 4.5.1.2	

1. State the difference between a scalar and vector quantity.

Give examples of scalars and vectors.

Scalars	Vectors

2. A vector quantity may be presented by an arrow. Explain what the features of the arrows represent.

3. The forces between two objects can be categorised as a contact or non-contact force. Explain the difference.

4. Give 3 examples of contact and non-contact forces.

Contact force	Non-contact force

Prove It!

Complete the table to show which quantities are scalars and which quantities are vectors.
Put **one** tick (✓) in each row. The first row has been completed for you.

Quantity	Scalar	Vector
Momentum		✓
Acceleration		
Distance		
Force		
Time		

(3)

Forces		
Book Ref.	**Spec. Ref.**	**Gravity**
	CS 6.5.1.3 Triple 4.5.1.3 MS3a,3c	1. State the equation which links the weight of an object to its mass and the gravitational field strength. Give the units. 2. The gravitational field strength near the Earth's surface is 9.81 N/kg. Calculate the weight of a 5kg object. Give the units. 3. An object on Earth is hung from a calibrated spring-balance (a newton meter). The meter shows a reading of 120N. Calculate the mass of the object. 4. This equation can be interpreted as "The weight of an object is **directly proportional** to the mass of object". Explain with a numerical example how changing the mass will affect weight. What is the symbol used to represent direct proportionality? 5. Describe how the gravitational field strength at a point depends on the distance from the object. 6. Define the term *centre of mass*.

Prove It!

Every object has a *centre of mass*. What is meant by the *centre of mass*?

.....

..... **(1)**

The child has a weight of 343 N. Gravitational field strength = 9.8 N / kg

Write down the equation which links gravitational field strength, mass and weight.

..... **(1)**

Calculate the mass of the child.

.....

.....

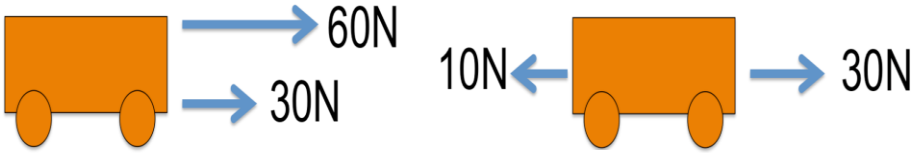
.....

Mass = ... kg **(3)**

Forces

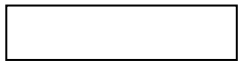
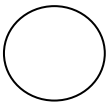
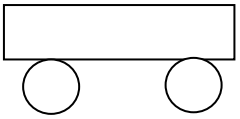
Book Ref.	Spec. Ref.	Resultant force
	CS 6.5.1.4 Triple 4.5.1.4	

1. For both situations shown below give the magnitude and direction of the resultant force.

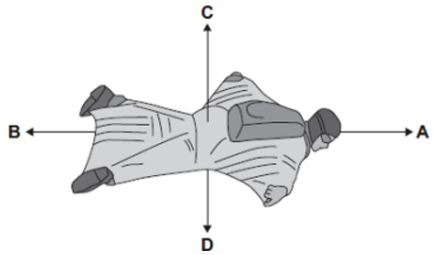


2. Describe the purpose of resultant force.

3. In each case draw and label the forces acting on the object.

A stationary book on a table	A ball falling down. It's accelerating downwards.
	
A shark swimming to the left at constant speed.	A car moving to the right but decelerating because the breaks are applied.
	

Prove It!

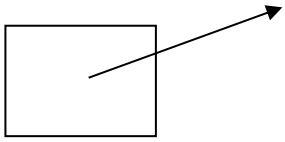
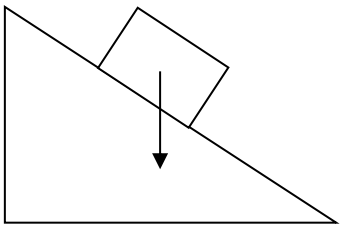
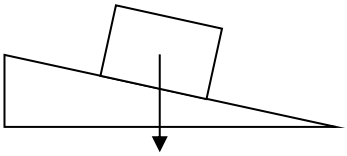
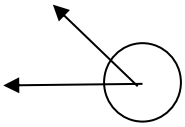
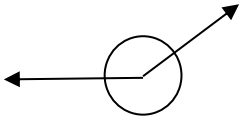
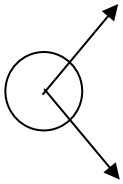
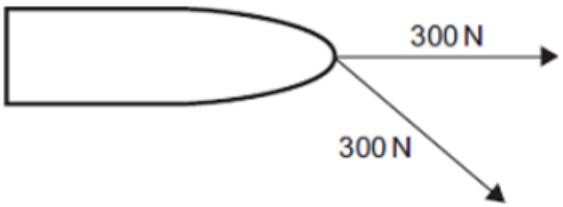


Draw a ring around the correct answer in the box to complete each sentence.

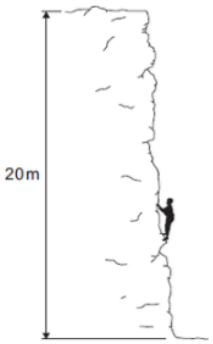
The BASE jumper accelerates forwards when force **A** is [smaller than / equal to / bigger than] force **B**.

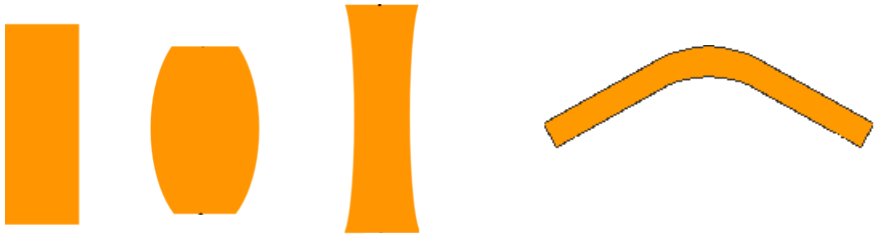
The BASE jumper falls with a constant speed when force **C** is [smaller than / equal to / bigger than] force **D**.

(2)

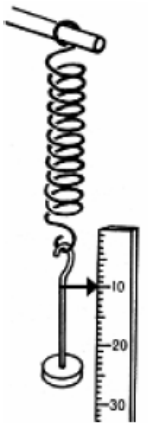
Forces		
Book Ref.	**Spec. Ref.**	**Resolving forces**
	CS 6.5.1.4 Triple 4.5.1.4 (HT only) MS5b	1. In the diagram below, add two arrows in order to resolve the force into two components, horizontal and vertical.  2. The diagrams below show weight acting on the same object on two different slopes. Add two arrows to each diagram to resolve the force into two components. One parallel to the slope and other perpendicular.   3. Which object will accelerate down the slope quickest? Use your answer to question 2 to explain your answer. 4. In each case below draw add the forces using a parallelogram. Label the resultant force with its length. The diagrams are drawn to scale.    **Prove It!** Add to **Diagram 2** to show the single force that has the same effect as the two 300 N forces. Determine the value of this resultant force. **Diagram 2** is drawn to scale. **Diagram 2**  Resultant force = ... N **(4)**

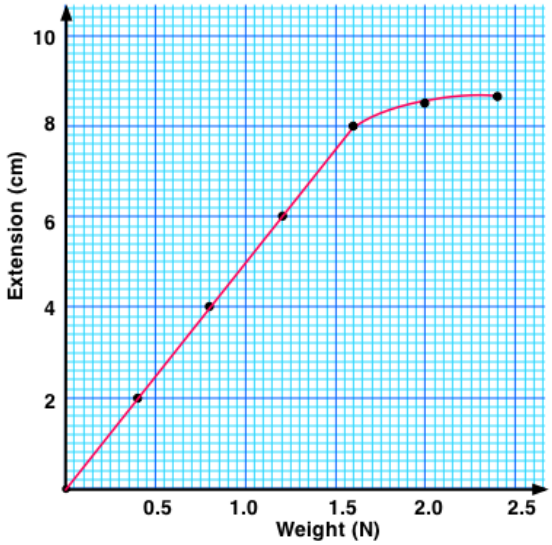
Forces

Book Ref.	Spec. Ref.	Work Done and Energy Transferred
	CS 6.5.2 Triple 4.5.2 WS4.5	1. Define the term 'work done'. 2. State the equation that links work done, force and distance. State the units for each. 3. What is 1 Joule equal to in newton-metres? 4. If 2000J of work is done, how much energy is transferred? 5. What will happen to the temperature of an object when work is done against frictional forces?
	MS3b,3c	**Maths Skills** 1. A child drags a tyre 5m over the ground. He pulls with the resultant force of 340N in the direction of motion. Calculate the work done. 2. A brick is pushed 1.4m along rough ground with a total force of 45N. Find the total energy transferred?
		Prove It  The climber weighs 660 N. (i) Calculate the work the climber must do against gravity, to climb to the top of the cliff. .... Work done = ... J **(2)** (ii) It takes the climber 800 seconds to climb to the top of the cliff. During this time the energy transferred to the climber equals the work done by the climber. Calculate the power of the climber during the climb. .... Power = ... W **(2)**

Forces		
Book Ref.	**Spec. Ref.**	**Forces and Elasticity**
	CS 6.5.3 Triple 4.5.3 MS3 MS3c	1. Add arrows to show the force acting on the objects as they are compressed, stretched and bent  compressed stretched bent 2. Explain why more than one force is required to change the shape of an object. 3. State Hooke's law. 4. What is meant by the term limit of proportionality? 5. State Hooke's law as an equation, explain what each variable represents and give the units. 6. A spring with an elastic constant of 4N/m is compressed by 0.3m. Calculate the force required to this. 7. A rubber strip which has an original length of 10cm is stretched to 15cm when 12N of weight is hanged from it. Calculate the spring constant in N/m. 8. Use the diagram below to explain the difference between elastic and inelastic deformation. 

Forces		
Book Ref.	**Spec. Ref.**	**CS: RPA19** **Triple: RPA6**
	CS 6.5.3 Triple 4.5.3 MS4a WS2.4 WS3.7	**Required Practical:** Investigate the relationship between force and extension for a spring.





1. The graph shows the results of an investigation carried out with the setup shown. Mark the limit of proportionality on the graph with an **X.**
2. Determine the spring constant using the graph the linear section of the graph. Show your working and give its units.

3. What is meant by the term accuracy?

4. Identify the hazard, risks and how to reduce the risks for this experiment.

Prove It!

Before taking any measurements, the student adjusted the ruler to make it vertical. Explain why adjusting the ruler was important.

.....

.....

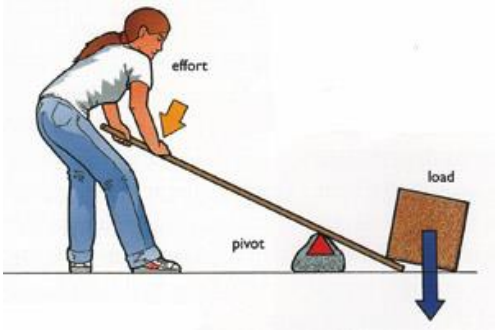
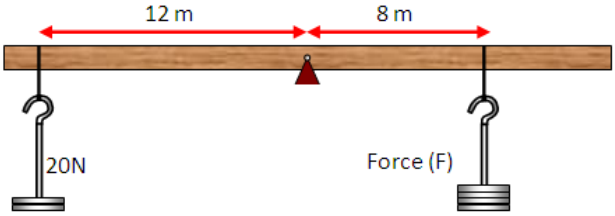
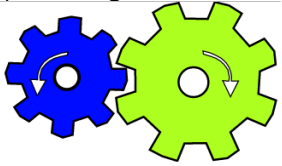
..... **(2)**

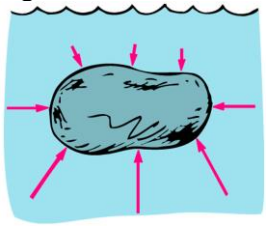
Describe **one** technique that you could have used to improve the accuracy of the measurements taken by the student.

.....

.....

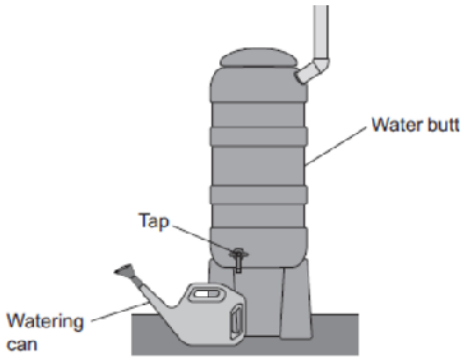
..... **(2)**

Forces		
Book Ref.	**Spec. Ref.**	**Moments, levers and gears**
	Triple only 4.5.4	1. With reference to the diagram, describe what is meant by the term moments.  2. State the equation that links moment, force and distance. Give the units of each component. 3. Explain why the girl is using the plank as shown below instead of lifting the box up by hand. Refer to your equation in 2.  4. Several forces may act on a single object. State the condition required for the object to not spin (i.e. it is balanced) 5. Calculate the anticlockwise moment in the set up shown below.  6. Provided the system is balanced shown is balanced. Calculate the unknown force F. 7. In the diagram below a small gear is used to turn a larger gear. Describe the difference in the moment applied to the small gear and the moment produced by the large wheel. 
Forces		

Book Ref.	Spec. Ref.	Pressure in a fluid and Atmospheric Pressure
	Triple Only 4.5.5.1 4.5.5.2 MS3b MS3c	1. Which two states of matter are fluids? What can fluids do which solids can't? 2. Figure 1 below shows the pressure on the surface of a stone as a result of the liquid.  Figure 1 The angle between the force from the liquid and the surface itself is the same at any point on the stone. What is this angle? 3. State the equation which links pressure, force and surface area. Give the units. 4. The pressure due to Earth's atmosphere is 101KPa. The average surface area of a person is 1.5m^2. Calculate the force total force applied on the person. 5. **HT only** Look carefully at figure 1 again. Explain why there is upward force, called upthurst, acting on the stone. 6. **HT only** Using the equation $P = h\rho g$. At the top of the stone there is 1.20m of water above it. Provided the density of water is 1050kg/m^3 and the gravitational field strength is 9.81N/kg, calculate the pressure on the stop of the stone **to 4sf**. 7. **HT only** The pressure at the bottom of the rock 12510Pa. If the surface area of top and bottom side is 2.50 x10^{-3} m^2, by calculating the difference in pressure at the top and bottom show that the upthrust on the stone is 0.30N to 2sf. 8. **HT only** If the weight of the stone is 0.8N, state if it will sink or float. Hence or otherwise describe the factors which determined if it will sink or float. 9. What is meant by the term Earth's *Atmosphere?* 10. Explain why the atmosphere exerts pressure on the surface of objects. 11. With reference to the density of air molecules, describe and explain what happens to atmospheric pressure at higher altitudes.
	MS2a MS4a	

Prove It!

The diagram shows a water butt used to collect rainwater.



A tap allows water to be collected from the water butt in a watering can.

If the tap was placed higher up on the water butt, what difference would it make to the rate of flow of water from the tap?

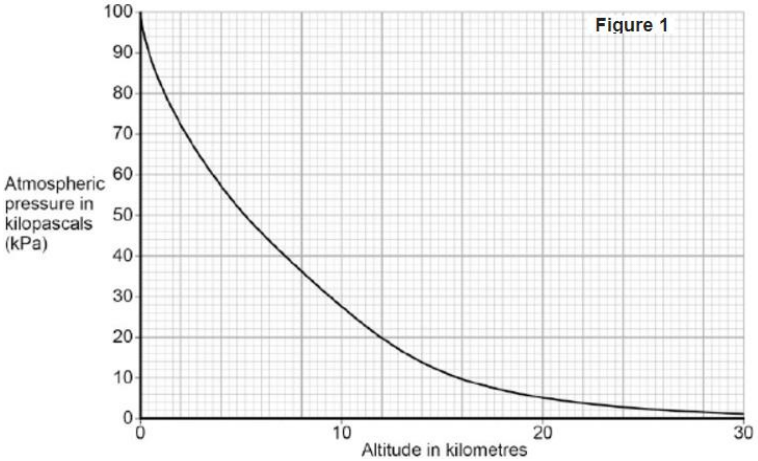
Explain your answer.

.....

.....

.....

..... **(2)**



When flying, the pressure inside the cabin of an aircraft is kept at 70 kPa.

The aircraft window has an area of 810 cm^2.

Use data from **Figure 1** to calculate the resultant force acting on an aircraft window when the aircraft is flying at an altitude of 12 km.

Give your answer to two significant figures

.....

.....

.....

..... Resultant force = ... N **(5)**

Forces

Book Ref.	Spec. Ref.	Distance, displacement, speed and velocity
	CS 6.5.6.1.1 6.5.6.1.2 6.5.6.1.3 Triple 4.5.6.1.1 4.5.6.1.2 4.5.6.1.3	1. Define displacement. 2. State the equation, with units, that links speed, distance and time. 3. Match the columns

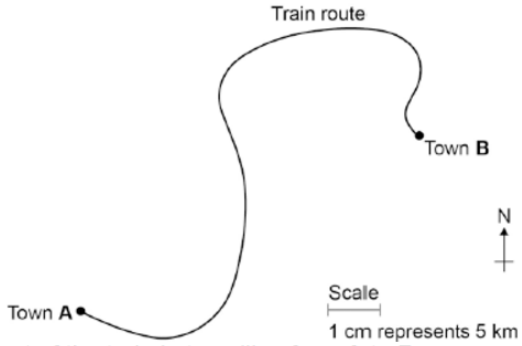
Distance		100km/h		Scalar
Displacement		30m at 53° from north		Scalar
Speed		20m/s to the right		Vector
Velocity		5m		Vector

4. Estimate the typical speeds for the following in m/s.

Walking: _____ Running: _____ Cycling:_____

Speed of sound:_____

Prove It!



determine the displacement of the train in travelling from **A** to **B**.
Show how you obtain your answer.

.....

.....

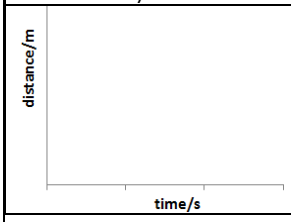
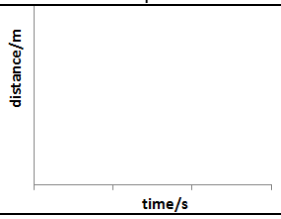
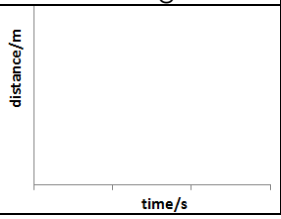
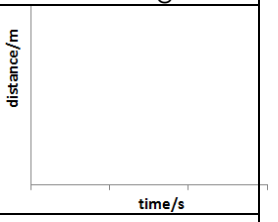
Displacement = ... km

Direction = ... **(2)**

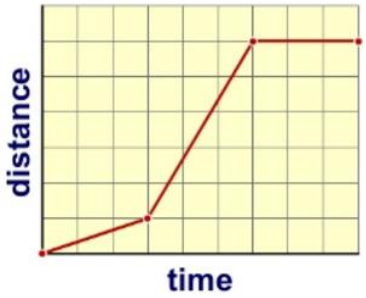
	MS2f,3b, 3c	**Maths Skills** 1. A car travels 250m in 14 seconds. Calculate the speed of car with units. 2. A train moves at a constant speed of 27m/s. Calculate the distance it travels in 120 seconds. 3. A car moves at 30m/s for an hour. Calculate the distance it travels. 4. A person initially runs along a track at 1.0 m/s for 20m and then speed up to 3.0 m/s for the remaining 30m. Calculate the average speed.

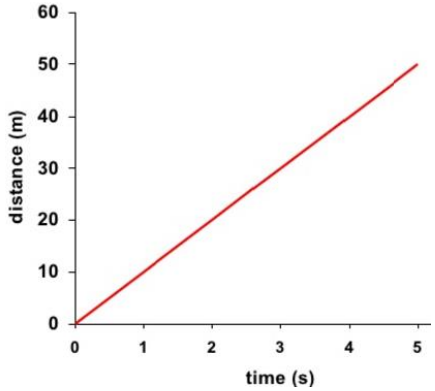
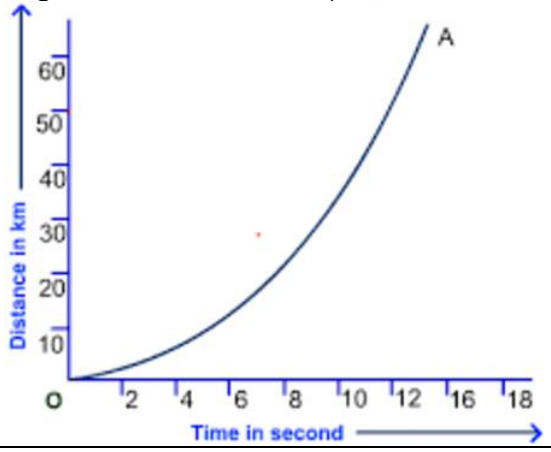
Forces

Book Ref.	Spec. Ref.	Distance-time relationship
	CS 6.5.6.1.4 Triple 4.5.6.1.4	1. Sketch the graph to show the motion of the following objects

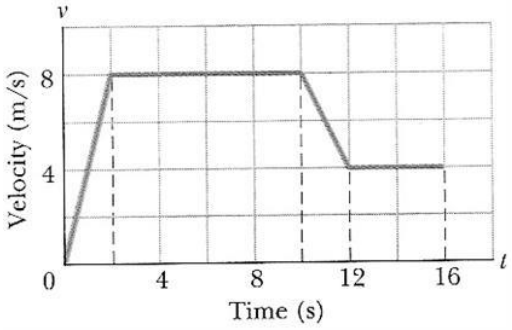
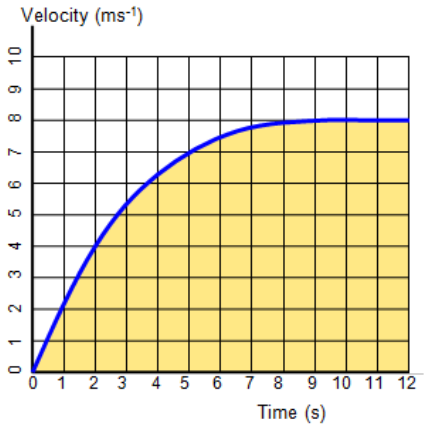
Stationary	Constant speed	Accelerating	Decelerating
			

2. Describe the motion of the object shown in the diagram below.



	MS 4a,4d,4e	**Maths Skills** 1. Use the graph below to calculate the velocity of the object  2. HT only Use a tangent to calculate the speed 10 seconds into the journey. 

Forces

Book Ref.	Spec. Ref.	Acceleration
	CS 6.5.6.1.5 Triple 4.5.6.1.5 MS3b MS3c MS3d MS4f	1. State the equation, with units, that links acceleration, change in velocity and time. 2. Define acceleration. 3. **Higher only** Explain why an object going in circles at constant speed is still considered to be accelerating.  4. Use the graph above to calculate the acceleration of the object between 0 and 2 seconds. 5. Describe the motion of the object between 2 and 10 seconds. 6. **Higher only** Calculate the distance travelled in the first 10 seconds of the journey.  7. **Higher only** Using the graph above estimate the total distance travelled by the object over the 12 seconds. 8. An object accelerates from 10m/s to 30m/s over a distance of 100m. Use the equation $v^2 - u^2 = 2as$ to calculate the acceleration of the object. 9. State the acceleration of an object falling freely under gravity near Earth's surface. Provide units. 10. Explain why objects falling through a fluid accelerate and then reach a terminal velocity.

Prove It!

There are places on the journey where the train accelerates without changing speed. Explain how this can happen.

.....

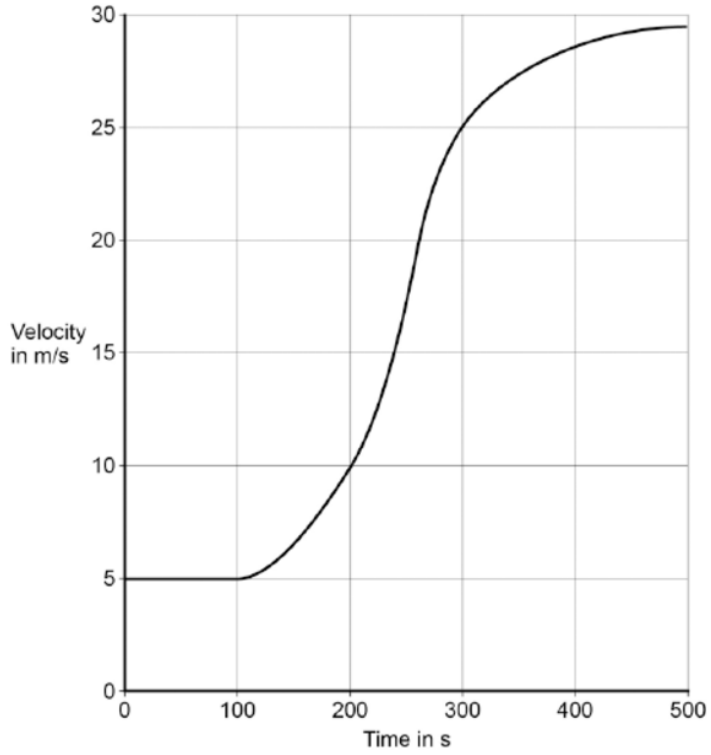
.....

.....

..... **(2)**

Figure 2 shows how the velocity of the train changes with time as the train travels along a straight section of the journey.

Figure 2



Estimate the distance travelled by the train along the section of the journey shown in **Figure 2**. To gain full marks you must show how you worked out your answer.

.....

.....

.....

Distance = ... m **(3)**

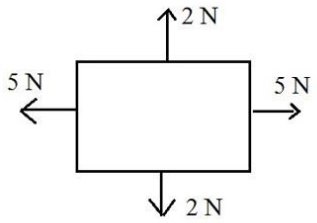
WS4.4
WS3.3
MS2h

Maths Skills

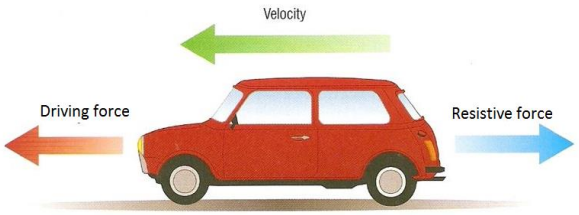
1. How many orders of magnitude is giga compared to mega?
2. How many orders of magnitude is centi compared to mega?
3. How many orders of magnitude is giga compared to milli?
4. How many orders of magnitude is tera compared to kilo?
5. How many orders of magnitude is mico compared to mega?
6. How many orders of magnitude is nano compared to mega?

Forces

Book Ref.	Spec. Ref.	Newton's First Law
	CS 6.5.6.2.1 Triple 4.5.6.2.1	



1. State the resultant force on the object.
2. The box is initially stationary. Describe what will happen to the object next.

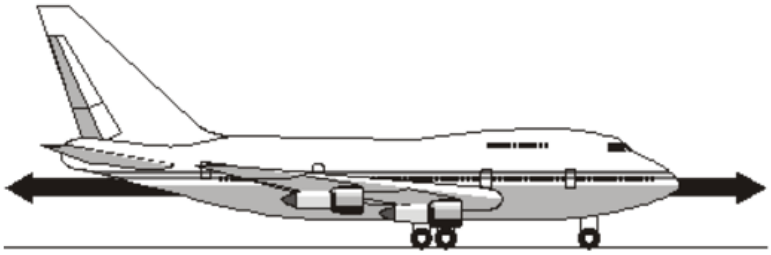


3. Explain why the velocity of the car constant even though there are two force acting on it.

4. **HT only** Define the term Inertia

Prove It!

The diagram shows an aircraft and the horizontal forces acting on it as it moves along a runway. The *resultant force* on the aircraft is zero.



(i) What is meant by the term *resultant force*?

.....

..... **(1)**

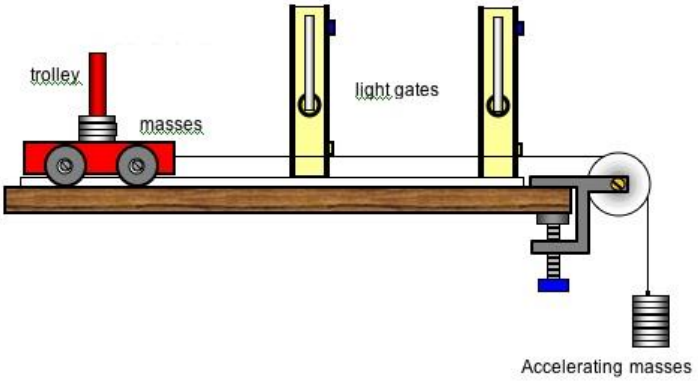
(ii) Describe the movement of the aircraft when the resultant force is zero.

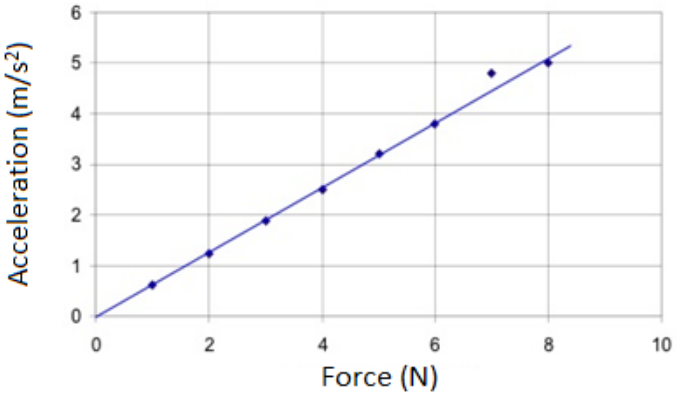
.....

..... **(1)**

Forces		
Book Ref.	**Spec. Ref.**	**Newton's 2nd law**
	CS 6.5.6.2.2 Triple 4.5.6.2.2 MS3a	1. State the equation for Newton's second Law, include units. 2. State Newton's second law in words. 3. The mass of the car above is 1200 kg. Calculate the acceleration of the cart.  4. **HT only** Define inertial mass 5. **HT only** Explain what affect inertial mass has on the ability to change the speed of an object. 6. Acceleration of a sprinter ~ 8m/s^2. State what the symbol ~ means. 7. Large Trucks weigh approximately 38 000kg. Calculate the resultant force required to accelerate at the same rate as the car above. **Maths Skill** Equation 1 : acceleration $\propto$ Force Equation 2 : acceleration $\propto \frac{1}{mass}$ 1. Explain what equation 1 means in words and describe what will happen to the acceleration if the force is doubled. 2. Explain what equation 2 means in words and describe what will happen to acceleration if the mass is doubled. **Prove It!** The aircraft has a take-off mass of 320 000 kg. Each of the 4 engines can produce a maximum force of 240 kN. Calculate the maximum acceleration of the aircraft. Show clearly how you work out your answer and give the unit. .... Acceleration = ... **(3)**

Book Ref.	Spec. Ref.	CS: RPA19 Triple: RPA7
	CS 6.5.6.2.2 Triple 4.5.6.2.2 WS3.7	**Required Practical** Investigate the effect of varying the force on the acceleration of an object of constant ass, and the effect of varying the mass of an object on the acceleration produced by a constant force.





1. Describe how the set up shown above can be used to produce the graph.

2. Explain how this graph is evidence for Newton's second law.

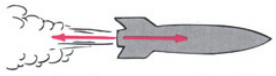
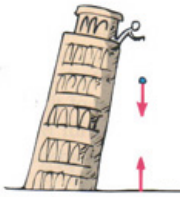
3. The accuracy of this experiment is reduced by friction between the table and the cart. Is this a random or systematic error, explain your answer.

4. This experiment can be done with a person using a stop watch to time the cart.
   However the results will be less accurate explain why.

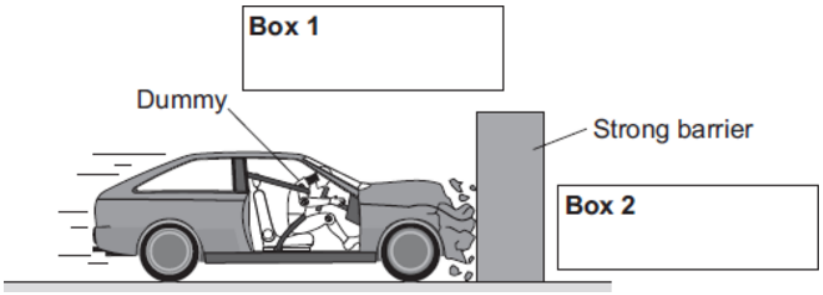
   Using the stop watch will also be less precise explain why.

Forces

Book Ref.	Spec. Ref.	Newton's 3rd law
	CS 6.5.6.2.3 Triple 4.5.6.2.3	1. State Newton's 3rd Law. 2. In each case describe the Newton's 3rd law pair. The first one has been done for you.

			
The man pulls the spring on the spring. The spring pulls on the man with an equal and opposite force.			

Prove It!



(i) Draw an arrow in **Box 1** to show the direction of the force that the car exerts on the barrier.

(1)

(ii) Draw an arrow in **Box 2** to show the direction of the force that the barrier exerts on the car.

(1)

(iii) Complete the following by drawing a ring around the correct line in the box.

The car exerts a force of 5000 N on the barrier. The barrier does not move. The force exerted by the barrier on the car will be [more than / equal to / less than] 5000 N.

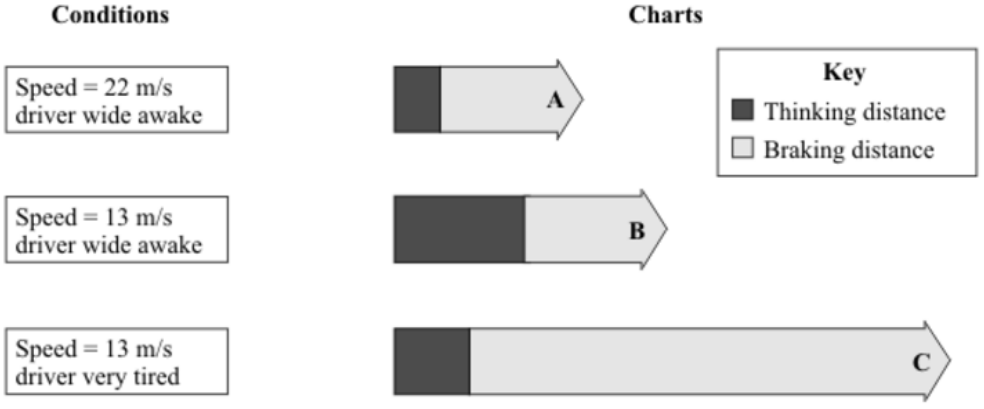
(1)

Forces

Book Ref.	Spec. Ref.	Stopping distance
	CS 6.5.6.3.1 6.5.6.3.2 6.5.6.3.3 6.5.6.3.4 Triple 4.5.6.3.1 4.5.6.3.2 4.5.6.3.3 4.5.6.3.4 MS 1d	1. A driver attempts an emergency stop. The distance travelled from spotting the hazard to completely stopping the car can be is called the stopping **distance.** Name and define the two distances which make up stopping **distance.** 2. Write the equation which links thinking distance, speed and reaction time and give units. 3. What is the typical reaction time of a person? Describe and explain 3 factors which can affect this. 4. Describe an experiment which can be used to investigate the reaction time of students. 5. Describe and explain how adverse road conditions and vehicle condition affects braking distance. 6. **Physics only** .The stopping distance of a typical car at 30mph is 23m. Estimate the stopping distance of the same car at 60mph.

Prove It!

Draw straight lines to match each chart to the correct conditions.
Draw only **three** lines.



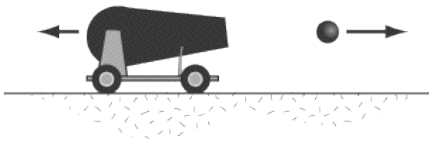
(2)

The three charts above all apply to dry road conditions.
How would the braking distances be different if the road were wet?

.....

..... **(1)**

Forces

Book Ref.	Spec. Ref.	Momentum
	HT only CS 6.5.7.1 6.5.7.2 Triple 4.5.7.1 4.5.7.2	1. State the equation which links momentum, mass and velocity 2. State the law of conservation of momentum. 3. The total momentum before the explosion is zero. With reference to the velocity of the canon gun and ball, explain why how momentum the diagram shows that momentum after is also zero. before  after 

Prove It!

The figure below shows a skateboarder jumping forwards off his skateboard.
The skateboard is stationary at the moment the skateboarder jumps.

The skateboard moves backwards as the skateboarder jumps forwards.
Explain, using the idea of momentum, why the skateboard moves backwards.

.....

.....

.....

.....

.....

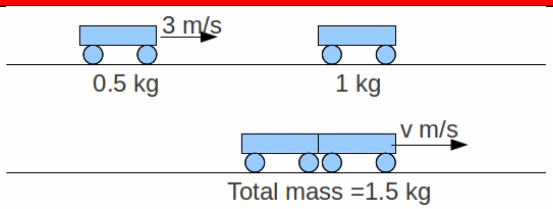
.....

.....

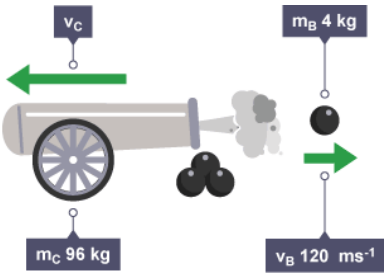
..... **(3)**

Forces

Book Ref.	Spec. Ref.	Momentum calculations
	Triple only 4.5.7.3	

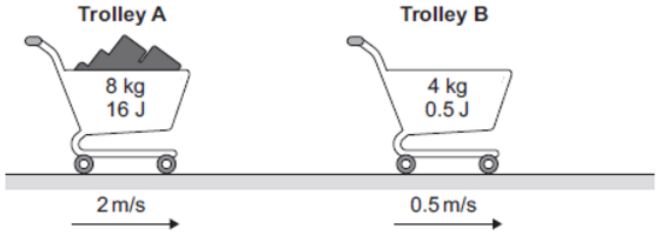


1. By conserving momentum calculate the speed of the combined carts after the collision



2. By conserving momentum calculate the recoil speed of the canon gun.

Prove It!



(i) Calculate the momentum of both trolley **A** and trolley **B**. Give the unit.

.....

.....

Momentum of trolley **A** = ...

Momentum of trolley **B** = ...

Unit .....

(4)

(ii) The trolleys in the diagram collide and join together. They move off together. Calculate the velocity with which they move off together.

.....

.....

.....

.....

Velocity = ... m / s

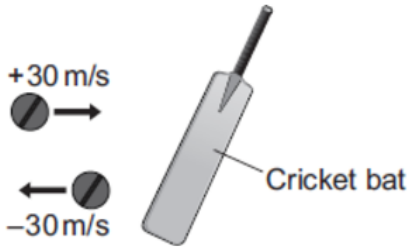
(3)

Forces

Book Ref.	Spec. Ref.	Changes in momentum
	Triple only 4.5.7.3	1. Use the equation $F = ma$ and $a = \frac{v-u}{t}$ to show that force equals rate of change of momentum. Explain your answer. 2. Using the equation derived in question 1, describe and explain 3 safety features of a car.

Prove It!

When the ball reaches the batsman it is travelling at 30 m/s. The batsman strikes the ball which moves off at 30 m/s in the opposite direction.



calculate the change in momentum of the ball.

.....

.....

Change in momentum = ... kg m/s **(2)**

The ball is in contact with the bat for 0.001 s.
calculate the force exerted by the bat on the ball.

.....

.....

Force = ... N **(1)**

A fielder, as he catches a cricket ball, pulls his hands backwards.
Explain why this action reduces the force on his hands.

.....

.....

.....

.....

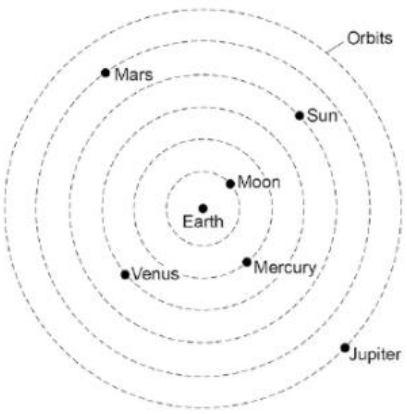
..... **(2)**

Forces		
Book Ref.	**Spec. Ref.**	**Our Solar System**

Triple only
4.8.1.1

WS1.1
WS1.2
WS1.4
WS3.3

1. What is the name of the star at the centre of our solar system?
2. What is the name of our galaxy?



3. Scientists used to believe this is what our Solar System used to look like. Explain how they were wrong.

4. Suggest one technological advancement that now means scientists have a better understanding of space.

5. What is a dwarf planet?
6. Describe the motion of a moon.
7. How was the Sun formed?
8. What sort of reactions occur in the Sun? Explain what happens in these reactions.

Prove It!

Brown dwarf stars are thought to have been formed in the same way as other stars.
They are too small for nuclear fusion reactions to take place in them.
Brown dwarf stars emit infrared radiation but are not hot enough to emit visible light.

(i) Describe how a star is formed.

.....

.....

.....

.....

(2)

(ii) Describe the process of nuclear fusion.

.....

.....

.....

(1)

Forces		
Book Ref.	**Spec. Ref.**	**The lifecycle of a star**

	Triple only 4.8.1.2	1. Put the following in order to describe the lifecycle of a star: *Nebula, main sequence star, black dwarf, protostar, red giant, white dwarf.* 2. Is the lifecycle in question 1 for a star the size of our Sun or bigger? 3. For the type of star not listed in question 2, write out the stages the star goes through in its lifecycle. 4. How are elements lighter than iron formed? 5. How are elements heavier than iron formed? 6. How are elements distributed throughout the universe?

Prove It!

As part of its life cycle, a star changes from being a protostar to a main sequence star.

Explain the difference between a protostar and a main sequence star.

.....

.....

.....

.....

(2)

The early Universe contained only atoms of hydrogen. The Universe now contains atoms of over one hundred different elements.

Explain how the different elements now contained in the Universe were formed.

.....

.....

.....

.....

.....

.....

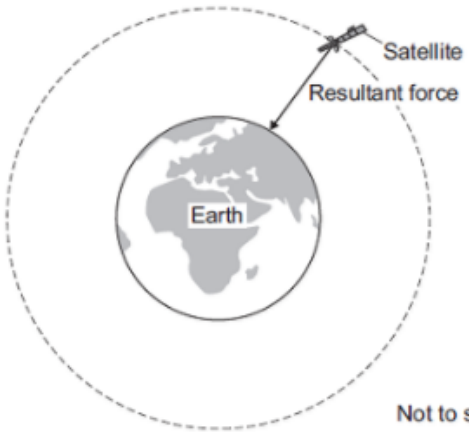
(3)

Forces		
Book Ref.	**Spec. Ref.**	**Orbit motion, natural and artificial satellites**

Triple only 4.8.1.3

1. Define the term 'orbit'.
2. What is a satellite? What are the 2 types of satellites? Give an example of each.
3. How is a planet different to a moon?
4. What is the difference between velocity and speed?
5. **HT only** - Explain how a planet stays in a circular orbit.
6. **HT only -** What does the size (radius) of an orbit depend on? Why?

Prove It!



The satellite experiences a resultant force directed towards the centre of the orbit.

The resultant force is called the centripetal force

(a) What provides the centripetal force on the satellite?

.....

(1)

(b) State **two** factors that determine the size of the centripetal force on the satellite.

1 .....

2 .....

(2)

Forces

Book Ref.	Spec. Ref.	Red-shift
	Triple only 4.8.2 WS1.1 WS1.3	1. What does the Big Bang theory suggest? 2. What is red-shift? How does it provide evidence for the Big Bang? 3. In terms of red-shift, what would we expect to see if we were looking at a galaxy that was very far away compared with a closer one? 4. Why is the Big Bang referred to as a theory? 5. When would scientists change or replace a theory? 6. Describe 3 areas of space physics that scientists still do not have theories to explain.

Prove It!

The teacher uses the waves in the ripple tank to model the changes in the wavelengths of light observed from distant galaxies.

When observed from the Earth, there is an increase in the wavelength of light from distant galaxies.

(i) State the name of this effect.

.....

(1)

(ii) What does this increase in wavelength tell us about the movement of most galaxies?

.....

.....

(1)

(iii) Explain how this observation supports the Big Bang theory of the formation of the Universe.

(4)

Electricity and Magnetism Keywords

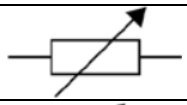
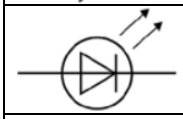
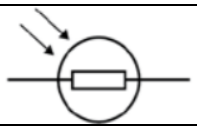
Add all the important keywords for this big idea in the grid below as you come across them in the study pack.

Word	Definition

Electricity

Book Ref.	Spec. Ref.	Circuit symbols and current
	CS 6.2.1.1 6.2.1.2 Triple 4.2.1.1 4.2.1.2 MS3b MS3c	

1. Complete the table

Symbol	Name	Function/Description
	Open switch	
		
	Battery	
		Only lets current flow in one direction.
	Resistor	
		
		
		Turns electrical energy into light.
	Fuse	
		Measure the current though components which are in series with it.
	Thermistor	
		

2. State the equation which links current, charge and time. Give the units.

3. In words, what does the term *electrical current* mean?

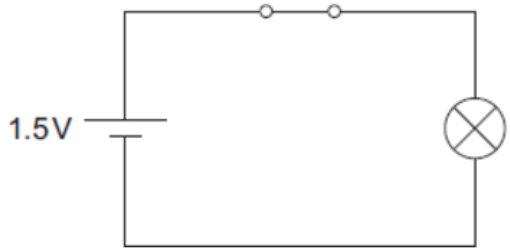
4. Calculate the current when 12.0 C of charge flows past a point in 20 seconds.

5. Calculate how much charge will flow if a 20 mA current flows for 5 minutes.

Electricity		
Book Ref.	**Spec. Ref.**	**Current, resistance and potential difference**
	CS 6.2.1.3 Triple 4.2.1.3 MS2a MS3b MS3c WS3.3	1. Describe the effect increasing the resistance in circuit has on the current through it. 2. The potential difference across a circuit component can be increased by adding more cells. What effect will this have on the current through the component? 3. State the equation which link potential difference, charge and work done (energy transferred). Give the units 4. A 25V power supply is connected to a bulb. In the time it was on, 25C of charge flowed through the bulb. Calculate the energy transferred. 5. State the equation which links current, potential difference and resistance. Give the units. 6. Calculate the resistance of a bulb with 0.6A flowing through it and a potential difference of 25V across it. Give your answer to 2sf with units.

Prove It!

The lamp is now included in a circuit. The circuit is switched on for 2 minutes. During this time, 72 coulombs of charge pass through the lamp.



calculate the energy transformed by the lamp while the circuit is switched on.

.....

.....

Energy transformed = ... J **(2)**

Calculate the resistance of the lamp.

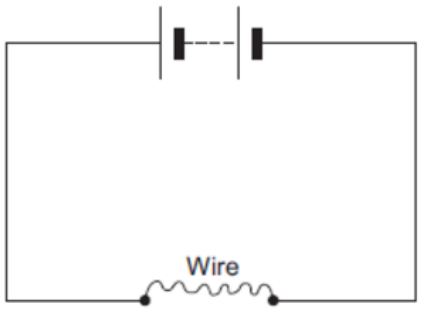
.....

.....

Resistance = ... Ω **(2)**

Electricity		
Book Ref.	**Spec. Ref.**	**CS: RPA15** **Triple: RPA3**
	CS 6.2.1.3 Triple 4.2.1.3 WS2.2 WS3.7	**Required Practical:** Use circuit diagrams to set up and check appropriate circuits to investigate the factors affecting the resistance of electrical circuits.

1. Add two components to the circuit diagram below which will allow the resistance of the wire to be determined.



2. To investigate what affect the length of the wire has on its resistance describe the graph you will need to plot. Explain what goes on each axis and how these numbers are obtained.

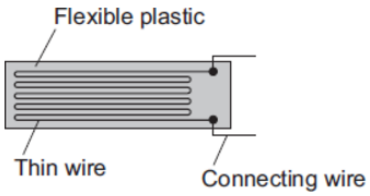
   x-axis :
   y-axis :

3. Name three other variables which need to be controlled.

4. A student said they got an anomaly, what did they mean?

Prove It!

The diagram shows a strain gauge, which is an electrical device used to monitor a changing force. Applying a force to the gauge causes it to stretch.
This makes the electrical resistance of the wire change.



Using the correct symbols, **add** to the diagram to show how a battery, an ammeter and a voltmeter can be used to find the resistance of the strain gauge drawn above. **(2)**

Before any force is applied, the unstretched gauge, correctly connected to a 3.0 V battery, has a current of 0.040 A flowing through it. Calculate the resistance of the unstretched gauge.

.....

.....

Resistance = ... Ω **(2)**

Stretching the gauge causes the current flowing through the gauge to decrease.
What happens to the resistance of the gauge when it is stretched?

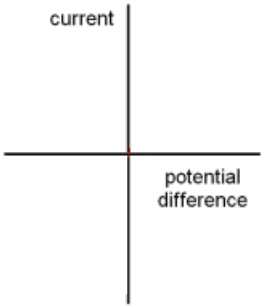
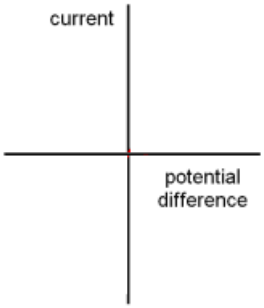
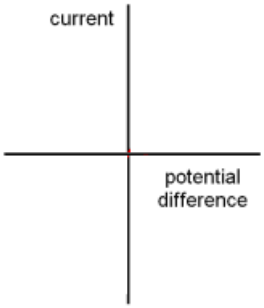
..... **(1)**

Electricity

Book Ref.	Spec. Ref.	Resistors
	CS 6.2.1.4 Triple 4.2.1.4	

1. State Ohm's Law

2. Sketch the IV graphs for the following components and explanation of the shape.

Component	Ohmic conductor	Filament lamp	diode
I-V Graph			
Explanation of graph			

3. Describe the properties and applications of thermistors.

4. Describe the properties and applications of LDRs.

Prove It!

Temporary traffic signs uses many small lights all powered by a rechargeable battery. These lights need to be very bright during the day so that they can be seen clearly. They do not need to be as bright at night.

Explain how using a light-dependent resistor can make the energy stored in the battery last longer. **(6)**

Electricity

Book Ref.	Spec. Ref.	CS: RPA16 Triple: RPA4
	CS 6.2.1.4 Triple 4.2.1.4	**Required Practical:** Use circuit diagrams to construct appropriate circuits to investigate the I-V characteristics of different circuit components.

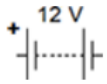
1. Name the two measurements that need to be taken to determine the resistance of an unknown component and identify the equipment needed.

2. Describe how the devices must be connected to the unknown component.

3. Which addition component is required in order to change the current in the circuit?

Prove It!

A student wants to investigate how the current through a filament lamp affects its resistance.
Use the circuit symbols in the boxes to draw a circuit diagram that she could use.

12 V battery	variable resistor	filament lamp	voltmeter	ammeter
				

(2)

Describe how the student could use her circuit to investigate how the current through a filament lamp affects its resistance.

.....

.....

.....

.....

.....

.....

.....

(4)

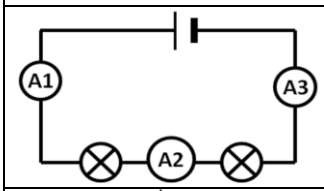
.....

Electricity

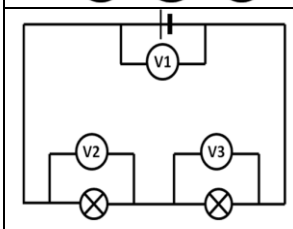
Book Ref.	Spec. Ref.	Series and parallel
	CS 6.2.2 Triple 4.2.2 MS3c MS3d	

1. Complete the tables, assume all the filament bulbs have the same resistance.

Series

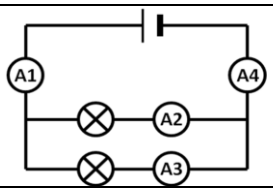


Position	Current (A)
A1	1.5
A2	
A3	

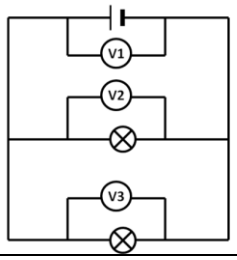


Position	Voltage (V)
V1	12
V2	
V3	

Parallel

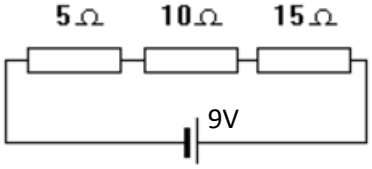


Position	Current (A)
A1	6.0
A2	
A3	
A4	



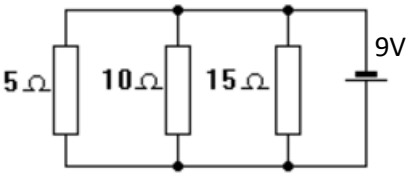
Position	Voltage (V)
V1	12
V2	
V3	

2. What effect does adding resistors in series have on the total resistance? Calculate the total resistance in the circuit below.



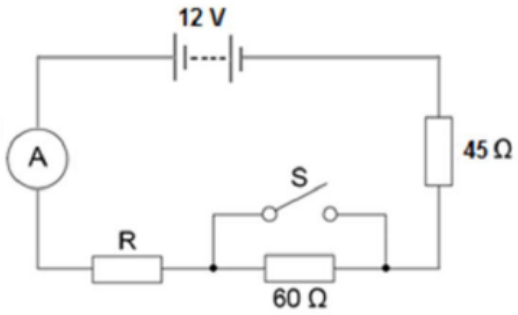
3. Use Ohm's Law to calculate the current in the series circuit. Use your answer to calculate the potential difference across the 10Ω resistor.

4. What effect does adding resistor in series have on the total resistance?



5. Apply Ohm's law to find the current through each resistor. Use your answer to calculate the current through the battery.

Prove It!



(a) The ammeter displays a reading of 0.10 A.
Calculate the potential difference across the 45 Ω resistor.

.....

.....

Potential difference = ... V **(2)**

(b) Calculate the resistance of the resistor labelled **R**.

.....

.....

.....

Resistance = ... Ω **(3)**

(c) State what happens to the total resistance of the circuit and the current through the circuit when switch **S** is closed.

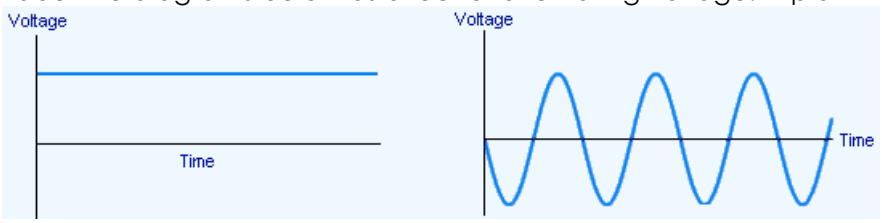
.....

.....

..... **(2)**

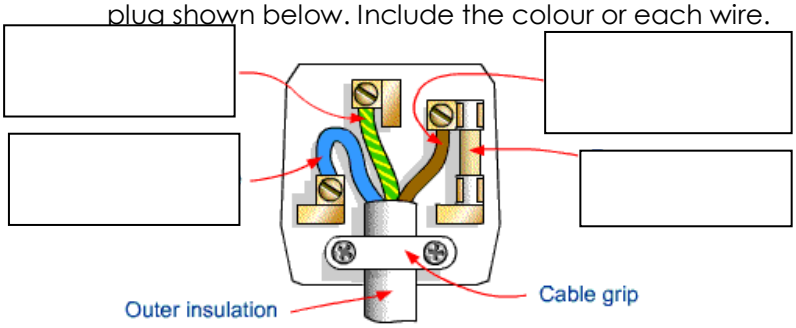
Electricity		
Book Ref.	**Spec. Ref.**	**Domestic uses and safety**
	CS 6.2.3 Triple 4.2.3	

1. Label the diagrams below as direct or alternating voltage. Explain the difference.



2. The UK's domestic electricity supply is an AC supply. What is the frequency and average voltage of this supply?

3. Three-core cables connect the mains to electrical appliances. Label the three-pin plug shown below. Include the colour or each wire.



4. Complete the table below.

Wire	Function	Voltage (V)
Live		
Neutral		
Earth		

Prove It!

An electrician is replacing an old electric shower with a new one.
If the electrician touches the live wire he will receive an electric shock.
Explain why.

.....

.....

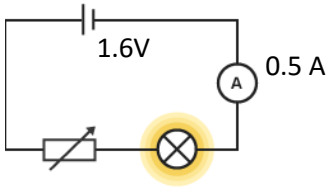
.....

.....

.....

..... **(4)**

Electricity

Book Ref.	Spec. Ref.	Power and Energy Transfers
	CS 6.2.4.1 6.2.4.2 Triple 4.2.4.1 4.2.4.2 MS2a MS3b MS3c	1. State the equation which links Power to energy and time. Give the units. 2. State the equation which links Power to current and voltage. Give the units. 3. State the equation which links power to current and resistance. Give the units. 4. A bulb transfers 70,000J of energy in 1hour. Calculate the power of the bulb with units. 5. A heater with a power rating of 1000W is connected to the UK mains supply. Calculated the current through the heater to 3sf. Give the units. 6. Calculate the power of a fan with current of 1.2A flowing through it and 500Ω resistance. 7. Describe 3 ways in which the total energy transferred by the bulb shown can be increased.  8. Describe the energy transfer in a heater connected to the mains supply. 9. Describe the energy transfer in an electric motor which is powered by a battery.

Prove It!

The charge that flows through the new shower in 300 seconds is 18 000 C.
The new electric shower has a power of 13.8 kW.
Calculate the resistance of the heating element in the new shower.
Write down any equations you use.

.....

.....

.....

.....

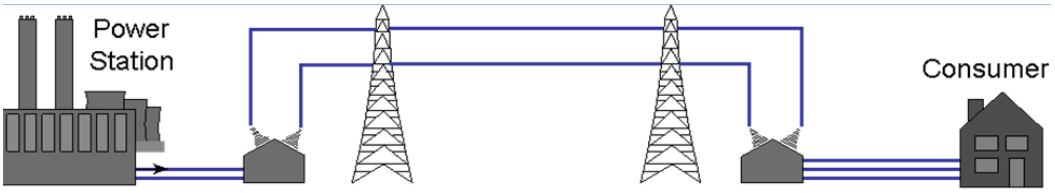
.....

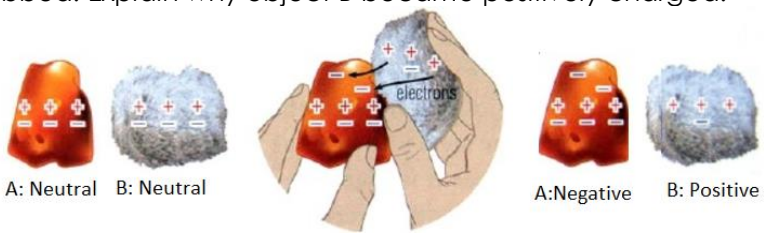
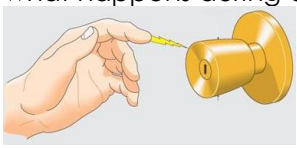
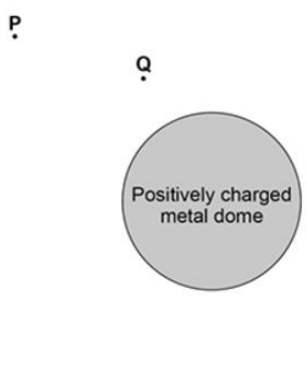
.....

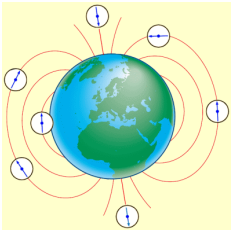
.....

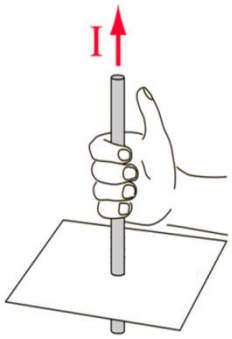
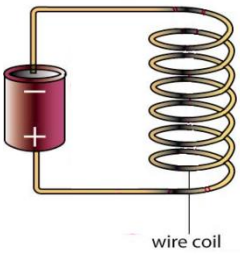
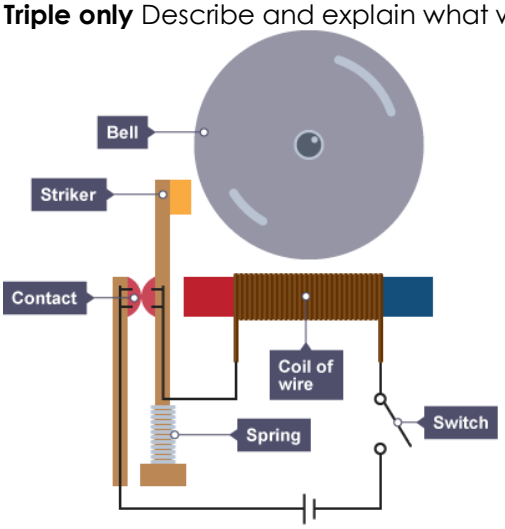
(5)

Resistance = ... Ω

Book Ref.	Spec. Ref.	National grid
	CS 6.2.4.3 Triple 4.2.4.3	1. Label the parts of the national grid.  2. The voltage produced at the power station is approximately 25,000V. Explain why a step up transformer is used to increase the voltage. 3. Explain why it is necessary to decrease the voltage before it goes to people's houses. **Prove It!** Electricity is distributed from power stations to consumers along the National Grid. The voltage across the overhead cables of the National Grid needs to be much higher than the output voltage from the power station generators. Explain why. .... **(3)**

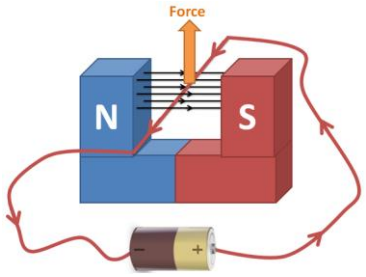
Electricity		
Book Ref.	**Spec. Ref.**	**Static electricity**
	Triple only 4.2.5.1 4.2.5.2	1. The diagram below shows what could happen when two insulating material are rubbed. Explain why object B became positively charged.  2. Object B is brought near another charged object, Object C. Describe what would happens if object C is negative or positive. 3. If enough charge builds up a static shock can occur. In terms of particles explain what happens during a static shock.  Draw electric field around the positively charged particle below. Describe how the strength of the electric field depends on the distance from the particle. + 4. Describe what will happen if a negatively charged particle is placed in the field. What is the name given to forces which act without the particles touching? **Prove It!** Draw the electric field pattern around the metal dome when it is isolated from its surroundings. Use arrows to show the direction of the electric field. (2)  Another positively charged object is placed in the electric field. In which position would the object experience the greatest force? (1)

Electricity		
Book Ref.	**Spec. Ref.**	**Magnetic fields**
	CS 6.7.1.1 6.7.1.2 Triple 4.7.1.1 4.7.1.2	1. Draw the magnetic fields around this magnet. N S 2. Where in your diagram is the magnetic field the strongest? What happens to the strength of the field you increase the distance from the magnet? 3. Describe what would happen if a second north pole was placed near the north pole above. 4. Describe what would happen if the north pole was placed near the south pole? Explain the direction of the arrows on your magnetic field. 5. Describe the difference between a permanent magnet and an induced magnet. 6. List 4 different magnetic materials. 7. The north pole of a bar magnet is pointed at a block of magnetic material. The bar magnet is rotated so the south pole faces the block of magnetic material. Describe what happens in each case. 8. What creates the magnetic field around the earth? Describe and explain the behaviour of a magnetic compass as it moves around the earth. 

Electricity		
Book Ref.	**Spec. Ref.**	**Electromagnetism**
	CS 6.7.2.1 Triple 4.7.2.1	1. Current flowing through a wire produces a magnetic field around itself. Draw the magnetic field on the diagram below. Explain how the strength of the magnetic field depends on distance.  2. The diagram below shows a solenoid. Draw the magnetic field around it and describe 3 ways to increase the strength of the magnetic field.  3. In the diagram above where is the strength of the magnetic field greatest? 4. **Triple only** Describe and explain what will happen when the switch is closed. 

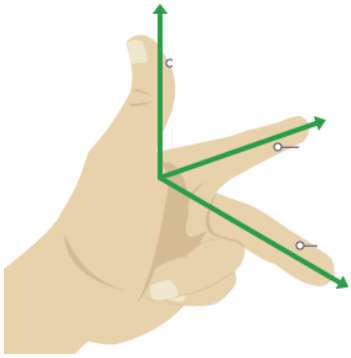
Book Ref.	Spec. Ref.	Fleming's left-hand rule
	CS 6.7.2.2 (HT only) Triple 4.7.2.2 (HT only)	

1. When a _____ carrying conductor is placed in a _____ _____ the magnet and the conductor exert a _____ on each other. This is known as the _____ effect.
2. Describe 3 ways in which the force on the wire can be increased.



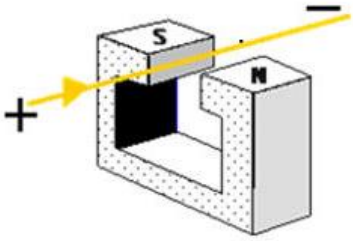
3. A current carrying wire of length 0.03m is placed at right angles to the field from a magnet. The magnetic flux density, B produced by the magnet is 0.05T. A current of 3.0A flows through the wire. Use the equation $F = BIl$ to calculate the force on the wire.

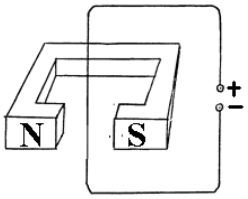
4. Fleming's left hand rule can be used to determine the direction of the force on the wire.



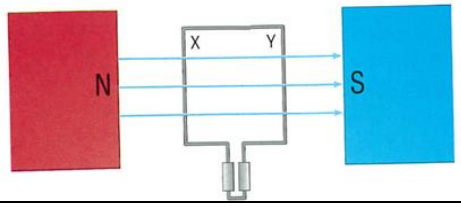
	What does it represent?	Rule for finding direction?
First finger		
Se**c**ond finger		
Thu**m**b		

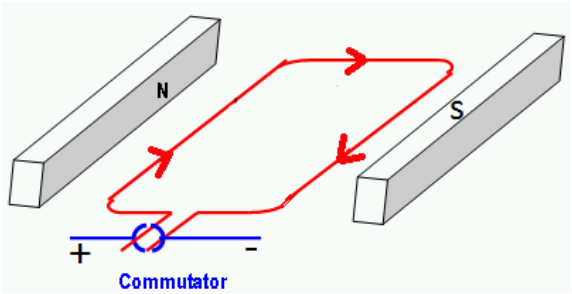
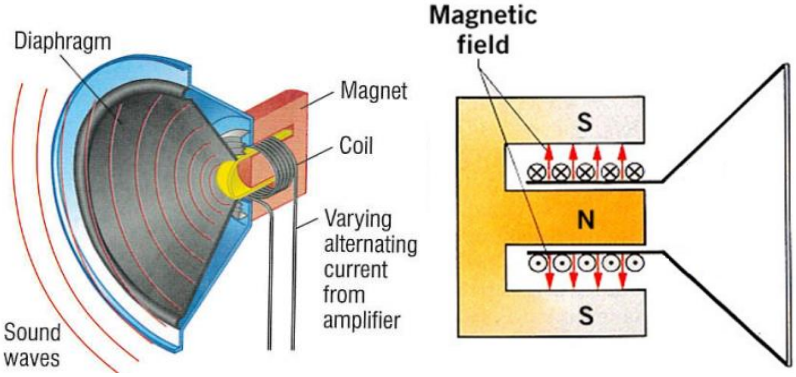
5. Add arrows to the diagrams below to show the direction of the force on the wires.





6. In the diagram below what is the force on the section between X and Y? Explain your answer.

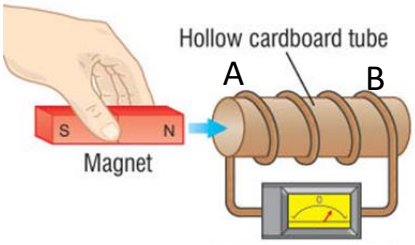


Electricity		
Book Ref.	**Spec. Ref.**	**Electric motors and loudspeakers**
	CS 6.7.2.3 (HT only) 6.7.2.4 (HT and physics only) Triple 4.7.2.3 (HT only) 4.7.2.4 (HT and physics only)	1. **HT only** In the diagram below a coil of wire carrying current in a magnetic field acts as a electric motor. Using the left hand rule add arrows to show the forces on each side of the coil.  2. Explain the function of the split ring commutator. 3. **Triple and HT only** A loud speaker is made by wrapping a coil around a magnet as shown on the first diagram below. When a current flows through the coil it experiences force which pushes the Diaphragm.  On the second diagram ⊗ represent current going into the page and ⊙ represent current coming out of the page. Using the left hand rule add arrows to the second diagram to show the direction in which the Diaphragm will move. 4. Explain why an alternating current is used.

Electricity		
Book Ref.	**Spec. Ref.**	**Induced potential**

Triple and HT only 4.7.3.1

1. If an electrical conductor _____ relative to a magntic _____ or if there is a _____ in the magnetic field around a conductor. A potential difference is _____ across the ends of the conductor. If the conductor is part of a complete circuit, a _____ is induced in the conductor. This is called the _____ effect.
   The induced _____ generates a magnetic field that _____ the original change, either the movement of the conductor or the change in magnetic field.
2. In the diagram below describe 3 ways in which a greater potential difference can be induced in the coil of wire.

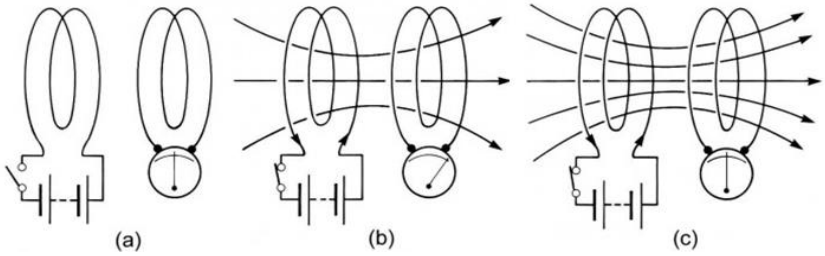


3. As the person pushes the magnet into the side A of the coil she feels a force pushing her back. Describe what is happening in the coils in order to make this happen.

4. Describe and explain what will happen if the North Pole is pulled away from side A of the coils.

5. The magnetic is moved into the middle of the coil and held at rest. Describe and explain the effect on the induced potential.

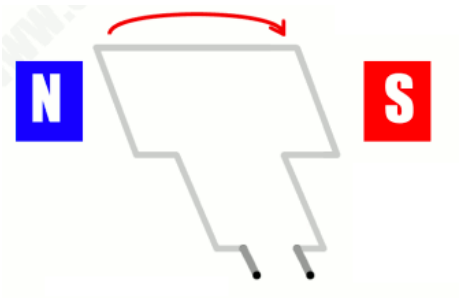
6. The diagrams below show what happens as soon as the switch in the 1st circuit is closed and what happens after the switch has been on for a long time. Explain the observations.

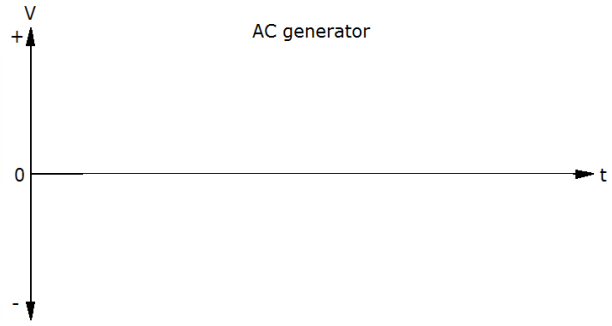


Electricity

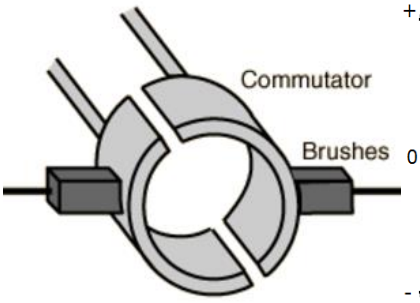
Book Ref.	Spec. Ref.	Uses of the Generator Effect and Microphones
	Triple and HT only 4.7.3.2 4.7.3.3	

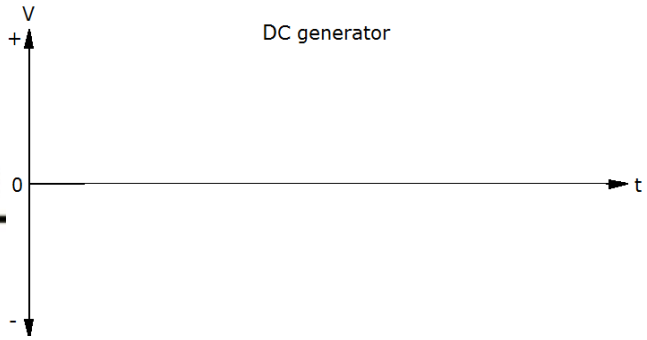
1. The diagram shows an alternator. Describe and explain what happens when the coil is spun around. Sketch the graph of induced potential difference against time.



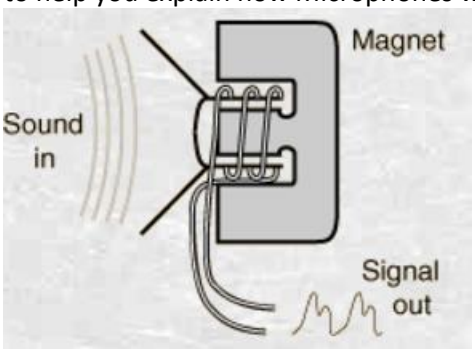


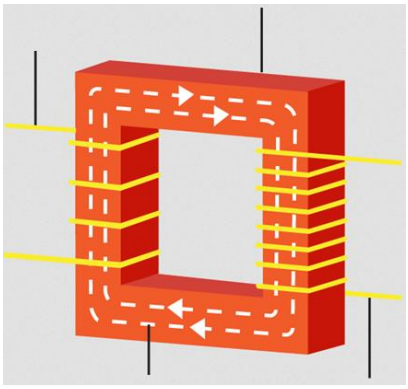
2. Adding a split ring commuter to the alternator turns it into a DC dynamo. Sketch a graph to show how the induced potential difference against time changes. Explain your answer.





3. Microphones convert the energy from sound waves into electricity. Use the diagram below to help you explain how Microphones work.

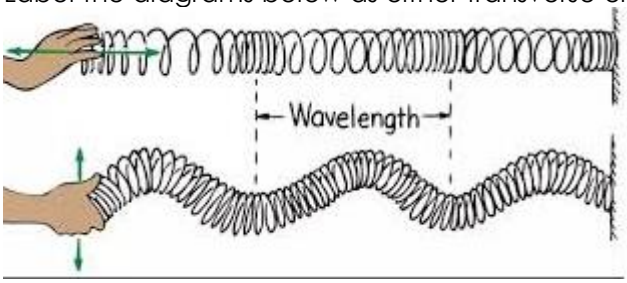


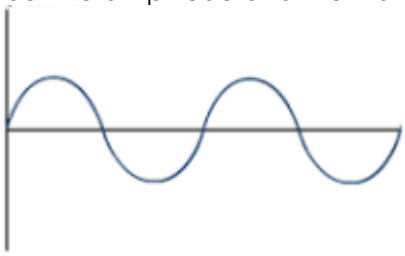
Book Ref.	Spec. Ref.	Transformers
	Triple and HT only 4.7.3.4 MS3b MS3c	1. Label the diagram of the transformer shown below.  2. Explain the choice of material for the core of the transformer. 3. Is the transformer shown above a step up or step down transformer? Explain your answer. 4. Without calculation if number of primary coils is 30 and the number of secondary coil is 10, what effect will this have on the output voltage? 5. The number of turns of the primary coil is 30 and the number of turns on the secondary coils 100 and the potential difference in the primary coil is 12V. Calculate the potential difference in the secondary coil by using the equation $\frac{V_P}{V_S} = \frac{N_P}{N_S}$. 6. The current and voltage in the primary coil is 5A and 230V. The voltage in the secondary coil is 10V. Use the equation $V_s I_s = V_p I_p$ to calculate the current in the secondary coil. 7. $I\,V$ represents power. What assumption is made when using the equation $V_s I_s = V_p I_p$. 8. Transformers only work when a alternating current is applied to the primary coil. Explain how transformers work.

Waves Keywords

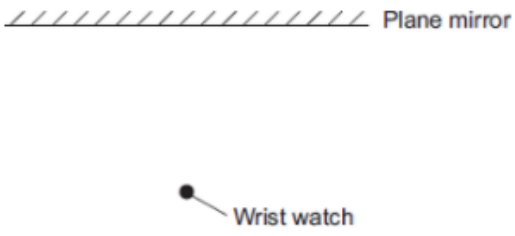
Add all the important keywords for this big idea in the grid below as you come across them in the study pack.

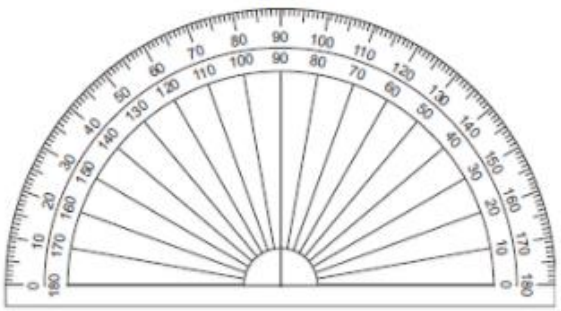
Word	Definition

Waves		
Book Ref.	**Spec. Ref.**	**Transverse and Longitudinal Waves**
	CS 6.6.1.1 Triple 4.6.1.1	1. Label the diagrams below as either transverse or longitudinal.  2. On the diagram above label a compression and a rarefaction on the longitudinal wave. 3. Explain the difference between longitudinal and transverse waves. Give an example of each in your explanation. 4. Describe the evidence that during a sound or water wave, particles (air or water) do not travel.
		Prove It! Waves may be either longitudinal or transverse. (a) Describe the difference between a longitudinal and a transverse wave. .... **(2)** (b) Describe **one** piece of evidence that shows when a sound wave travels through the air it is the wave and not the air itself that travels. .... **(1)**

Waves		
Book Ref.	**Spec. Ref.**	**Properties of Waves**
	CS 6.6.1.2 Triple 4.6.1.2	1. Label the amplitude and the wavelength on the wave below:  2. Define the term 'frequency'. 3. What is the equation to calculate a period? Give the units of each component. 4. What is the equation that links frequency, wavelength and wave speed? Give the units for each component. 5. Outline a method to measure the speed of sound in air.
	MS1a MS1b MS3b MS3c	Maths Skills 1. The frequency of an ocean wave is measured as 0.2Hz. Calculate the period of this wave. Include units with your answer and give it to an appropriate number of significant figures. 2. A wave has a frequency of 4.0 x 107 Hz and a speed of 3.0 x 108 m/s. Find its wavelength. Give your answer in decimal form. 3. The wavelength of a wave is 1.2m and exactly 2 complete waves are produced per second. Calculate the speed of the wave. Give your answer to an appropriate number of significant figures.
Waves		

Book Ref.	Spec. Ref.	RPA8 (triple), RPA 20 (CS) **Make observations to identify the suitability of apparatus to measure the frequency, wavelength and speed of waves in a ripple tank and waves in a solid and take appropriate measurements.**
	CS 6.6.1.2 Triple 4.6.1.2 AT4 WS2.2 WS2.3 WS2.6 WS3.4 WS3.8	1. Describe how a ripple tank can be set up to measure the speed of a wave. Include any measurements you will need to take and any calculations you will need to do. 2. Explain why the waves appear not to move when you reach a certain frequency. 3. A student conducted an experiment and she noticed the shadow lines were very close together which was making it very hard to measure the wavelength. How could she improve her results? Why would they be better? 4. A different student wanted to measure the speed of waves through a solid. Outline an experiment they could do to obtain these results. 5. All results contain uncertainty. What does this mean?

Book Ref.	Spec. Ref.	Reflection of Waves
	Triple only 4.6.1.2	1. When a wave hits a boundary, what are the 3 possible outcomes? 2. **Diagram 2** shows the apparatus a teacher uses to demonstrate that sound can be reflected. **Diagram 2**  (i) Using a ruler, draw on **Diagram 2** to show how sound from the loudspeaker is reflected by the sheet of metal to the sound sensor. 3. In the question above, the sheet of metal was replaced first with a sheet of this paper then with a piece of thick glass. Explain what would happen to the readings on the sound level meter in each case. a) With the paper b) With the glass 4. A student holds a wrist watch in front of a plane mirror. The student can see an image of the wrist watch in the mirror. The diagram shows the position of the wrist watch and the mirror.  Draw a ray diagram showing how the image of the wrist watch is formed. Mark the position of the image.

Waves		
Book Ref.	**Spec. Ref.**	**RPA9** **Investigate the reflection of light by different types of surface and the refraction of light by different substances.**
	CS 6.6.1.3 Triple 4.6.1.3 AT4, 8 WS2.2 WS2.3	1. A student wanted to investigate the refraction of light by different surfaces and was given a ray box and a number of blocks made of different materials. Outline what the student should do with this equipment for their investigation.
	WS1.2 MS5a	2. Draw a ray diagram to show a typical refraction of light entering and exiting a Perspex block. You should label the incident, refracted and emerging rays as well as the angle of incidence and refraction.
		3. Explain why different material blocks would give rise to different angles of refraction.
		4. What would happen if the ray of light was shone along the normal?
	WS3.4	5. **Figure 2** shows the protractor used to measure angles ***i*** and ***r***. **Figure 2**  What is the resolution of the protractor?
		6. A student measured 101°. What is the uncertainty of this measurement?

In an investigation, a student always aims the light from the ray box at point **P**.
She moves the ray box to give different values of angle *v*.
She records angle *y* for each of these values. The table shows her results.

Angle *v* measured in degrees	Angle *y* measured in degrees
30	19
40	25
50	31
60	35
70	39
80	41

The student studies the data and comes to the following conclusion.

> Angle *y* is directly proportional to angle *v*.

MS3a

Her friend says that this conclusion is **not** correct.

(i) Use data from the table to explain why the conclusion is **not** correct.

.....

(ii) Write a correct conclusion for the experiment.

.....

WS2.7

.....

(iii) Why is your conclusion only valid when angle *v* is between 30° and 80°?

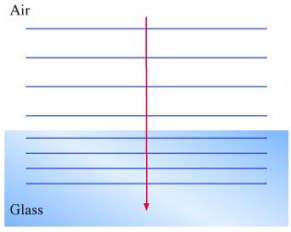
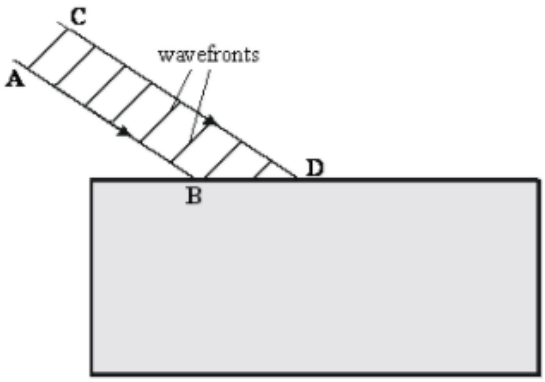
.....

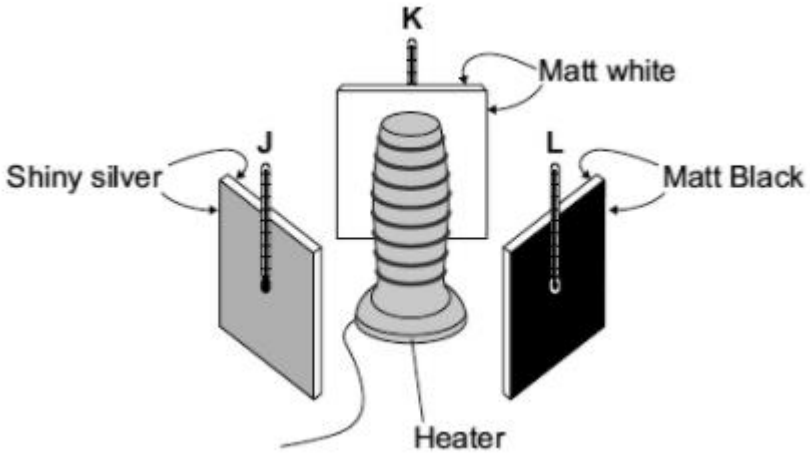
.....

Waves		
Book Ref.	**Spec. Ref.**	**Sound Waves**
	Triple only 4.6.1.4 (HT)	1. Are sound waves longitudinal or transverse? 2. How do sound waves travel… a) in air? b) in a solid? 3. What happens when a sound wave reaches the ear drum? 4. Why can dogs hear some sounds that humans cannot? 5. What is the normal range of human hearing?
	WS4.5	Maths Skills Convert the following: a) 10 Hz is _____ kHz b) 100 Hz is _____ kHz c) 1000 Hz is _____ kHz d) 1 kHz is _____ Hz e) 1.6 kHz is _____Hz f) 10^3 kHz _____ Hz

Waves		
Book Ref.	**Spec. Ref.**	**Waves for Detection and Exploration**
	Triple only 4.6.1.5 (HT)	1. What is an ultrasound wave? What frequency would it be? 2. How is ultrasound used to produce the image of an unborn baby? 3. How are seismic waves produced? What are the 2 types? 4. Explain how the 2 types of seismic wave provide evidence for the structure and size of the Earth's core. 5. Describe how depth detectors on boats work.
		Prove It! The picture shows a pre-natal scan obtained using ultrasonic waves.  (i) Explain how ultrasonic waves are used to produce the image of an unborn baby. .... **(2)** (ii) Give another use for ultrasonic waves. ..... **(1)**
Waves		

Book Ref.	Spec. Ref.	Types of Electromagnetic Waves
	CS 6.6.2.1 Triple 4.6.2.1	1. Give the names of the waves in the electromagnetic spectrum in order from longest wavelength to shortest wavelength. 2. Which electromagnetic wave has the highest frequency? 3. Identify the colour in the visible light part of the spectrum that has the highest frequency. 4. All electromagnetic waves travel at the same speed but have different wavelengths. Use the equation for wavespeed to explain how this is possible? 5. Give one example where energy is transferred by electromagnetic waves.
		Prove It! The figure below shows an incomplete electromagnetic spectrum. A **microwaves** B C **ultraviolet** D **gamma** (a) What name is given to the group of waves at the position labelled **A** in the figure above? Tick **one** box. infrared ☐ radio ☐ visible light ☐ X-ray ☐ **(1)**

Waves		
Book Ref.	**Spec. Ref.**	**Properties of Electromagnetic Waves**
	CS 6.6.2.2 (HT only) Triple 4.6.2.2 (HT only)	1. Draw a ray diagram to show the refraction of a wave at the boundary between two different media – air and a glass block. 2. **HT only** - A wave is travelling between substance A and substance B. The wave travels at the same speed in both substances. Would refraction occur? Explain your answer. 3. **HT only** - This is a wave front diagram. Use this diagram to explain what is happening to the wavelength as it travels from air to glass. **Note the frequency does not change**.  4. Explain why this diagram **does not** show refraction.
		Prove It! **HT only** - The diagram below shows a beam of light striking a perspex block.  (i) Continue the paths of the rays AB and CD inside the perspex block. (ii) Draw the wavefronts of the beam of light in the perspex. (iii) Explain why the beam behaves in the way you have shown. ....

Waves		
Book Ref.	**Spec. Ref.**	**RPA10 (triple), RPA 21 (CS)** **Investigate how the amount of infrared radiation absorbed or radiated by a surface depends on the nature of that surface.**
	CS 6.6.2.2 Triple 4.6.2.2	1. A student set up the equipment below to find out the amount of infrared radiation absorbed by 3 different surfaces: 
	WS2.1	Suggest a hypothesis for this investigation.
	WS2.2	2. What measurements would the students need to take for this investigation?
		3. Outline the control variables for this experiment and why control variables are necessary.
	WS3.7	4. A second student did this experiment but replaced the thermometer with a temperature sensor connected to a computer. What was the advantage of this?
		5. Although the second student used different equipment they still obtained very similar results to the first student. Would these results be considered repeatable or reproducible? Explain the difference.

Waves		
Book Ref.	**Spec. Ref.**	**Properties of Electromagnetic Waves**
	CS 6.6.2.3 Triple 4.6.2.3 WS1.5	1. **HT only** - How are radio waves produced? 2. **HT only** - Explain how radio waves can induce oscillations in an electrical circuit. 3. Explain how gamma rays originate from the nucleus of an atom. 4. What is radiation dose measured in and state the three most dangerous types of electromagnetic radiation. What are the risks of using electromagnetic radiation? 5. Explain the term ionising with respect to gamma and X-rays.
		Prove It! Some types of food are treated with *gamma* radiation. Low doses of radiation slow down the ripening of fresh fruit and vegetables while higher doses of radiation kill the bacteria that make the food go off. (a) (i) What is *gamma* radiation? ..... **(1)** (ii) Food packed in crates or boxes can be treated using this method. Why must a source that emits *gamma* radiation be used? .... **(1)** (iii) A suitable source of gamma radiation is the isotope caesium 137. Complete the following sentence by choosing the correct word from the box. **electrons** **neutrons** **protons** An atom of caesium 137 has two more ..... than an atom of caesium 135. **(1)**

Waves

Book Ref.	Spec. Ref.	Uses and Applications of Electromagnetic Waves

CS 6.6.2.4

Triple 4.6.2.4

WS1.4

1. Complete the table to summarise the practical applications of the electromagnetic waves:

EM Wave	Use	(HT) Why is this wave suited to this use?
Radio waves		
Microwaves		
Infrared		
Visible light		
Ultra-violet		
X-ray		
Gamma ray		

Waves		
Book Ref.	**Spec. Ref.**	**Lenses**
	Triple only 4.6.2.5	1. How does a lens form an image? 2. Complete the table summarising convex lenses:

	Convex	**Concave**
Describe how the lens works		
Draw a diagram to show how the lens works		
How is the lens represented in a ray diagram?		
Can this produce a real image, a virtual image or both?		

3. Define the term 'focal length'.

4. What is the equation that links magnification, image height and object height?

5. Why does magnification have no units?

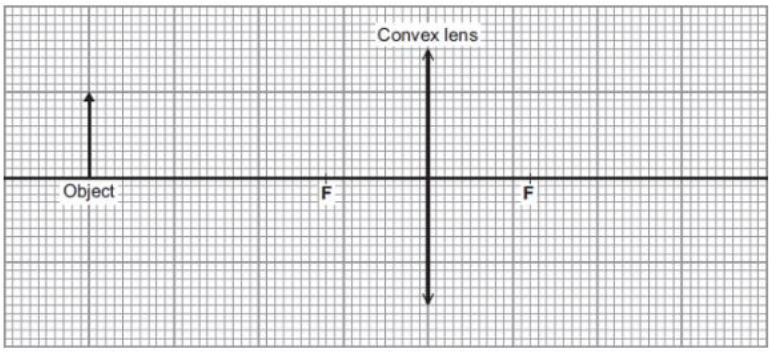
6. Calculate the magnification of an object that is 14mm tall but the virtual image is 35mm tall when placed under a magnifying glass.

MS1c

	Triple only 4.6.2.5	Prove it!

(a) A camera was used to take a photograph. The camera contains a convex (converging) lens.

Complete the ray diagram to show how the lens produces an image of the object.



F = Principal focus

(4)

(b) State **two** words to describe the nature of the image produced by the lens in the camera.

1 .....

2 .....

(2)

(Total 6 marks)

Waves		
Book Ref.	**Spec. Ref.**	**Visible Light**
	Triple only 4.6.2.6	1. What colours make up white light? 2. Draw a diagram to show specular and diffuse reflection. How are they different? 3. What does the term 'opaque' mean? 4. How is the colour of an opaque object determined? 5. What is happening to white light when an object appears… a. White? b. Black? 6. What is the name for objects that transmit light? 7. Why do red trousers appear black if a red filter is used? 8. What colour will a red pen appear when looked at through a blue filter? Explain your answer.
		Prove It! A student is wearing glasses with a red filter for lenses. He stands at looks at a set of traffic lights. What colour will the red, amber and green lights appear through the glasses?

Waves		
Book Ref.	**Spec. Ref.**	**Perfect Black Bodies and Radiation**
	Triple only 4.6.3.1 4.6.3.2	1. What do all bodies (objects) emit? 2. What is the relationship between an objects temperature and the amount of infrared radiation it absorbs/emits in a given time? 3. What is a perfect black body? 4. What does the intensity and wavelength of the emission depend on? 5. **HT only –** What can be said about the absorption and emission of radiation if an object remains at a constant temperature? 6. **HT only –** What does the temperature of the Earth depend on? 7. **HT only** - Why are cloudy nights generally warmer than clear nights?
		Prove It! Liquid coolant, heated by the car engine, enters the radiator. As the coolant passes through the radiator, the radiator transfers energy to the surroundings and the temperature of the coolant falls. (a) Why is the radiator painted black? .... **(2)**

Energy Keywords

Add all the important keywords for this big idea in the grid below as you come across them in the study pack.

Word	Definition

Book Ref.	Spec. Ref.	Energy Stores and Systems
	CS 6.1.1.1 Triple 4.1.1.1	1. Complete the table to summarise the types of energy stores and an explanation:

Energy Store	Objects with energy in this store
Kinetic	Anything moving has energy in its kinetic energy store e.g. a car.
Electrostatic	
Nuclear	
Thermal	

2. A system is an object or group of objects. What is a closed system?

3. Describe the changes in stored energy that occur in…

a) An electric kettle boiling water.

b) A car braking and coming to a stop.

c) A tennis ball hitting a racket.

Prove It!

The student jumps off the bridge.

Complete the sentences to describe the energy transfers.

Use answers from the box.

elastic potential	gravitational potential	kinetic	sound	thermal

Before the student jumps from the bridge he has a store of

..... energy.

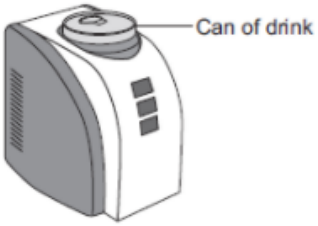
When he is falling, the student's store of ..... energy increases.

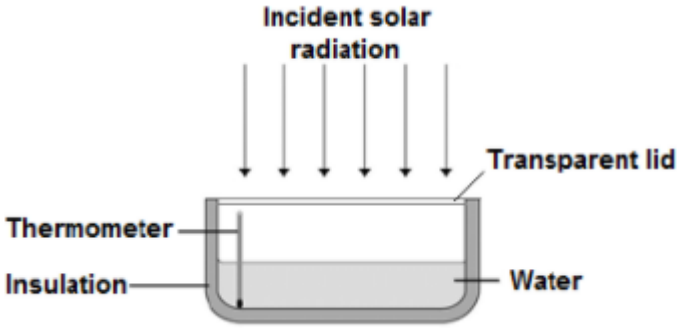
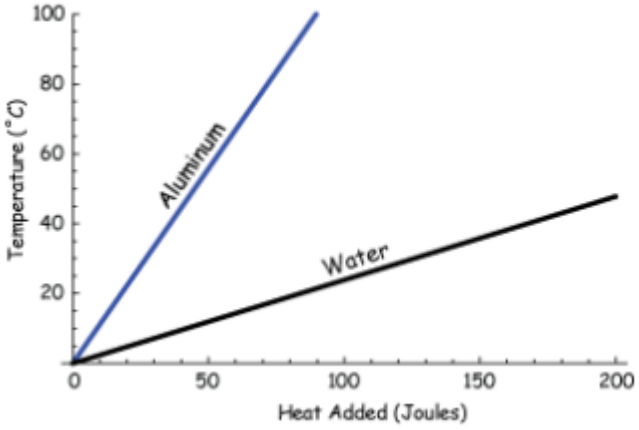
When the bungee cord is stretched, the cord stores energy as

..... energy.

(3)

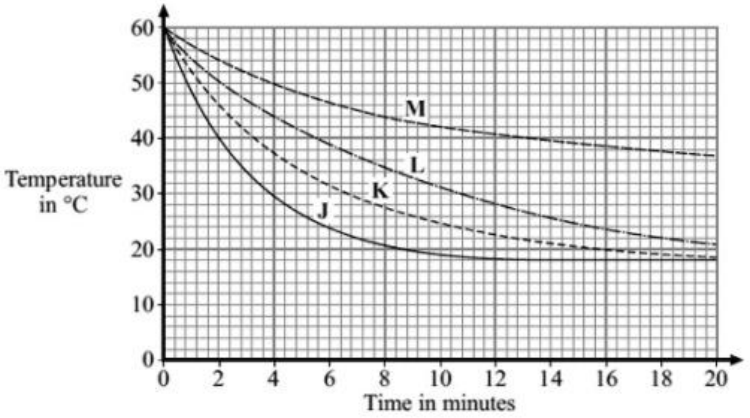
Book Ref.	Spec. Ref.	Changes in Energy
	CS 6.1.1.2 Triple 4.1.1.2 WS4.3	1. State the equation that links kinetic energy, mass and velocity. Give units for each. 2. The equation to calculate elastic potential energy is: elastic potential energy = 0.5 × spring constant × (extension)^2 $\quad E_e = \frac{1}{2} k e^2$ State the units for each of the variables in the equation. 3. State the equation that links gravitational potential energy, height, gravitational field strength and mass. Give units for each. 4. From the equations above, which would you use to calculate… a) Energy of a moving object? b) Energy of an object raised off the ground? c) Energy stored in a stretched spring? 5. In a closed system, if a raised object had 20,000J of gravitational potential energy stored before it was dropped, how much kinetic energy would it have when it was dropped? What is the law called?
	MS1b MS2a MS3b MS3c	Maths Skills 1. A van of mass 2450kg is travelling at 40.0m/s. Calculate the energy in its kinetic energy store. Give your answer in standard form. 2. A moped with 1.17 x 10^4 J of energy in its kinetic energy store travels at 12.0m/s. What is the mass of the moped? Give your answer to an appropriate number of significant figures. 3. A 50kg mass is raised through a height of 6m. Find the energy transferred to its gravitational potential energy store. The gravitation field strength is 9.8N/kg on Earth. 4. A flea of mass 1.0 x 10^{-3}g jumps vertically from the ground. At the top of the jump the flea has gained 1.96x10^{-6}J of energy in its g.p.e store. How high has the flea jumped? 5. The flea from Q5 falls from the top of the jump. Assuming there is no air resistance, calculate the speed of the flea when it hits the ground. Give your answer to 2 significant figures.

Energy		
Book Ref.	**Spec. Ref.**	**Energy Changes in Systems**
	CS 6.1.1.3 Triple 4.1.1.3	1. What is the equation that links specific heat capacity, mass, change in thermal energy and temperature change? Give units for each. 2. What is the definition of specific heat capacity?
		Prove It! A 'can-chiller' is used to make a can of drink colder. **Figure 1** shows a can-chiller. **Figure 1**  (a) The can-chiller decreases the temperature of the liquid in the can by 15 °C. The mass of liquid is 0.33 kg. The specific heat capacity of the liquid is 4200 J / kg °C. Calculate the energy transferred from the liquid as it cools. .... Energy = ... J **(2)** (b) Complete the following sentence. The specific heat capacity of a substance is the amount of energy required to change the ..... of one kilogram of the substance by one degree Celsius. **(1)**
	MS3b	**Maths Skills** 1. Water has a specific heat capacity of 4200J/kg°C. How much energy is needed to heat 2.00kg of water from 10°C to 100°?

Energy		
Book Ref.	**Spec. Ref.**	**RPA1 (triple) RPA14 (CS)** **Investigation to determine the specific heat capacity of one or more materials. The investigation will involve linking the decrease of one energy store to the increase in temperature and subsequent increase in thermal energy stored.**
	CS 6.1.1.3 Triple 4.1.1.3 AT1,5 WS2.7 MS3a MS4d	1. A student set up the apparatus below:  She wanted to calculate the thermal energy change over an hour. She knew the specific heat capacity of water is 4200J/kg°C. What other measurements would she need to take? 2. Why would this calculation not give her an exact value for the thermal energy from the Sun? How could she improve her experiment? 3. As mass and and specific heat capacity are constants. The results should show that energy transferred is directly proportional to change in temperature. What does that mean? What is the symbol used to show to variables are directly proportional? 4. The graph below shows the energy transferred as 2 materials are heated:  Calculate the gradient of the line for water. What is the intercept?

Energy		
Book Ref.	**Spec. Ref.**	**Power**
	CS 6.1.1.4 Triple 4.1.1.4 MS3b MS3c	1. What is the definition of power? 2. What is the equation that links power, energy transferred and time? Give units. 3. What is the equation that links power, work done and time? Give units. 4. What can you infer from the 2 equations about energy transferred and work done? 5. What is 1 Watt in Joules/second? 6. Two cars are identical in every way except the power of their engines. They completed the same race but the car with the more powerful energy crossed the line first. Explain why in terms of energy transferred. 7. Two electric motors lift 20kg. Motor A does this in 3 seconds and motor B does this in 5 seconds. Which is the more powerful? Why? 8. Two different electric motors lift two different objects. The first motor requires 8000J to lift object A to the top of a building and it takes 40s. The second motor requires 20,000J to life object B to the top of the same building and it takes 20s. Which motor is more powerful? Use calculations in your answer.
		Prove It! A company that makes light bulbs provides information about some of their products. The table shows some of this information. **Power in watts** / **Lifetime in hours** / **Cost of bulb in £** **Filament bulb**: 60 / 1250 / 2.00 **LED bulb**: 12 / 50 000 / 16.00 (i) Suggest why it is important to confirm this information independently. ..... **(1)** (ii) A homeowner is thinking about replacing his filament bulbs with LED bulbs. A 12 W LED bulb gives the same light output as a 60 W filament bulb. Suggest reasons why the homeowner is likely to choose LED bulbs. Use the information given in the table. (2)

Energy		
Book Ref.	**Spec. Ref.**	**Energy Transfers in a System**
	CS 6.1.2.1 Triple 4.1.2.1	1. Complete the sentence: Energy cannot be …….. or …….. It can only be transferred, stored or dissipated. 2. What does the term dissipated mean? Give an example. 3. What type of energy is most likely to be dissipated? 4. What happens to the surroundings when energy is dissipated? 5. Name the energy transfers taking place in… a) A hairdryer. b) A mobile phone. c) A compressed spring 6. A student oiled the gears on his bike. What is the name of this process? Explain how this reduced unwanted energy transfers. 7. A metal spoon has higher thermal conductivity than a wooden spoon. What does this mean? 8. When designing a house, builders consider the thickness of the walls and the thermal conductivity of the materials used to build the walls. Explain why. 9. What other design features are built into houses to minimise unwanted energy transfers?
		Prove It! Which **two** of the following statements are true? Tick (✓) **two** boxes. Appliances only transfer part of the energy usefully. ☐ The energy transferred by appliances will be destroyed. ☐ The energy transferred by appliances makes the surroundings warmer. ☐ The energy output from an appliance is bigger than the energy input. ☐

Book Ref.	Spec. Ref.	RPA2 Investigate the effectiveness of different materials as thermal insulators and the factors that may affect the thermal insulation properties of a material.
	Triple only 4.1.2.1 AT1,5 WS2.1 WS2.2 WS3.7	1. A student wanted to investigate different materials as thermal insulators. The student was given a beaker with a lid, a thermometer, a kettle and a range of different insulating materials. Outline a method that would enable the student to carry out their investigation. 2. List 4 materials the student could test in this experiment. 3. In this experiment identify: a. The independent variable b. The dependent variable. 4. Identify as many control variables as possible and explain how you will control them. Why is it important to control these variables? 5. What is the greatest source of error in this investigation? How could you minimise this? 6. A student did another experiment but this time decided just to use one material and vary the thickness of that material. Write a hypothesis for this investigation.
	WS3.2 WS3.5	**Maths Skills** A student investigated 4 different types of fleece for a warm jacket. Describe the results of the investigation. 

Energy

Book Ref.	Spec. Ref.	Efficiency
	CS 6.1.2.2 Triple 4.1.2.2 MS1c	1. State the equation that links useful output energy transfer, efficiency and total input energy transfer. 2. What is the unit of energy transfer? 3. Why does efficiency have no units? 4. If you wanted to express efficiency as a percentage, what would you have to do to your answer? 5. As well as using energy transfer, efficiency can be measured using another variable. Name that variable. 6. HT only – Look at the old car below and explain how the design of cars has changed to improve their efficiency. 
	MS1a MS3b MS3c	**Maths Skills** 1. A motor is supplied with 250W of power and outputs 120W of useful power. What is the efficiency of the motor? Give your answer as a decimal. 2. A lamp with an efficiency of 74% is supplied with 350J of energy. How much energy is usefully transferred by the lamp?
		Prove It! The total power input to a pumped storage power station is 600 MW. The useful power output is 540 MW. (i) Calculate the efficiency of this pumped storage power station. .... Efficiency = ... **(2)** When the total power input to the motor was 5 W the motor could not lift the 2.5 N weight. State the efficiency of the motor. Efficiency = ... % **(1)**

Energy

Book Ref.	Spec. Ref.	National and Global Energy Resources
	CS 6.1.3 Triple 4.1.3 WS1.3 WS1.4 WS1.6	1. What are the 3 types of fossil fuel? 2. Name 8 other sources of energy. 3. What is the definition of a renewable resource? 4. Identify each of the sources in Q2 as renewable (R) or finite (F). 5. Which of the energy resources are the least reliable? Why? 6. Which of the energy resources have the biggest environmental impact? Outline what these environmental impacts are. 7. If scientists know about the negative impacts to the environment of using some of these energy resources, why hasn't everyone stopped using them? 8. Some people don't believe that burning fossil fuels contributes to global warming. Explain why peer review of scientists work is very important.
		Prove It! Information about the two electricity generation systems is given in **Figure 2**. **Figure 2** The wind turbine costs £50 000 to buy and install. The hydroelectric generator costs £20 000 to buy and install. The average power output from the wind turbine is 10 kW. The hydroelectric generator will produce a constant power output of 8 kW. Compare the advantages and disadvantages of the two methods of generating electricity. Use your knowledge of energy sources as well as information from **Figure 2**. **(6)**

Energy		
Book Ref.	**Spec. Ref.**	**Density**

CS
6.3.1.1
6.3.1.2
Triple
4.3.1.1
4.3.1.2

1. State the equation for density with units.

2. Calculate the mass of a block of wood with volume of 0.001 m^3. The density of wood is typically 0.70 x 10^3 kg/m^3. Give the units.

3. Draw a particle diagram for each state of matter.

Solid	Liquid	Gas

4. Describe how the density changes from solid to gas.

5. In terms of the arrangement of particles explain why one of these has significantly lower density.

Prove It!

The information in the box is about the properties of solids and gases.

Solids:
- have a fixed shape
- are difficult to compress (to squash).

Gases:
- will spread and fill the entire container
- are easy to compress (to squash).

Use your knowledge of kinetic theory to explain the information given in the box.
You should consider:
- the spacing between the particles
- the movement of individual particles
- the forces between the particles.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total 6 marks)

Energy

Book Ref.	Spec. Ref.	
		CS: RPA17 **Triple: RPA5**

CS 6.3.1.1 Triple 4.3.1.1

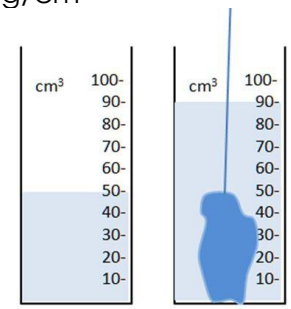
Required Practical: Determine the densities of regular and irregular solid objects and liquids.

1. A 20.00ml sample of liquid is put into an empty beaker that had a mass of 31.44g. The breaker with the liquid was weighed at 55.89g. What is the mass of the liquid?

2. Given 1ml = 1cm^3, calculate the density of the liquid in g/cm^3.

3. The length width and height of a rectangular cuboid is measured using a venire calliper. Length is 21.50cm, width is 5.03cm and height is 10.01cm. Given the mass of the cuboid is 800g. Calculate the density of the object in g/cm^3

4. The mass of the rock shown below is 100g. Calculate the density of the rock in g/cm^3



Prove It!

A student wants to calculate the density of the two objects shown in the figure below.

Metal cube

Small statue

© Whitehoune/iStock/Thinkstock, © Marc Dietrich/Hemera/Thinkstock

Describe the methods that the student should use to calculate the densities of the two objects.

.....

.....

.....

.....

.....

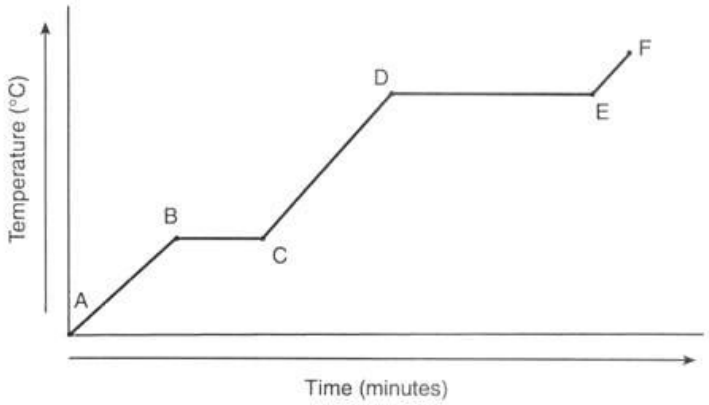
.....

.....

(Total 6 marks)

Energy

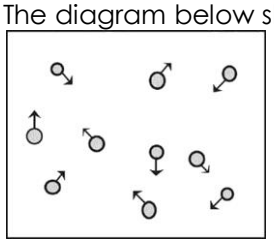
Book Ref.	Spec. Ref.	Internal energy and specific heat capacity

	CS 6.3.2.1 6.3.2.2 Triple 4.3.2.1 4.3.2.2	1. What is meant by the term internal energy? 2. The diagram below shows what happens as ice is heated until it becomes steam.  For each example describe and explain the change in internal energy. a) C-D Water is heated from 0°C to 100°C b) B-C Ice is melted into water at 0°C. 3. Define the term specific heat capacity. 4. The increase in temperature can be determined using the following equation: $\Delta E = m\, c\, \Delta\theta$. How much energy is needed to heat 0.2kg of oil from 10°C to 60°C. The heat capacity of oil is 2000J/kg°C. 5. Define specific latent heat of fusion. 6. Define specific latent het of vaporisation. 7. When 0.15kg of a molten metal is allowed to solidify it released 75000J of energy. Using the equation $E = mL$ calculate the specific latent heat of fusion of metal. Give the units. 8. Explain when specific heat capacity and specific latent heat are used.
Energy		
Book Ref.	**Spec. Ref.**	**Particle motion in gases**

CS 6.3.3.1

Triple 4.3.3.1

1. The diagram below shows gas particles in a box. Describe their motion.

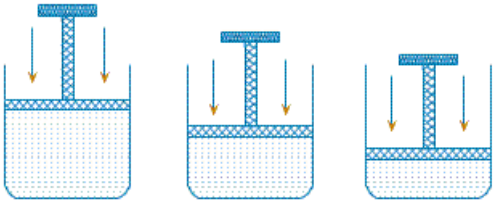


2. Describe the effect that adding heat has on the temperature and motion/energy of the particles.

3. What causes pressure on the walls of the container? Explain what will happen to the pressure if the temperature is increased but the volume kept constant.

4. Sketch a graph of pressure against temperature.

5. **Physics only**. By considering the force on the piston from the motion of the particles, describe and explain the effect on pressure as a result of pressing down on the piston (assume mass of the gas and temperature is constant).



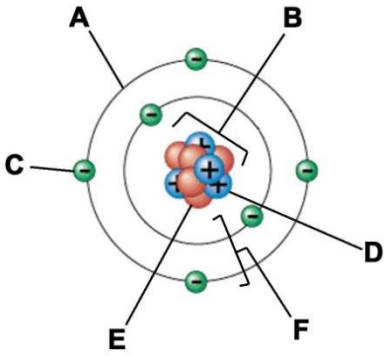
6. The pressure of the gas is initially 200kPa and its volume is 0.30m^3 Calculate the pressure when the volume is reduced to 0.12m^3. Use the equation $pV = constant$ and give your answer to 2 significant figures with units.

7. **Physics only HT only**. The term work done and energy transferred are equivalent. A person pressing down on a bike pump does work on the gas. Describe and explain the effect this has on the gas.

Energy

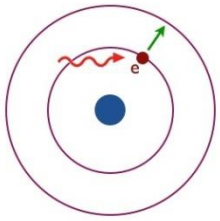
Book Ref.	Spec. Ref.	Atoms isotopes and ions
	CS 6.4.1.1 6.4.1.2 Triple 4.4.1.1 4.4.1.2	

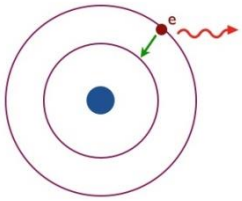
1. Label the structure of the atom from A-F. Give the charge and mass of the sub atomic particles.



2. State the approximate radius of an atom in meters. How much smaller is the nucleus compared to the whole atom?

3. The diagrams below show how electrons can move between energy levels. Describe what is happening in each diagram.





4. Complete the table for an atom of sodium.

$^{23}_{11}Na$

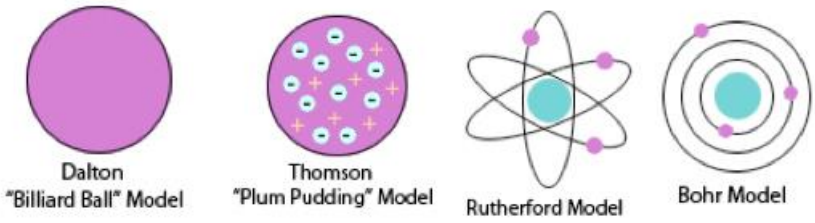
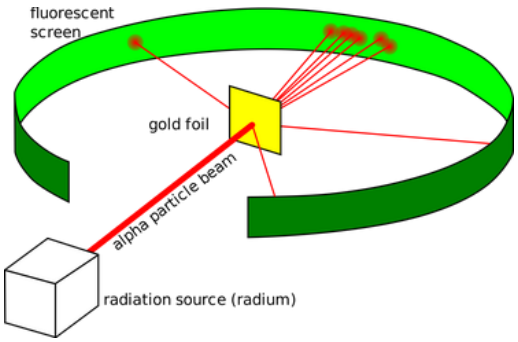
Mass number	
Atomic number	
Number of electrons	
Number of neutrons	

5. Describe, with the help of numbers the difference and similarities between the atoms shown below.

$^{12}_{6}C$ $^{13}_{6}C$ $^{14}_{6}C$

6. The carbon atoms above are neutral. Explain how a positive carbon ion can be produced from one of these atoms.

Energy

Book Ref.	Spec. Ref.	Model of the atom
	CS 6.4.1.3 Triple 4.4.1.3 WS1.1	1. The world was once believed to be flat. Explain why scientific models change over time. The following questions refer to change in the model of atoms shown below.  2. The discovery of the electron led to the formation of the plum pudding model. Describe the plum pudding model. 3. According to the plum pudding model firing alpha particles at atoms is like firing a bullet at paper. The diagram below shows the results of the alpha particle scattering experiment. Complete the table.  4. Describe how Bohr modified the nuclear model of the atom. 5. Suggest why the neutron wasn't discovered until 20 years after the discovery of the nucleus.

Observation	Conclusion
Most alpha particles went straight through	
A few alpha particles were deflected back by more than 90°	

Energy

Book Ref.	Spec. Ref.	Radioactive decay and nuclear radiation

CS 6.4.2.1 6.4.2.2

1. Uranium-238 is an example of an unstable isotope. What will eventfully happen to unstable atoms? Explain why.

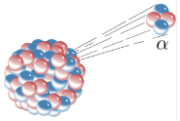
Triple 4.4.2.1 4.4.2.2

2. Describe what effect, if any, increasing temperature or pressure has on the rate of radioactive decay. Explain your answer.

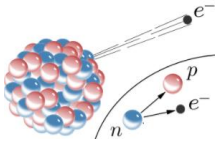
3. Why alpha, beta and gamma particles are called ionising radiation.

4. A Geiger-Muller tube can be used measure the activity of a radioactive source. Define the term *activity* and give its units.

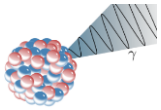
5. The diagram below shows the alpha decay of $^{238}_{92}U$. Write an equation for the decay.



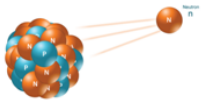
6. The diagram below shows the beta decay of $^{234}_{90}Th$. What's happening in the nucleus is shown in the corner. Write an equation for the decay.



7. The diagram below shows the gamma emission from $^{240}_{94}Pu$. Write an equation for the decay.



8. The diagram below shows the neutron emission from a $^{13}_{4}Be$.

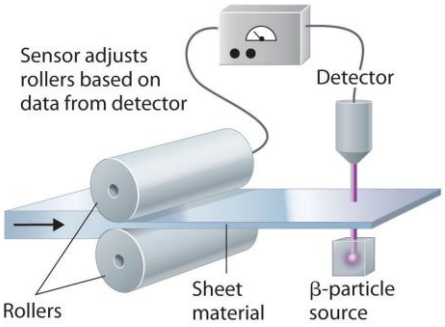


9. Complete the table.

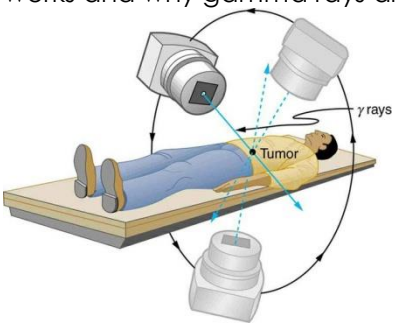
Type of radiation	Stop by which material?	Range in air	Ionising power (rank from 1st to 3rd)
Alpha			
Beta			
Gamma			

10. The diagram below shows how smoke alarms use alpha particles. Explain why the smoke causes the alarm to sound.

11. The diagram below shows how beta particles are used to monitor the thickness of paper. Describe and explain what will happen if the paper comes in too thick.

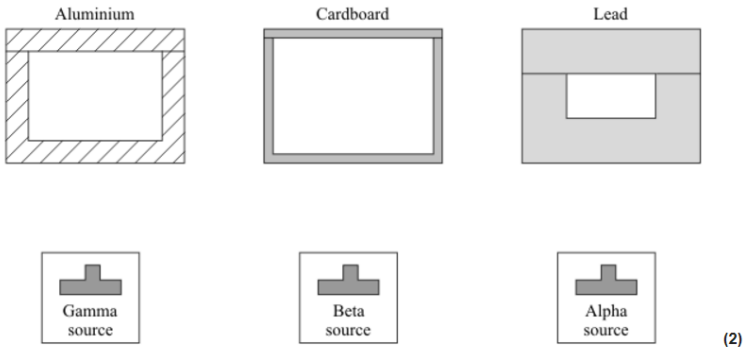


12. Gamma rays are be used in radiotherapy. Explain the how the machine shown below works and why gamma rays are used rather than beta and gamma.

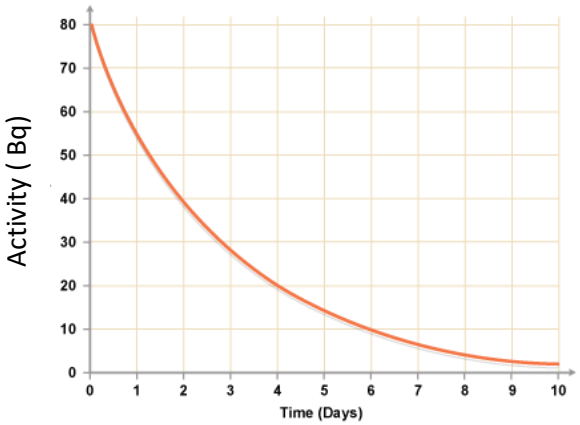


Prove It!

The diagram shows three different boxes and three radioactive sources. Each source emits only one type of radiation and is stored in a different box. The box reduces the amount of radiation getting into the air.



Draw **three** lines to show which source should be stored in which box so that the minimum amount of radiation gets into the air. **(2)**

Energy		
Book Ref.	**Spec. Ref.**	**Half-lives and the random nature of radioactive decay**
	CS 6.4.2.3 6.4.2.4 Triple 4.4.2.3 4.4.2.4 WS1.5	1. Define the term half-life. 2. Use the diagram below to determine the half-life of the sample.  **3.** **HT only** A radioactive sample contains 200mg of a radioactive isotope. The half life of the isotope is 5 hours. Calculate how much of the sample will be radioactive after 20hours. 4. Due to the nature of radioactive decay, the mass of radioactive isotopes left cannot be predicted this accurately. Explain why. **5.** HT only The half life of a radioactive sample is 3 days. What fraction of the sample will still be radioactive after 9days. **6.** **HT only** The activity of an old block of wood is 25 counts per minute. The activity of a living block of wood is 200 counts per minute. Given the half life of the isotope in the wood is 5730 years. Calculate the age of the wood 7. Explain the difference between contamination and irradiation. Which of these will result in an object becoming radioactive? 8. Describe and explain the precautions needed when using radioactive samples.

Energy		
Book Ref.	**Spec. Ref.**	**Hazards, use and background radiation**
	Triple Only 4.4.3.1 4.4.3.2 4.4.3.3 WS1.4	

1. There is background radiation around us all of the time. Approximately 20 counts per second. Name 3 natural and 3 artificial sources of background radiation.

2. Suggest a location and an occupation in which the background radiation is above the normal level.

3. What is the unit for radiation dose?

4. Match the radioactive isotope with its use based on the half-life.

Name of isotope	Half life
Technetium - 99	6 hours
Americium-241	432 years
Carbon - 14	5730 years

Use
Finding the age of artefact
Ingested by patient for brain scans
Smoke detectors

5. Explain your choice of answers.

6. Before a scan patients ingest iodine-131. Describe how an image of certain internal organs can be produced using this method.

7. Cancer is the uncontrollable division of a group of cells. Explain how nuclear radiation can be used as treatment.

Prove It!

Radioactive sources that emit alpha, beta or gamma radiation can be dangerous.
What is a possible risk to health caused by using a radioactive source?

.....

..... **(1)**

People working with sources of nuclear radiation risk damaging their health.

State **one** precaution these people should take to reduce the risk to their health.

.....

..... **(1)**

Book Ref.	Spec. Ref.	Nuclear fission and fusion
	Triple Only 4.4.4.1 4.4.4.2	

1. Nuclear fission rarely occurs spontaneously. Describe what happens during nuclear fission and explain how we can increase the chance of fission occurring.

2. Describe everything that is produced in a fission reaction.

3. What is meant by the term chain reaction? You may draw a diagram to help you.

4. Describe the difference between the chain reaction which occurs in a nuclear reactor and a nuclear weapon explosion.

5. Nuclear fusion reactions occur in the core of stars like the sun. Describe what happens during fusion reaction.

6. Where does the energy released fusion reaction come from?

Prove It!

Nuclear fission is used in nuclear power stations to generate electricity. Nuclear fusion happens naturally in stars.

(i) Explain briefly the difference between *nuclear fission* and *nuclear fusion*.

.....

.....

.....

.....

..... **(2)**

(ii) What is released during both nuclear fission and nuclear fusion?

..... **(1)**

Reflections Page

Each time you come across something you find hard, write it down here and ask your teacher to help you with it.

Topic I Found Hard	Page Number	What was difficult about this?	Tick when you have got help from your teacher