4 **(a)** State two conditions required for two-source interference fringes to be observed.

1. .....

.....

2. .....

..... [2]

(b) Fig. 4.1 shows the setup for a Young's double slit experiment. Two thin polarisers are initially aligned such that light from the slits are polarised in parallel planes. The slit separation of the double slit is 0.10 mm, the distance between the double slit and the screen is 1.50 m and the separation of two consecutive dark fringes produced is 0.90 cm.

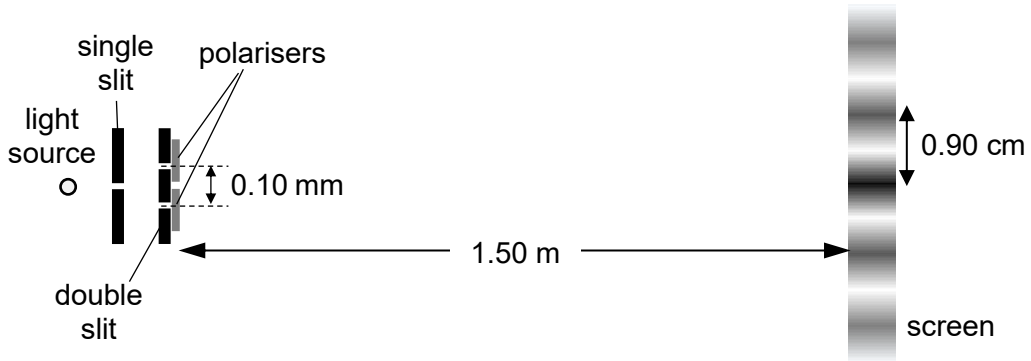

Fig. 4.1

(i) Calculate the wavelength λ of the light source.

λ = ... m [2]

(ii) One of the polarisers is rotated by an angle of 45° about an axis parallel to the incident light. The other polariser remains in its original position.

Describe the appearance of the fringes with reference to its original appearance.

.....

.....

..... [2]

(c) 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. 4.2.

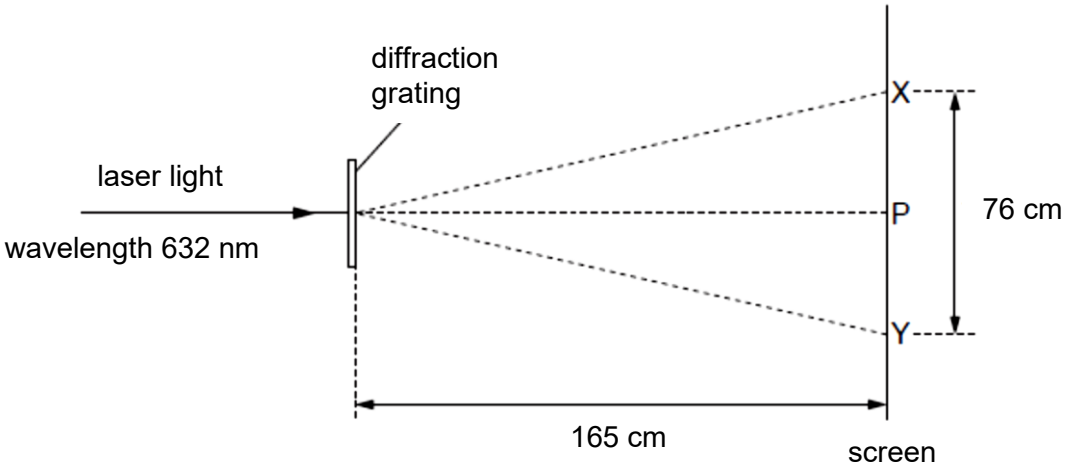

Fig. 4.2 (top view)

(i) Spots of light are observed on a screen placed parallel to the grating. The distance between the grating and the screen is 165 cm. The brightest spot is P. The spots formed closest to P and on each side of P are X and Y.

X and Y are separated by a distance 76 cm.

Calculate the number of lines per metre on the grating.

number of lines per metre = ... m^{-1} [3]

(ii) The grating in **(c)(i)** is now rotated by an angle of 90° about an axis parallel to the incident laser beam, as shown in Fig. 4.3.

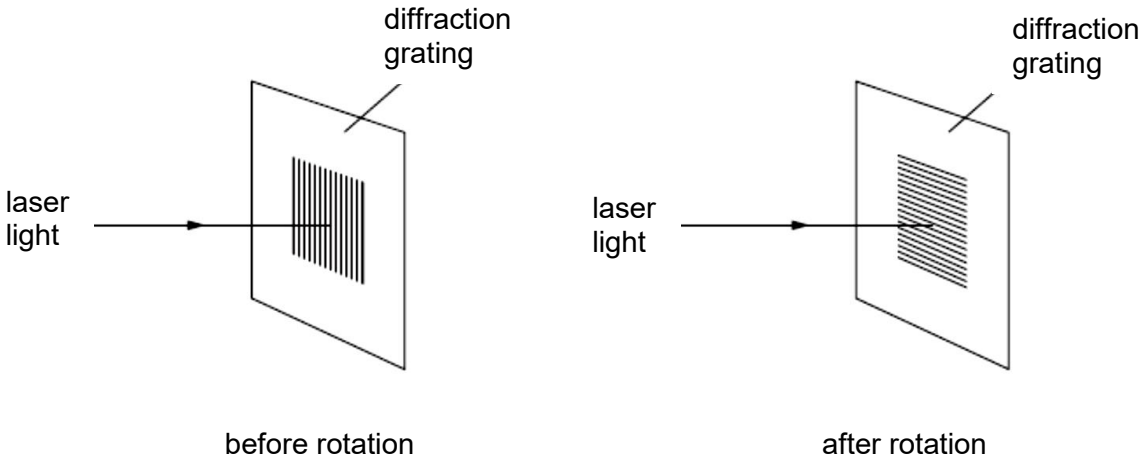

Fig. 4.3

The bright spots X, P and Y on the screen before the diffraction grating is rotated are shown on Fig. 4.4.

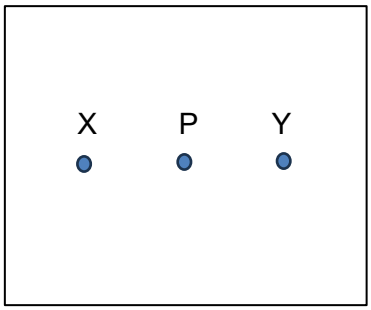

Fig. 4.4

On Fig. 4.5, draw the new respective positions of the spots on the screen after the diffraction grating is rotated. Label the new spots X', P' and Y'.

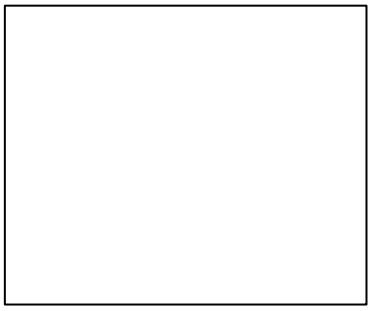

Fig. 4.5

[2]