

6 (a) State what is meant by a magnetic field.

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.....

..... [2]

(b) A long, straight wire P carries a current into the page, as shown in Fig. 6.1.

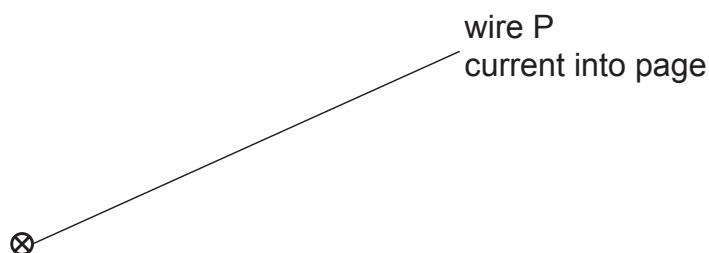


Fig. 6.1

On Fig. 6.1, draw four field lines to represent the magnetic field around wire P due to the current in the wire. [3]

(c) A second long, straight wire Q, carrying a current of 5.0A out of the page, is placed parallel to wire P, as shown in Fig. 6.2.

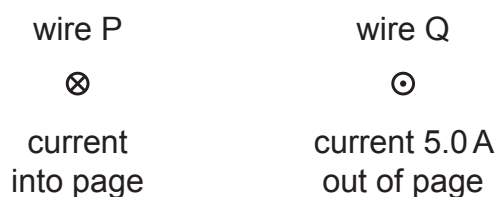


Fig. 6.2

The flux density of the magnetic field at wire Q due to the current in wire P is 2.6 mT.

(i) Calculate the magnetic force per unit length exerted on wire Q by wire P.

force per unit length = N m⁻¹ [2]

(ii) State the direction of the force exerted on wire Q by wire P.

..... [1]

(iii) The flux density of the magnetic field at wire P due to the current in wire Q is 1.5 mT.

Determine the magnitude of the current in wire P. Explain your reasoning.

current = A [2]

[Total: 10]

- 6 A rectangular coil PQRS of wire is free to rotate about its axis XY, as shown in Fig. 6.1.

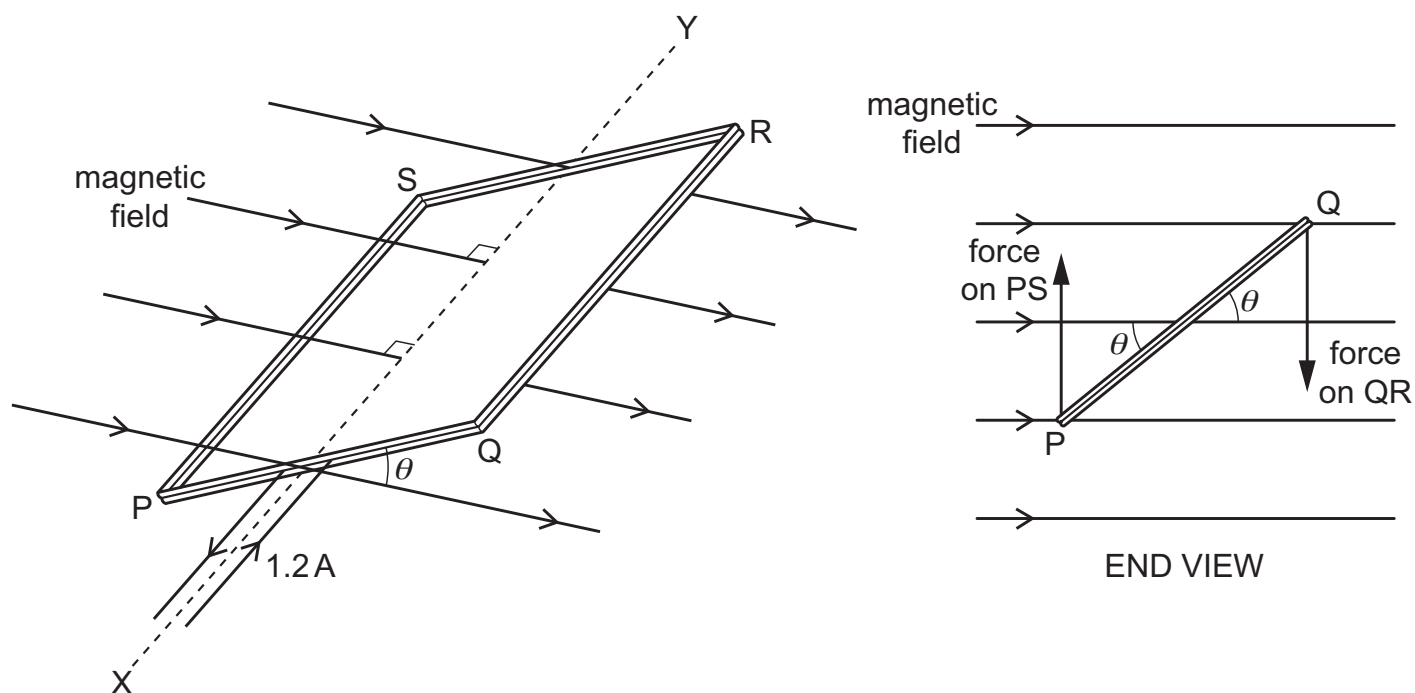


Fig. 6.1 (not to scale)

The coil has length QR of 5.4 cm , width PQ of 2.5 cm and has 190 turns of wire.
 The plane of the coil is at an angle θ to a uniform magnetic field of flux density $5.2 \times 10^{-3}\text{ T}$.
 The axis XY of the coil is normal to the field.
 The current in the coil is 1.2 A .

- (a) (i) Calculate the magnitude of the force on side QR of the coil.

force = N [3]

- (ii) Use your answer in (a)(i) to show that the torque τ on the coil is given by

$$\tau = 1.6 \times 10^{-3} \cos \theta \text{ N m.}$$

[2]

- (iii) Using the expression in (a)(ii) sketch, on the axes of Fig. 6.2, a graph to show the variation of the torque τ with angle θ for values of θ between 0 and 360°. Label the τ axis with an appropriate scale.

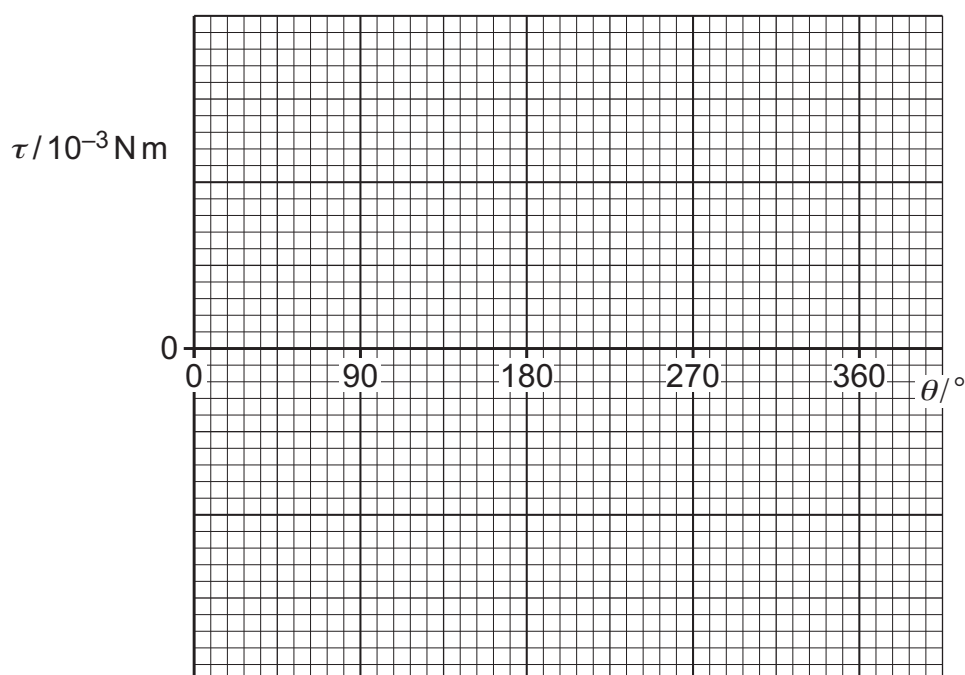


Fig. 6.2

[3]

- (b) The coil is now replaced by an identical coil wound on a ferrous core.

Suggest, with a reason, how the torque on this coil compares with the torque on the original coil.

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.....
..... [2]

[Total: 10]