4 Fig. 4.1 shows a large rectangular coil used in a power station generator. The coil, with 38 turns, each 2.0 m long and 1.2 m wide, is rotating at 50 revolutions per second in a magnetic field of flux density 0.29 T.

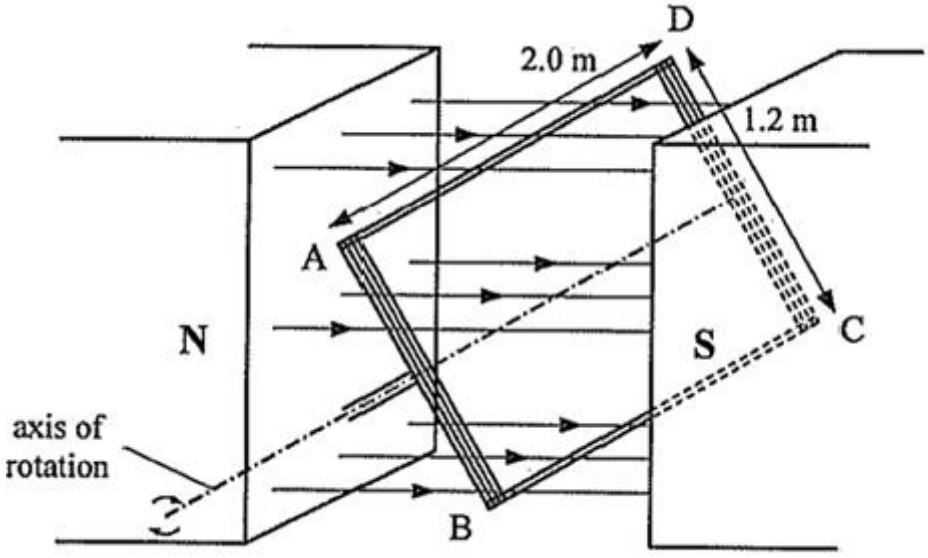

Fig. 4.1

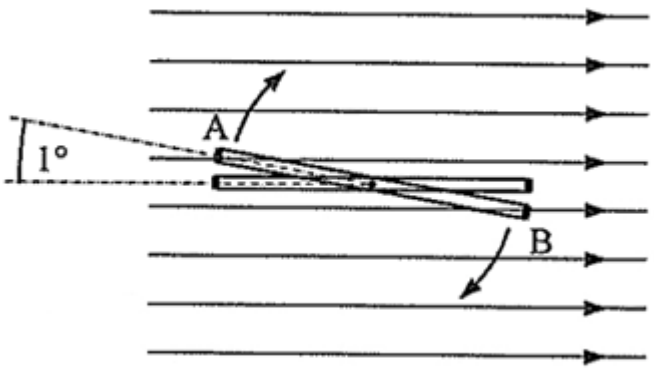

Fig. 4.2

Fig. 4.2 shows the coil from the side view, near the time when maximum e.m.f. occurs.

Consider the coil rotating through an angle of 1°.

(a) Show that the time taken for it to rotate 1.0° is 5.6×10^{-5} s.

[1]

(b) Determine the change in flux linkage of the coil in 5.6×10^{-5} s.

change in flux linkage = …….. Wb turns [2]

(c) Hence, determine the e.m.f. generated by the coil during the 5.6×10^{-5} s.

e.m.f. = …….. kV [1]

(d) State the direction of the current induced in side AD as a result of this e.m.f. Explain your answer using the laws of electromagnetic induction.

……

……

……

…… [2]

(e) Given that at time $t = 0$ the coil is parallel to the plane of the magnetic field, sketch on the same axes, the variation with time in one cycle of the

1. magnetic flux linkage,
2. induced current

Label your graphs (1) and (2) clearly.

[2]