6 In this question: ⊗ represents a current into the page

⊙ represents a current out of the page

(a) Define magnetic flux density.

.....

..... [2]

(b) **(i)** Sketch the pattern and direction of the magnetic field lines around the current-carrying wire in Fig. 6.1.

⊗

Fig. 6.1

[2]

(ii) Sketch the pattern and direction of the magnetic field lines between the two magnets in Fig. 6.2.

Fig. 6.2

[1]

(c) A current-carrying square coil of side 4.0 cm with N turns placed in a magnetic field experiences a torque about an axis through the centre of the coil.

(i) Show the direction of the forces on the sides of the coil in Fig. 6.3.

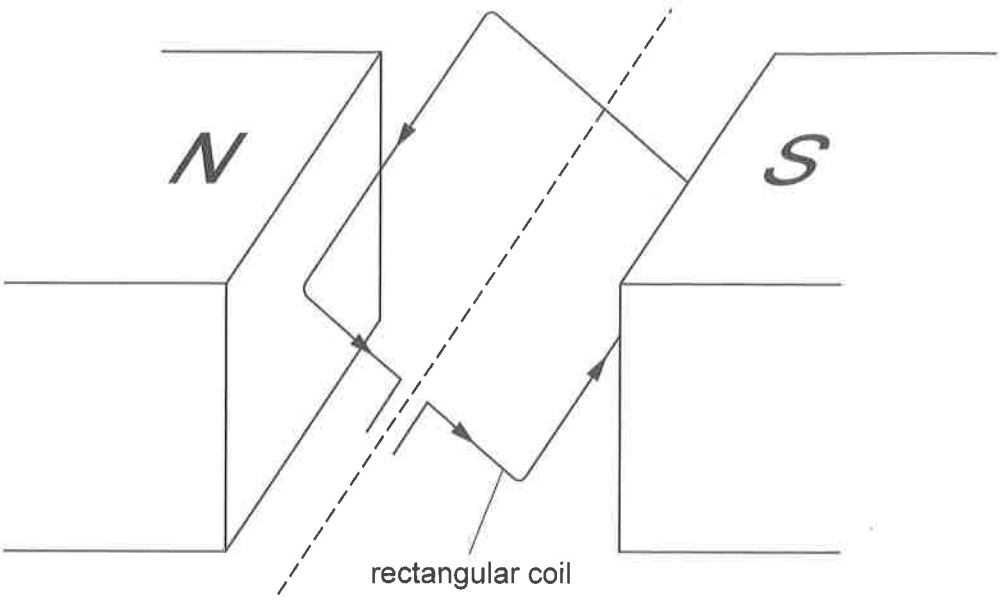

Fig. 6.3

[2]

(ii) The current in the coil is 1.25 A. The magnetic flux density is 0.85 T.

The forces on the sides of the coil form a couple.

Calculate the torque of the couple due to one turn of the coil.

torque = ... Nm [3]

(d) At a later time, the coil has rotated.

(i) Draw the forces acting on the sides of the coil in this orientation in Fig. 6.4.

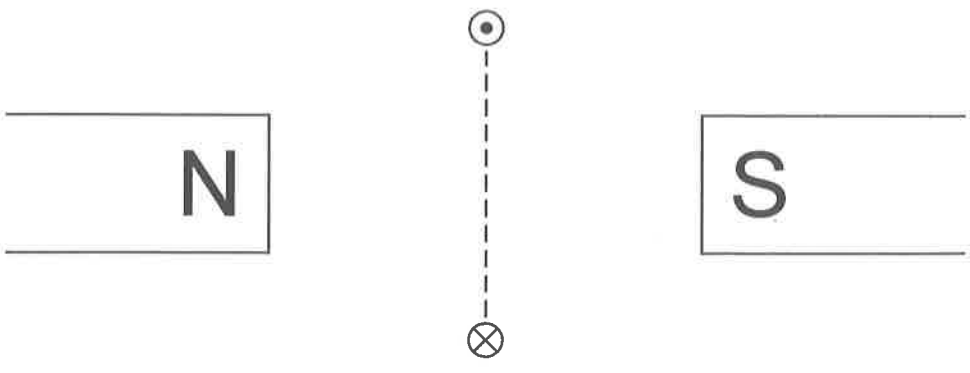

Fig. 6.4

[2]

(ii) The coil rotates from the position shown in Fig. 6.3 to the position shown in Fig. 6.4.

The magnitude of the forces on the sides of the coil does not change, however the torque on the coil changes.

Explain these observations.

.....

.....

.....

..... [3]

(e) The potential difference across the coil is 5.6 V.

(i) Calculate the resistance of the coil.

resistance = ... Ω [1]

(ii) The coil is made from copper wire of diameter 0.10 mm.

The resistivity of copper is $1.68 \times 10^{-8}\,\Omega\,\text{m}$.

Calculate the number of turns N of wire used to form the coil.

number of turns = ... [4]

[Total: 20]