8 In a power station generator, a large rectangular coil is rotating at 50 revolutions per second in a magnetic field of magnetic flux density of 0.29 T. The coil as shown in Fig. 8.1 has 38 turns each 2.0 m long and 1.2 m wide.

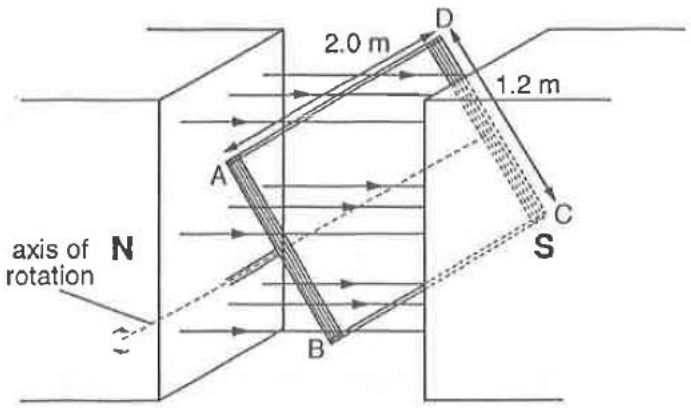

Fig. 8.1

The maximum output e.m.f. of the coil occurs when it moves near the plane of the magnetic field as shown in Fig. 8.2.

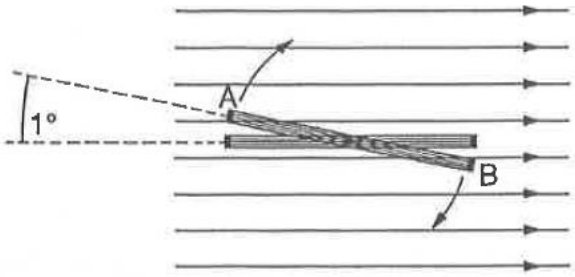

Fig. 8.2

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

……...

…….. [1]

(b) For the coil moving through an angle of 1.0° near the plane of the magnetic field, calculate

(i) the time taken for it to rotate 1.0°

time = ……..s [2]

(ii) the flux cut by one turn of the coil in this time

flux cut = ……..Wb [3]

(iii) the e.m.f. generated by one turn of the coil in this time

e.m.f. = ……V [2]

(iv) the e.m.f. generated by all 38 turns of the coil in this time

e.m.f. = ……V [1]

(c) **(i)** The value obtained in **(b)(iv)** is the peak value of the sinusoidal output of the coil. Calculate the r.m.s. value of the output of the coil.

r.m.s. value of the output = ……V [1]

(ii) State the direction of the current induced in side AD as a result of this e.m.f. Explain how you deduced your answer.

……

……

…… [2]

(d) **(i)** State *Lenz's* law.

……

…… [1]

(ii) Explain the following two situations, using the laws of electromagnetic induction:

1. A copper disc spins freely between the poles of an unconnected electromagnet as shown in Fig. 8.3.

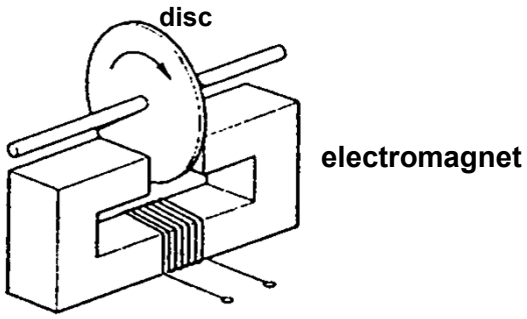

Fig 8.3

Describe and explain what will happen to the speed of rotation of the disc when a direct current is switched on in the electromagnet.

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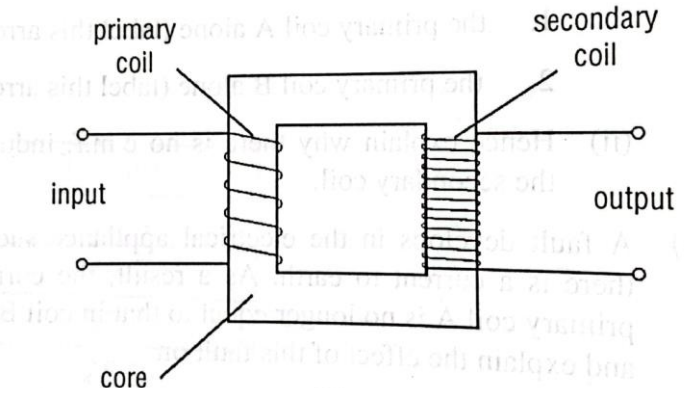
..... [4]

2. A simple iron-cored transformer is shown below.



Suggest why the input voltage and the output e.m.f. have the same frequency.

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..... [3]

[Total: 20]

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