4 In an electric motor, a rectangular coil consisting of 500 turns of wire is placed in a uniform magnetic field of flux density 0.38 T, as shown in Fig. 4.1.

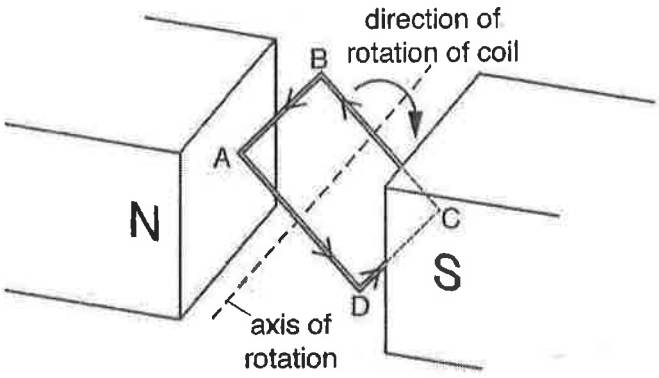


**Fig. 4.1**

Sides AB and CD of the rectangular coil each have length 4.3 cm.

**(a)** The current in the coil is 4.8 A.

Calculate the force on the AB and CD sides of the rectangular coil, and state the direction in which the forces act.

| | force / N | direction |
|---|---|---|
| AB | | |
| CD | | |

[3]

**(b) (i)** The coil rotates through 90° from the position where side AD is horizontal to the position where the side AD is vertical.

The forces on sides AB and CD do not change but the power provided by the motor to turn the coil varies. Explain this observation.

.....

.....

.....[2]

**(ii)** Explain why the forces on sides BC and AD do not affect the motion of the coil.

.....

.....

.....[2]

**(c)** The coil in Fig. 4.1 does not rotate continuously without using a metal split ring in the circuit.

Fig. 4.2 shows a split ring.

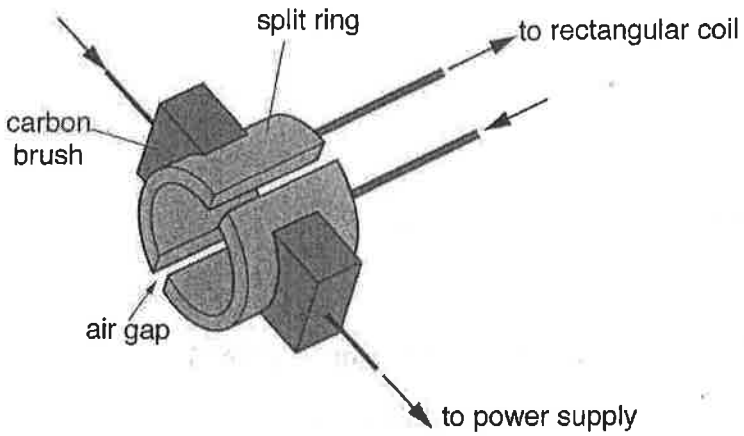


**Fig. 4.2**

**(i)** Explain why, without the metal split ring, the coil stops rotating with the side AD shown in Fig. 4.1 in the vertical position.

.....

.....[1]

**(ii)** Explain how a metal split ring enables the coil to rotate.

.....

.....

.....[1]

**(d)** Suggest how curved pole pieces, as shown in Fig. 4.3, can achieve a smoother running motor.

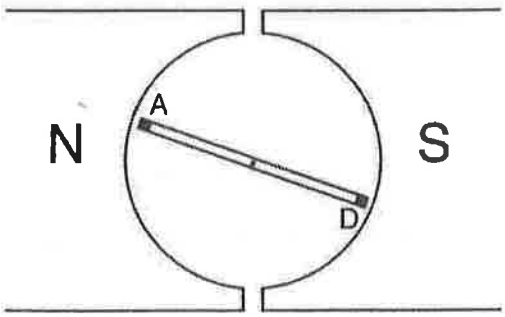


**Fig. 4.3**

.....

.....

.....[1]

[Total: 10]