



**BEATTY SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2026
SECONDARY FOUR EXPRESS / G3**

CANDIDATE
NAME

CLASS

REGISTER
NUMBER

PHYSICS

Paper 2

Theory

6091/02

20 Aug 2026

1 hour 45 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Section A

Answer **all** questions.
Write your answers in the spaces provided.

Section B

Answer **one** question.
Write your answers in the spaces provided.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
A	70
B	10
Total	80

Section A

Answer **all** the questions in this section.

- 1 A monorail undergoing some tests takes 10 minutes to travel along a straight and horizontal path to its destination.

Fig. 1.1 shows the velocity-time graph of the monorail.

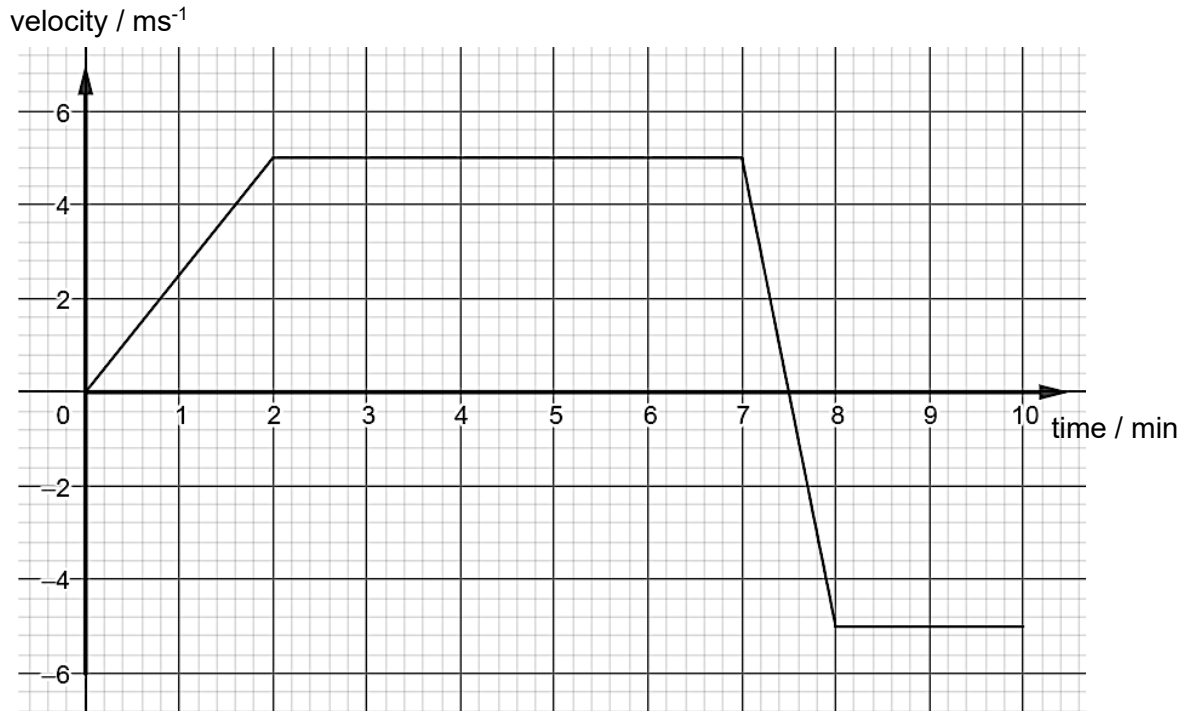


Fig. 1.1

- (a) Calculate the acceleration of the monorail in the first 2 minutes. Give your answer in m/s^2 .

acceleration = m/s^2 [2]

- (b) Describe the motion of the monorail between time = 7 to 8 mins.

.....

 [2]

- (c) Calculate the displacement of the monorail at time = 10 mins.

displacement = [2]

- (d) In the space provided, sketch the displacement-time graph of the monorail during the 10 minutes of testing. Indicate all relevant time values on the graph.

[2]

[Total: 8]

- 2 Fig.2.1 shows a student abseiling on a vertical wall.

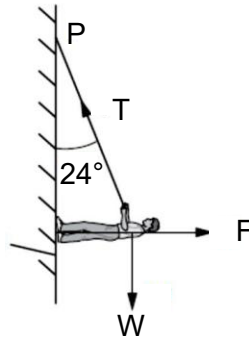


Fig. 2.1

The weight W of the student is 620 N. The rope, of negligible weight, is attached to the student and to a fixed point P where it makes an angle of 24° to the vertical wall. The reaction force F acts at right angle to the wall. The student is at equilibrium.

- (a) In the space provided, draw a labelled vector diagram to determine the magnitudes of tension T in the rope and the reaction force F . State clearly the scale you have used.

$T = \dots\dots\dots$; $F = \dots\dots\dots$ [1]

scale = $\dots\dots\dots$ [1]

- (b) Reaction force F forms a pair of action-reaction forces. Identify another action-reaction pair experienced by the student on Fig. 2.1.

.....

..... [1]

- (c) As the student descends, the angle which the rope makes with the vertical wall decreases.

Describe how the magnitudes of the tension T and force F will change.

.....
 [1]

[Total: 4]

- 3 Fig. 3.1 shows a typical hydraulic jack used to lift lorry tyres at an automobile workshop. An oil reservoir that is open to the atmosphere is connected to the hydraulic jack.

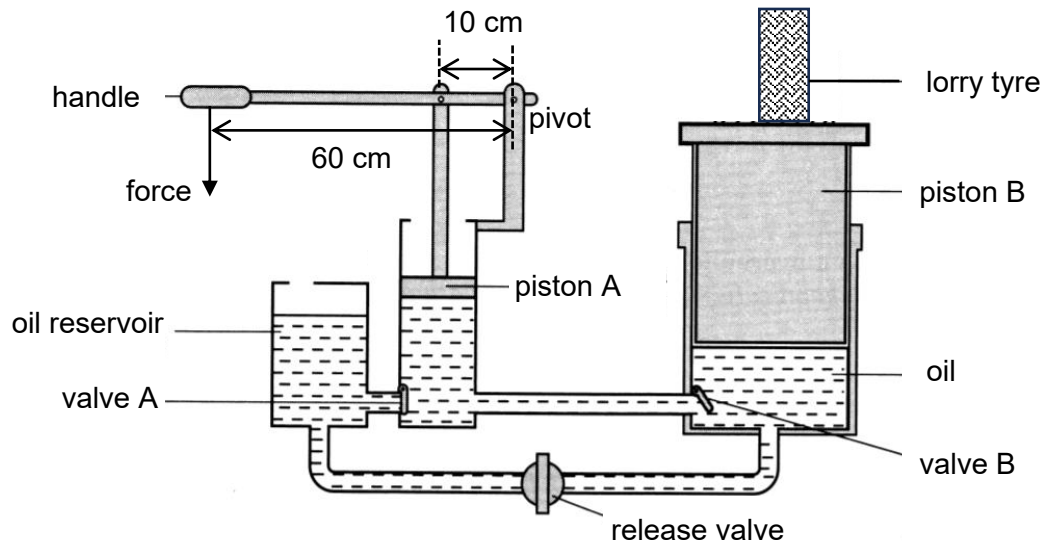


Fig. 3.1

To lift a lorry tyre resting on piston B, a mechanic closes the release valve and presses on the handle to push down piston A. The cross-sectional areas of pistons A and B are 0.080 m^2 and 0.960 m^2 respectively.

Take g to be 10 N/kg .

- (a) If the lorry tyre has a weight of 75 kg ,
- (i) calculate the pressure exerted on the oil in the hydraulic jack,

pressure in oil = [2]

- (ii) calculate the minimum force needed to press down the handle so that the lorry tyre is lifted.

minimum force = [2]

- (b) When the handle is pressed, valve A closes while valve B opens. This enables oil to flow from piston A to piston B.

Using your understanding of the kinetic particle model of matter, explain why the oil flows from piston A to piston B without any loss of pressure.

.....

 [3]

- (c) State and explain what will happen if the release valve breaks and oil can flow freely through the release valve.

.....

 [2]

[Total: 9]

- 4 A curved glass tube is open at one end and sealed at the other. A dense liquid is poured into the tube. The liquid traps air in the sealed end.

Fig. 4.1 shows the tube, the liquid and the trapped air.

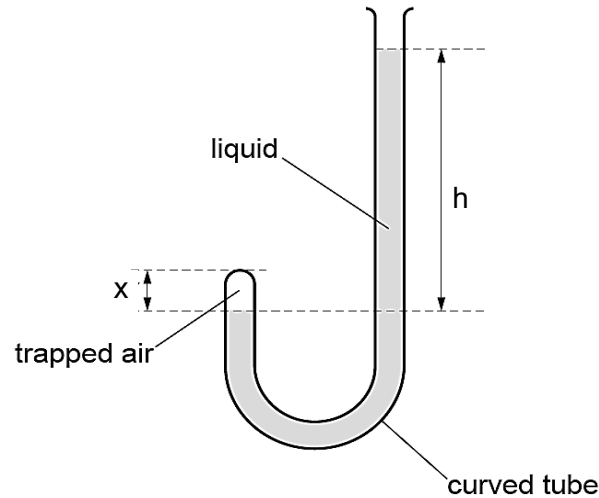


Fig. 4.1

- (a) The difference between the liquid levels is h . At room temperature, h is 0.480 m. The atmospheric pressure is 1.01×10^5 Pa and the gravitational field strength g is 10 N/kg. The density of the liquid is 1.30 g/cm^3 .

- (i) Convert 1.3 g/cm^3 into kg/m^3 .

$$1.3 \text{ g/cm}^3 = \dots\dots\dots \text{ kg/m}^3 \quad [1]$$

- (ii) Calculate the pressure of the trapped air.

$$\text{pressure} = \dots\dots\dots [2]$$

- (b) The glass tube is then brought into a cold room at atmospheric pressure.

- (i) Describe how energy is conducted thermally through the glass until the liquid is at thermal equilibrium with the cold air.

.....

.....

.....

.....

..... [2]

- (ii) The original height of the trapped air is x .

State how x will change when the glass tube is placed in the cold room. Explain your answer in terms of molecules.

.....

 [2]

- (iii) Explain how h will be affected when the glass tube is placed in the cold room.

.....

 [2]

[Total: 9]

- 5 A small pebble of mass m is dropped from the top of a cliff of height 380 m. The pebble has a speed v just before it hits the bottom of the cliff. Assume negligible air resistance.

- (a) (i) State the Principle of Conservation of Energy.

.....

 [1]

- (ii) Explain how the Principle of Conservation of Energy is demonstrated in the dropping of the pebble just before it hits the bottom of the cliff.

.....

 [3]

- (b) Calculate v , the speed of the pebble just before it hits the bottom of the cliff.

$$v = \dots\dots\dots [2]$$

- (c) When the same pebble is dropped from the top of another cliff, it has a speed of $\frac{1}{2} v$ just as it hits the bottom of the cliff.

Suggest **one** change that could have caused the speed to be halved. Support your claim by showing all your workings and/or graphs.

.....

 [3]

[Total: 9]

- 6 A barista at a café uses a machine to heat some water at $25\text{ }^{\circ}\text{C}$ to $120\text{ }^{\circ}\text{C}$ under high pressure. The steam produced is then injected into 150 cm^3 of cold milk at $4\text{ }^{\circ}\text{C}$ to create milky froth as shown on Fig. 6.1. The final temperature of the milky froth is $60\text{ }^{\circ}\text{C}$.

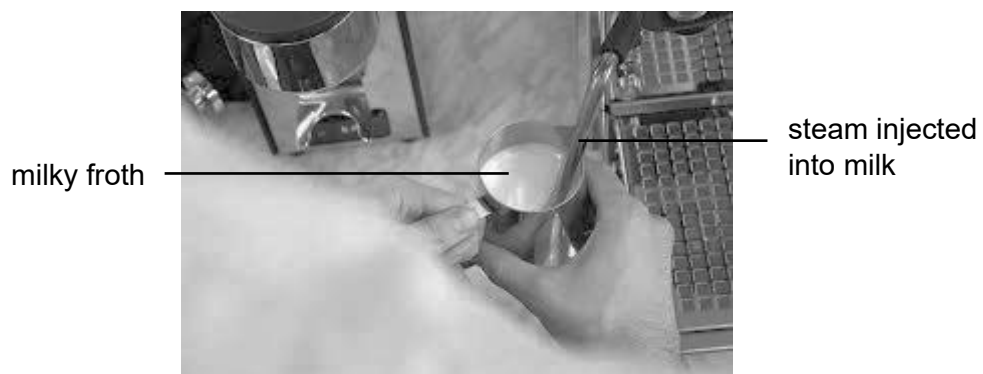


Fig. 6.1

The following information is provided.

specific heat capacity of water = $4.20\text{ kJ}/(\text{kg }^{\circ}\text{C})$

specific heat capacity of milk = $3.90\text{ kJ}/(\text{kg }^{\circ}\text{C})$

specific heat capacity of steam under high pressure = $2.20\text{ kJ}/(\text{kg }^{\circ}\text{C})$

specific latent heat of vaporisation of water = 2260 kJ/kg

density of cold milk = 1.04 g/cm^3

- (a) Calculate the mass of milk used by the barista.

mass of milk = [1]

- (b) Calculate the mass of steam injected into the cold milk.

mass of steam = [3]

- (c) Fig. 6.2 shows part of the machine called a steam wand that is inserted into the cold milk. The wand causes the milk to stir and creates bubbles in the milk.

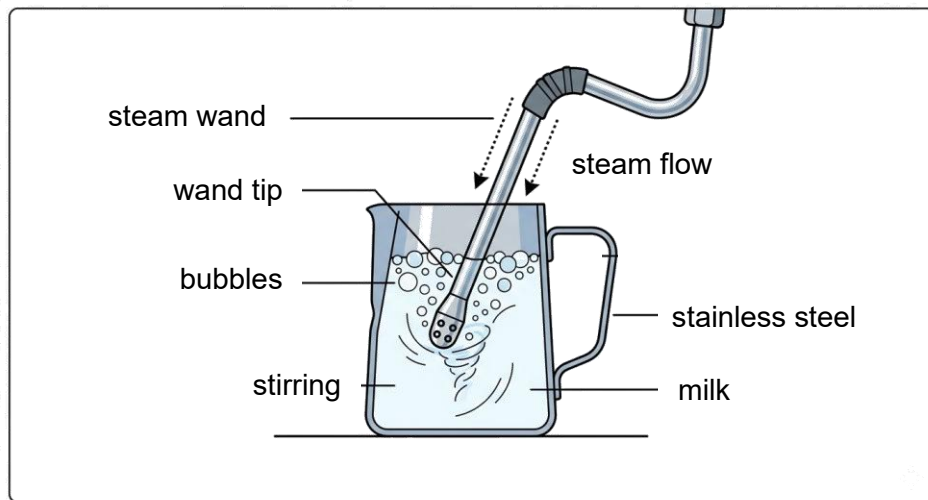


Fig. 6.2

State how energy from the steam is transferred thermally to the cold milk.

.....

 [2]

[Total: 6]

- 7 A student builds a model of the top half of a converging lens using a set of glass prisms made from identical material.

Fig. 7.1 shows three parallel blue light rays incident on the glass prisms at different angles.

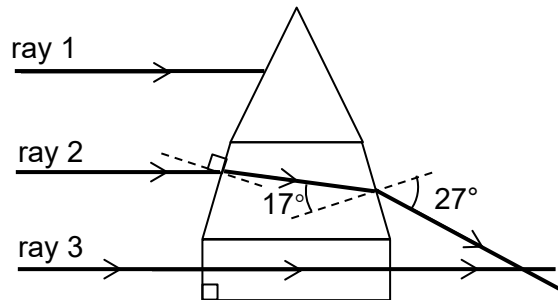


Fig. 7.1

- (a) Calculate the refractive index of the glass prisms.

refractive index = [2]

- (b) Red light, which has a longer wavelength than blue light, experiences a lower refractive index in the same glass prism.

The student replaces ray 1 with a ray of red light.

- (i) Complete Fig. 7.1 by continuing the path taken by the red light in the prism and in air subsequently. Label the ray R. [1]

- (ii) Among the visible light colours, red has the lowest refractive index.

State two components of the electromagnetic spectrum that are expected to have lower refractive indices than red light in the same glass prisms.

1.

2.

[1]

- (iii) State and explain whether red light travels faster than blue light in the glass prisms.

.....

.....

..... [2]

[Total: 6]

- 8 Fig. 8.1 shows how the resistance of a thermistor changes with temperature.

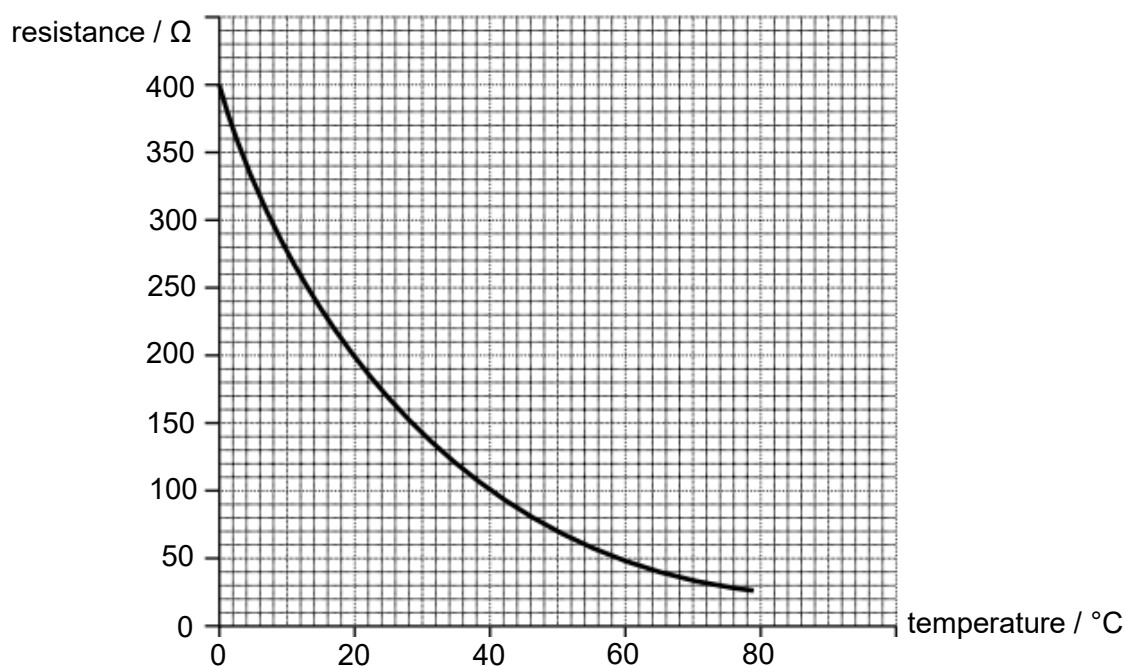


Fig. 8.1

- (a) By referring to Fig. 8.1, determine

- (i) the resistance when the temperature is 20 °C,

resistance = [1]

- (ii) the temperature when the resistance is 70 Ω.

temperature = [1]

- (b) The thermistor is connected to a circuit as shown in Fig. 8.2.

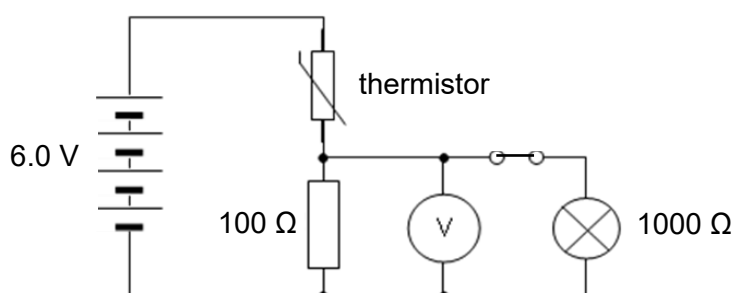


Fig. 8.2

- (i) Calculate the current in the battery when the circuit is in a room at 20 °C.

current = [2]

- (ii) Calculate the power output of the lamp when the resistance of the thermistor is $70\ \Omega$.

power = [2]

- (c) Describe and explain how the brightness of the lamp in Fig. 8.2 will change as the temperature increases from $20\ ^\circ\text{C}$ to the temperature in (a)(ii).

.....

.....

.....

.....

.....

..... [3]

[Total: 9]

- 9 Polonium, a rare and highly radioactive metal, was discovered by the famous scientist couple, Pierre and Marie Curie, in 1898. Named after Poland, this extremely toxic metal has an isotope polonium-210 (Po-210) that emits particles as it undergoes radioactive decay into lead-206 (Pb-206).

(a) Radioactive decay is a spontaneous process.

Explain what is meant by a spontaneous process.

.....

 [1]

(b) The atomic numbers of polonium-210 and lead-206 are shown on Table 9.1.

Table 9.1

element	atomic number
polonium-210	84
lead-206	82

(i) Identify the particle emitted when a polonium-210 atom decays into lead-206 atom.

..... [1]

(ii) Write a balanced nuclear equation, in nuclide notation, of the radioactive decay of Po-210 to Pb-206.

..... [1]

(iii) Fig. 9.1 shows particle radiation from the sample of Po-210 entering a uniform magnetic field.

On Fig. 9.1, draw the expected path of the particle radiation in the magnetic field.

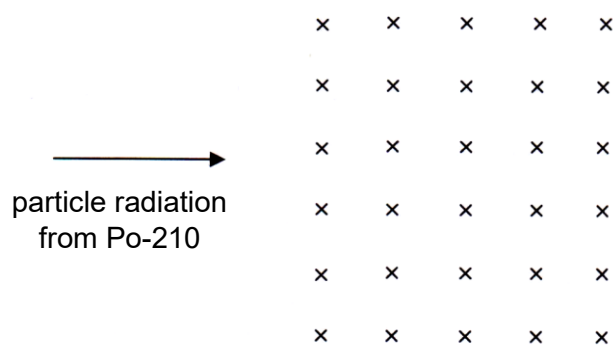


Fig. 9.1

[1]

- (c) Table 9.2 shows the count rate of a sample of polonium-210. The background radiation averages 50 counts per minute.

Table 9.2

count rate / counts per minute	time / days
20 786	0
13 731	90
10 418	140
7907	200

Using Table 9.2, determine the half-life of polonium-210.

half-life = [2]

- (d) Pierre Curie also paved the way in discovering medical applications of radiation. One example of a radioactive nuclide used in medicine is iridium-192 that emits gamma radiation.

- (i) State **one** possible medical use of iridium-192.

.....
 [1]

- (ii) Describe the half-life, penetrating ability and ionising ability of iridium-192 that makes it suitable for the medical use identified in (d)(i).

half-life

 penetrating ability

 ionising ability
 [3]

[Total: 10]

Section B

Answer **one** question from this section.

- 10 (a) Fig. 10.1 shows a simple d.c motor. The coil ABCD is in the horizontal position and the coil rotates about an axis PQ at its centre.

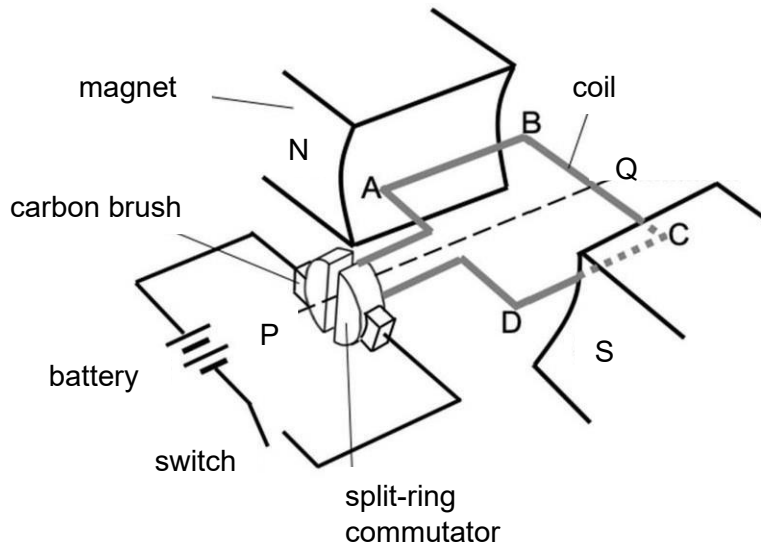


Fig. 10.1

- (i) On Fig. 10.2, draw the magnetic field pattern between the north pole and the south pole of the two bar magnets on Fig. 10.1.



Fig. 10.2

[1]

- (ii) When the switch is closed, the coil starts to rotate continuously in the same direction.

State the direction of the rotation and explain why the coil rotates continuously.

.....

.....

.....

.....

.....

..... [4]

- (iii) The moment of the force acting on the coil ABCD varies over time. At time = 0 s, the coil is horizontal.

On Fig. 10.3, sketch the change of moment of the force on the arm AB in Fig. 10.1 over a complete rotation. T is the time taken for one complete rotation.

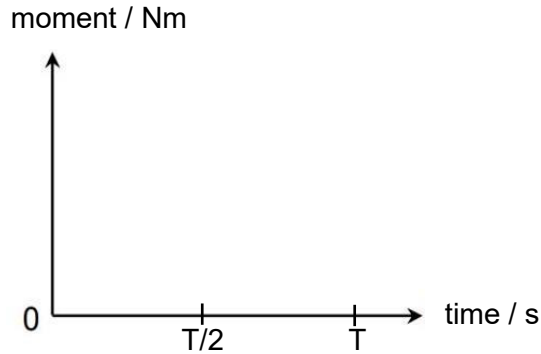


Fig. 10.3

[1]

- (iv) The coil ABCD is replaced with a thicker wire.

Explain how this change affects the rotation of the coil.

.....

.....

.....

..... [2]

- (b) At maximum speed, a desk fan is rated 50 W, 230 V.

Calculate the cost of using the desk fan for 7 hours every day for 30 days if the electricity tariff is 29.72 cents.

cost = [2]

[Total: 10]

- 11** Fig. 11.1 shows a transformer connecting an overhead 25 000 V electrical power line to a house.

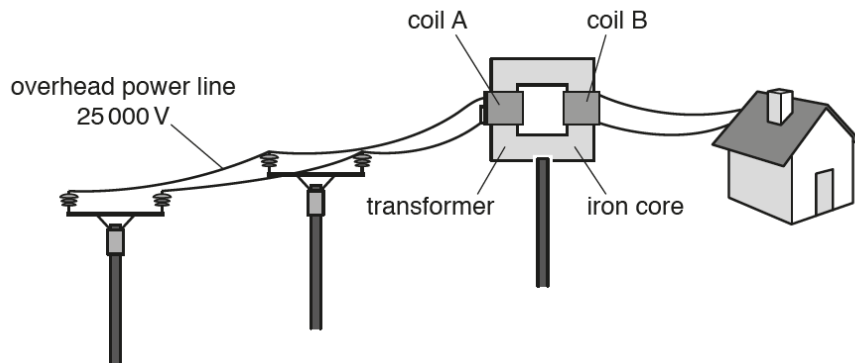


Fig. 11.1

- (a)** State and explain whether coil A or coil B in the transformer has a larger number of turns.

..... [1]

- (b)** Explain why a high voltage like 25 000 V is used for electricity transmission in the overhead power lines.

.....

 [2]

- (c)** The house must be supplied with a voltage of 240 V.

Given that the number of turns in coil B is 50, calculate the number of turns in coil A.

number of turns = [2]

- (d) The generator that supplies electricity contains a coil that rotates between the poles of a magnet.

The coil rotates 50 times in one second and produces an alternating voltage output with a maximum value of 500 V.

- (i) On the grid in Fig. 11.2, sketch a voltage–time graph showing the output voltage.

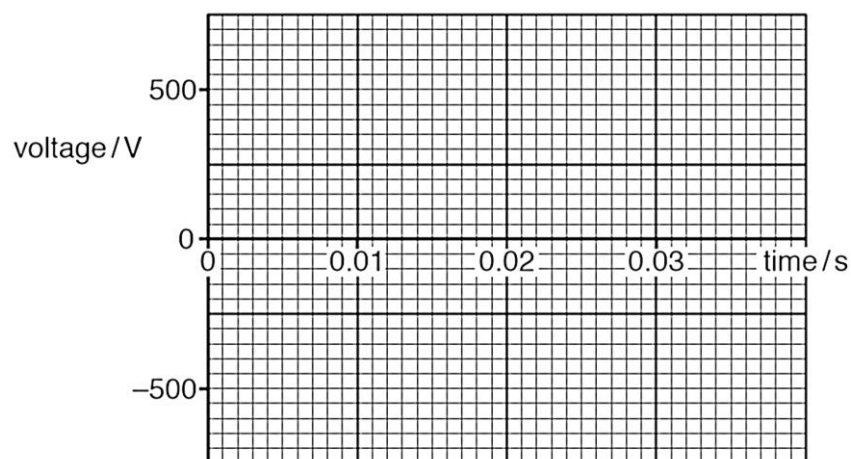


Fig. 11.2

[1]

- (ii) A malfunction causes the coil to rotate with a frequency of 25 Hz.

By using Faraday's Law of electromagnetic induction, state and explain how the reduced frequency affects the output voltage.

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.....

.....

.....

..... [2]

- (iii) Fig. 11.3 shows swallows resting peacefully on overhead power lines.

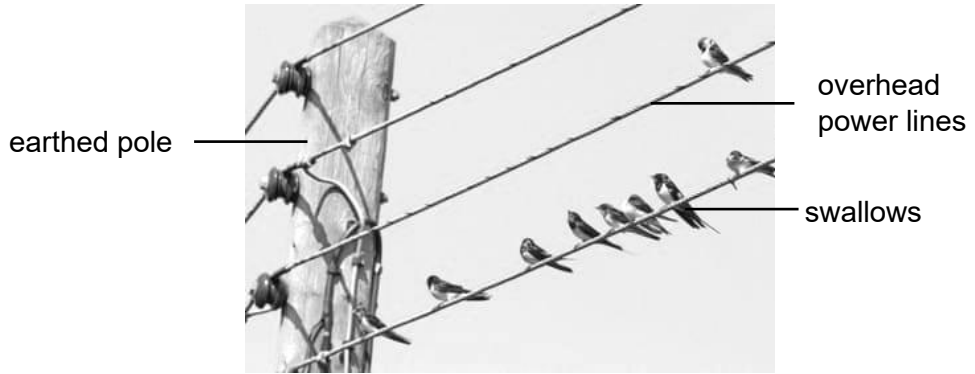


Fig. 11.3

Explain why it is deadly for any swallow to perch on the power lines with its wings in contact with the earthed pole.

.....
.....
..... [2]

[Total: 10]

End of Paper