4 The coil in a generator is situated in a uniform magnetic field, as shown in Fig. 4.1.

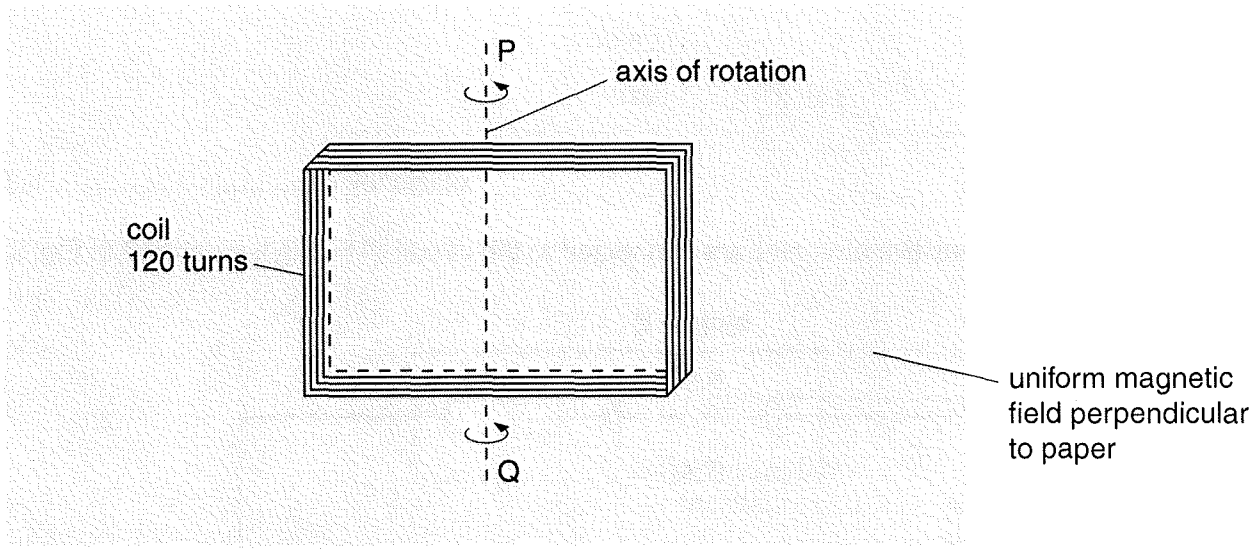

Fig. 4.1

The coil is rotated about the axis PQ, as shown in Fig. 4.1. An electromotive force (e.m.f.) is induced in the coil. The e.m.f. is measured with a cathode-ray oscilloscope (c.r.o.).

The waveform displayed on the c.r.o. is shown in Fig. 4.2.

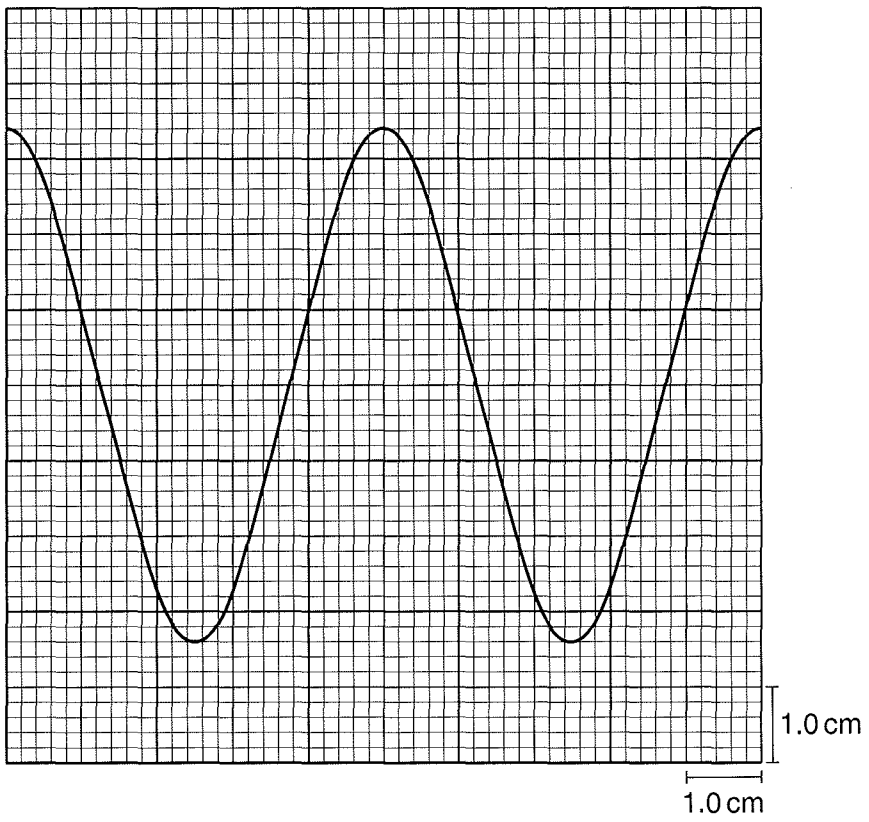

Fig. 4.2

The Y-plates sensitivity of the c.r.o. is $0.050\,V\,cm^{-1}$ and the time-base setting is $8.0\,ms\,cm^{-1}$.

(a) **(i)** Use Faraday's law of electromagnetic induction to explain the variation of the e.m.f. induced in the coil.

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..... [4]

(ii) Determine from Fig. 4.2, for the induced e.m.f.,

1. the maximum value,

maximum e.m.f. = ...V [1]

2. the frequency.

frequency = ... Hz [2]

(b) The coil has 120 turns and a cross-sectional area of $1.3 \times 10^{-3}\,m^2$.

The maximum induced e.m.f. E_0 is given by the expression

E_0 = maximum magnetic flux linkage × angular speed of the coil.

Use this expression and your answers in **(a)(ii)** to calculate the magnetic flux density of the field.

magnetic flux density = ... T [3]