

9.2 Single-Slit Diffraction

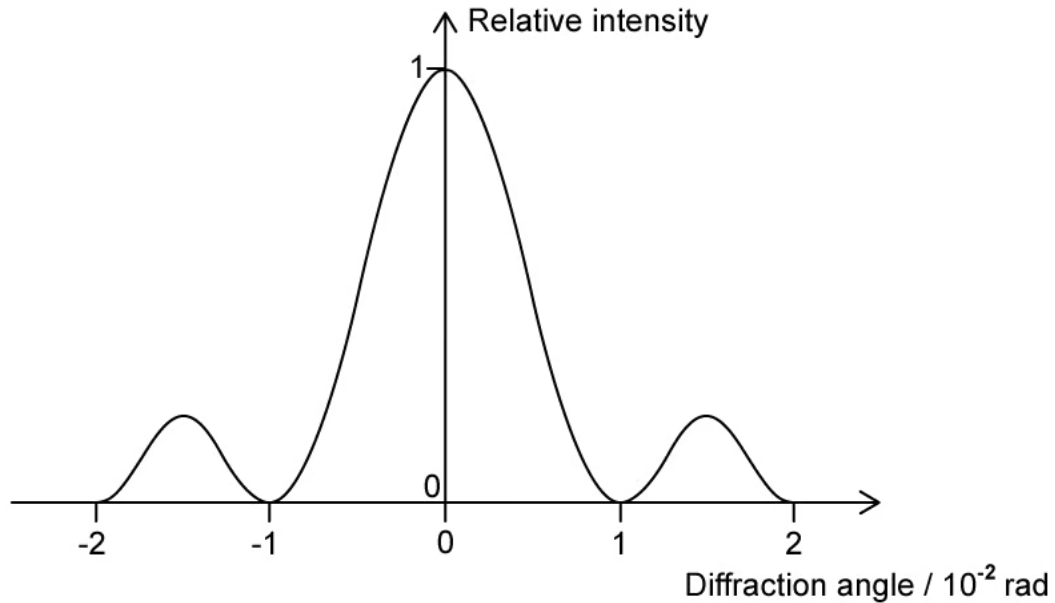
Question Paper

Course	DPIB Physics
Section	9. Wave Phenomena (HL only)
Topic	9.2 Single-Slit Diffraction
Difficulty	Hard

Time allowed: 20
Score: /10
Percentage: /100

Question 1

The diffraction pattern for light passing through a single slit is shown on the graph below.



What is the $\frac{\textit{slit width}}{\textit{wavelength of light}}$?

- A. 0 m
- B. 1×10^{-2} m
- C. 2×10^{-2} m
- D. 100

[1 mark]

Question 2

Monochromatic light is incident on two slits that are identical. An interference pattern is produced on a screen some distance away. Upon returning to the experiment a Physicist notices that there are fewer maxima now present on the screen.

What aspect of the equipment set up has been changed?

- A. The screen and slits have been moved further apart
- B. The wavelength of the light used is longer
- C. The wavelength of the light used is shorter
- D. One of the slits has become blocked

[1 mark]

Question 3

When monochromatic light is incident on a single slit a diffraction pattern forms on a screen. The width of the slit is increased.

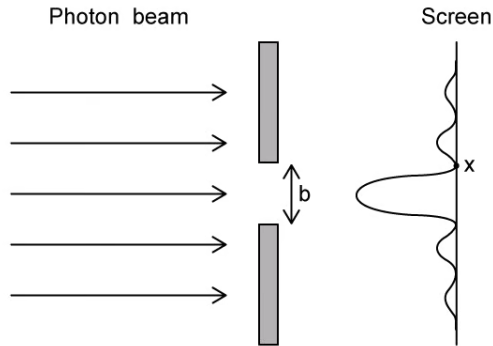
What are the changes in the width of the central and subsidiary maxima and in the intensity of the central and subsidiary maxima of the single slit diffraction pattern?

	Width of central maximum	Intensity of central maximum	Width of subsidiary maximum	Intensity of subsidiary maximum
A.	decreases	increases	decreases	increases
B.	increases	increases	increases	decreases
C.	decreases	decreases	decreases	increases
D.	increases	increases	decreases	decreases

[1 mark]

Question 4

A beam of photons moving in the direction shown is incident on a rectangular slit of width, b . The angle produced at X by the interference pattern of the photons diffracting through the slit is θ .



What is the component of the energy of the photons at point X on the screen?

- A. $E = \frac{\theta b}{hc}$
- B. $E = \theta b$
- C. $E = \frac{hc}{\theta b}$
- D. $E = \frac{\theta b}{c}$

[1 mark]

Question 5

A beam of light of wavelength λ is incident upon a single slit of width w . After passing through the slit, the light is incident on a screen at a distance Q from the slit.

Which of the following changes, carried out separately, will result in an increased width of the central maxima observed on the screen?

	λ	w	Q
A.	increase	increase	increase
B.	decrease	increase	decrease
C.	decrease	decrease	decrease
D.	increase	decrease	increase

[1 mark]

Question 6

A parallel beam of coherent light of wavelength p nm is incident on a rectangular slit of width p μ m. After passing through the slit the light is incident on a screen a distance p m away.

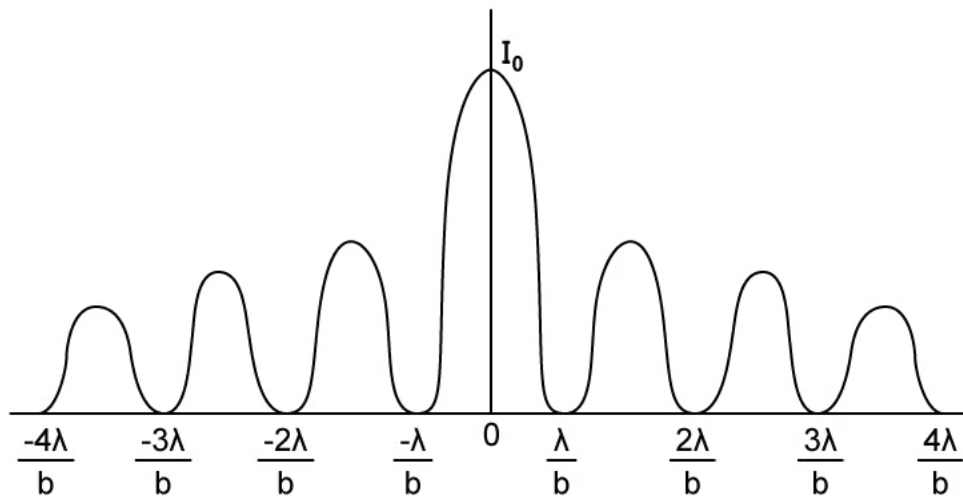
What is the width of the central maximum of the diffraction pattern as measured on the screen?

- A. $p \times 10^{-6}$
- B. $p^2 \times 10^{-3}$
- C. $2p^2 \times 10^{-3}$
- D. $2p^2$

[1 mark]

Question 7

A parallel beam of light of wavelength 400 nm is incident normally on a slit of width b . The distance between the slit and the screen is 0.2 m and the distance of the second order of maximum from the centre of the screen is 10 mm.



What is the width of the slit?

- A. 1×10^{-4} m
- B. 1×10^{-2} m
- C. 0.1 m
- D. 1 m

[1 mark]

Question 8

A parallel beam of light of wavelength λ passes through a slit of width b . The transmitted light is collected on a screen D m away where $D \gg b$.

What is the distance between the two second-order minima?

A. $\frac{D\lambda}{2b}$

B. $\frac{2D\lambda}{b}$

C. $\frac{4D\lambda}{b}$

D. $\frac{8D\lambda}{b}$

[1 mark]

Question 9

Radiation is incident on a single rectangular slit. The diffracted beam that emerges from the slit is incident on a screen. Both the slit width and the wavelength of the radiation are tripled. The intensity of the radiation remains the same.

Which answer option correctly describes the total number of photons incident every second on the screen and the angular width of the central maximum of the diffracted beam?

	Number of photons incident every second	Angular width of the central maximum
A	tripled	unchanged
B	a third	unchanged
C	unchanged	tripled
D	tripled	a third

[1 mark]

Question 10

A monochromatic source of light of wavelength λ is incident on a single slit of width b . The interference pattern is visible on the screen where the angle of the third minima is θ .

What is the wavelength of the light?

A. $\frac{b\theta}{6}$

B. $\frac{b\theta}{3}$

C. $\frac{b\theta}{2}$

D. $b\theta$

[1 mark]