7 The setup in Fig. 7.1 shows the top view of a 12 V D.C supply connected in series with a metal rod PQ of mass 30 g and length 0.50 m.

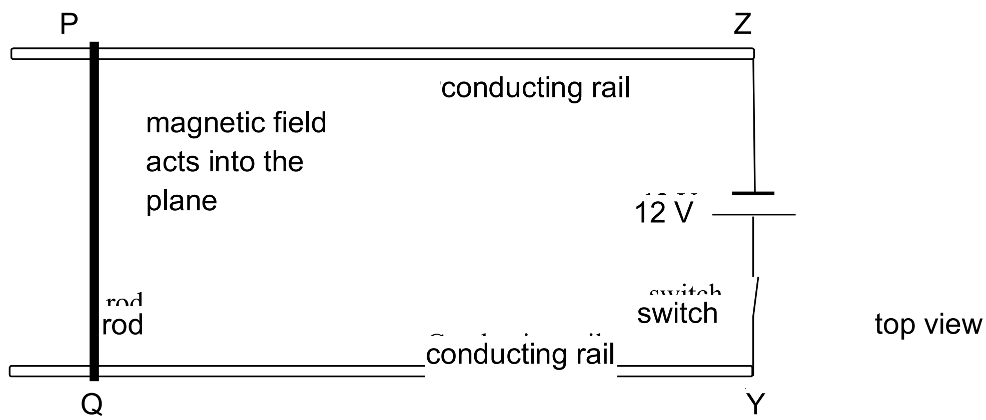

Fig. 7.1

The rod has a resistance of 24 Ω and lies in a region of a uniform magnetic field. The magnetic field strength B is 1.0 T and the direction of the field is perpendicular to and acts into the plane of the page. The two ends of the rod rest on the conducting rails and are free to move in the plane of the rails. The frictionless connecting rails are very long and have negligible electrical resistance. The rod is initially at rest.

Fig. 7.2 shows the side view of the setup. The conducting rails are inclined at an angle of 30° above the horizontal. The switch is closed and current is flowing in the conducting rail as shown in Fig. 7.2.

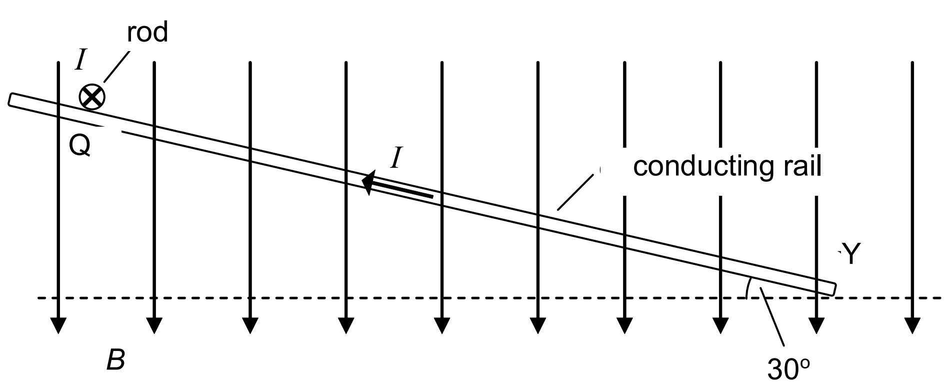

Fig. 7.2

(a) On Fig. 7.2, draw the forces acting on the rod. Label the forces clearly. [1]

(b) Calculate the initial acceleration of the rod when the switch is closed, and state its direction.

initial acceleration = ... $m\ s^{-2}$

direction of acceleration: .... [4]

(c) Using laws of electromagnetic induction, state and explain how the speed of the rod will vary as it moves along the slope.

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.... [4]