Name: .... (   )

ASSUMPTION ENGLISH SCHOOL
PRELIMINARY EXAMINATION 2025

PHYSICS
6091 / 02

ASSUMPTION ENGLISH
A Montfortian Gabrielite Education Institution

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LEVEL: Sec 4 Express   **DATE:** 2 September 2025

CLASS: Sec 4/1   **DURATION:** 1 hour 45 minutes

Additional Materials provided: -

INSTRUCTIONS TO CANDIDATES
Do not open this booklet until you are told to do so.

Write your NAME and INDEX NUMBER at the top of this page.

SECTION A (70 marks)
STRUCTURED QUESTIONS
Answer **all** questions. Write your answers in the spaces provided on the question paper.

SECTION B (10 marks)
FREE-RESPONSE QUESTIONS
Answer **one** question. Write your answers in the spaces provided on the question paper.

For Examiner's Use	
Paper 1	40
Paper 2 Section A	70
Paper 2 Section B	10
Paper 3	40
Total %	100

At the end of the examination, hand in this question booklet.

This Question Paper consists of 18 printed pages including this page.
[Turn over

SECTION B – STRUCTURED QUESTIONS (70 marks)
Answer **all** the questions in the spaces provided.

1 Fig. 1.1 shows the displacement-time graph of a ball falling in the air. The acceleration due to free fall is 10 m/s^2.

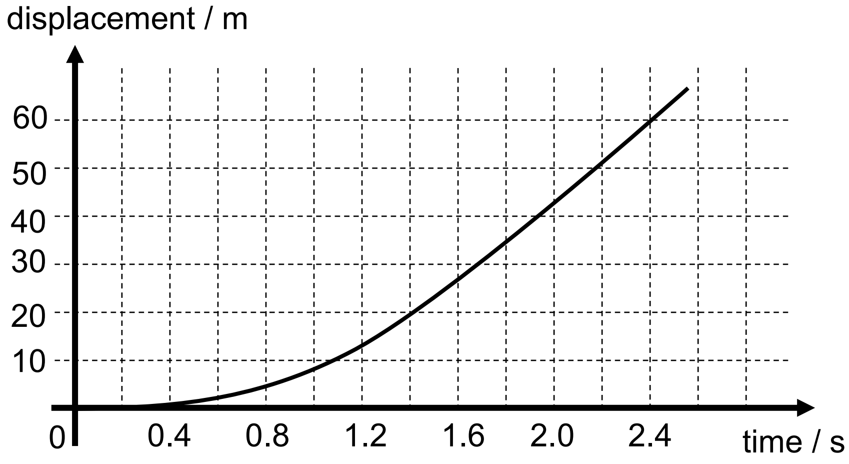


Fig. 1.1

(a) Using Fig. 1.1, describe how the graph shows the velocity of the falling ball is changing in the first 1.2 s.

....

.... [1]

(b) Determine the terminal velocity of the ball.

terminal velocity = ... [2]

(c) Explain, in terms of forces, how the ball reaches terminal velocity as it falls from rest.

....

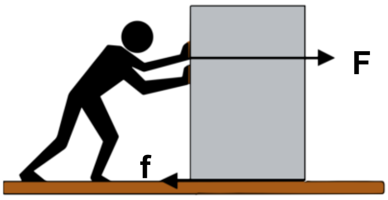
....

....

.... [2]

2 A man is pushing a heavy box along a flat ground with a constant force **F**.

A frictional force, **f** acts in a horizontal direction.



(a) Initially, the forces on the box are balanced and the box is stationary.

(i) State what is meant by *balanced forces*.

……………………………………………………………………………………..

…………………………………………………………………………………….. [1]

(ii) Describe one **other** possible state of motion of the box when the forces acting on it are balanced.

……………………………………………………………………………………..

…………………………………………………………………………………….. [1]

(b) The man stops pushing the box after some time. Explain what happens to the motion of the box.

………………………………………………………………………………………

………………………………………………………………………………………

……………………………………………………………………………………… [2]

(c) The weight of the box exerts a downward force on the ground. This is one force in an action-reaction pair.

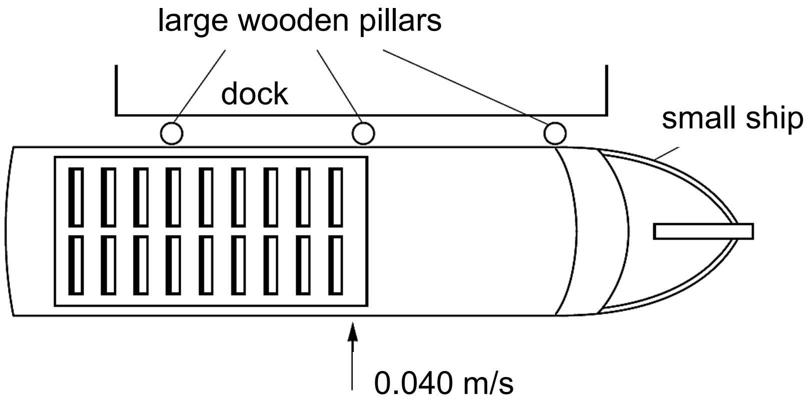
Describe the other force in the pair.

………………………………………………………………………………………

………………………………………………………………………………………

……………………………………………………………………………………… [2]

3 The figure shows the top view of a small ship of mass 1.2×10^6 kg. The ship is moving sideways at a speed of 0.040 m/s as it comes to a rest at a dock.



(a) Calculate the energy in the kinetic store of the ship when it is approaching the wall.

energy = ……………… [2]

(b) The ship hits three wooden pillars when it approaches the wall. The ship is in contact with the pillars for 0.60 s before it comes to rest.

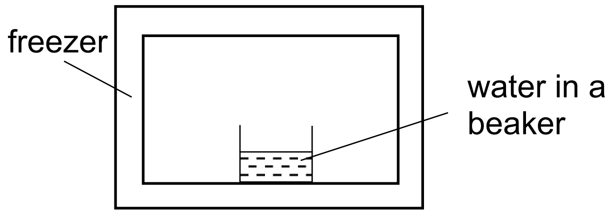
(i) Show that the average force exerted on the side of the ship is 80 kN.

[3]

(ii) Calculate the distance moved by the wooden pillars when they are hit by the ship.

distance = ……………… [2]

4 A beaker of water is placed in a freezer. The beaker contains 250 g of water initially at 30 °C.



The maximum rate at which energy is transferred away from the water by the freezer is 100 J/s.

It is known that the specific heat capacity of water is 4.2 J/g°C and specific latent heat of fusion of water is 334 J/g.

(a) Explain what is meant by the *specific heat capacity* of water is 4.2 J/g°C.

....

.... [1]

(b) Calculate the amount of energy released when the water is cooled from 30 °C to 0 °C.

energy released = ... [2]

(c) Calculate the mass of ice produced if the beaker of water at 0 °C is kept in the freezer for the next 10 minutes.

mass = ... [2]

5 Water waves are moving towards the seashore. Fig. 5.1 shows the top view of the wavefronts at a particular instant.

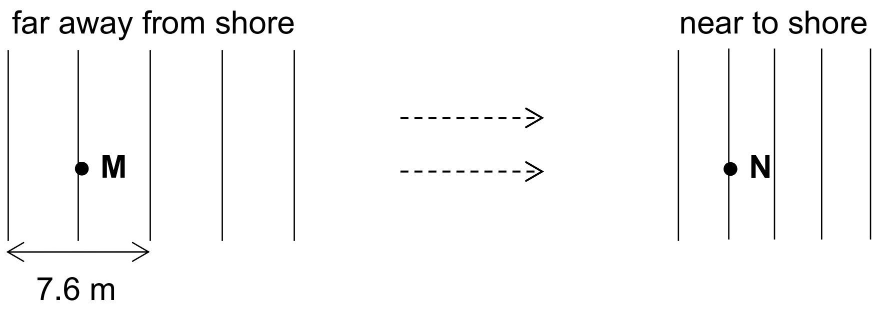


Fig. 5.1 (not drawn to scale)

Fig. 5.2 shows the displacement-time graph of a particle at point **M**.

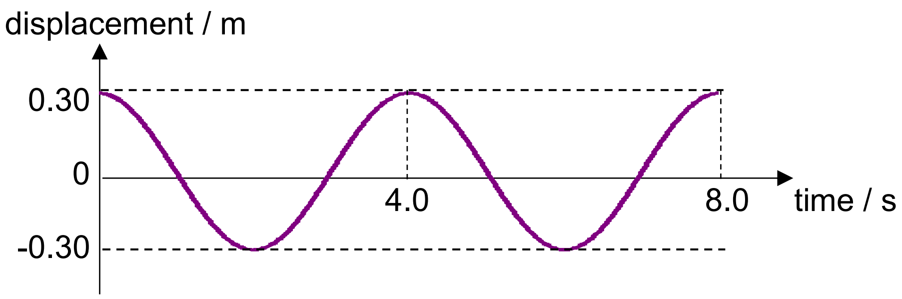


Fig. 5.2

(a) **(i)** Describe how wavefront can be used to obtain wavelength.

…………………………………………………………………………………..

………………………………………………………………………………….. [1]

(ii) Calculate the wavelength of the water wave when it is far from the shore.

wavelength = ……………… [1]

(iii) Determine speed of the water wave when it is far from the shore.

speed = ……………… [2]

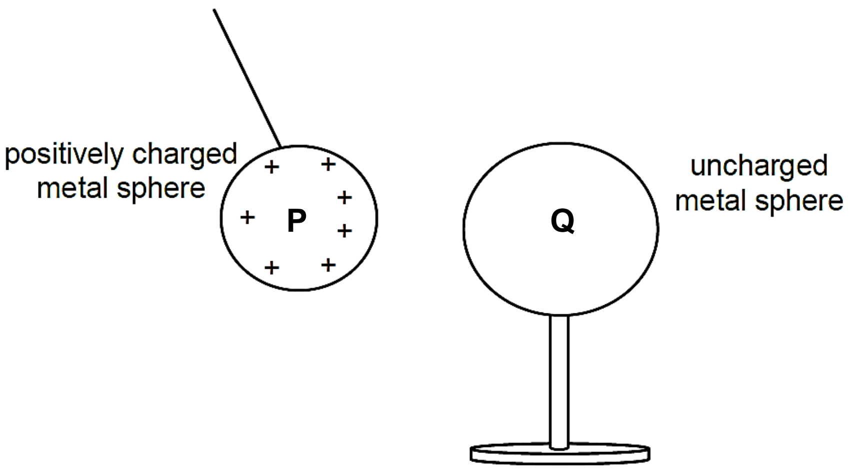
(b) Explain why the particle at point **N** has a shorter wavelength compared to the particle at point **M**.

....

....

.... [2]

6 A light positively charged metal sphere **P** is suspended by a plastic thread near an uncharged metal sphere **Q**, which is supported on an insulated stand, as shown in the figure.



(a) Explain why sphere **P** is attracted to sphere **Q**. You may draw charges on sphere **Q** in the figure above.

....

....

.... [2]

(b) Sphere **Q** is moved towards the left until it contacts sphere **P**.

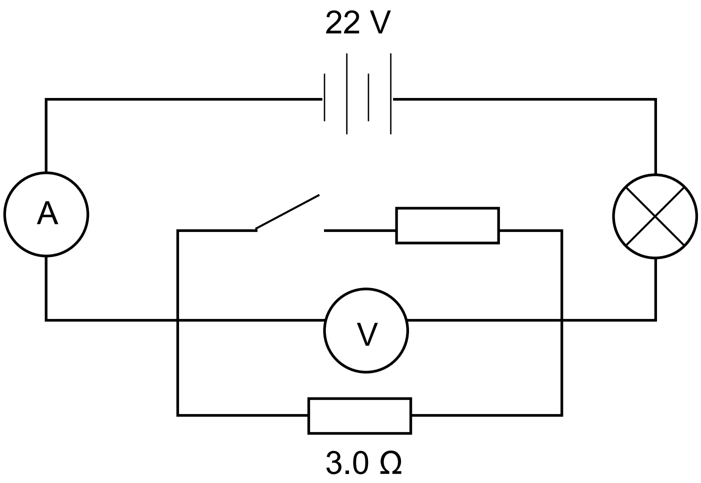
Describe and explain what happens to sphere **P**.

....

....

.... [2]

7 A 9.0 Ω light bulb is connected to a 22 V battery. When the switch is closed, the ammeter reading is 2.0 A.



(a) Calculate the potential difference across the light bulb.

potential difference = ……………… [2]

(b) Calculate the current in the 3.0 Ω resistor.

current = ……………… [2]

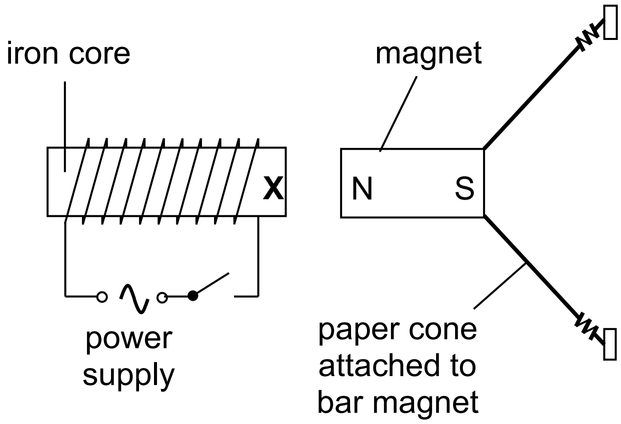
(c) The switch is now open. Explain how the brightness of the light bulb will change.

………………………………………………………………………………………

………………………………………………………………………………………

……………………………………………………………………………………… [2]

8 In the figure, a paper cone is attached to a magnet. The magnet is placed near end **X** of an electromagnet that is connected to an alternating current power supply.



(a) Explain how a sound can be produced by the paper cone when the power supply is switched on.

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

……………………………………………………………………………………… [3]

(b) State, any changes to the sound produced, when

(i) a power supply is changed to a direct current,

……………………………………………………………………………..

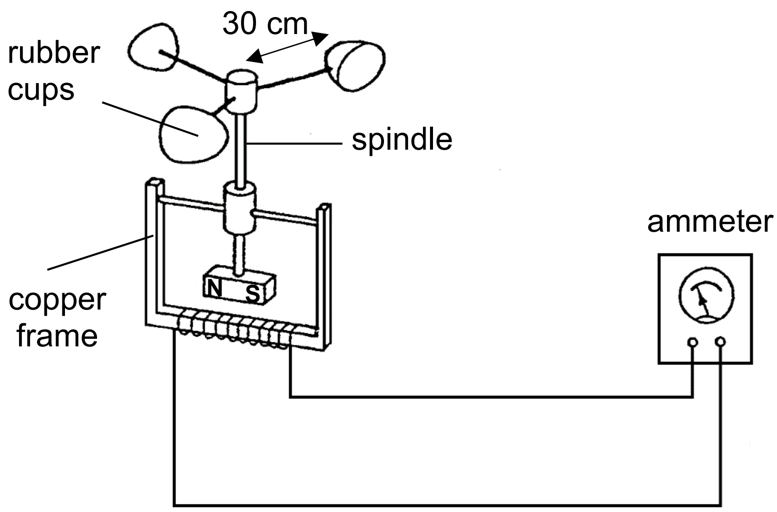
…………………………………………………………………………….. [1]

(ii) more turns of coil around the iron core.

……………………………………………………………………………..

…………………………………………………………………………….. [1]

9 The figure below shows a device that is set up to measure the speed of wind. A coil is wound around a copper frame. When the wind blows onto the rubber cups, the spindle rotates. The ammeter needle deflects when the spindle rotates.



(a) Explain how the rotating spindle causes the ammeter needle to be deflected.

....

....

.... [2]

(b) Describe and explain the change to the ammeter reading when the wind speed increases.

....

....

.... [2]

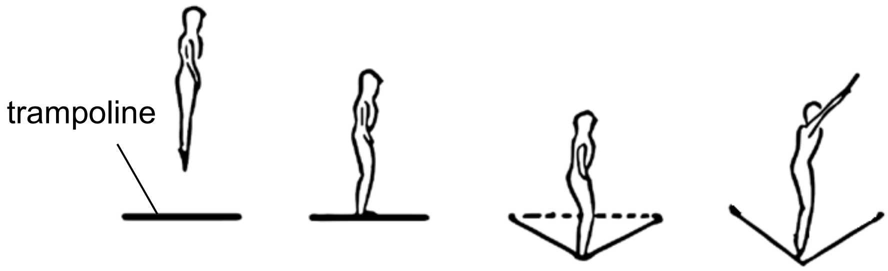
(c) When the wind is blowing in one direction, the average force exerted by the wind on the rubber cup is 50 N.

Calculate the moment on the rubber cup.

moment = ... [2]

10 A boy of mass 50 kg falls vertically onto a trampoline.

The figure below shows the position of the boy at four different points (**O**, **A**, **B** and **C**) during the fall. The boy starts to fall at point **O** from rest, bounces off the trampoline and reaches a maximum height after rebound.



His displacement from the trampoline is recorded every 0.25 seconds using a data logger and the data is shown in Table 10.1.

Table 10.1

time / s	displacement / m	extension of trampoline / m
0.00	5.36	0.00
0.25	4.75	0.00
0.50	3.62	0.00
0.75	2.02	0.00
1.00	0.00	0.00
1.25	-0.65	0.14
1.50	-1.24	0.36
1.75	0.98	0.00
2.00	2.57	0.00
2.25	3.78	0.00
2.50	4.52	0.00
2.75	3.91	0.00
3.00	2.78	0.00

(a) **(i)** Using Table 10.1, determine the distance that the boy falls from points **O** to **A** and **A** to **B**.

OA = ………………

AB = ……………… [1]

(ii) Calculate the average speed of the boy from points **O** to **B**.

average speed = ……………… [2]

(iii) Calculate the energy decrease in the gravitational potential store when the boy falls from points **O** to **B**.

The gravitational field strength is 10 N/kg.

energy decrease = ……………… [2]

(iv) Describe the main energy transfer of the boy from points **O** to **B**.

………………………………………………………………………………..

………………………………………………………………………………..

………………………………………………………………………………..

……………………………………………………………………………….. [2]

(b) The boy bounces up at point **C**.

(i) State the time at which the boy reaches the highest point.

time = ……………… [1]

(ii) Using data from Table 10.1, explain the type of acceleration that the boy is having when he is bouncing up.

………………………………………………………………………………..

………………………………………………………………………………..

………………………………………………………………………………..

……………………………………………………………………………….. [2]

11 Isotopes of some elements may be unstable and undergo nuclear decay, releasing radiation.

One example is the isotope radium-226, which decays into radon-222 with the emission of an alpha particle.

(a) Explain what is meant by *unstable*.

....

.... [1]

(b) Describe an alpha (α) particle.

....

.... [1]

(c) In nuclide notation, radium-226 is written as ${}^{226}_{88}Ra$.

Write the nuclide equation to represent the alpha decay of radium-226 to radon-222. The chemical symbol for radon is Rn.

.... [2]

(d) Explain why this reaction is a nuclear decay instead of nuclear fission.

....

....

.... [2]

(e) The isotope radon-222 is also unstable and continues to decay into smaller nuclides. The half-life of radon-222 is 8.3 days.

The initial mass of a sample of radon-222 is observed to be 100 g.

Calculate the number of days it will take for 12.5 g of radon-222 to be left in the sample.

number of days = ... [2]

(f) Explain why it is harmful when alpha particles are in the human body.

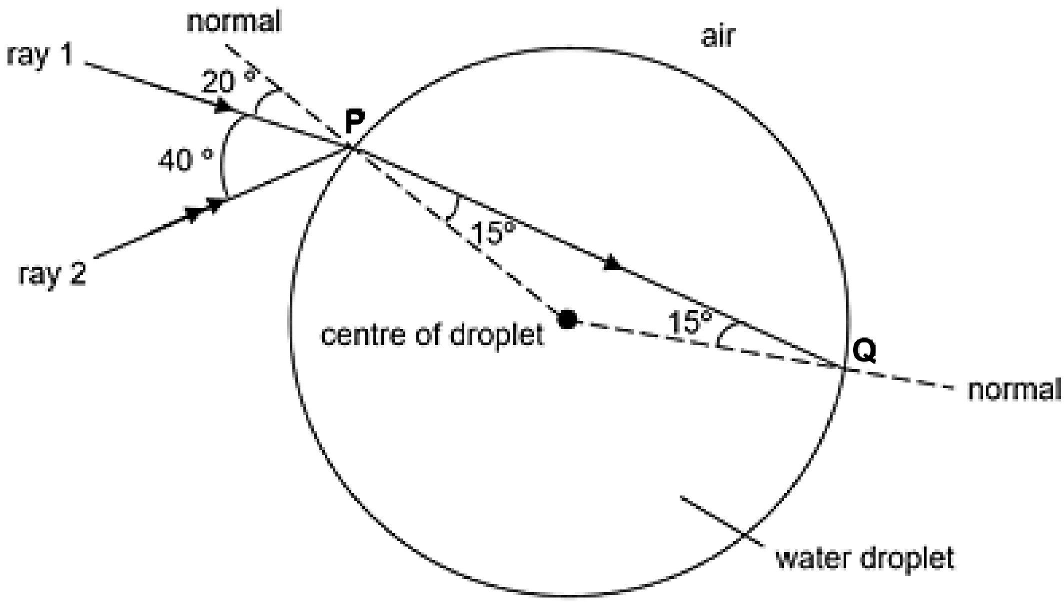
....

....

.... [2]

SECTION B – FREE RESPONSE QUESTIONS (10 marks)
Answer **one** question from this section.

12 Two light rays from a lamp strike a water droplet at point **P**.



The angles of incidence and refraction for ray 1 at point **P** are 20° and 15° respectively.

The angle of incidence for ray 1 at point **Q** is the same as the angle of refraction at point **P**.

(a) Explain why ray 1 bends at point **P**.

……………………………………………………………………………………

……………………………………………………………………………………

…………………………………………………………………………………… [2]

(b) Determine the angle of refraction of ray 2 at point **P**.

angle of refraction = ……………… [2]

(c) Explain what is meant by *critical angle*.

....

....

.... [1]

(d) Explain the path of ray 2 when it strikes the other side of the water droplet.

....

....

....

....

....

....

.... [3]

(e) Suggest how water can be used to produce a magnified image.

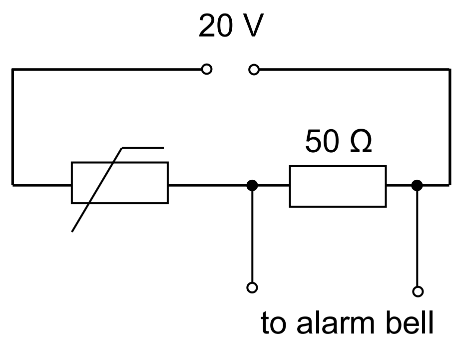
....

....

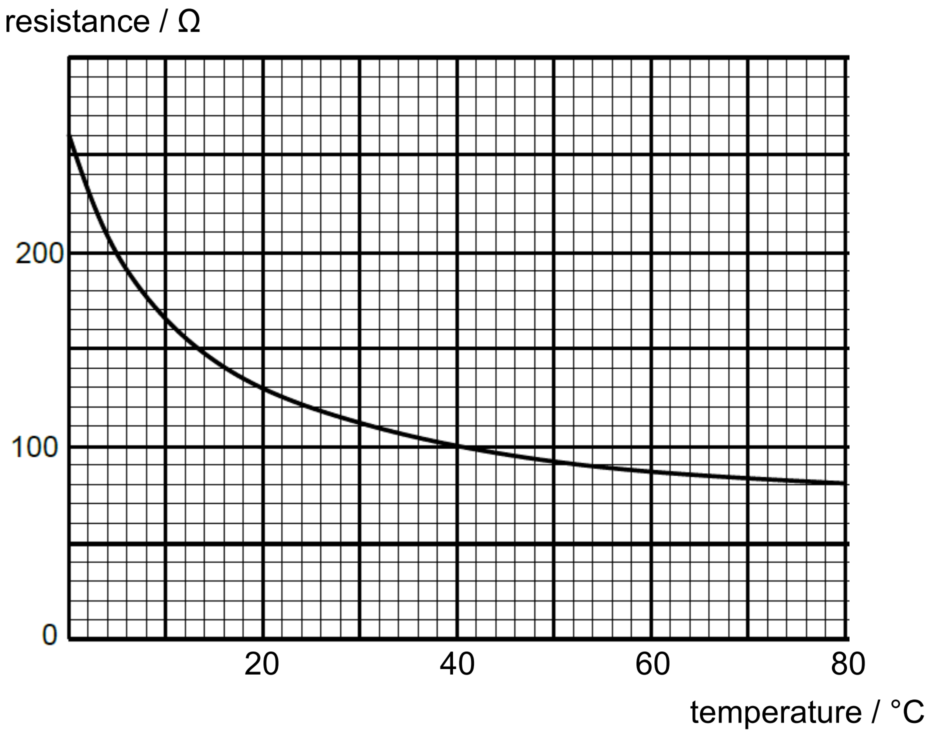
....

.... [2]

13 An alarm system consisting of a negative temperature coefficient (NTC) thermistor, a 50 Ω resistor and an alarm bell. The alarm bell is triggered when the temperature of the surrounding reaches 50 °C. There is negligible current flowing to the alarm bell below the trigger temperature.



The graph below shows the resistance of the thermistor at different temperatures.



(a) Explain why it is necessary to include a fixed resistor in the circuit.

....

....

....

.... [2]

Using the graph,

(b) state the resistance of the thermistor at the trigger temperature,

resistance = ……………… [1]

(c) determine the minimum potential difference at which the alarm bell operates.

minimum potential difference = ……………… [2]

(d) Explain how the alarm bell will be switched on as the temperature increases from 10 °C to 50 °C.

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

…………………………………………………………………………………… [2]

(e) Calculate the power supplied to the circuit at 50 °C.

power = ……………… [2]

(f) Suggest why this thermistor may not be suitable to use in alarm bells with higher trigger temperature.

……………………………………………………………………………………

…………………………………………………………………………………… [1]

- End of Paper -