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

.....

.....

.....

..... [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.

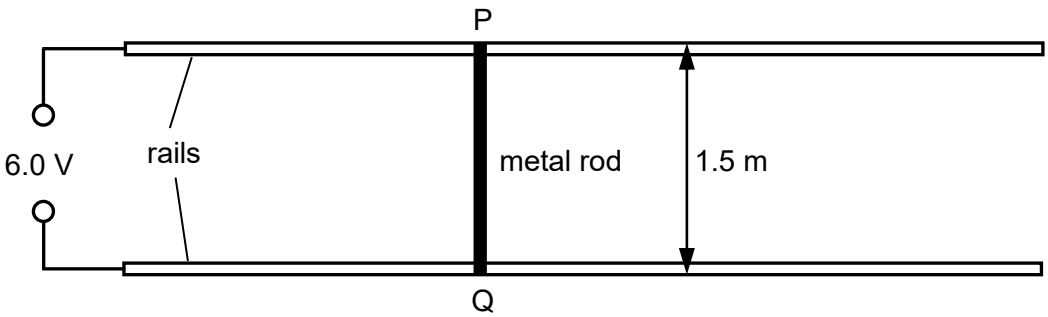

Fig. 8.1 (top view)

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.

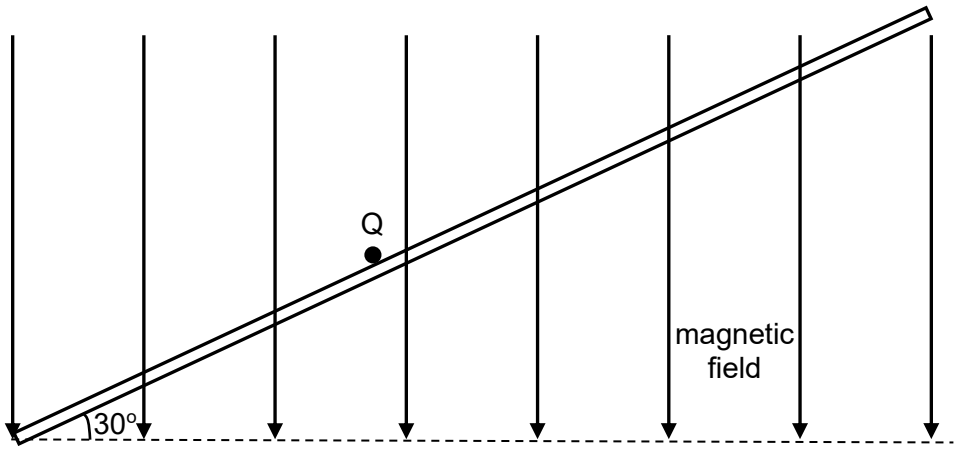

Fig. 8.2 (front view)

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.

.....

.....

.....

.....

.....

..... [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.

.....

.....

.....

..... [2]

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

.....

.....

.....

.....

.....

..... [3]

[Total: 20]