BENENDEN

SIXTH FORM 2018

PHYSICS

1 hour 30 mins

Full Name: _____

Current school: _____

Date: _____

Instructions to Candidates:

- Total marks for this paper = 100
- If you have not covered any of the topics in this paper, please indicate this and have a go at the question anyway
- You may use a calculator
- Please show all working in full

You may find the following equations useful

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

$$\text{voltage} = \text{current} \times \text{resistance}$$

$$n = \frac{\sin i}{\sin r}$$

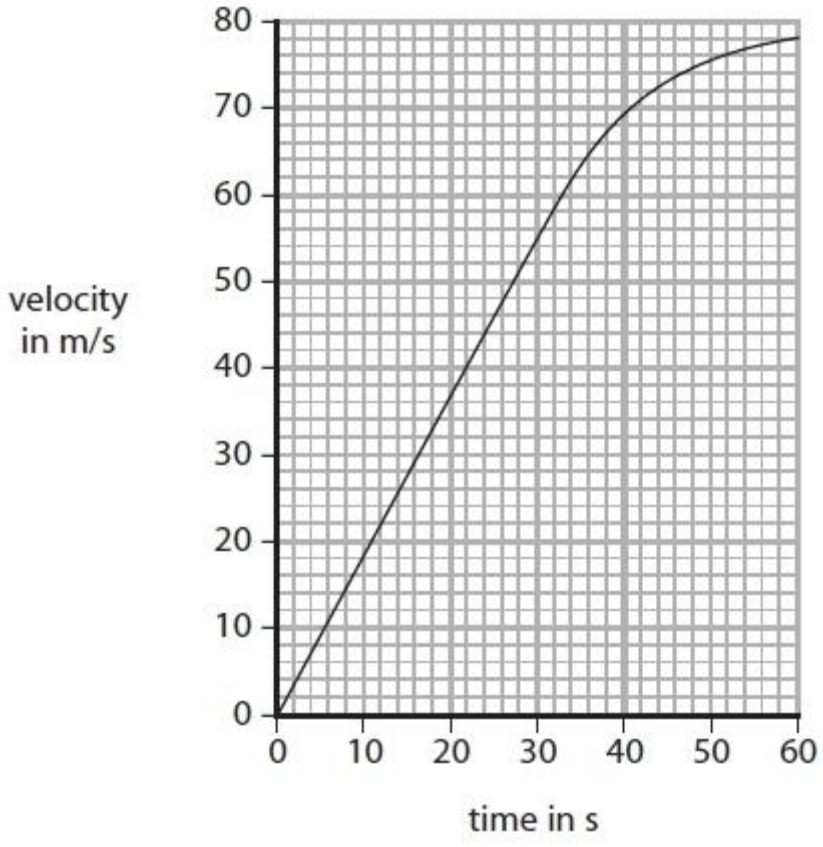
$$\text{gravitational p.e.} = \text{mass} \times g \times \text{height}$$

$$\text{work done} = \text{force} \times \text{distance moved}$$

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

Q1.

The graph shows how the velocity of an aircraft changes as it accelerates along a runway.



(a) Use the graph to find the average acceleration of the aircraft.

(3)

Acceleration = ... m/s^2

(b) Explain why the acceleration is not constant, even though the engines produce a constant force.

(3)

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(Total for question = 6 marks)

Q2.

Two students, Jenny and Cho, are investigating motion.

Jenny walks in a straight line.

Cho measures the distance Jenny has walked at 10 s intervals.

(a) State **two** measuring instruments the students should use.

(2)

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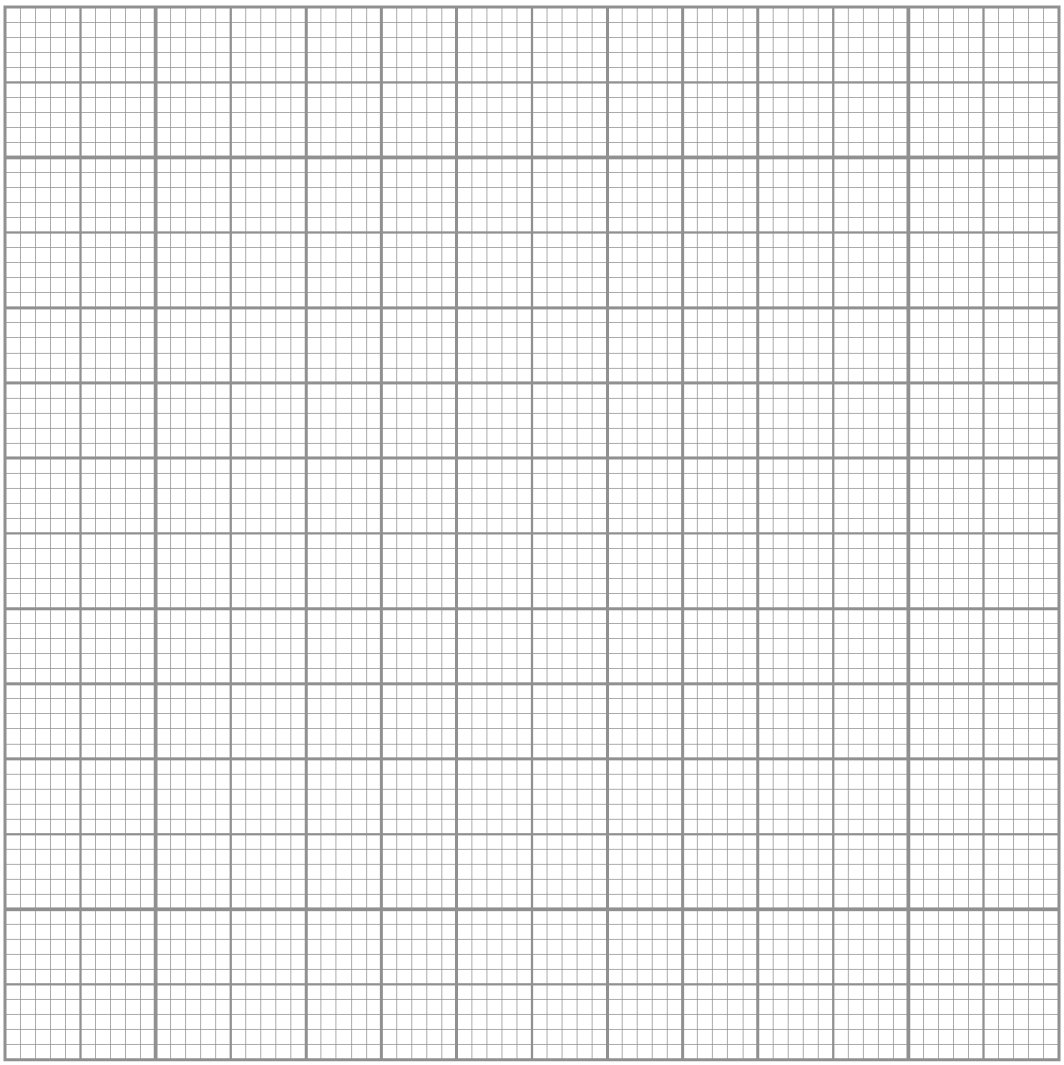
2 .....

(b) The table shows their measurements.

Time in s	Distance walked in m
0	0
10	14
20	19
30	24
40	28
50	30
60	31

Draw a graph of distance against time for this data.

(3)



(c) How far had Jenny walked after 35 s?

(1)

Distance walked = ... m

(d) (i) Describe how Jenny's speed changed during the investigation.

(1)

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(ii) What feature of the graph shows this change?

(1)

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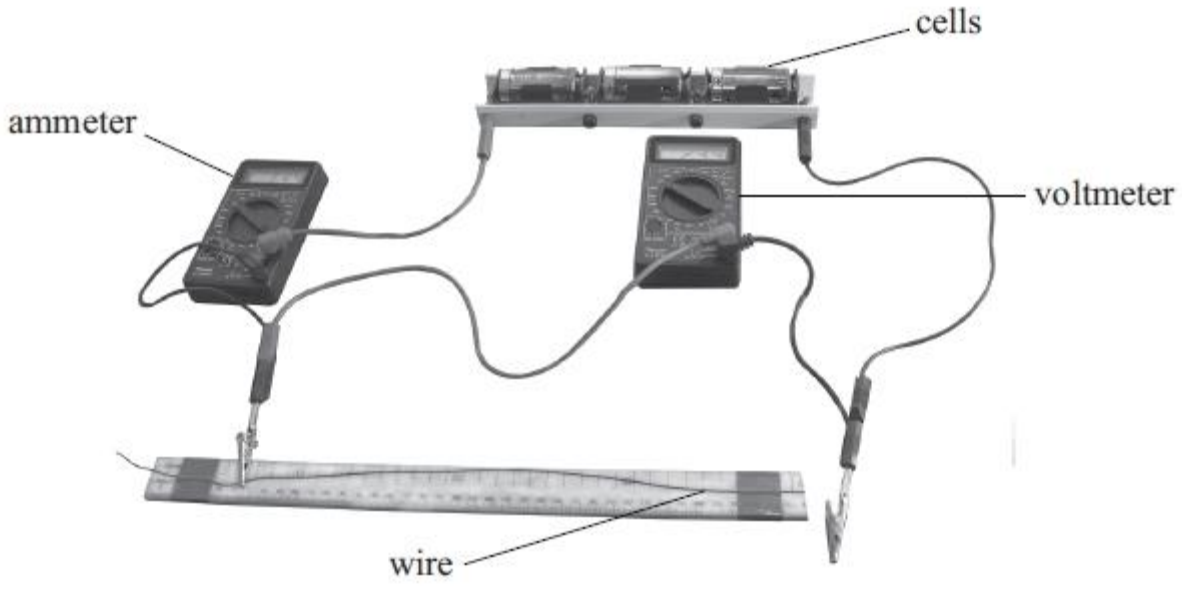
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(Total for question = 8 marks)

Q3.

A student investigates how the resistance of a wire depends on its length.

The photograph shows the circuit that the student uses.



(a) Draw a circuit diagram to show how the components in the photograph are connected.

(3)

(b) (i) Complete the table by naming the key variables in this investigation.

(1)

independent variable	
dependent variable	

(ii) Describe the method the student should use for this investigation.

(5)

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(c) The table shows the student's measurements.

Length of wire in cm	Voltage in V	Current in A	Resistance of wire in Ω
20	4.5	3.6	1.3
40	4.5	1.8	2.5
60	4.5	1.2	3.8
80	4.5	0.9	5.0
100	4.5	0.7	

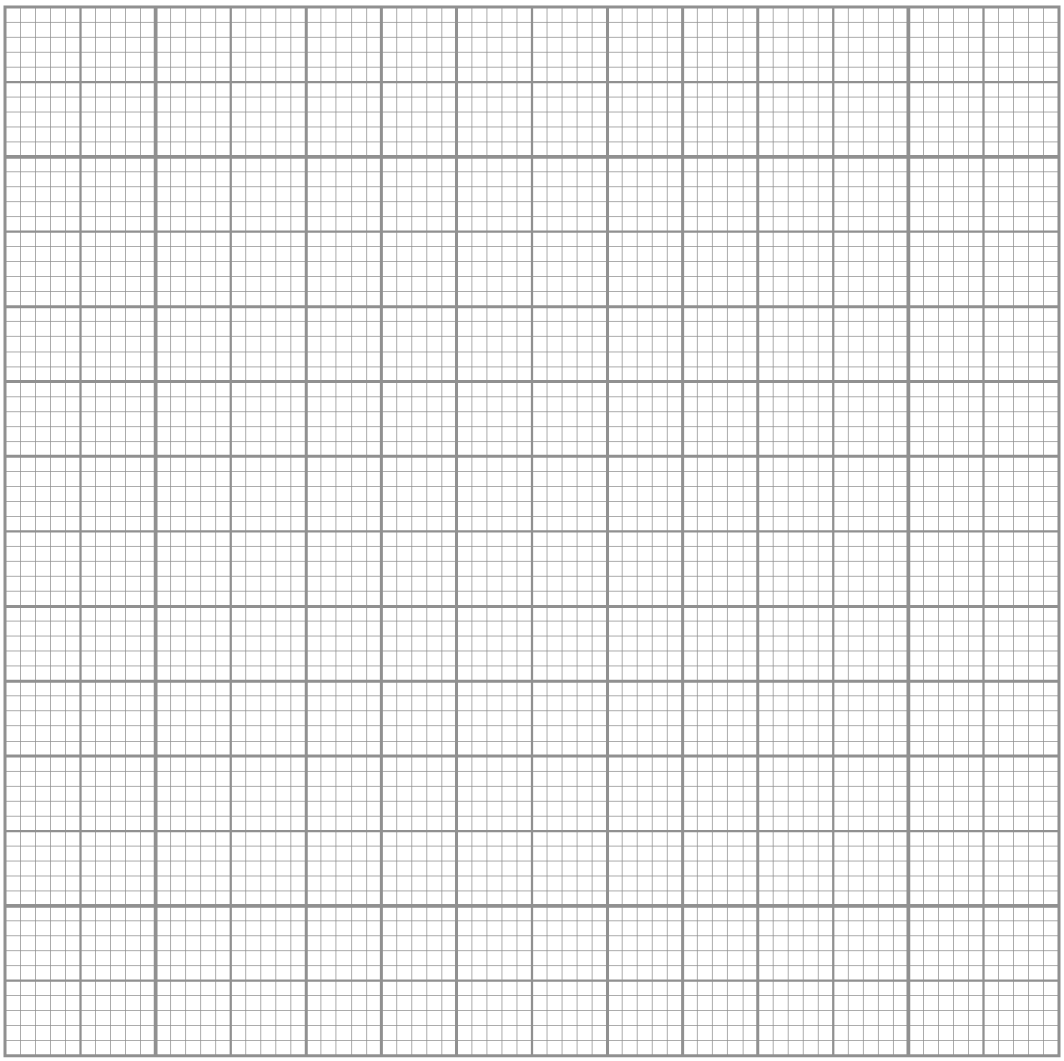
(i) State the equation linking voltage, current and resistance.

(ii) Complete the table by calculating the missing value of resistance.

(1)

(d) (i) Use the results from the table opposite to plot a graph of resistance (*y*-axis) against length of wire (*x*-axis) and draw the line of best fit.

(5)



(ii) Write a conclusion for the investigation.

(1)

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(iii) Explain how the graph supports this conclusion.

(2)

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(Total for question = 18 marks)

Q4.

(a) A student wants to find the refractive index of a glass block.

(i) Draw a diagram to show how the student should set up the apparatus needed to find the refractive index of a glass block.

Label your diagram.

(2)

(ii) What measurements should the student take to find the refractive index of the glass block?

(2)

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(iii) Describe how the student should use these measurements to find the refractive index of the glass block.

(2)

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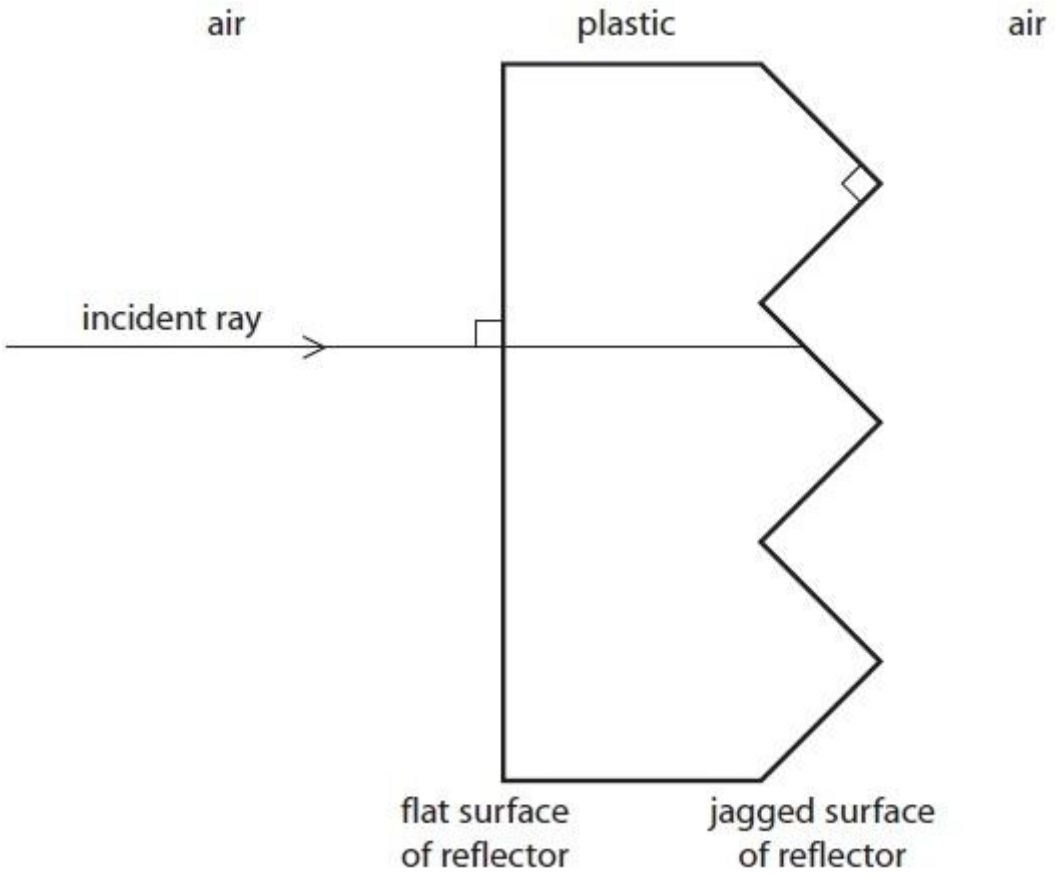
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(b) The diagram shows a section through a bicycle reflector.

A ray of light is incident on the flat surface of the reflector.



(i) The critical angle for the plastic of the reflector is less than 45°.

Continue the incident ray on the diagram to show the path of the ray until it emerges from the plastic.

(2)

(ii) What happens to the incident ray as it enters the plastic?

(1)

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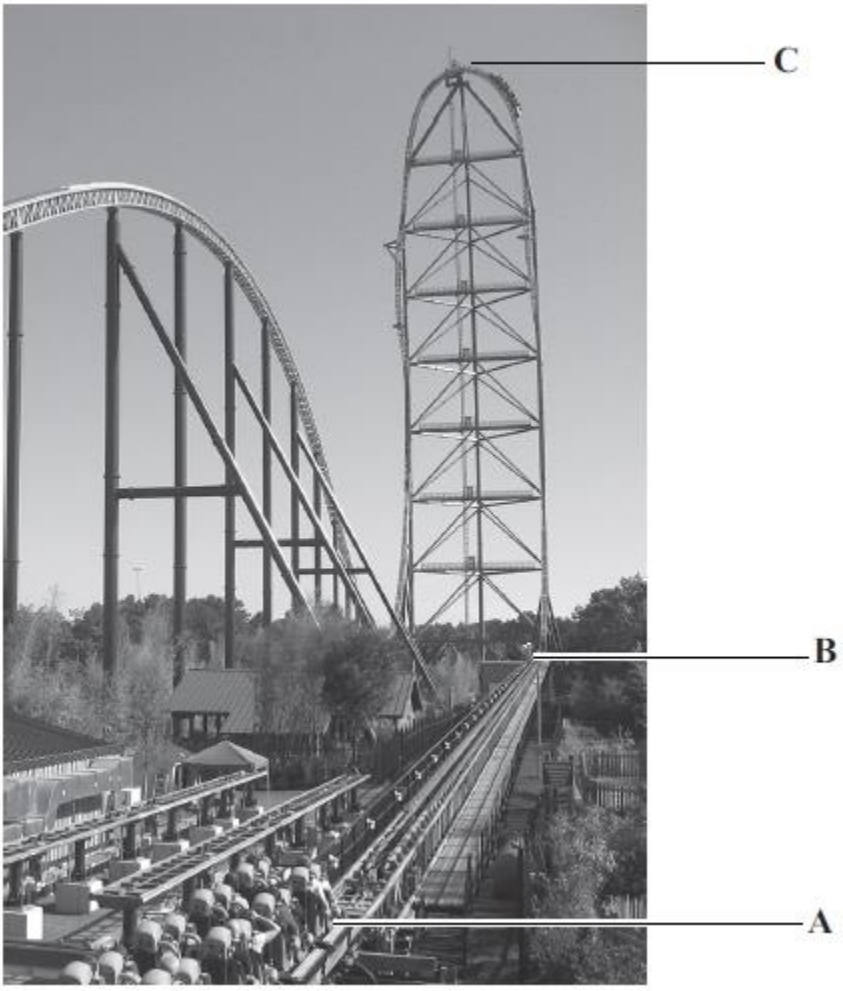
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(Total for question = 9 marks)

Q5.

The photograph shows a type of rollercoaster.

The car is launched from point **A** in the photograph, accelerates to point **B** and then rises over point **C**.



(a) Each loaded car has a mass of 2000 kg. **C** is 128 m above **B**.

(i) State the equation linking gravitational potential energy, mass, height and gravitational field strength.

(ii) Show that the gravitational potential energy gained by the car when it rises from **B** to **C** is about 2.6 MJ.

(3)

(b) The car gains kinetic energy when work is done on it by the launching system between **A** and **B**.
Assume there are no energy losses.

(i) State the minimum kinetic energy that the car must have at **B** for it to reach **C**.

(1)

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(ii) How is the kinetic energy gained related to the work done?

(1)

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(iii) Write down the equation linking work done, force and distance.

(iv) The launching system provides a force of 32 kN.

Calculate the minimum length of track needed between **A** and **B** for the car to reach **C**.

(3)

Length of track = ... m

(c) Sometimes the car does not reach **C**, but rolls backwards to the start.

This can happen when it becomes windy or the track becomes wet.

Explain why these conditions could cause the car to stop before it reaches **C**.

(2)

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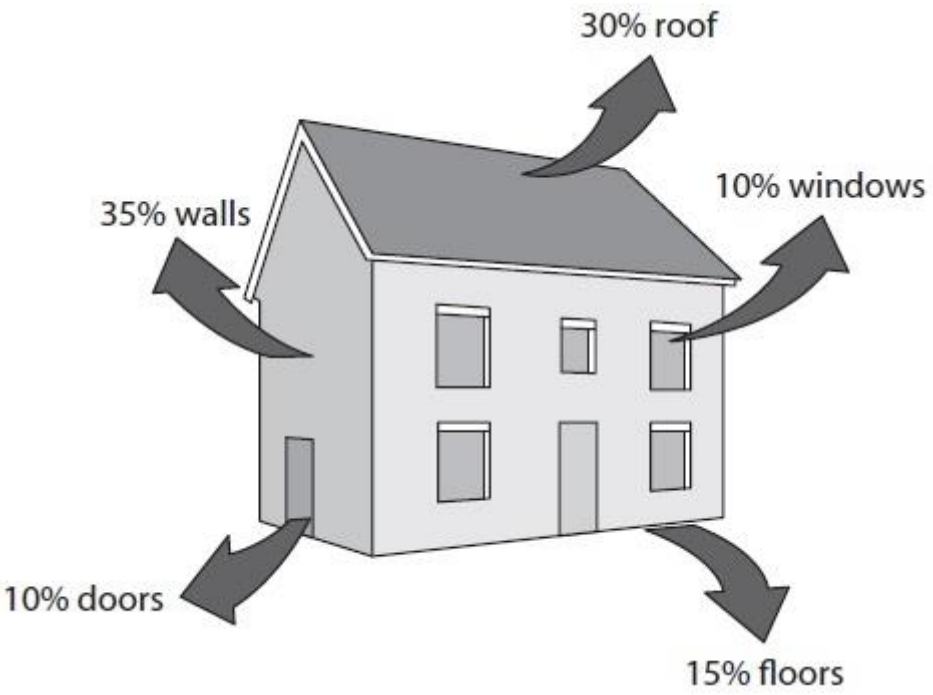
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(Total for question = 10 marks)

Q6.

The diagram shows typical values for the percentage energy losses from a house.



(a) Most energy is lost through

(1)

- ☒ **A** the floors
- ☒ **B** the roof
- ☒ **C** the walls
- ☒ **D** the windows

(b) The total percentage energy loss from the roof and the windows is

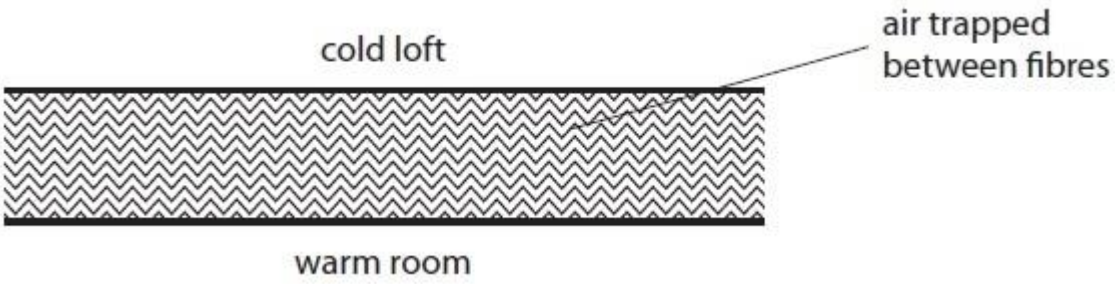
(1)

- ☒ **A** 10%
- ☒ **B** 20%
- ☒ **C** 30%
- ☒ **D** 40%

(c) Insulation is used to reduce energy losses from houses.

Insulating material often consists of fibres with air between them.

The diagram shows a section through some insulating material.



(i) Explain how this type of insulation reduces energy loss by **conduction**.

(2)

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(ii) Explain how this type of insulation reduces energy loss by **convection**.

(2)

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(Total for question = 6 marks)

Q7.

Liquid helium boils at 4.2 K.

(a) Convert 4.2 K to a temperature in °C.

(1)

temperature = ...°C

(b) Liquid helium boils to form helium gas.

(i) State two ways in which the arrangement and motion of the molecules change as the helium becomes a gas.

(2)

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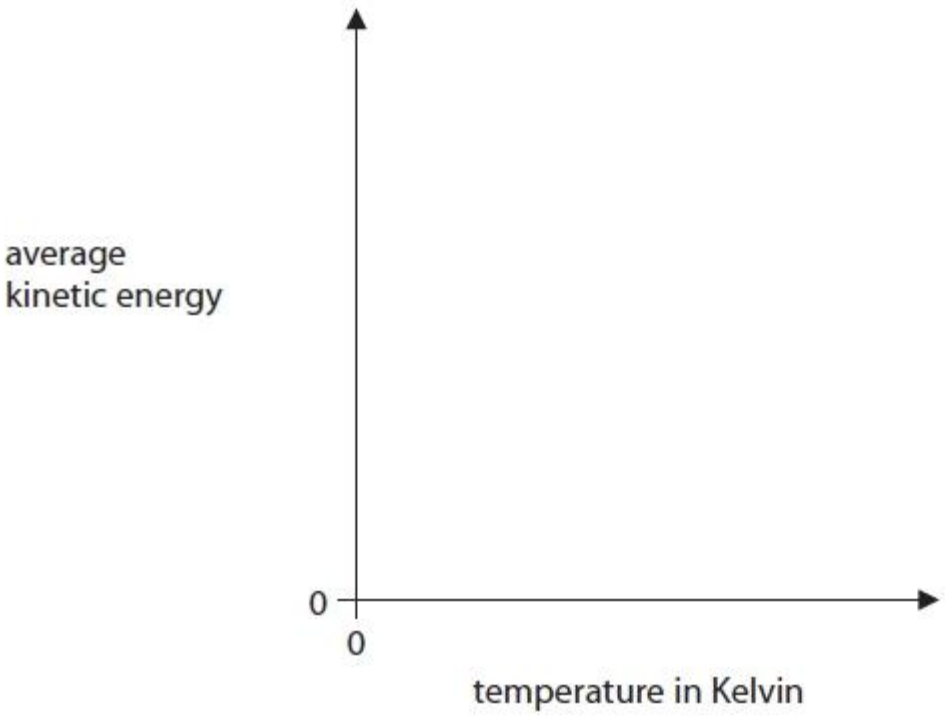
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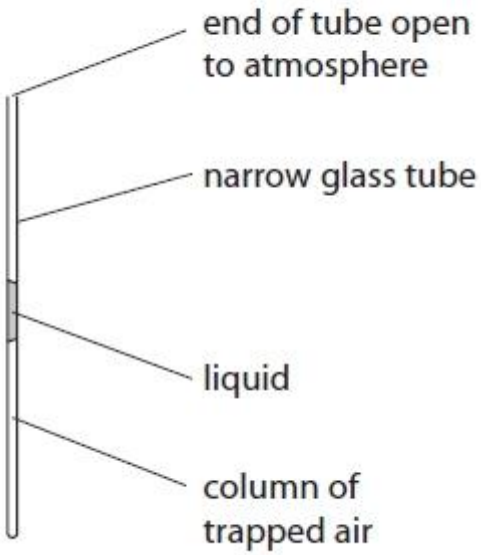
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(ii) The average kinetic energy of the molecules in helium gas depends on its Kelvin temperature.
Sketch a graph on the axes below to show this relationship.

(2)



(c) Some air is trapped in a narrow glass tube so that its pressure remains constant.



Describe how this apparatus can be used to investigate the relationship between the temperature and the volume of air at constant pressure.
You may add to the diagram to help your answer.

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(Total for question = 9 marks)

Q8.

The volume of a piece of brass is 16.3 cm^3.

A student measures its mass using an electronic balance.
The mass of the brass is 138 g.

(a) (i) State the equation linking density, mass and volume.

(ii) Calculate the density of brass. Give the unit.

(4)

density = ...

(b) The student notices that the electronic balance has a zero error, so it shows mass readings that are all slightly too small.

This means that the density value is

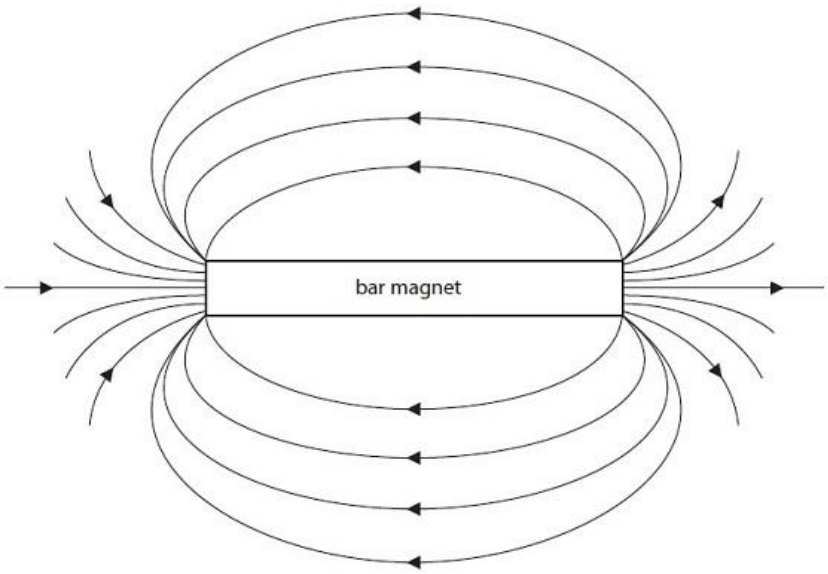
(1)

- ☒ **A** incorrect and slightly too large
- ☒ **B** incorrect and slightly too small
- ☒ **C** correct because the student used three significant figures
- ☒ **D** correct because the mass of the block is more than zero

(Total for question = 5 marks)

Q9.

The diagram shows the magnetic field pattern around a bar magnet.



(a) Complete the diagram above by labelling the poles on the bar magnet.

(2)

(b) Describe an experiment to investigate the shape of the magnetic field pattern of a bar magnet.

You may draw a diagram to help your answer.

(3)

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(Total for question = 5 marks)

Q10.

A student is listening to a radio.



(a) The radio is powered by batteries that provide a direct current (d.c.).

What is **direct current**?

(1)

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(b) Radio waves are part of the electromagnetic spectrum.

(i) Suggest a property of radio waves that makes them suitable for use in communication.

(1)

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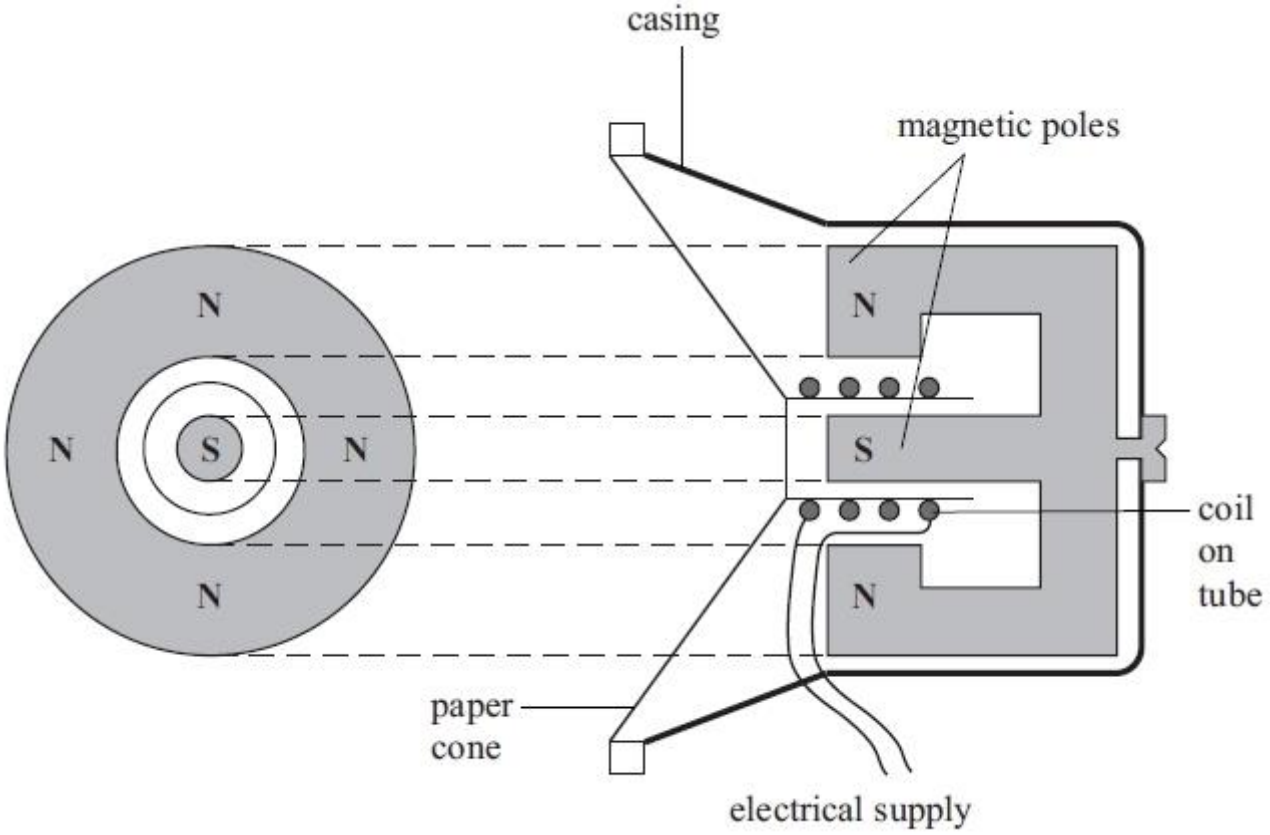
(ii) Complete the table to show uses and possible harmful effects of some other parts of the electromagnetic spectrum.

(4)

Part of electromagnetic spectrum	Use	Possible harmful effect on people
microwaves		
ultraviolet		

(c) In the radio, sound is produced by a loudspeaker.

The diagram shows the construction of a loudspeaker.



Describe how a loudspeaker uses an electrical supply to produce sound waves.

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(Total for question = 11 marks)

Q11.

A teacher shows his class how to investigate the half-life of a radioactive source.



(a) The readings from the counter need to be corrected for background radiation.

(i) State **one** source of background radiation.

(1)

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(ii) Describe the method the teacher should use to correct for background radiation.

(3)

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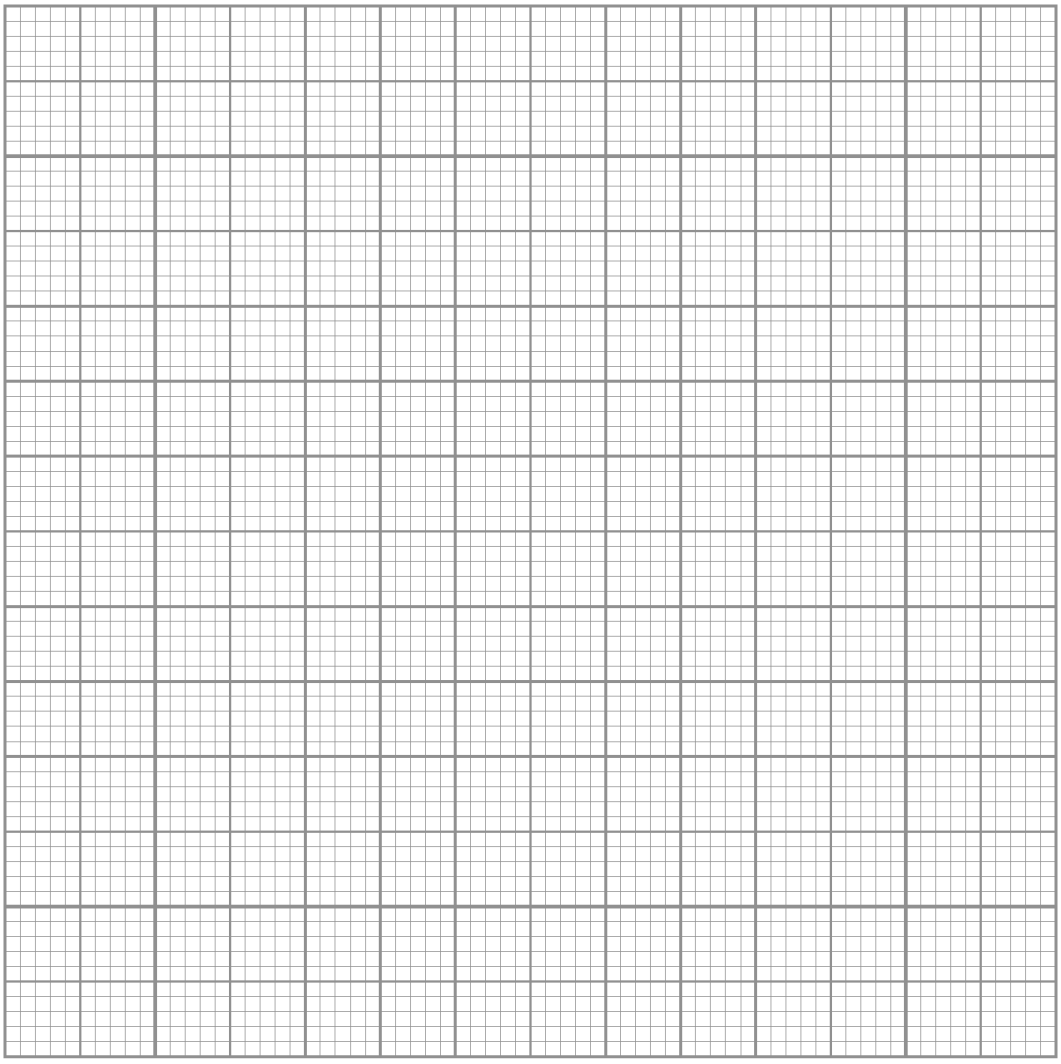
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(b) Every half a minute, the teacher records the count rate.
He corrects for background radiation and produces this results table.

Time in minutes	Corrected count rate in Bq
0	49
0.5	30
1.0	24
1.5	18
2.0	15
2.5	11
3.0	10
3.5	9
4.0	5
4.5	6

(i) Draw a graph of corrected count rate against time for these results.

(5)



(ii) Use your graph to estimate the half-life for this material.

(1)

Half-life = ... minutes

(c) The isotope technetium-99 is a gamma emitter with a half-life of 6 hours. It is used as a radioactive tracer in medicine.

The technetium-99 is injected into a patient's bloodstream and carried around the body by the blood. The radiation it emits is detected outside the body.

Explain why technetium-99 is suitable for use as a tracer in this way.

(3)

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(Total for question = 13 marks)