## Section B

Answer **one** question from this Section in the spaces provided.

**7** **(a)** Fig. 7.1 shows a stretched string connected to an oscillator at one end and a load over a smooth pulley at the other end. The length of the string between the oscillator and the pulley is $L$.

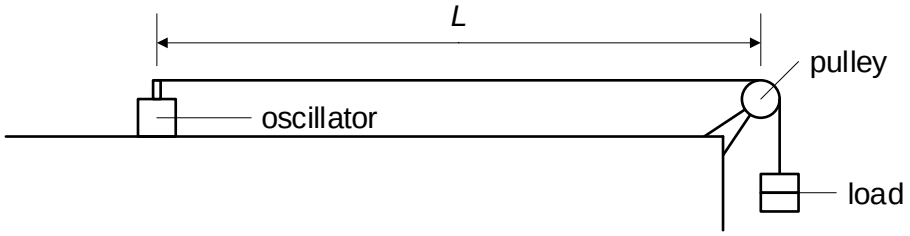


**Fig. 7.1**

**(i)** Explain why observable stationary waves are seen on the string when the oscillator is vibrating vertically at certain discrete frequencies.

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..... [3]

**(ii)** Show that the discrete frequencies in **(a)(i)** are integer multiples of $\frac{v}{2L}$ where $v$ is the speed of the wave on the string.

[1]

**(iii)** When the frequency of the oscillator is 40.0 Hz, a stationary wave with 5 nodes is seen for $L = 0.600$ m.

Calculate $v$.

$v$ = ..... m $s^{-1}$ [2]

**(iv)** The speed $v$ of the wave on the string is related to the tension $T$ in the string by

$$v = k\sqrt{T}$$

where $k$ is a constant.

Determine the new frequency of the oscillator such that a stationary wave with 5 nodes is still seen on the string if the tension is decreased by 2%.

new frequency = ..... Hz [2]

**(b) (i)** Fig. 7.2 shows a point source positioned a distance *D* from a single slit of width 0.30 mm. The point source emits monochromatic light of wavelength 600 nm.

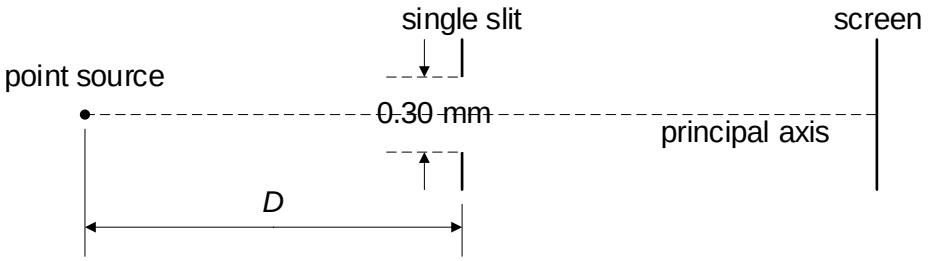


**Fig. 7.2 (not to scale)**

**1.** Show that the angle of the first minimum of the diffraction pattern from the principal axis is $2.0 \times 10^{-3}$ rad.

[1]

**2.** Sketch on Fig. 7.3, the diffraction pattern of the light after passing through the single slit. The maximum intensity of the central bright fringe is $I_0$.

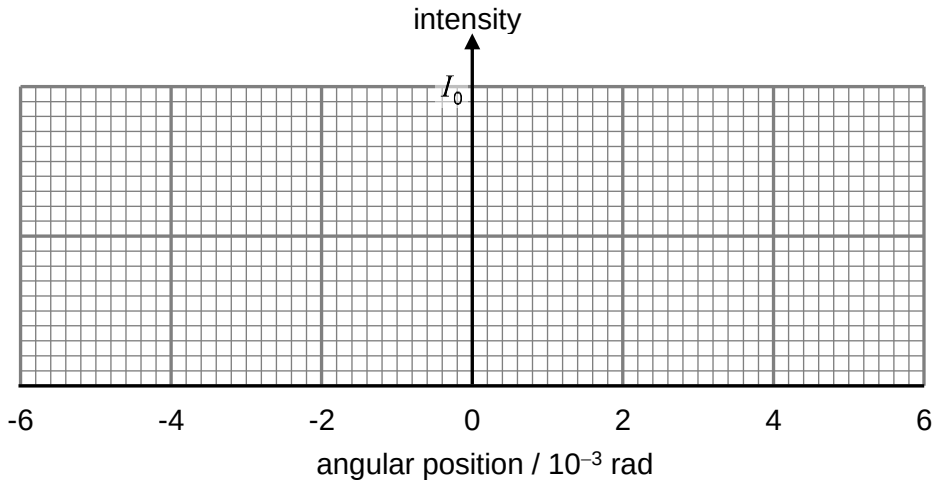


**Fig. 7.3**

[2]

**3.** A second identical point source is placed 0.50 m beside the original point source at the same distance *D* from the single slit.

Determine *D* where the two point sources are just resolved.

*D* = ..... m [2]

**(ii)** The second point source is now removed. An opaque film with a width of 0.10 mm is positioned at the centre of the single slit such that a double slit is formed as shown Fig. 7.4.

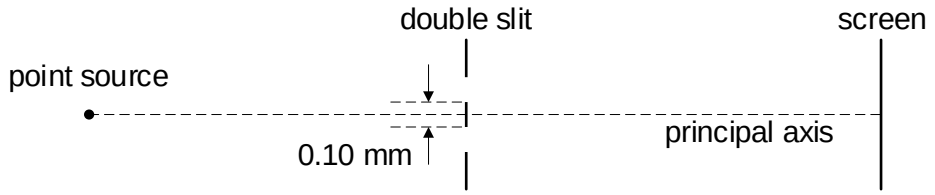


**Fig. 7.4 (not to scale)**

**1.** Determine the separation between the two slits.

separation = ..... mm [1]

**2.** Besides a change in intensity, state, with numerical values, the other changes to the diffraction pattern observed in Fig. 7.3.

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..... [3]

**3.** Determine, in terms of $I_0$, the maximum intensity of the pattern after the film is applied.

maximum intensity = ..... [3]