



**ASSUMPTION
ENGLISH**

A Montfortian Gabrielite Education Institution

Preliminary Examination Secondary Four Express

NAME

CLASS

INDEX

NUMBER

Physics

Paper 2

6091/02

31 August 2026

1 hour 45 minutes

Candidates answer on the Question Paper.

Additional materials: NIL

READ THESE INSTRUCTIONS FIRST

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

Write your NAME, CLASS 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 19 printed pages including this page.

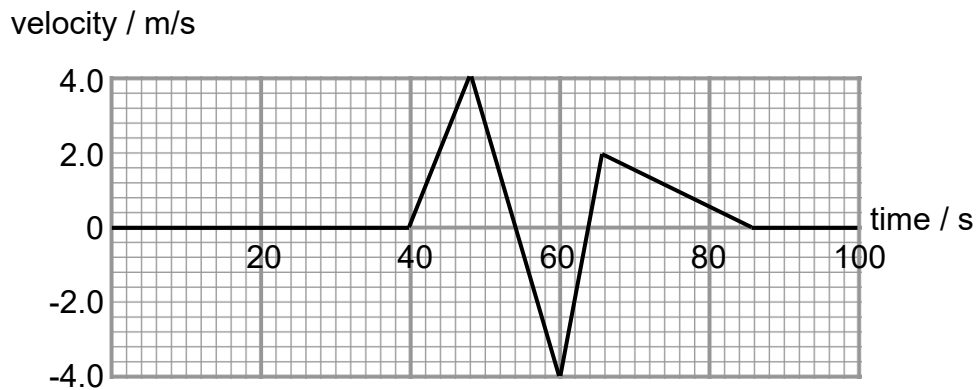
[Turn over

SECTION A – STRUCTURED QUESTIONS (70 marks)

Answer **all** the questions in the spaces provided.

- 1 An airplane with mass 250 000 kg is moving at constant height. It then experiences sudden vertical movements due to severe air turbulence.

The figure below shows how its vertical velocity changes over 100 s, where upward velocity is taken as positive.



- (a) State the time which the plane first met with air turbulence.

time = [1]

- (b) Explain, in terms of forces, the motion of the airplane between $t = 48$ s and $t = 60$ s.

.....

..... [2]

- (c) Calculate the maximum magnitude of the acceleration experienced by the airplane during the 100 s.

maximum acceleration = [2]

- 2 A man accelerates along a straight, level road on an electric scooter at 1.5 m/s^2 for 40 m. The total mass of the man and the scooter is 90 kg. A constant resistive force of 45 N acts on the man and the scooter.



- (a) Determine the driving force provided by the motor of the scooter.

driving force = [2]

- (b) The efficiency of the motor is 60%. Calculate the total energy transferred by the battery to the motor.

total energy = [2]

- (c) **G** is the centre of gravity of the man.

The rider decides to step closer to the rear wheel while maintaining an upright position. Explain how this shift in position affects the moment about the rear wheel.

.....

.....

.....

..... [2]

- 3** A beaker of cold water is placed onto a hotplate. The hotplate is then turned on.

(a) Describe the change in internal energy of the water.

.....

..... [1]

(b) State the main thermal process occurring throughout the water.

..... [1]

(c) Explain, in terms of its particles, how energy is transferred from the hotplate to the base of the beaker.

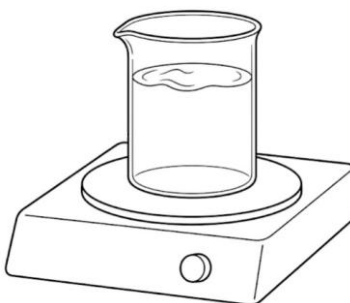
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..... [2]

(d) The total weight of the beaker and the water is 4.8 N. The diameter of the base of the beaker is 8.0 cm.



Calculate the pressure exerted by the beaker on the top surface of the hotplate, giving your answer to appropriate significant figures.

pressure = [2]

- 4 Ultrasound waves are used to produce images of an unborn child. An emitter-receiver probe is placed on the mother's skin, as shown in the diagram below.



- (a) Describe ultrasound in terms of its particle vibration.

.....

 [1]

- (b) The emitted pulse took 0.032 ms to return to the probe. The speed of ultrasound in human tissue is 1500 m/s.

Calculate the distance between the emitter and the unborn child.

distance = [2]

- (c) Suggest how the method of obtaining an image using ultrasound differs from that of X-rays.

.....

 [1]

- 5 (a) (i) Define *electric field*.

.....

..... [1]

- (ii) Draw the electric field lines between the two charges.



[2]

- (b) A girl combs her hair with a plastic comb. The comb has a negative charge now.

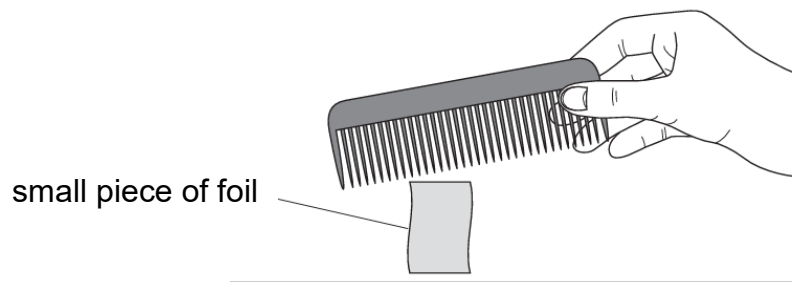
- (i) Explain how her hair becomes charged.

.....

.....

..... [1]

- (ii) The girl then holds the comb over a small piece of metal foil.



Explain why the foil jumps up and sticks to the comb.

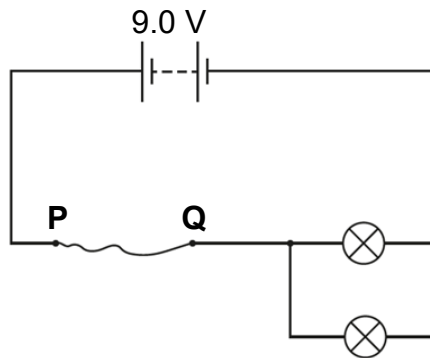
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..... [2]

- 6 A resistance wire **PQ** is connected to a battery with an electromotive force (e.m.f.) of 9.0 V. The light bulbs are identical, and each have a resistance of $1.5\ \Omega$. The current flowing through each bulb is 2.0 A.



- (a) Define *electromotive force (e.m.f.)*.

.....
 [1]

- (b) Determine the potential difference across each bulb.

potential difference = [1]

- (c) Calculate the resistance of wire **PQ**.

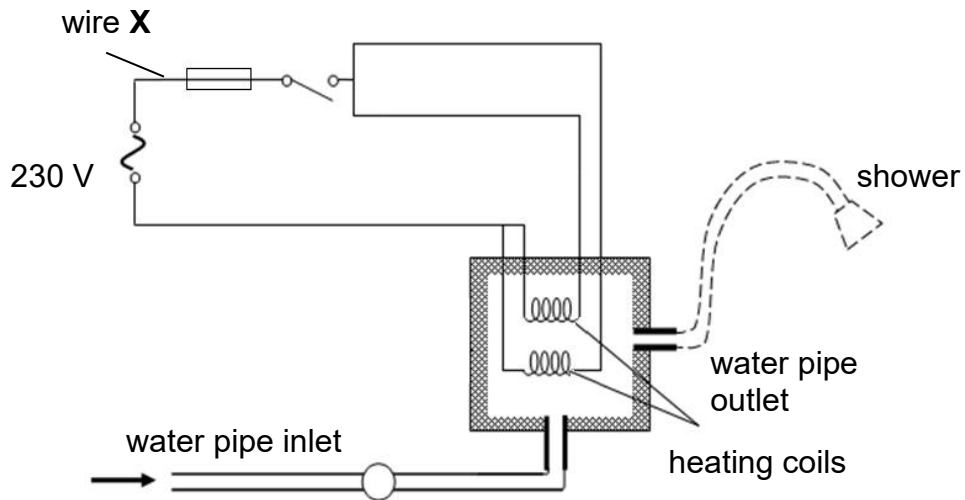
resistance = [2]

- (d) PQ is replaced by another wire of similar length and thickness is made of a metal of higher resistivity. Explain any change to the brightness of the bulbs.

.....

 [2]

- 7 The figure shows a simple circuit of a shower system connected to the mains supply. The shower system is fitted with two 230 V, 2.0 kW heating coils.



- (a) Explain why the fuse and switch are placed along wire X.

.....

 [2]

- (b) A 20 A fuse is used in the circuit. Explain whether this is a suitable fuse rating to use.

.....
 [3]

- (c) The mains plug used in this circuit does not have a third wire.

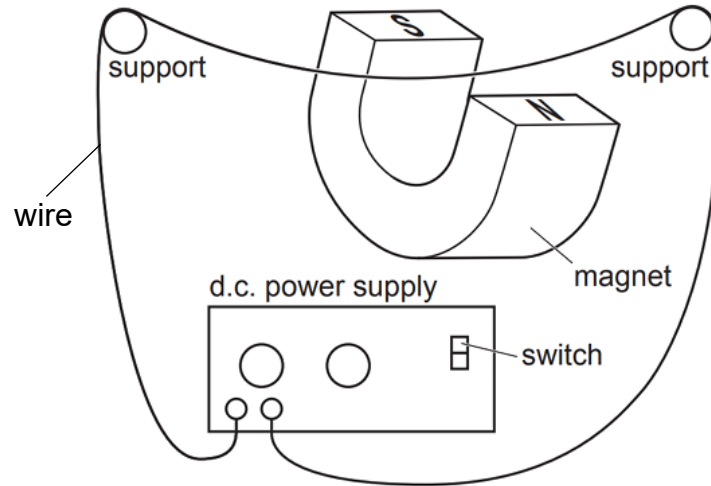
State the name of this third wire and suggest why this wire is not present in this circuit.

name of wire:

suggestion:

..... [2]

- 8 A flexible, light copper wire is suspended loosely between two insulated supports. A section of the wire hangs between the two magnetic poles of a strong U-shaped magnet. The wire is connected to a direct current (d.c.) power supply and a switch.



When the switch is closed, the loose wire moves down.

- (a) Explain why the wire moves down when the switch is closed.

.....

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.....

..... [2]

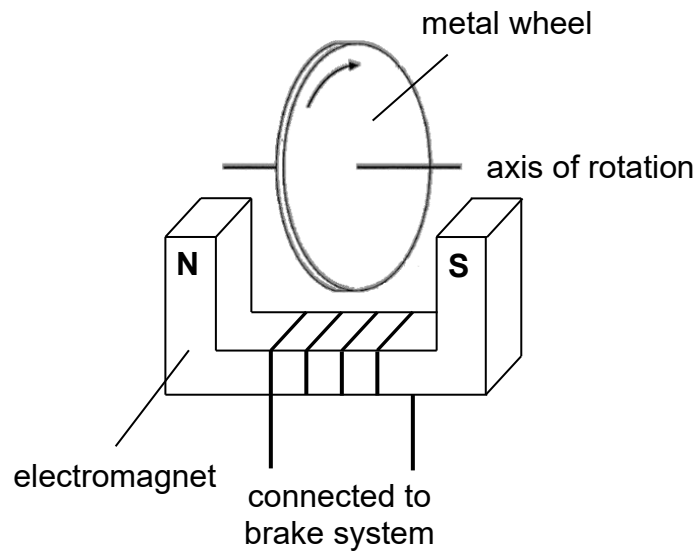
- (b) On the figure above, draw an arrow on the wire between the two supports to show the direction of the current. [1]

- (c) State one modification to increase the magnitude of the force acting on the wire.

.....

..... [1]

- 9 The diagram shows an electromagnet braking system used in high-speed trains. When the brake system is activated, current passes through the coils wound around the electromagnet, causing the metal wheel to slow down.



- (a) Explain why current is induced in the rotating wheel when the brake system is activated.

.....

 [2]

- (b) Explain why the induced current in the wheel flows in a direction that slows down the rotation of the wheel.

.....

 [1]

- (c) Explain why iron is chosen to be the core material for the electromagnet.

.....

 [1]

- (d) Describe the change in energy of the metal wheel when the brake system is activated.

.....

.....

.....

.....

[2]

- 10** A patient with thyroid cancer is treated using a capsule containing a small dose of iodine-131 ($^{131}_{53}\text{I}$). Iodine-131 is a radioactive isotope that undergoes beta decay to form a stable isotope of xenon (Xe). High-energy gamma rays are emitted alongside the decay.

- (a)** Describe what happens when a nucleus of iodine-131 undergoes beta decay.

.....

 [2]

- (b)** Write the nuclide equation for the decay of iodine-131.

..... [2]

- (c)** The half-life of iodine-131 is 8.0 days. A detector is placed near the capsule. The background count is 220 counts/min. At $t = 0$ days, the activity recorded is 5300 counts/min.

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

.....
 [1]

- (ii)** Calculate the activity of the capsule after 24 days have passed.

activity = [2]

- (d)** Explain which emission, beta-particle or gamma rays, can be detected outside the body of the patient.

.....
 [1]

- 11** An engineer is designing an automatic night-light system for a smart home. The circuit relies on a light-dependent resistor (LDR) to sense changes in light levels and trigger a light-emitting diode (LED) when it gets dark.

To calibrate the system, the engineer isolates the LDR and records how its resistance changes under different light intensities. The data gathered is shown in Table 11.1.

Table 11.1

light intensity / unit	resistance / Ω
10	8000
50	4000
100	1000
500	150

Table 11.2 shows the surrounding conditions at different light intensity.

Table 11.2

condition	light intensity / unit
night	10
dim room	50
cloudy day	100
bright office	500

The LDR is then connected with a fixed resistor. Fig. 11.3 shows an incomplete circuit with the missing LDR.

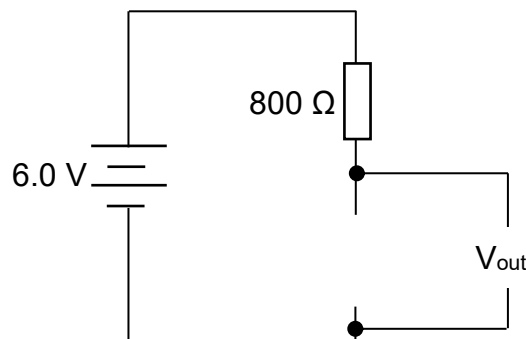


Fig. 11.3

(a) On Fig. 11.3, draw the circuit symbol of an LDR. [1]

(b) The light intensity falling on the LDR gets higher.

Explain what happens to the voltage across

1. the LDR,

.....

.....

.....

..... [2]

2. the fixed resistor.

.....

.....

..... [1]

(c) Using the data in Tables 11.1 and 11.2, calculate the current through the fixed resistor on a cloudy day.

current = [2]

(d) The output voltage V_{out} is connected to a switch and an LED. The LED requires a V_{out} of at least 3.0 V to turn on.

Explain whether the LED will be turned on when the room is dim.

.....

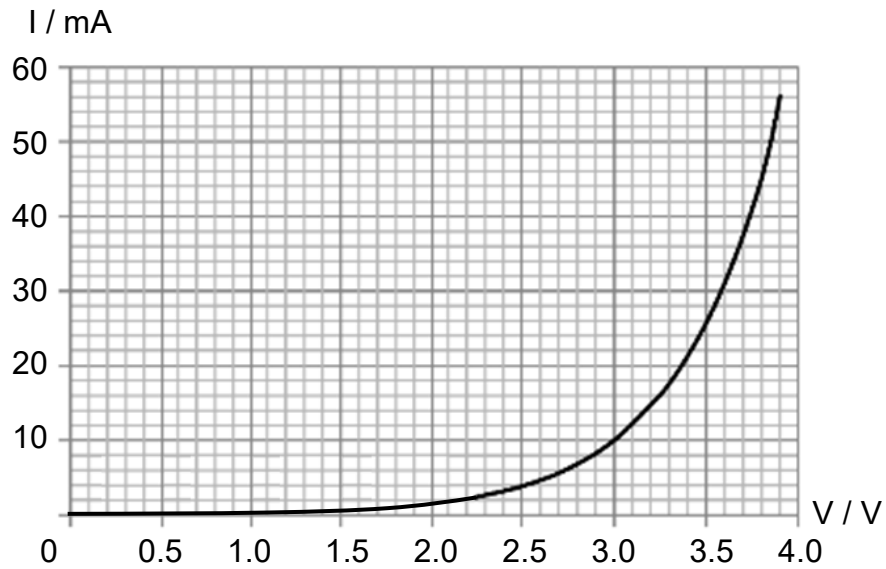
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..... [3]

- (e) The I-V characteristic graph of the LED used in the night-light system is shown below.



Describe how the resistance of the LED changes as the voltage across it increases from 0 to 3.9 V.

.....

 [2]

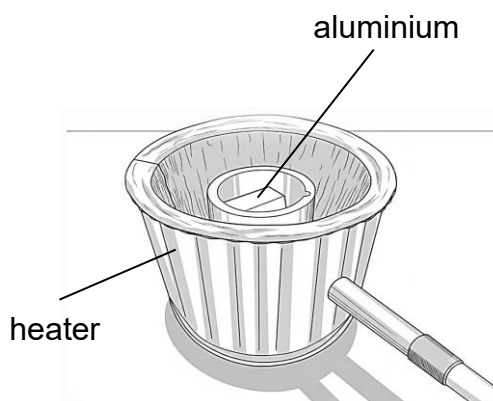
- (f) Suggest one advantage of using an LED instead of a traditional filament lamp for a home night-light system.

.....
 [1]

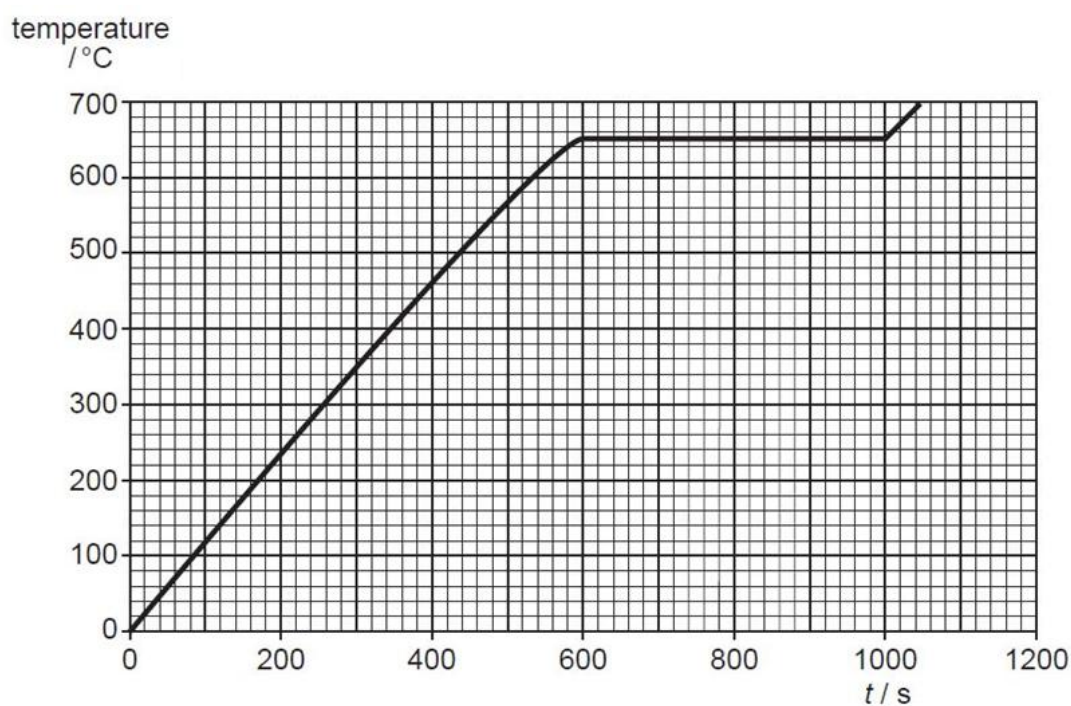
SECTION B – FREE RESPONSE QUESTIONS (10 marks)

Answer **one** question from this section.

- 12** A solid aluminium bar of mass 300 g is placed inside a ceramic container and heated, as shown in the diagram below.



The graph below shows how the temperature of aluminium varies with time. The specific heat capacity of aluminium is $880 \text{ J/(kg}^\circ\text{C)}$.



- (a)** State the melting point of aluminium.

melting point = [1]

- (b) Explain how the energy transferred to the aluminium affects the motion of its particles between

$t = 0$ and $t = 600$ s:

.....

.....

$t = 600$ s and $t = 1000$ s:

.....

..... [2]

- (c) Find the energy transferred into the aluminium before it begins to melt.

energy = [2]

- (d) Calculate the rate of energy transfer of the furnace.

rate of energy transfer = [2]

- (e) Determine the specific latent heat of fusion of aluminium.

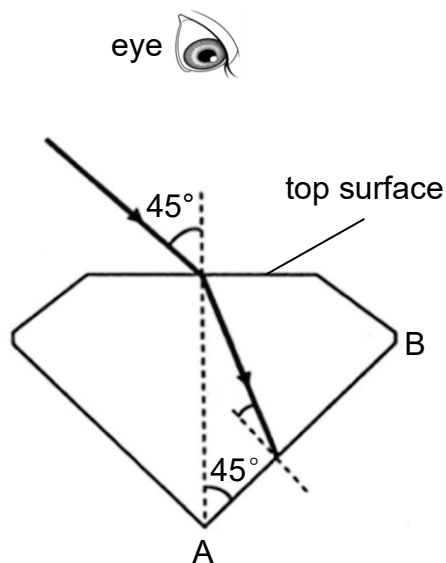
specific latent heat of fusion = [2]

- (f) Suggest one source of error in this set-up.

.....

..... [1]

- 13 A narrow beam of yellow light strikes the top surface of a diamond at an angle of 45° . The light ray travels toward side AB after entering the diamond.



The refractive index of diamond for yellow light is 2.42.

- (a) Define *refractive index*.

.....
 [1]

- (b) Calculate the angle of refraction as the yellow light enters the top surface of the diamond from air.

angle of refraction = [2]

- (c) Calculate the speed of yellow light in the diamond.

speed = [2]

- (d) The critical angle of this gemstone is 24.4° . Explain what happens to the light ray when it hits side AB.

.....

.....

.....

..... [2]

- (e) A diamond is observed to be shiny brightly when viewed from the top surface of the diamond.

Explain how the high refractive index of a diamond contributes to how bright a diamond shines.

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..... [2]

- (f) Over time, a film of sweat and grease from human skin coats the diamond. Suggest why this causes the diamond to appear less shiny to an observer viewing from the top surface.

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..... [1]

- End of Paper -