9.2 Single-Slit Diffraction

Question Paper

Course	DP IB Physics
Section	9. Wave Phenomena (HL only)
Topic	9.2 Single-Slit Diffraction
Difficulty	Medium

To be used by all students preparing for DP IB Physics HL
Students of other boards may also find this useful

Question 1

In two separate experiments, monochromatic light is incident on a single slit. The diagrams show the interference patterns obtained on a screen far from the slit. In diagram 1, the wavelength of light is λ_1 and the slit width is b_1. In diagram 2, the wavelength of light is λ_2 and the slit width is b_2.

Diagram 1

Diagram 2

What is the correct expression linking wavelength and slit width of the two interference patterns?

A. $\lambda_2 < \lambda_1$

B. $b_2 < b_1$

C. $\frac{\lambda_1}{b_1} > \frac{\lambda_2}{b_2}$

D. $\frac{\lambda_1}{b_1} < \frac{\lambda_2}{b_2}$

[1 mark]

Question 2

Which of the statements are true for single-slit interference?

I. Blue light produces a larger angle of diffraction than red light
II. The smaller the slit width, the larger the angle of diffraction for a constant wavelength

A. Neither

B. I only

C. II only

D. Both

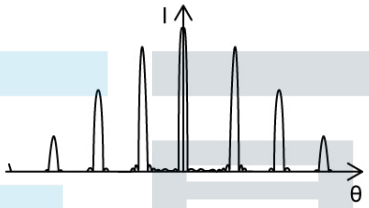
[1 mark]

Question 3

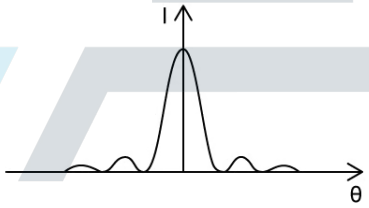
Several diffraction experiments are performed with light diffracted through different numbers of slits. Which row. in the table below, correctly matches the number of slits and the intensity pattern observed on the screen?

	Experiment 1	Experiment 2	Experiment 3	Experiment 4
A.	5–slit diffraction grating	Single Slit	Double Slit	10–slit diffraction grating
B.	10–slit diffraction grating	Single Slit	Double Slit	5–slit diffraction grating
C.	10–slit diffraction grating	Double Slit	Single Slit	5–slit diffraction grating
D.	5–slit diffraction grating	Double Slit	Single Slit	10–slit diffraction grating

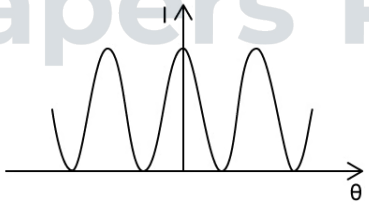
1.



2.



3.



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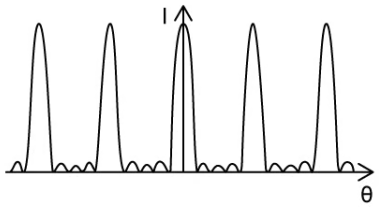
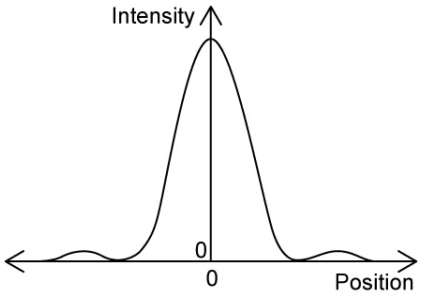


[1 mark]

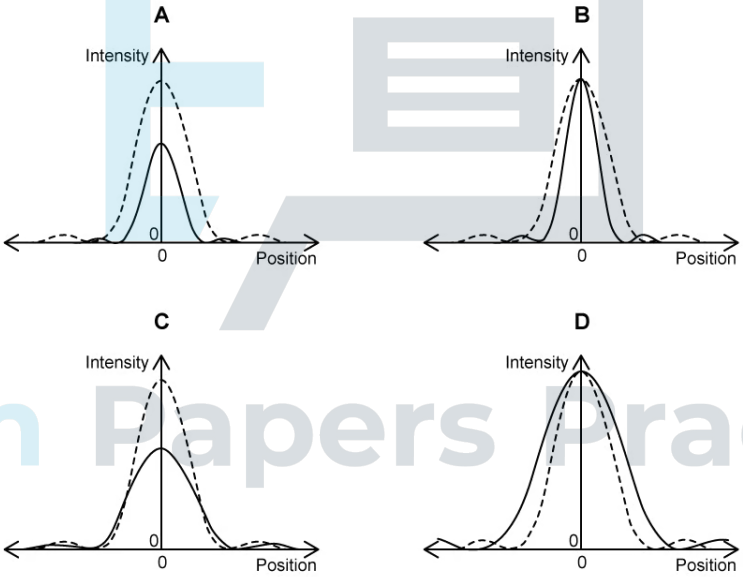
Question 4

Monochromatic light is incident on a narrow rectangular slit in an optical experiment. The diffracted light is observed on a distant screen. The graph below shows how the intensity of light varies with position on the screen.



The width of the slit is increased. The original diffraction pattern is shown by the solid line.

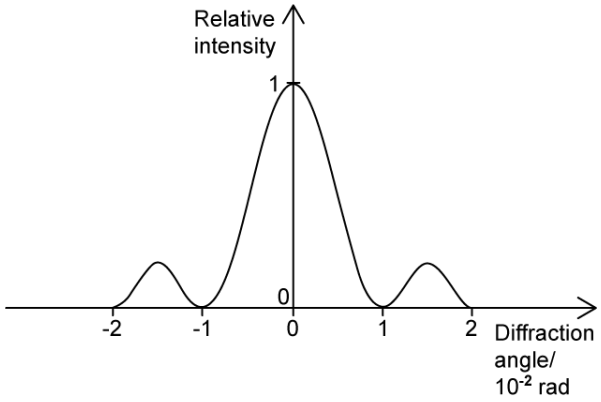
Which graph shows how the intensity of light observed varies with position on the screen?



[1 mark]

Question 5

The diagram shows the diffraction pattern for light travelling through a single slit of width 2.0 mm.



What is the wavelength of the light used?

A. 2.0 cm

B. 2.0 mm

C. 20 μm

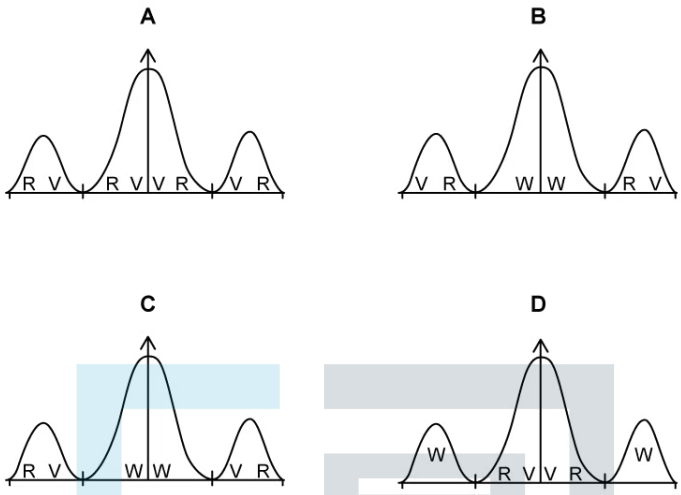
D. 20 nm

[1 mark]

Question 6

White light is diffracted through a single slit.

Which row in the table indicates the correct positions of red (R), violet (V) and white (W) light on the intensity pattern seen on a screen?



[1 mark]

Question 7

A single slit diffraction pattern is performed several times using light of different colours, slits of different widths and different distances to the screen. Which change will decrease the width of the central peak?

A. Change the light source from red to blue

B. Change the light source from blue to red

C. Make the slit width narrower

D. Move the screen further away

[1 mark]

Question 8

A parallel beam of coherent light of wavelength λ is incident on a rectangular slit of width b. After passing through the slit the light is incident on a screen a distance D from the slit where D is much greater than b.

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

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

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

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

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

[1 mark]

Question 9

In a diffraction experiment with a single slit, the first minimum is observed at a diffraction angle θ. The intensity of the central maximum of the diffraction pattern is I. The light source stays the same. What is the effect on I and θ of reducing the slit width?

	θ	I
A.	decreases	increases
B.	increases	decreases
C.	decreases	decreases
D.	increases	increases

[1 mark]

Question 10

A single slit produces a diffraction pattern. The angle from the centre of the pattern to the first minimum point is *Y*. The slit width is then halved and the frequency of light is doubled.

What is the new angle from the centre of the pattern to the first minimum point?

A. $4Y$

B. $\frac{1}{2}Y$

C. Y

D. $\frac{1}{4}Y$

[1 mark]