5 **(a)** Parallel light rays from the Sun are incident normally on a magnifying glass. The magnifying glass directs the light to an area A of radius r, as shown in Fig. 5.1.

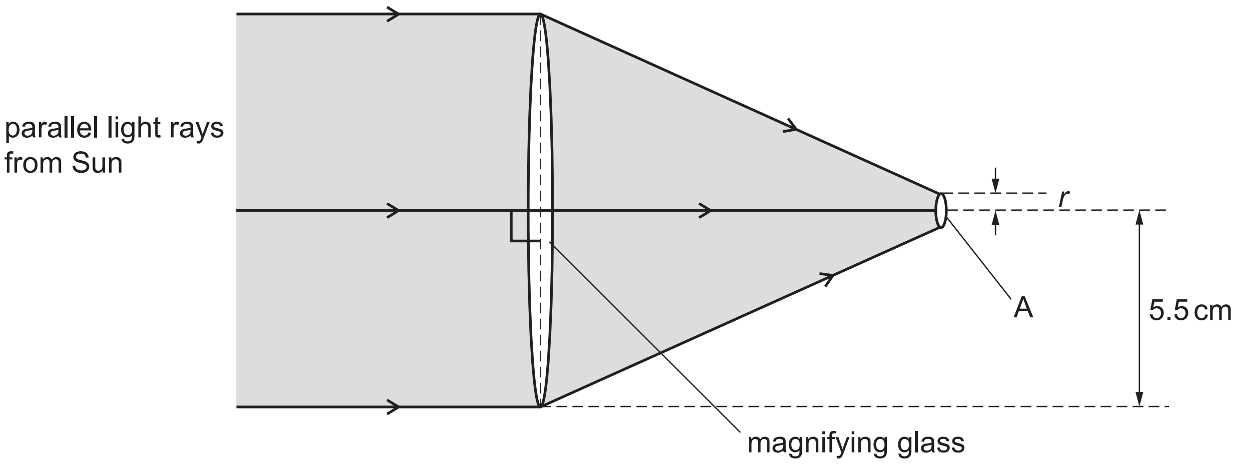

Fig. 5.1 (not to scale)

The magnifying glass is circular in cross-section with a radius of 5.5 cm. The intensity of the light from the Sun incident on the magnifying glass is 1.3 kW m^{-2}.

Assume that all of the light incident on the magnifying glass is transmitted through it.

(i) Calculate the power of the light from the Sun incident on the magnifying glass.

power = ... W [2]

(ii) The value of r is 1.5 mm.

Calculate the intensity of the light on area A.

intensity = ... W m^{-2} [1]

(b) A laser emits a beam of electromagnetic waves of frequency 3.7×10^{15} Hz in a vacuum.

(i) Show that the wavelength of the waves is 8.1×10^{-8} m.

[2]

(ii) State the region of the electromagnetic spectrum to which these waves belong.

.... [1]

(iii) The beam from the laser now passes through a diffraction grating with 2400 lines per millimetre. A detector sensitive to the waves emitted by the laser is moved through an arc of 180° in order to detect the maxima produced by the waves passing through the grating, as shown in Fig. 5.2.

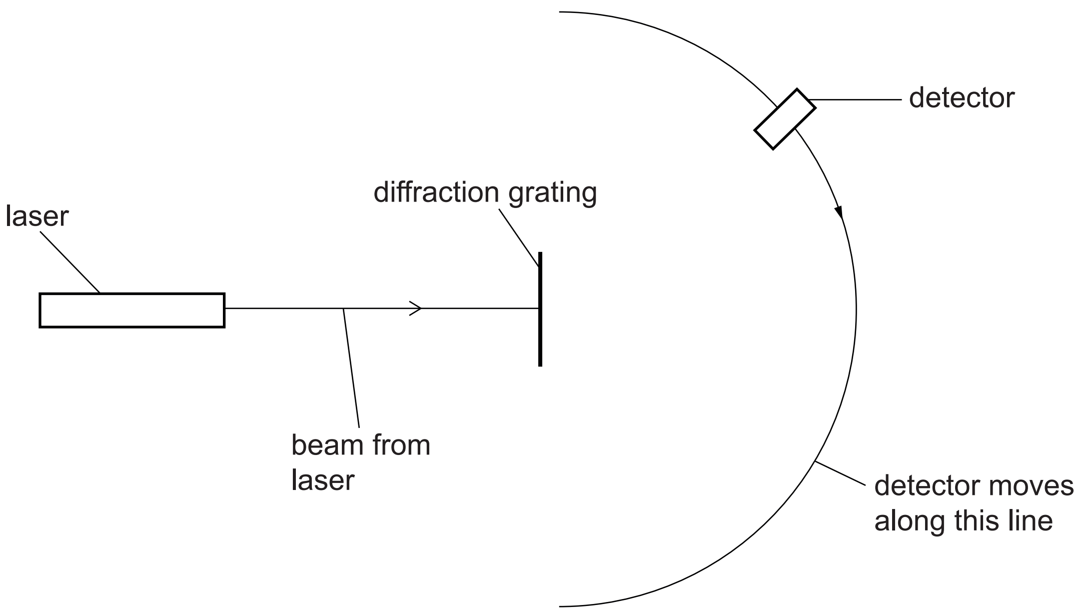

Fig. 5.2

Calculate the number of maxima detected as the detector moves through 180° along the line shown in Fig. 5.2. Show your working.

number of maxima detected = ... [4]

(iv) The laser is now replaced with one that emits electromagnetic waves with a wavelength of 300 nm.

Explain, without calculation, what happens to the number of maxima now detected. Assume that the detector is also sensitive to this wavelength of electromagnetic waves.

....

....

.... [2]

[Total: 12]