8 **(a)** In Fig. 8.1 below, a negatively charged sphere of mass m of 6.0 g and charge q of -5.0×10^{-2} C performs uniform circular motion horizontally in a clockwise direction on a smooth insulated board. The plane of the board is kept parallel to the ground. This motion takes place in a region with a uniform magnetic field that is perpendicular to the plane of the board.

The magnitude of the mass' instantaneous velocity is v and its direction is shown in Fig. 8.1.

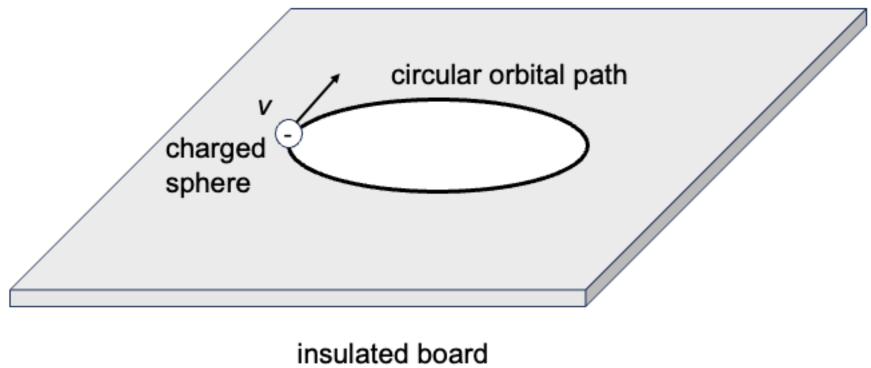

Fig 8.1

(i) Figure 8.2 below shows the frontal view of the charged sphere and the insulated board. The position of the centre of the circular path is indicated.

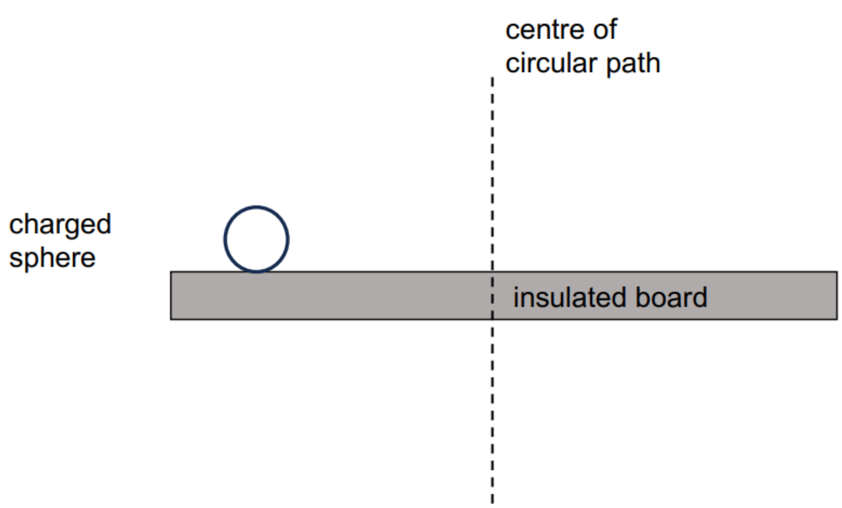

Fig. 8.2

Draw and label on Fig. 8.2 the forces acting on the charged sphere during its circular motion.

[3]

(ii) State the direction of the magnetic field.

………………………………………………………………………………………………… [1]

(iii) Given that the magnetic field has magnetic flux density B of 0.50 T, determine the period T of the charge's revolution.

T = ………………….. s [3]

(iv) A downward uniform electric field is now added. State and explain the effect on the path of the charged particle.

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………………………………………………………………………………………………… [3]

(b) A metal rod PQ of mass 0.200 kg is placed on a pair of conducting rails which are separated by a distance of 50.0 cm and are parallel to the horizontal. The two rails are electrically connected at their right end. A uniform magnetic field of flux density 8.00 T is applied perpendicularly to the plane of the rails. The rod has a resistance of 10.0 Ω, and the rails and their connection have negligible resistances. Fig. 8.3 show the top view of the setup.

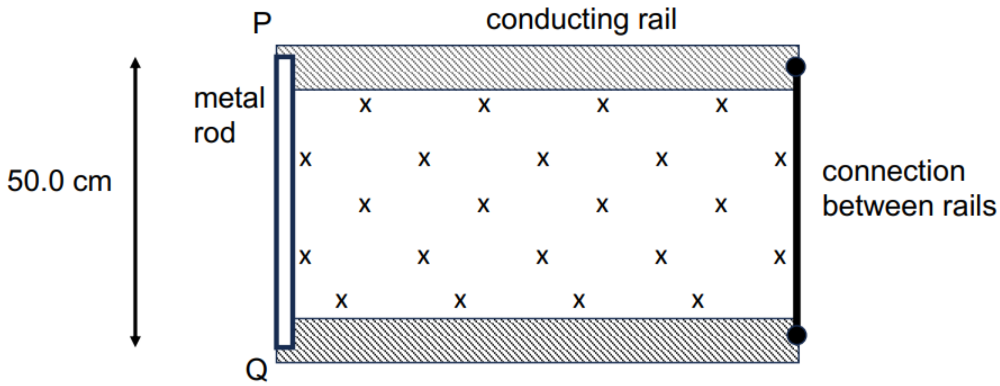

Fig 8.3

(i) State Lenz's law.

……………………………………………………………………………………………………

…………………………………………………………………………………………………… [1]

(ii) The rod is given a slight rightward push and it slides rightwards on the conducting rails at an initial velocity of 2.00 m s^{-1}. Explain why this results in an induced current in the metal rod.

……………………………………………………………………………………………………

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…………………………………………………………………………………………………… [2]

(iii) Calculate the induced current when the rod has an initial velocity of 2.00 m s^{-1}.

induced current = ………………….. A [2]

(iv) The rod will eventually slow down and come to a complete stop, but it does not move leftwards.

Explain why this is so.

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…………………………………………………………………………………………………….. [3]

(v) An additional rightward force F_{ext} is applied on the rod, as shown in Fig. 8.4.

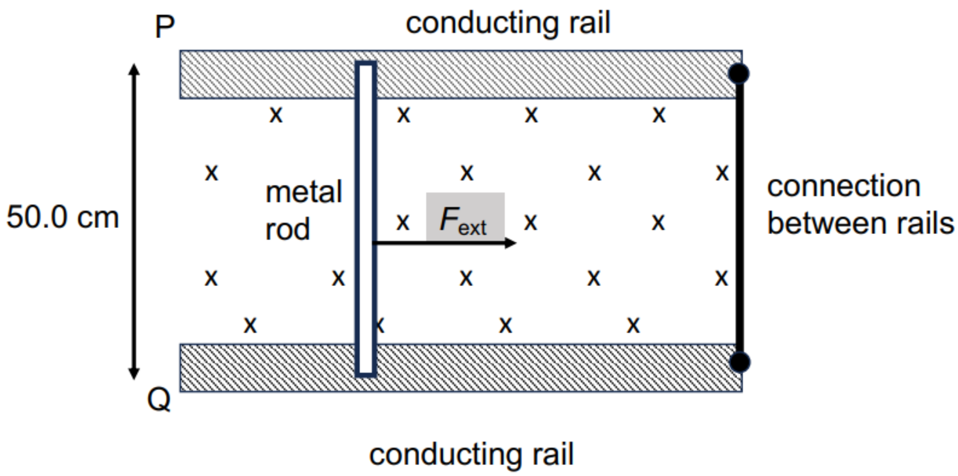

Fig. 8.4

Calculate the magnitude of F_{ext} that is required to keep the metal rod at a constant rightward velocity of 2.00 m s^{-1}.

magnitude of F_{ext} = ………………….. N [2]

[Total: 20]

End of Paper