6 **(a)** Sound waves travel from a source S to a point X along two paths SX and SPX, as shown in Fig. 6.1.

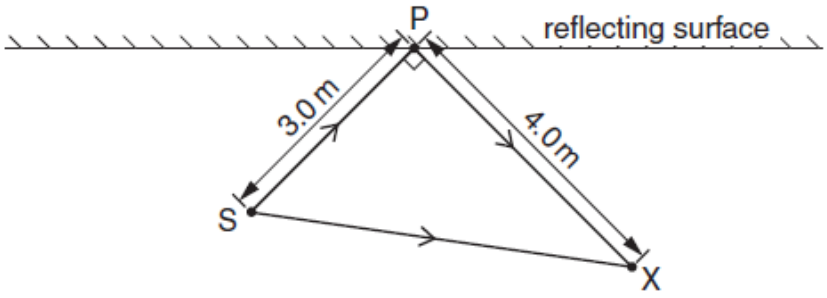

Fig. 6.1

(i) The frequency of the sound from S is 400 Hz and the speed of sound in air is 320 m s^{-1}. Calculate the wavelength of the sound waves.

wavelength = ... m [1]

(ii) The distance SP is 3.0 m and the distance PX is 4.0 m. The angle SPX is 90°.

Suggest whether a maximum or a minimum is detected at point X if there is a phase change of π of the sound wave upon reflection on the surface. Explain your answer.

.....

.....

..... [2]

(b) 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. 6.2.

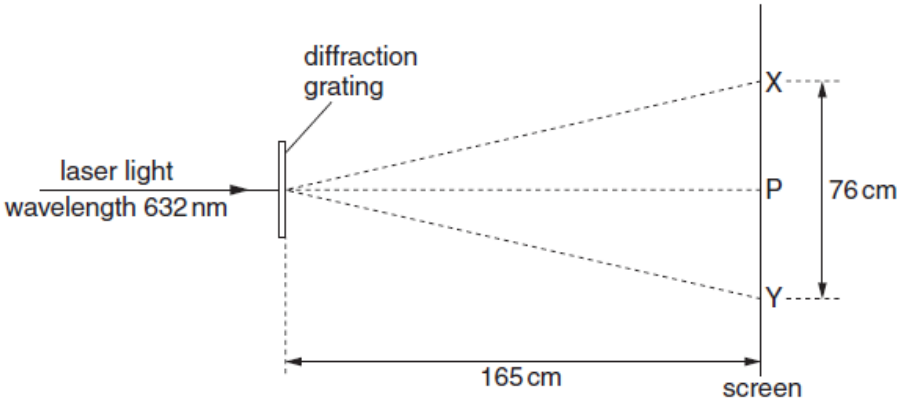

Fig. 6.2

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 of 76 cm.

(i) Calculate the number of lines per metre on the grating.

number per metre = ... [2]

(ii) The grating is now rotated about an axis parallel to the incident laser beam, as shown in Fig. 6.3.

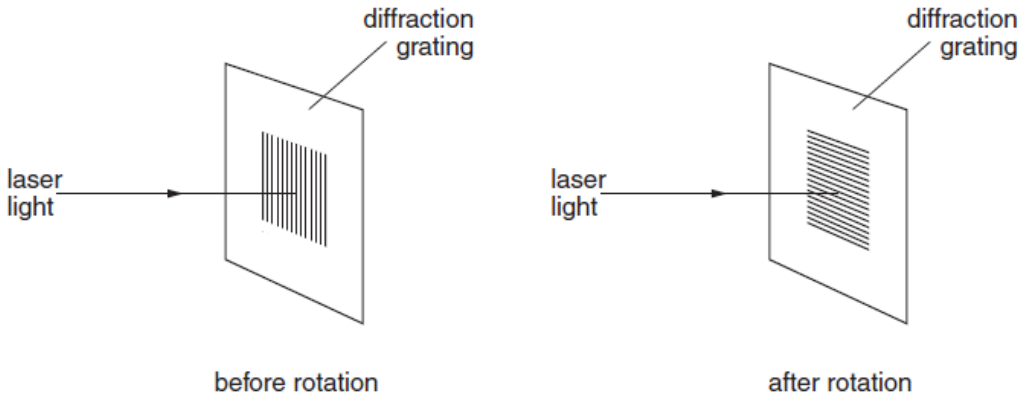

Fig. 6.3

State what effect, if any, this rotation will have on the positions of the spots P, X and Y.

.....

.....

..... [2]

(c) In another experiment using the apparatus in **(b)**, a student notices that the distances XP and PY, as shown in Fig. 6.1, are not equal.

Suggest a reason for this difference.

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…..……………………………..……………………………………………………………... [1]