

7 (a) State Faraday's law of electromagnetic induction.

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..... [2]

(b) An aircraft is flying horizontally at constant speed v through the Earth's magnetic field, as shown in Fig. 7.1.

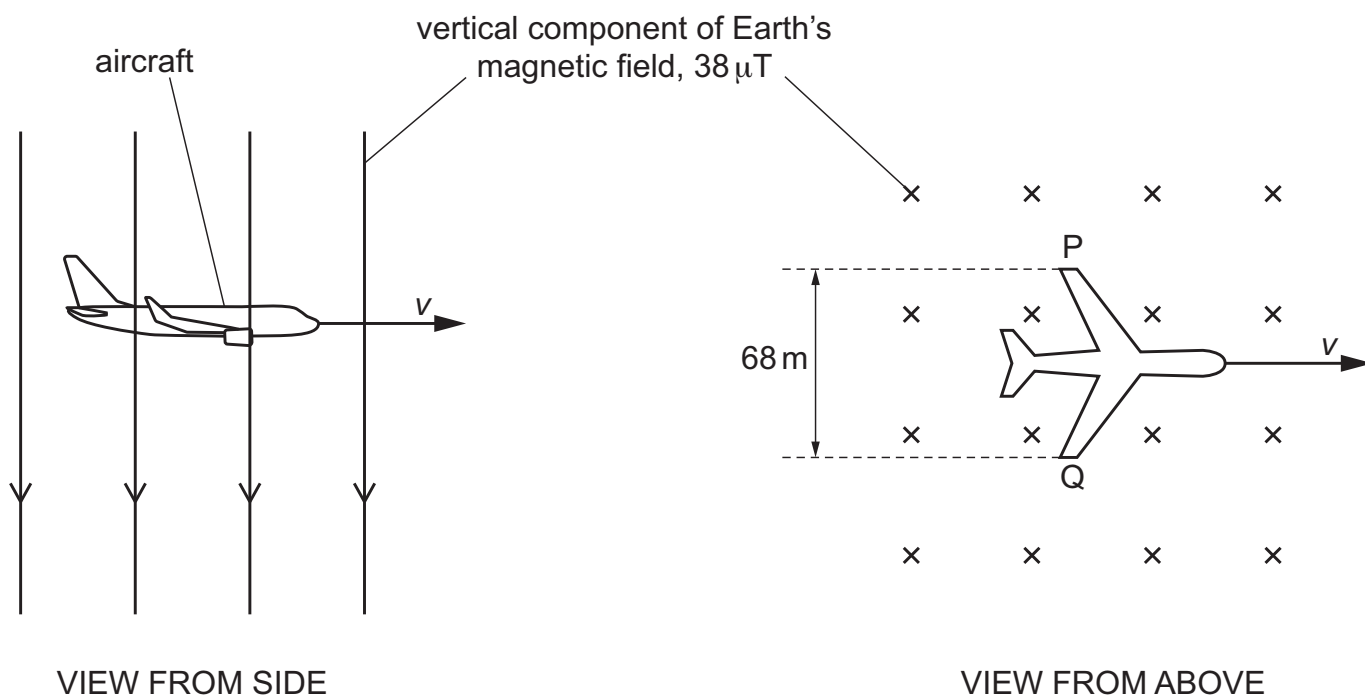


Fig. 7.1

At the location of the aircraft, the vertical component of the Earth's magnetic field is $38\mu\text{T}$ towards the ground.

The distance between the wingtips P and Q of the aircraft is 68 m.

As the aircraft moves through the magnetic field, an electromotive force (e.m.f.) of 0.54 V is induced between the wingtips P and Q.

(i) Calculate the magnetic flux cut by the wings of the aircraft in a time of 15 s. Give a unit with your answer.

magnetic flux = unit [2]

(ii) Determine the area of flux cut by the wings in a time of 15 s.

area =m² [2]

(iii) Use your answer in (b)(ii) to determine the speed *v* of the aircraft.

v =ms⁻¹ [2]

(iv) Use Lenz’s law of electromagnetic induction to explain which of the wingtips P and Q is at the higher induced potential.

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..... [3]

[Total: 11]

- 7 A bar magnet is suspended from a spring. One pole of the magnet oscillates freely in a coil of wire, as shown in Fig. 7.1.

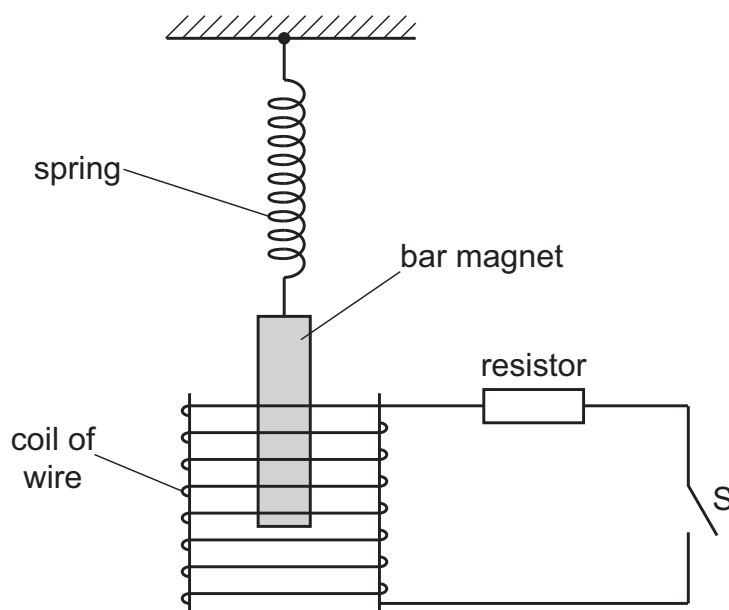


Fig. 7.1

The switch S is initially open.

- (a) The switch S is now closed. As a result, the oscillations of the magnet are lightly damped.

- (i) State what is meant by damping.

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..... [2]

- (ii) Describe what is observed to indicate that the damping is light.

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..... [1]

- (iii) By reference to electromagnetic induction and to conservation of energy, explain why the oscillations are damped.

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..... [3]

(b) The procedure in **(a)** is repeated after replacing the resistor with one of greater resistance.

Suggest, with a reason, the effect of this change on the oscillations.

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..... [2]

[Total: 8]

7 (a) State Faraday's law of electromagnetic induction.

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..... [2]

(b) A metal rod is accelerated uniformly from rest in a uniform magnetic field as shown in Fig. 7.1.

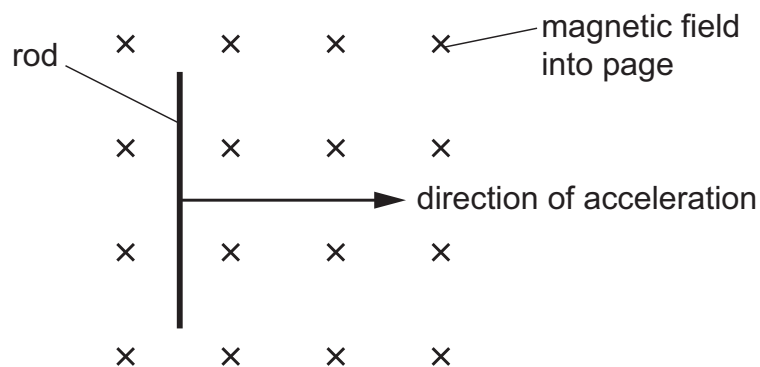


Fig. 7.1

The rod has length l and the flux density of the magnetic field is B .

An electromotive force (e.m.f.) is induced in the rod. The variation with time t of the induced e.m.f. E is shown in Fig. 7.2.

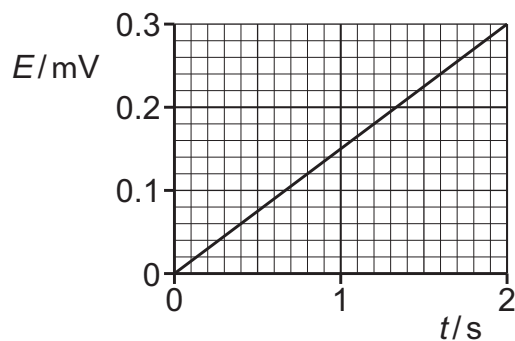


Fig. 7.2

(i) Explain how Fig. 7.2 shows that E is proportional to the velocity v of the rod.

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..... [2]

- (ii) Use Faraday's law to show that the variation of E with time t is given by

$$E = Blat$$

where a is the acceleration of the rod.

[3]

- (iii) The length of the rod is 0.45 m. The acceleration a of the rod is 7.8 ms^{-2} .

Determine the value of B .

$B = \dots\dots\dots \text{ T}$ [2]

[Total: 9]