

8 (a) (i) State *Faraday's law of electromagnetic induction*.

.....
.....[1]

(ii) An application of electromagnetic induction is inductive charging. In inductive charging, the device to be charged is placed on a charging plate as shown in Fig. 8.1.

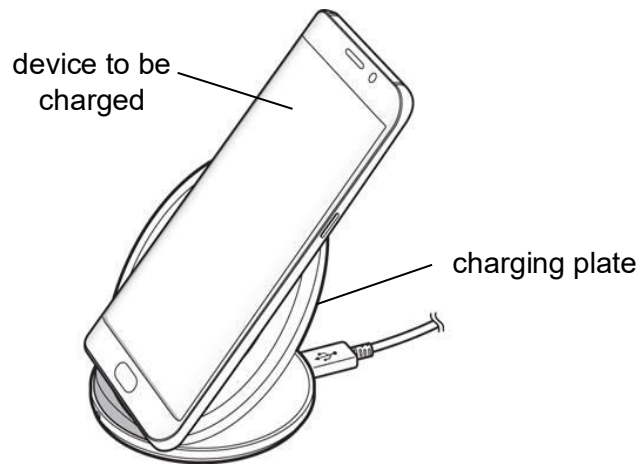


Fig. 8.1

Using the laws of electromagnetic induction, suggest how inductive charging works.

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

- (iii) Suggest one advantage and one disadvantage of inductive charging.

Advantage:

.....
.....[1]

Disadvantage:

.....
.....[1]

- (b) The charging plate must be connected to an alternating power supply. The variation with time t of the supply voltage V is given by

$$V = 340 \sin(377t)$$

where V is measured in volts and t in seconds.

- (i) Calculate the frequency of the supply voltage.

frequency = Hz [2]

- (ii) Calculate the root-mean-square value of the supply voltage.

root-mean-square value = V [1]

- (iii) By reference to heating effect, explain what is meant by the root-mean-square value calculated in (ii).

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[1]

- (c) Two conducting rods, AB and CD, are placed on two horizontal, parallel and smooth metal rails of negligible resistance as shown in Fig 8.2. The two rails are 10.0 cm apart. A uniform magnetic field of flux density 0.54 T is applied perpendicularly to the plane of the rails into paper.

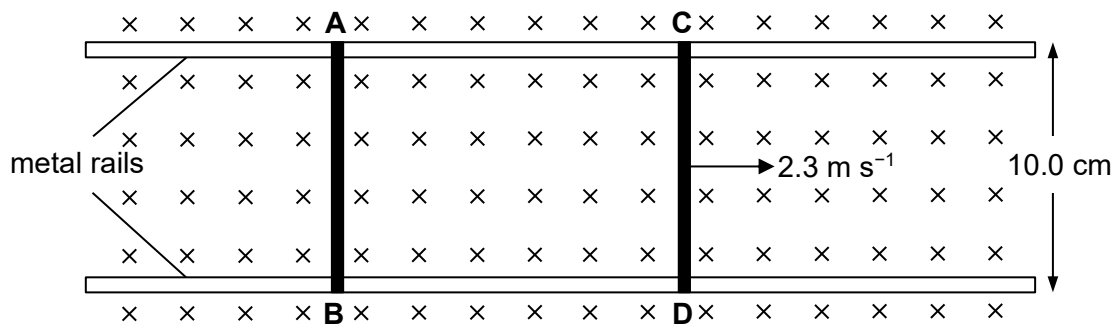


Fig. 8.2 (plan view)

Rod AB has a resistance of $0.83 \, \Omega$ while rod CD has negligible resistance. Both rods have the same mass of 34 g.

Rod CD is suddenly made to move at a constant speed of $2.3 \, \text{m s}^{-1}$.

- (i) Calculate the e.m.f. induced in rod CD.

e.m.f. induced = V [2]

- (ii) State which end of rod CD is at a higher potential.

.....[1]

- (iii) Calculate the initial current in rod AB.

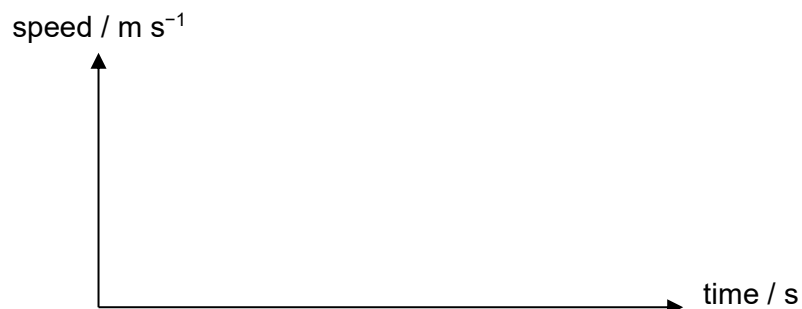
current =A [2]

- (iv) Calculate the initial acceleration of rod AB, and state its direction.

acceleration = m s^{-2} [2]

direction = [1]

- (v) Sketch the variation with time of the speed of rod AB, indicating clearly the value of the maximum speed reached. [2]



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