4 A laser produces a narrow beam of coherent light of wavelength 632 nm. The beam is incident normally on a diffraction grating, as shown in Fig. 4.1.

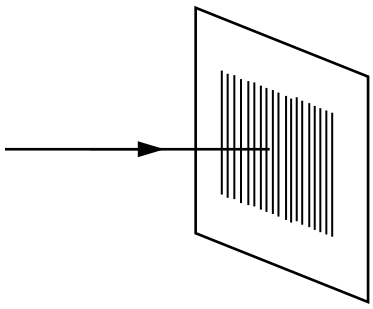

Fig. 4.1

(a) Describe how diffraction of light takes place at the grating.

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.....

..... [1]

(b) The diffraction pattern on the screen is shown in Fig. 4.2. The brightest spot is O. The two bright spots closest to O is 3.5 cm away from O.

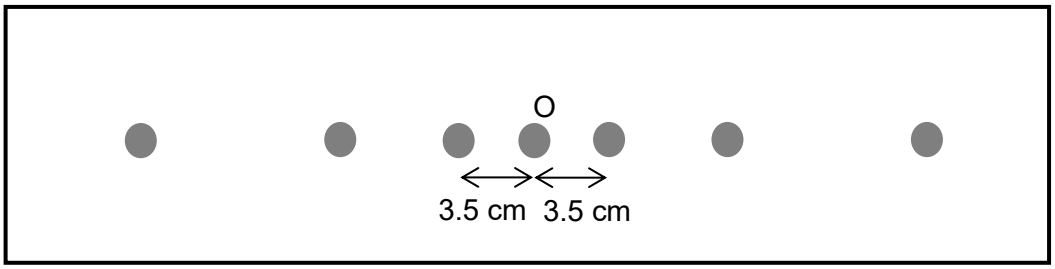

Fig. 4.2 (Not to scale)

The diffraction grating is placed 10 cm from the screen.

Determine the number of lines per metre on the grating.

number of lines per metre = ... [3]

(c) A second laser is directed normally to another diffraction grating with the same number of lines as in **(b)**.

Describe and explain how the new appearance of the diffraction grating pattern provide evidence for any changes to the following.

(i) the wavelength of the second laser,

.....

.....

.....

.....

.....

..... [2]

(ii) the orientation of the diffraction grating.

.....

.....

.....

..... [1]

(d) The diffraction grating in **(c)** is added directly in front of the first grating such that the orientation of the two diffraction gratings are perpendicular to each other. The diffraction pattern in Fig. 4.3 is observed.

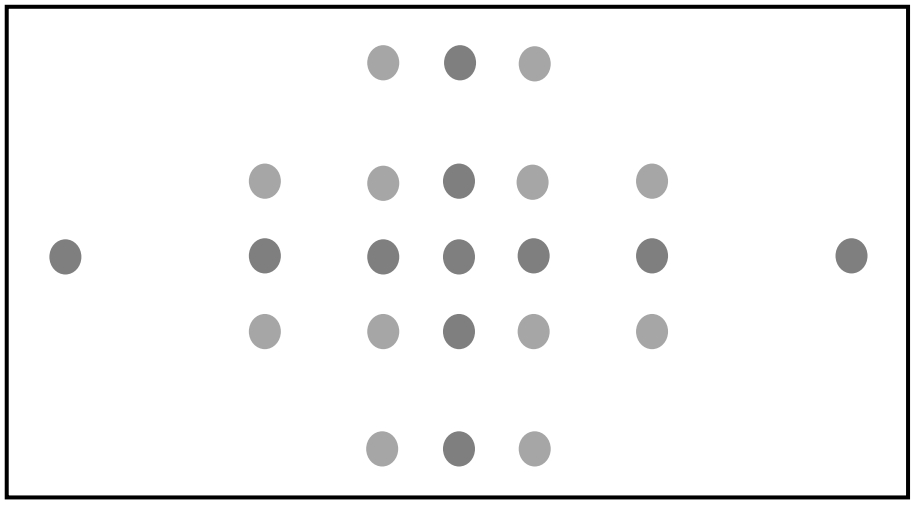

Fig. 4.3

Suggest how the pattern in Fig. 4.3 is formed.

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..... [2]

(e) A student sets up the apparatus in Fig. 4.1 but rotates the diffraction grating by 45° such that the laser is no longer normal to the grating.

Suggest and explain whether the position of the brightest spot O in Fig. 4.2 will change.

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.....

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..... [1]

[Total: 10]