3 A diffraction grating is set up at the centre of a rotating table which completes a revolution in every 3.0 s. The grating is illuminated normally by monochromatic light of wavelength λ from a source which is also mounted on the table as shown in Fig. 3.1.

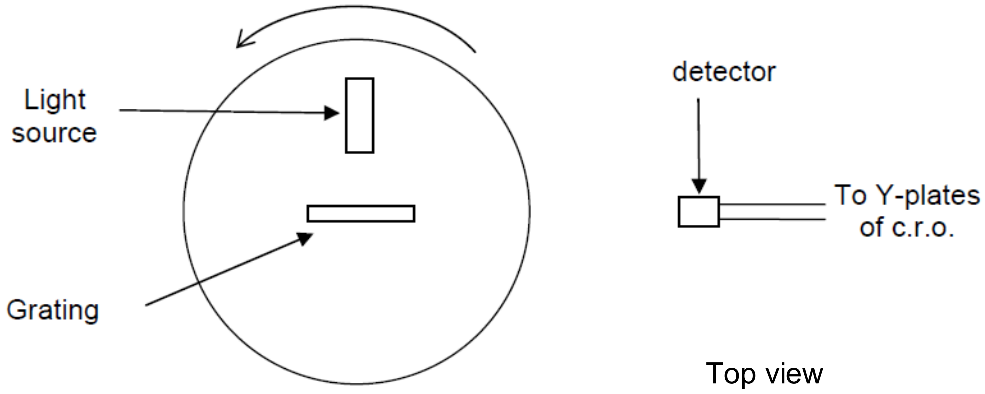

Fig. 3.1

The emergent beams of light from the grating are monitored by means of a stationary detector. The output from the detector is displayed on a cathode ray oscilloscope (c.r.o.). With the time-base set at 0.10 s cm^{-1}, the trace obtained is shown in Fig. 3.2. The relative positions of the peaks are as indicated.

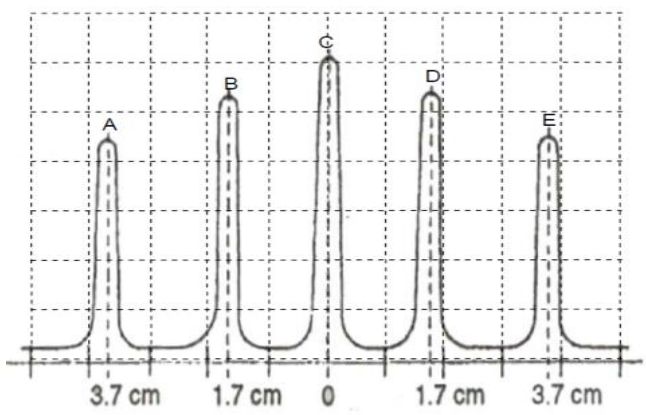

Fig. 3.2

(a) Calculate the angular speed of rotation of the grating.

angular speed = ... rad s^{-1} [1]

(b) Explain why the peaks in Fig. 3.2 do not have the same intensity.

....

....

....

.... [2]

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(c) **(i)** If θ is the angle between the emergent ray and the normal. Use your answer in **(a)**, determine θ for peak E.

θ = ... radian [2]

(ii) Using peak E, hence calculate the wavelength of the light if the grating has 550 lines per mm.

wavelength = ... nm [2]

(iii) Explain why

1. it is preferable to calculate the wavelength using peak E rather than peak D.

....

....

.... [1]

2. only 5 peaks are observed with some calculations.

....

.... [2]

(d) Sketch, in Fig. 3.2, the trace on the c.r.o, if the diffraction grating is replaced by a double slit of the same slit separation and slit width as the diffraction grating.

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