

Section B

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

- 8 (a)** Explain how an electric field and a magnetic field may be used for the velocity selection of charged particles. You may draw a diagram if you wish.

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...[4]

- (b) A simple generator consists of a coil with a large number of turns that rotates at a constant rate in a uniform magnetic field, as shown in Fig. 8.1.

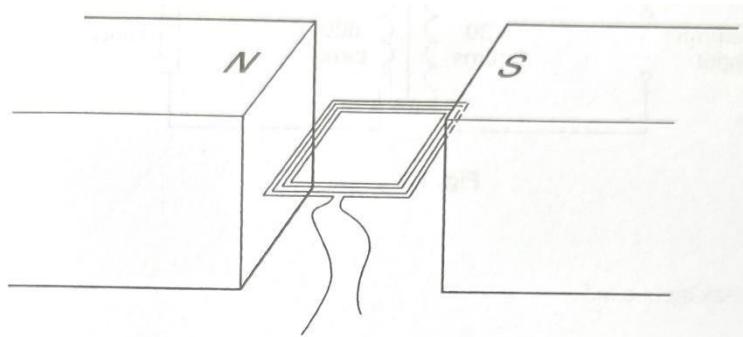


Fig. 8.1

- (i) Explain why an e.m.f. is generated when the coil rotates.

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[2]

- (ii) State two factors that affect the magnitude of the maximum e.m.f.

1.
2.

[2]

- (iii) Explain briefly, in words, why the e.m.f. is sinusoidal.

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[2]

- (c) A rectangular coil of dimensions 30 cm by 24 cm has 15 turns. A uniform magnetic field of flux density 0.018 T is at right-angles to the plane of the coil.

The magnetic field is kept constant for 2.0 s and then reduced to zero over a time of 4.0 s, as shown in Fig. 8.2.

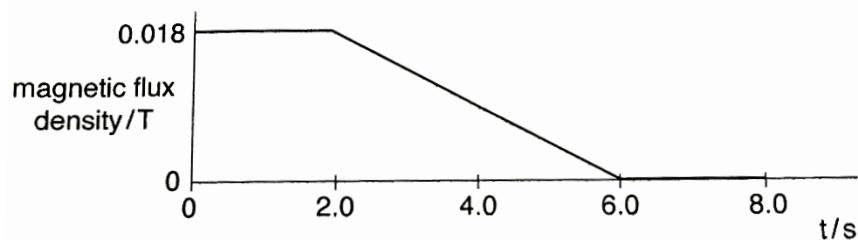
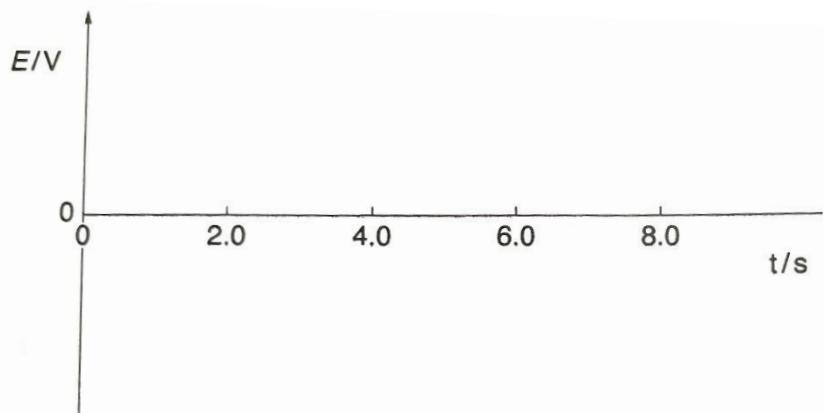


Fig. 8.2

- (i) Calculate the magnitude of the induced e.m.f. between 2.0 and 6.0 s.

e.m.f. V [2]

- (ii) On Fig. 8.3, sketch a graph to show the variation with time of the e.m.f. E induced in the coil.



[2]

Fig. 8.3

- (d) Fig. 8.4 shows the top view of a train, travelling on a flat ground heading due east at 30.0 m s^{-1} . **CD** is a horizontal metal axle of the train which is 1.5 m long. Assume the resistance of the axle is 0.400Ω and resistance of the other parts of the train is negligible.



Fig. 8.4

The Earth's magnetic field strength is $6.0 \times 10^{-5} \text{ T}$ and acts downwards at 65° to the horizontal.

- (i) Calculate the rate at which thermal energy is being generated in the axle.

$$\text{rate} = \dots \text{W} [4]$$

- (ii) State and explain which end of the axle **CD** is at a higher potential.

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[2]