RAFFLES INSTITUTION

PRELIMINARY EXAMINATION 2025

Higher 2

CANDIDATE NAME		CLASS INDEX NUMBER	

CLASS	2	5	S	0		

PHYSICS 9749/03

Paper 3 Longer Structured Questions **24 September 2025**

2 hours

Section B

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Use a black or dark blue pen. You may use an 2B pencil for any diagrams or graphs.
- Write your name, index number and class in the spaces at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen. Do **not** use correction fluid or tape.
- You may use an approved calculator.

Section B
Answer **one** question only.

You are advised to spend one and a half hours on Section A and half an hour on Section B.

The number of marks for each question or part question is shown in brackets [ ].

For Examiner's Use	
8	/ 20
9	/ 20
Deduction	

Section B

Answer **one** question from this Section in the spaces provided.

8 **(a)** Define *magnetic flux density*.

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..... [2]

(b) A metal rod PQ of mass *m* and resistance 5.0 Ω is placed on top of two smooth parallel metal rails of negligible resistance. The rails are 1.5 m apart. A source of e.m.f. 6.0 V and negligible internal resistance is connected across the rails as shown in Fig. 8.1.

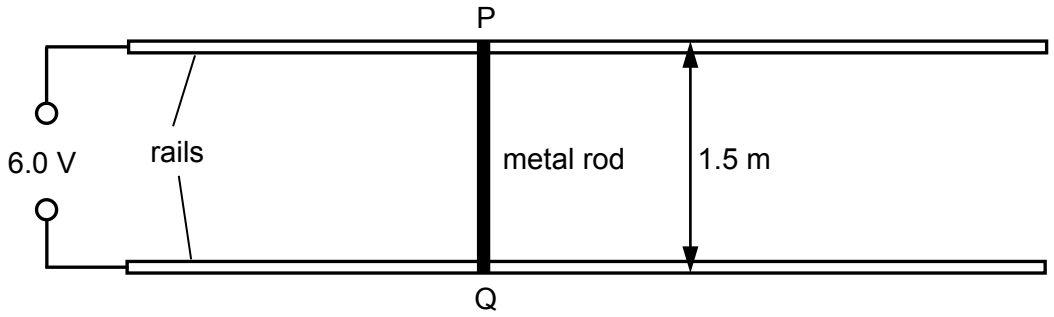

Fig. 8.1 (top view)

The rails are inclined at an angle of 30° to the horizontal and located in a region with a uniform magnetic field of flux density 0.021 T directed vertically downwards as shown in Fig. 8.2.

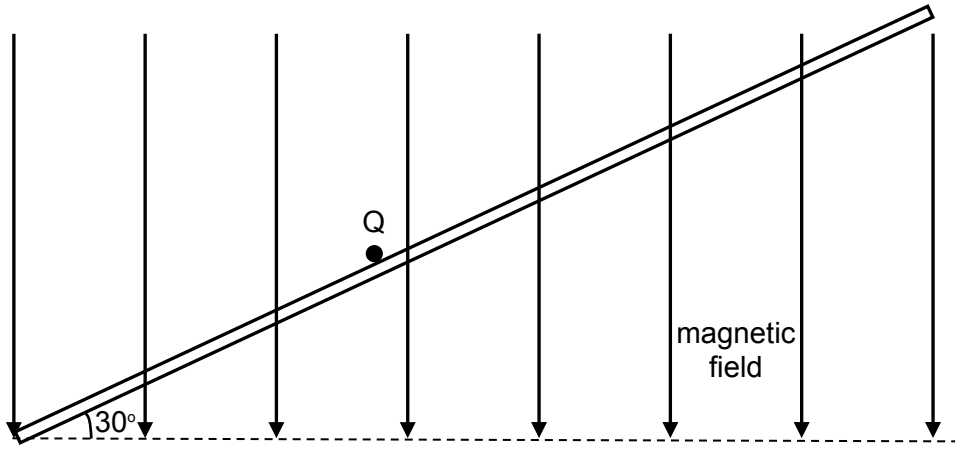

Fig. 8.2 (front view)

Rod PQ remains stationary on the rails.

(i) On Fig. 8.2, draw and label arrows to show all the forces acting on rod PQ. [2]

(ii) Calculate the current through rod PQ.

current = ... A [1]

(iii) Determine the mass *m* of rod PQ.

m = ... kg [3]

(iv) Rod PQ is replaced by another rod XY of the same length and material but with double the cross-sectional area. Rod XY is now placed on the rails.

State and explain what happens to the rod XY.

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..... [3]

(c) The source of e.m.f. is replaced with resistor R and switch S as shown in Fig. 8.3.

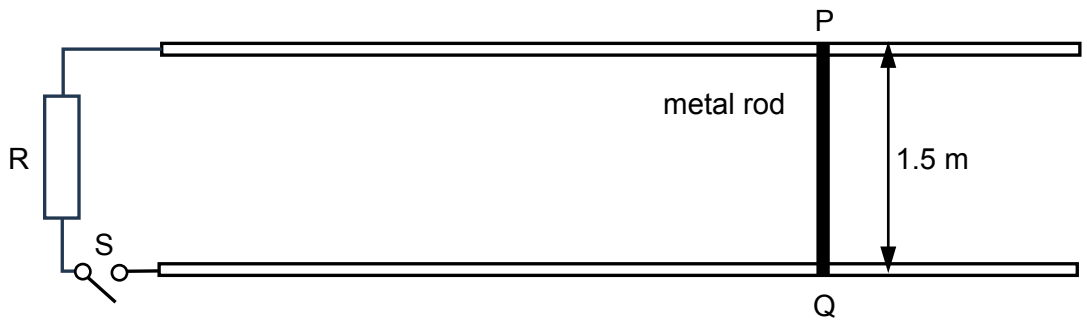

Fig. 8.3

Switch S is open. Rod PQ is released from rest and moves down the rails.

(i) Explain why an e.m.f. is induced across rod PQ.

.....

..... [1]

(ii) Determine the e.m.f. induced across rod PQ when it is at a distance of 2.0 cm down the slope from the point of release.

e.m.f. = ... V [3]

(iii) Switch S is now closed and rod PQ is released from rest at the same initial position.

1. Using Lenz's law, state and explain the direction of the induced current in rod PQ.

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..... [2]

2. Without further calculation, state and explain the change, if any, this would make to your answer in **(c)(ii)**.

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.....

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[3]

[Total: 20]

9 **(a)** State the name of a phenomenon that gives evidence that light behaves like

(i) a wave

.....

..... [1]

(ii) a stream of particles (photons)

.....

..... [1]

(b) A hydrogen lamp is found to produce red light and blue light. The wavelengths of the lights are 6.56×10^{-7} m and 4.86×10^{-7} m.

(i) Explain why the lamp produces lights of specific wavelengths.

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..... [3]

(ii) The blue light from the hydrogen lamp is incident normally on a metal surface with work function energy of 2.00 eV.

Show, by appropriate calculations, that photoelectric emission will be observed.

[3]

(iii) The intensity of the blue light is 6.80×10^3 W m^{-2}. The area of the metal surface is 3.00 cm^2.

1. Show that the power of the blue light that is incident on the metal surface is 2.04 W.

[1]

2. Calculate the force exerted by the photons of the blue light on the metal surface, assuming that all the photons are absorbed.

force = ... N [4]

(c) The red and blue lights of **(b)** are part of the Balmer series of light emitted by the hydrogen atom. The wavelengths λ_n of the Balmer series are given by:

$$\frac{1}{\lambda_n} = R\left(\frac{1}{4} - \frac{1}{n^2}\right)$$

where R is a constant and has the value of 1.097×10^7 m^{-1} and n is an integer greater than 2. That is, n = 3, 4, 5, …., etc.

(i) Determine:

1. the value of n that gives the red light

n for red light = ... [1]

2. the value of *n* that gives the blue light.

n for blue light = ... [1]

(ii) Calculate the shortest wavelength in the Balmer series.

wavelength = ... m [2]

(iii) Use your answers in **(c)(i)** and **(c)(ii)**, sketch a partial energy level diagram for the Balmer series. Label the energy levels with their respective values of energy.

[3]

[Total: 20]