DEPARTMENT FOR CURRICULUM,
RESEARCH, INNOVATION AND LIFELONG LEARNING
Directorate for Learning and Assessment Programmes
Educational Assessment Unit

Track 3

Annual Examinations for Secondary Schools 2018

YEAR 11 PHYSICS TIME: 2 hours

Name: _____ Class: _____

Answer ALL questions in the spaces provided on the Examination Paper.
All working must be shown. The use of a calculator is allowed.
Where necessary take the acceleration due to gravity $g = 10\ m/s^2$.

Density	$m = \rho V$		
Pressure	$P = \rho g h$	$F = P A$	
Moments	Moment $=$ F $\times$ perpendicular distance		
Energy	$PE = m g h$	$KE = \frac{1}{2}mv^2$	Work Done $=$ F s
	Work Done $=$ Energy Converted		$E = P t$
Force	$F = m a$	$W = m g$	
Motion	Average Speed $= \frac{\text{total distance}}{\text{total time}}$	$s = \frac{(u + v)\, t}{2}$	$s = ut + \frac{1}{2}at^2$
	$v = u + at$	$v^2 = u^2 + 2as$	Momentum $= m v$
Electricity	$Q = I t$	$V = I R$	$E = Q V$
	$P = I V$	$R \propto L/A$	$E = I V t$
	$R_T = R_1 + R_2 + R_3$	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$	
Electromagnetism	$\frac{N_1}{N_2} = \frac{V_1}{V_2}$		
Heat	$\Delta Q = m c \Delta\theta$		
Waves	$\eta = \frac{\text{real depth}}{\text{apparent depth}}$	$\eta = \frac{\text{the speed of light in air}}{\text{the speed of light in medium}}$	
	$v = f \lambda$ $f = \frac{1}{T}$	$m = \frac{h_i}{h_o} = \frac{\text{image distance}}{\text{object distance}}$	
Radioactivity	A = Z + N		

Marks Grid: For the Examiners' use ONLY

Question	1	2	3	4	5	6	7	8	9	10	11	Theory	Multiply by 0.68	Prac	Final Mark
Mark	10	10	10	10	10	10	10	10	15	15	15	125	85	15	100
Score															

Section A: This section has 8 questions. Each question carries 10 marks (Total: 80 marks).

1. Figure 1 (a) shows a helical spring. A metal block of mass 0.45 kg is hung from the spring as shown in Figure 1 (b).

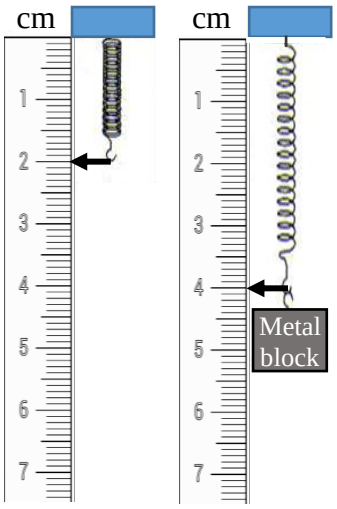


Figure 1

a) In Figure 1 (b), draw and label two forces acting on the spring and the metal block. **[2]**

b) Explain why forces are vector quantities.

_____

_____ **[1]**

c) Find the extension produced by the metal block.

_____ **[1]**

d) Calculate the extension when another block, of mass 0.15 kg, is also added to the spring. Assume the elastic limit is not exceeded.

_____

_____ **[2]**

e) Calculate the density of the 0.45 kg block given that its dimensions are 0.08 m by 0.05 m by 0.04 m.

_____

_____ **[3]**

f) Underline the correct answer.
The density of a larger block made of the same material will be (the same as, greater than, smaller than) the one calculated in (e). **[1]**

2. An electric motor (Figure 2) lifts a 250 g wooden block through a height of 1.5 m in 5.0 s.

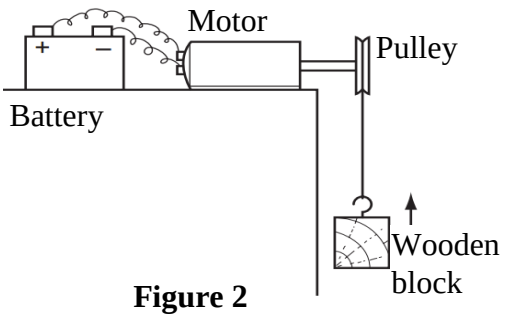


Figure 2

a) Name the input energy and output energy of the motor.

Input energy: _____ **[1]**

Output energy: _____ **[1]**

b) Calculate the weight of the wooden block.

_____ **[2]**

c) Calculate the work done by the motor to lift the block of wood by a height of 1.5 m.

_____ **[2]**

d) Calculate the power developed by the motor while lifting the wooden block.

_____ **[2]**

e) Given that the power input to the motor is 1.5 W, calculate its efficiency.

_____ **[2]**

3. Jennifer, of mass is 60 kg, is standing at the edge of a diving board 5.0 m away from the pivot, as shown in Figure 3. The support provides an upward force **F** to keep the diving board balanced.

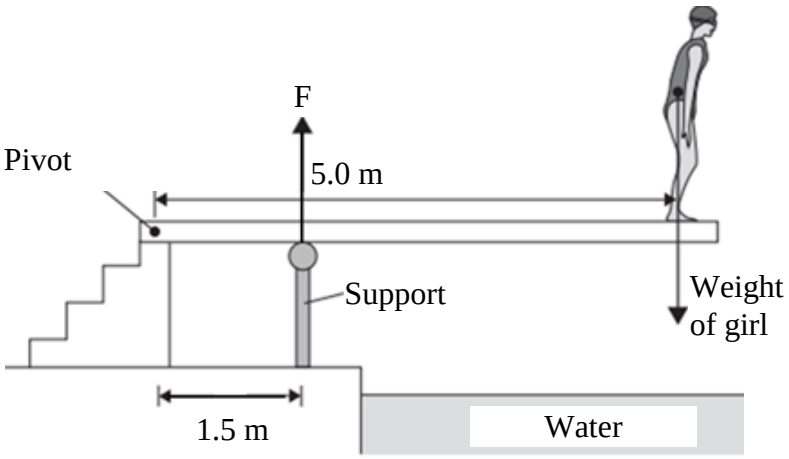


Figure 3

a) Calculate Jennifer's weight and hence her moment about the pivot.

_____

_____ **[3]**

b) The diving board is in equilibrium. State the value of the moment of force **F** acting about the pivot.

_____ **[1]**

c) Calculate the value of the upward force F at the support.

_____

_____ **[2]**

d) Name the TWO conditions necessary for the diving board to be in equilibrium.

_____

_____ **[2]**

e) The density of water is 1000 kg/m^3. Determine the pressure of water on Jennifer when she is at a depth of 3.5 m.

_____

_____ **[2]**

4. The asteroid belt, which is found between Mars and Jupiter, is made up of a very large number of asteroids like the one shown in Figure 4.

Figure 4

a) Give TWO reasons why asteroids are not considered to be planets.

_____

_____ **[2]**

b) Is the force of gravity of an asteroid smaller or larger than that of planet Earth? Explain.

_____

_____ **[3]**

c) A meteor is an asteroid that burns up as it enters the Earth's atmosphere. Figure 5 shows the path of a meteor as it gets closer to the Earth. It is shown in three positions: A, B and C. The arrow shows the direction of the force of gravity acting on the meteor at B.

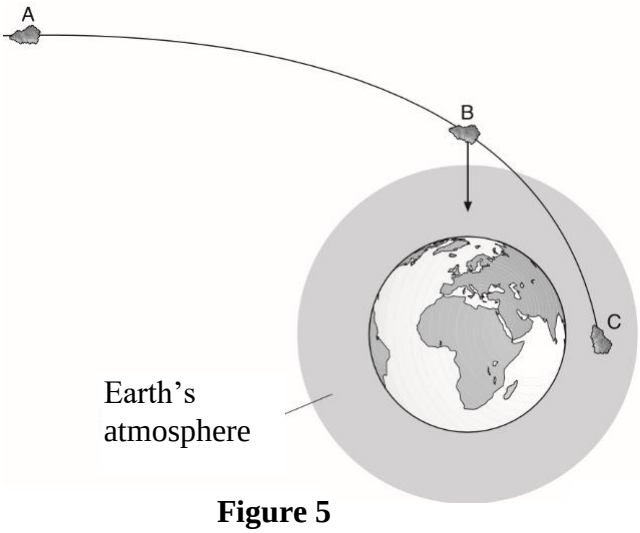


Figure 5

i. Draw arrows on Figure 5 to show the direction of the force of gravity on the meteor at A and on the meteor at C. **[2]**

ii. Explain how the force of gravity on the meteor changes as it travels from A to C.

_____

_____ **[2]**

iii. At which point is the asteroid travelling the fastest? _____ **[1]**

5. Figure 6 shows an electric kettle.

a) Suggest ONE reason why the heating element is placed at the bottom of the kettle.

_____

_____ **[2]**

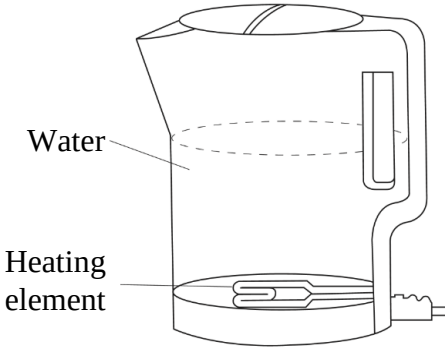


Figure 6

b) The mains plug of the kettle has three wires. One of them is the earth wire whose insulation has green and yellow stripes. What are the names and colours of the other two wires?

Name _____ Colour _____

Name_____ Colour _____ **[2]**

c) The mains supply is 230 V and the current in the heating element is 8.0 A. Calculate the power of the heating element.

_____

_____ **[2]**

d) Find the electrical consumption of the kettle in kWh when it is used for 5 minutes every day for a whole week.

_____

_____ **[2]**

e) Calculate the cost per week when using this kettle given that electricity costs 15 c per kWh.

_____ **[2]**

6. An iron rod is placed inside a coil of wire as shown in Figure 7.

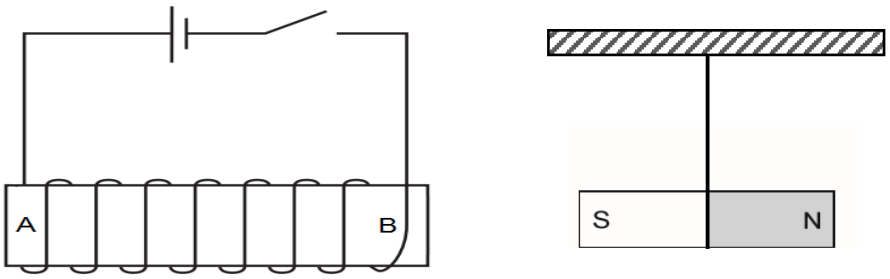


Figure 7

a) Mark the direction of the current in Figure 7 when the switch is closed. Hence, state the polarity of end B: _____ **[2]**

b) Suggest ONE way to make the electromagnet stronger.

_____ **[1]**

c) Will the suspended magnet be attracted or repelled when the switch is closed?

_____ **[1]**

d) Figure 8 shows an ideal transformer. The primary coil has 1000 turns while the secondary coil has 6000 turns. A 3.0 V a.c. power supply is connected across the primary coil. The ammeter measures 0.015 A.

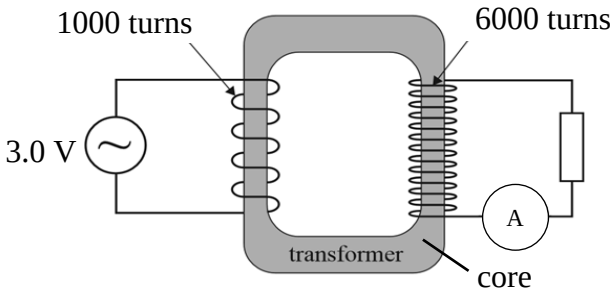


Figure 8

i. Name the type of transformer shown in Figure 8. _____ **[1]**

ii. Name a suitable material for the core of the transformer. _____ **[1]**

iii. Calculate the output voltage in the secondary coil.

_____

_____

_____ **[2]**

iv. Hence calculate the power in the secondary coil of the transformer when the current in the secondary coil is 0.015 A.

_____

_____ **[2]**

7. Figure 9 shows a **distance-time** graph representing part of a journey travelled using a motorcycle.

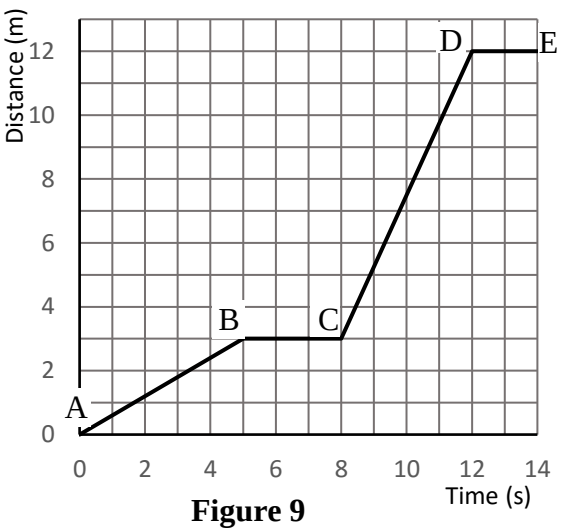


Figure 9

a) State the type of motion along the sections:

i. AB _____ **[1]**

ii. BC _____ **[1]**

b) Which section of the graph shows the motorcycle travelling at the greatest speed? Explain.

_____

_____ **[2]**

c) Calculate this greatest speed.

_____

_____ **[3]**

d) State the value of the total distance travelled. _____ **[1]**

e) Calculate the average speed of the motorcycle over the 14 seconds shown.

_____ **[2]**

8. The following list represents five nuclei of atoms:

$$^{226}_{88}\mathrm{U} \quad ^{210}_{83}\mathrm{V} \quad ^{222}_{86}\mathrm{W} \quad ^{214}_{83}\mathrm{X} \quad ^{210}_{84}\mathrm{Y}$$

a) Write down the number of protons and neutrons inside nucleus $^{226}_{88}\mathbf{U}$.

Number of protons: _____ Number of neutrons _____ **[2]**

b) Which nuclei belong to the same element? What do we call such nuclei?

_____ **[2]**

c) Table 1 lists different radioactive nuclei that can be used in diagnostic tools for medicine.

i. Define the term ‘half-life’.

_____

_____

_____ **[2]**

Table 1

Radioactive nucleus	Radiation emitted	Half-life
Strontium-90	β	28.8 years
Carbon-14	β	5730 years
Technetium-99	γ	6 hours
Cobalt-60	γ	5.27 years

ii. Technetium-99 can be injected in the body to produce images of human organs. Using the data in Table 1, justify why it is used for this purpose.

_____

_____ **[2]**

iii. Strontium-90 contains 64×10^{10} radioactive nuclei. Calculate the time that passes for the sample to contain 4×10^{10} radioactive nuclei of strontium-90.

_____

_____ **[2]**

Section B. This section has 3 questions. Each question carries 15 marks (Total: 45 marks).

9. **This question is about thermal energy.**

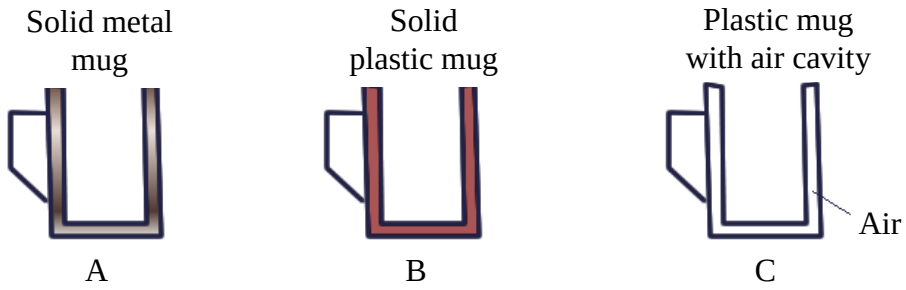


Figure 10

a) Mark had a metal mug A as shown in Figure 10. Using a 3D printer, he manufactured two more mugs, B and C, which had the same dimensions as the metal mug. He then sprayed all the mugs with the same dark colour and finish. The same amount of boiling water was poured in each mug.

i. In which mug does the water reach room temperature first? Explain.

_____

_____ **[2]**

ii. Mug C is made from the same plastic as mug B. Explain why mug C is likely to keep the drink warm for a longer time than mug B.

_____ **[2]**

iii. Suggest a way to reduce heat losses by evaporation from the mugs.

_____ **[1]**

b) Alicia wanted to find the rate at which heat is transferred to water from the sun. She investigated this idea using the apparatus shown in Figure 11. She knows the value of the specific heat capacity of water.

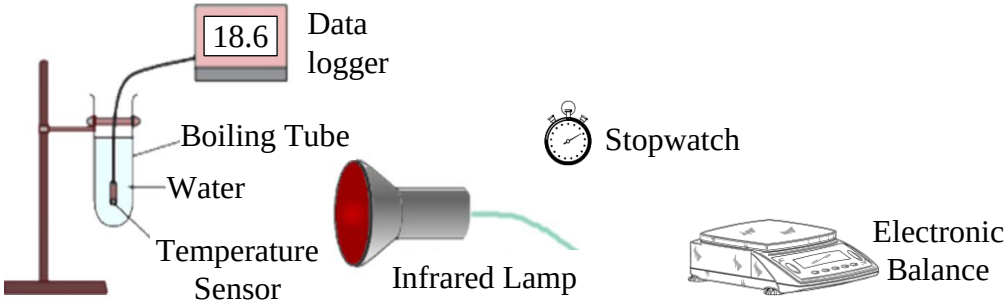


Figure 11

i. Describe how she carries out her investigation using ONLY the apparatus shown in Figure 11.

_____

_____

_____

_____

_____ **[4]**

ii. Mention ONE precaution that she should take during the experiment.

_____ **[1]**

iii. The initial temperature of the water in the boiling tube was 18.6°C. Calculate the heat energy transferred to 30 g of water, whose specific heat capacity is 4200 J/kg °C, when the final temperature becomes 36.6°C.

_____

_____

_____ **[3]**

iv. Calculate the rate of heat transferred per second to the water given that the experiment lasted 5 minutes.

_____

_____

_____ **[2]**

10. **This question is about electricity.**

a) Maria was given a sample of nichrome wire. To investigate the current-voltage characteristics of the wire, she set up the circuit shown in Figure 12 and obtained the results shown in Table 2.

Table 2					
Current I / A	0	0.20	0.39	0.59	0.80
Voltage V / V	0	1.5	3.0	4.5	6.0

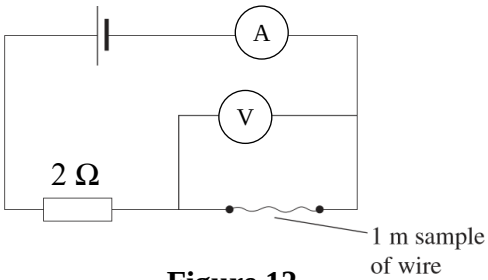


Figure 12

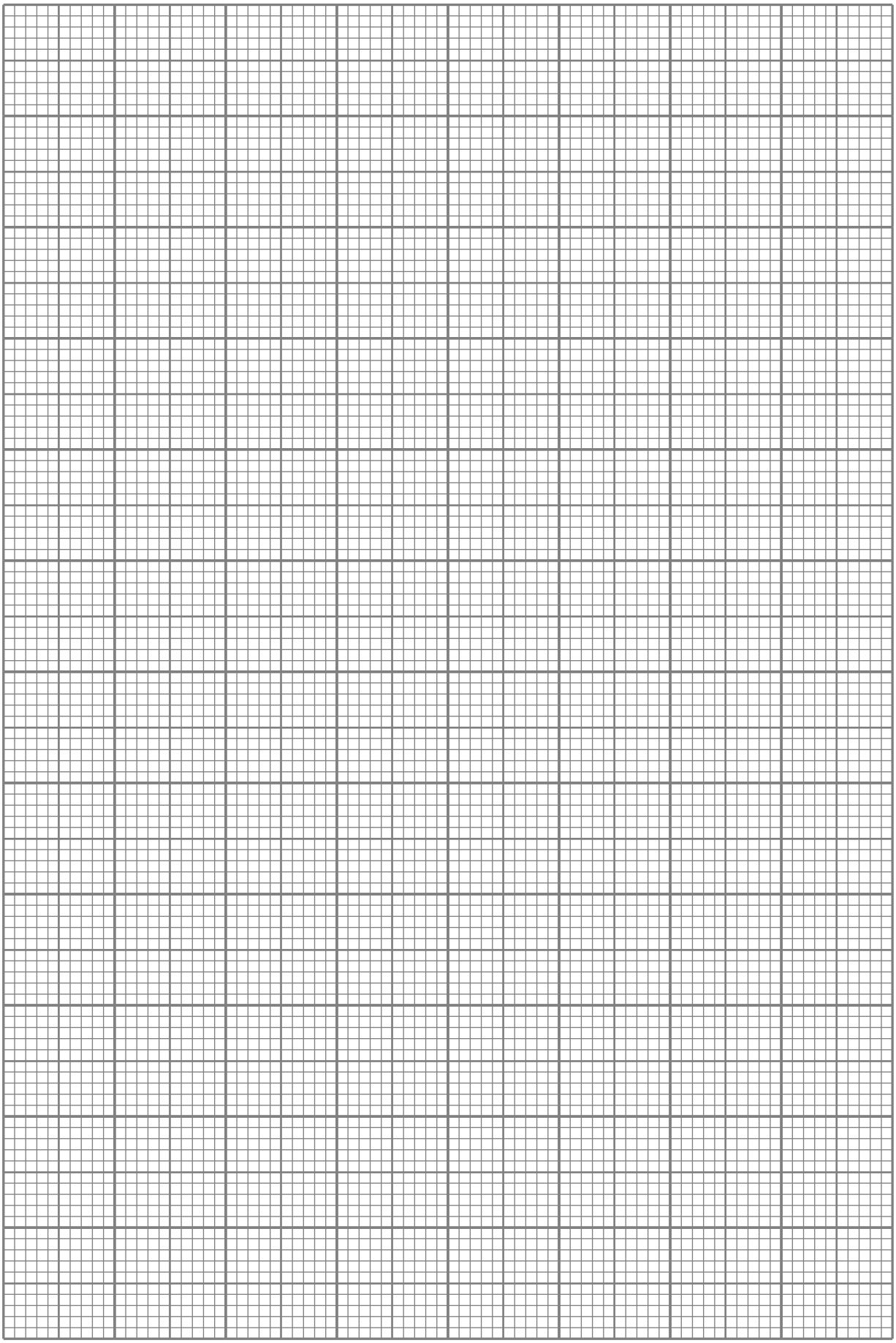
i. Plot a graph of **Current** on the *y*-axis against **Voltage** on the *x*-axis. **[4]**

ii. The gradient of the graph is equal to $\frac{1}{R}$. Therefore calculate the resistance of the wire.

_____

_____ **[2]**

iii. On the graph, draw a sketch of an **I-V** graph for another nichrome wire with the same length but with twice the cross sectional area. **[1]**



b) A 12 V battery is connected to a number of resistors as shown in Figure 13.

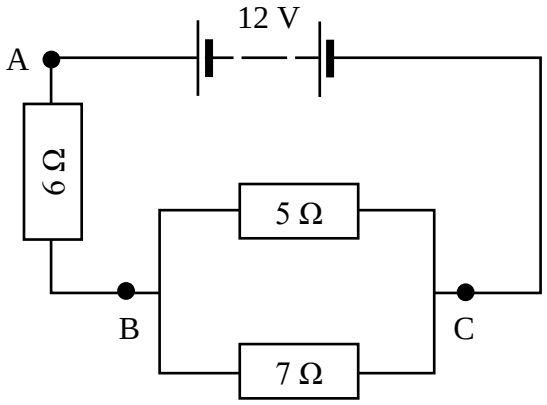


Figure 13

i. Calculate the total resistance between points B and C in Figure 13.

_____

_____ **[2]**

ii. Find the total resistance between points A and C in Figure 13.

_____ **[1]**

iii. Calculate the total current flowing in the circuit.

_____ **[2]**

iv. Calculate the current flowing through the 5 Ω resistor.

_____

_____

_____

_____ **[3]**

11. **This question is about waves.**

a) Figure 14 shows plane water waves approaching a barrier.

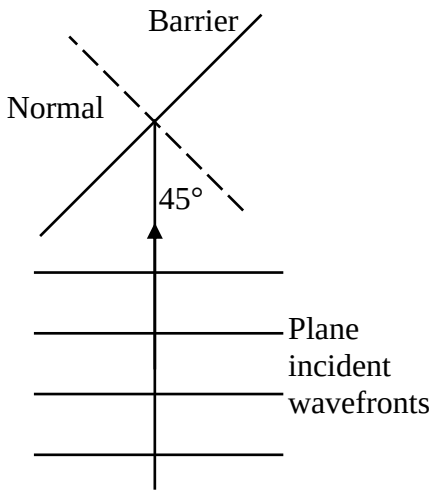


Figure 14

i. Mark the wavelength on the incident wavefronts on Figure 14. **[1]**

ii. Complete the diagram to show the path of the reflected wavefronts on Figure 14. **[1]**

iii. Label the angle of reflection (r) and write its value on Figure 14. **[1]**

b) A student measures the speed of sound in a laboratory, as shown in Figure 15. The sound is received by two microphones placed a distance **'s'** apart. The time interval **'t'** between the sound arriving at the two microphones is recorded.

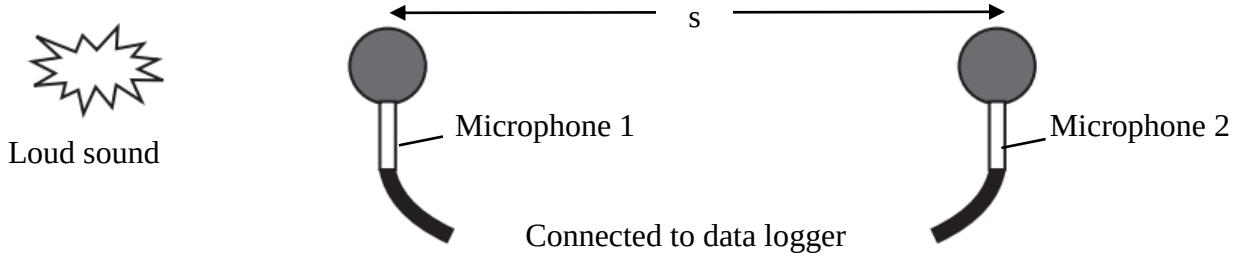


Figure 15

i. What type of waves are sound waves? _____ **[1]**

ii. How are sound waves propagated through air?

_____ **[1]**

iii. Figure 16 shows the trace on an oscilloscope (CRO) detected by microphone 1. Microphone 2 detects a quieter sound. On Figure 16, draw the trace due to microphone 2. **[1]**

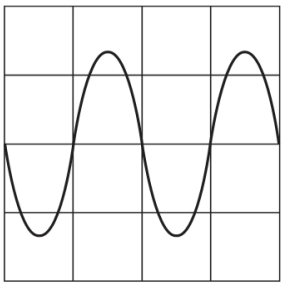


Figure 16

iv. Given that the distance **s** between the microphones is 1.7 m and the time recorded by data logger is 0.005 s, calculate the speed of sound in air.

_____

_____ **[2]**

v. This experiment is repeated underwater using ultrasound where the microphones can still detect the sound. What is meant by the term 'ultrasound'?

_____

_____ **[1]**

vi. The speed of ultrasound in water is 1500 m/s. Calculate the frequency when the wavelength of the ultrasound is 0.030 m.

_____

_____ **[2]**

c) A camera is used to take a close-up photo of an object **O**. The focal length of the lens is 3.0 cm and the object **O** is placed 8 cm away from the lens. Object **O** is 2 cm high.

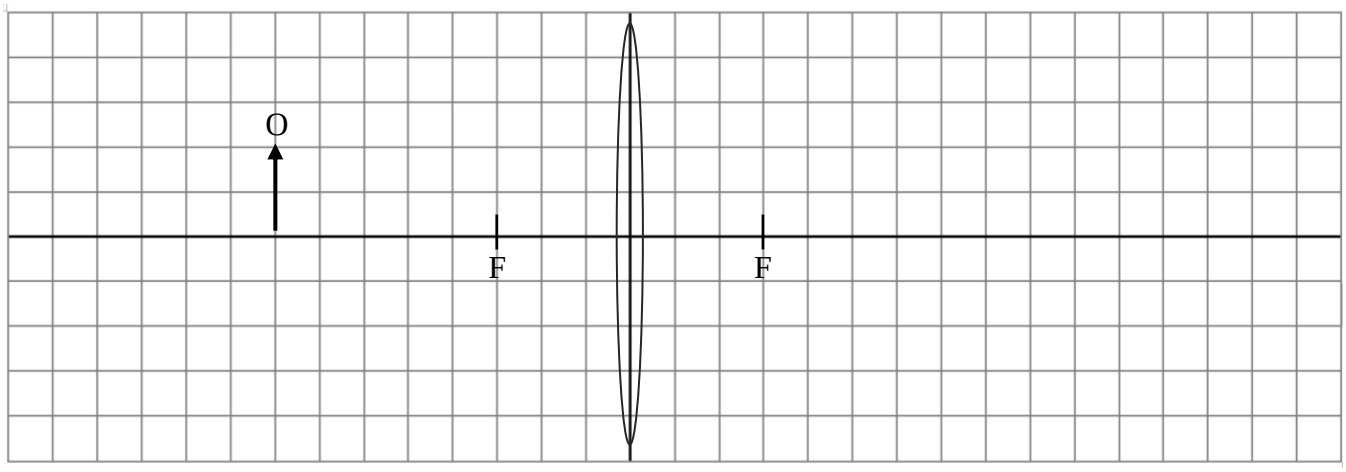


Figure 17

i. On Figure 17 draw two rays from the top of the object **O** that meet at the image **I**. **[3]**

ii. Mention ONE property of the image **I** formed.

_____ **[1]**