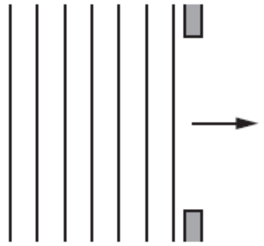
1. Nov/2023/Paper_ 9702/11/No.27

In an experiment, water waves in a ripple tank are incident on a gap, as shown.



Some diffraction of the water waves is observed.

Which change to the experiment would provide a better demonstration of diffraction?

A Increase the amplitude of the waves.

B Increase the frequency of the waves.

C Increase the wavelength of the waves.

D Increase the width of the gap.

2. Nov/2023/Paper_ 9702/11/No.28

Light of wavelength λ is emitted from two point sources R and S and falls onto a distant screen.

At point P on the screen, the light intensity is zero.

What could explain the zero intensity at P?

A Light from the two sources is emitted 180° out of phase and the path difference to P is $\frac{1}{2}\lambda$.

B Light from the two sources is emitted in phase and the path difference to P is λ.

C Light from the two sources is emitted 90° out of phase and the path difference to P is λ.

D Light from the two sources is emitted in phase and the path difference to P is $\frac{1}{2}\lambda$.

3. Nov/2023/Paper_ 9702/11/No.29

A beam of red light of wavelength 720 nm is incident normally on a diffraction grating and produces a diffraction pattern on a screen placed parallel to the grating.

The beam of red light is replaced with a beam of electromagnetic radiation of wavelength X, which is incident normally on the same diffraction grating.

The third-order maximum for the electromagnetic radiation of wavelength X is at the same position on the screen as the second-order maximum for the red light.

What is wavelength X?

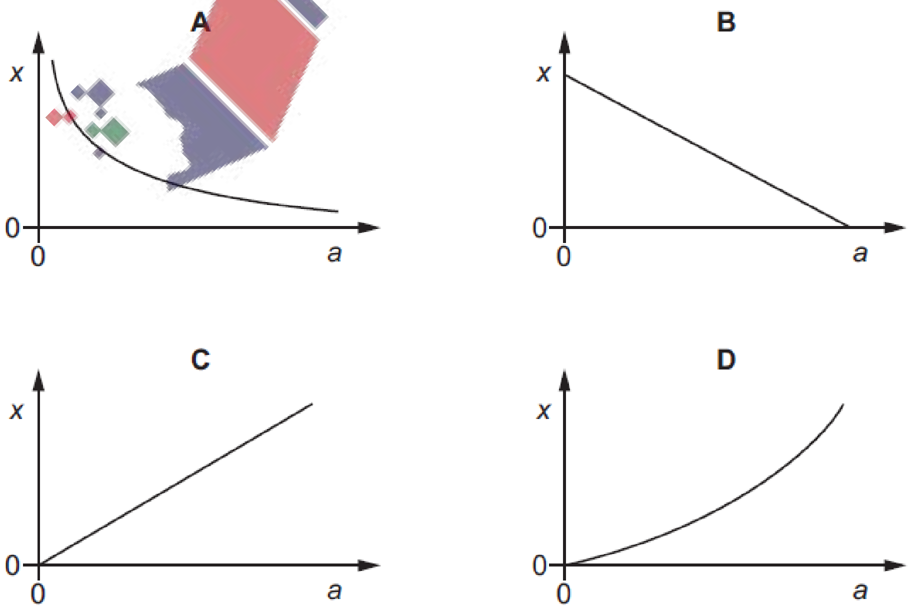
A 480 nm **B** 540 nm **C** 960 nm **D** 1100 nm

4. Nov/2023/Paper_ 9702/12/No.27

Coherent light of constant wavelength is incident normally on a double slit. Interference fringes are formed on a screen that is a fixed distance from the double slit. The screen is parallel to the double slit.

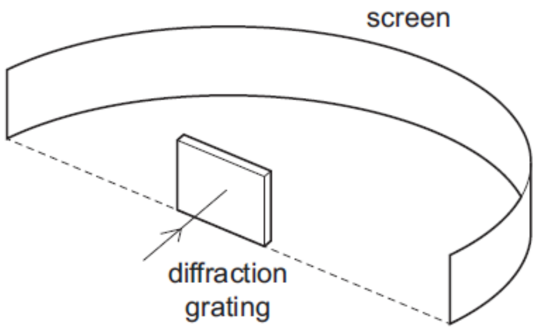
The separation of the slits is varied.

Which graph best shows the variation with slit separation a of the spacing x of the interference fringes?



5. Nov/2023/Paper_ 9702/12/No.29

Light of wavelength 690 nm passes through a diffraction grating with 300 lines per mm, producing a series of bright spots (maxima) on a screen.



What is the total number of bright spots that are produced?

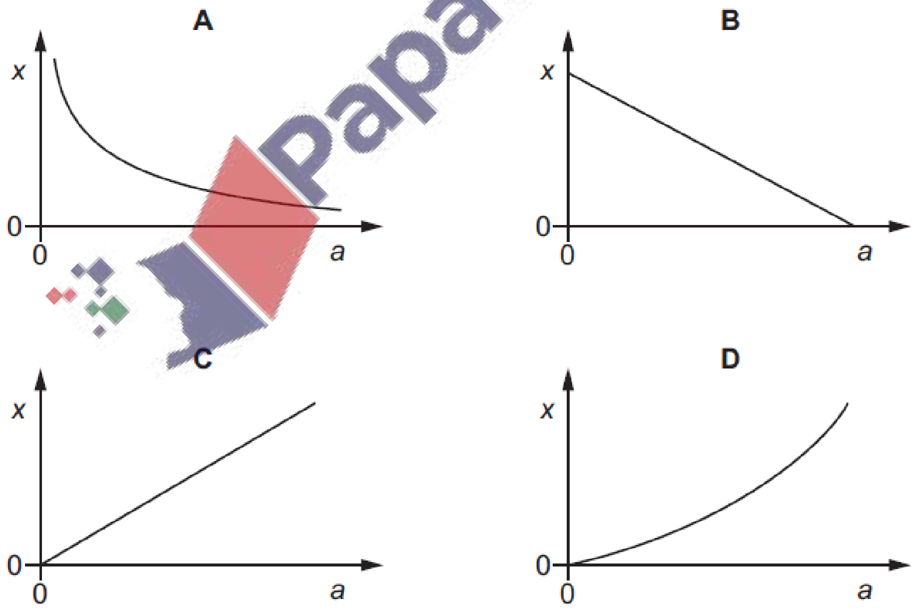
A 4 **B** 5 **C** 8 **D** 9

6. Nov/2023/Paper_ 9702/13/No.28

Coherent light of constant wavelength is incident normally on a double slit. Interference fringes are formed on a screen that is a fixed distance from the double slit. The screen is parallel to the double slit.

The separation of the slits is varied.

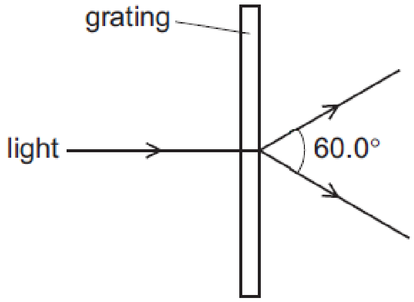
Which graph best shows the variation with slit separation a of the spacing x of the interference fringes?



7. Nov/2023/Paper_ 9702/13/No.29

A diffraction grating is used to measure the wavelength of light.

The spacing of the slits in the grating is 1.15×10^{-6} m. The angle between the first-order diffraction maxima is 60.0°, as shown.



What is the wavelength of the light?

A 288 nm **B** 498 nm **C** 575 nm **D** 996 nm

8. Nov/2023/Paper_ 9702/21/No.4

(a) State the principle of superposition.

....

....

.... [2]

(b) Coherent light is incident normally on two identical slits X and Y. The diffracted light emerging from the slits superposes to produce an interference pattern on a screen positioned at a distance of 1.9 m from the slits.

Fig. 4.1 shows the arrangement and the central part of the interference pattern of bright and dark fringes formed on the screen.

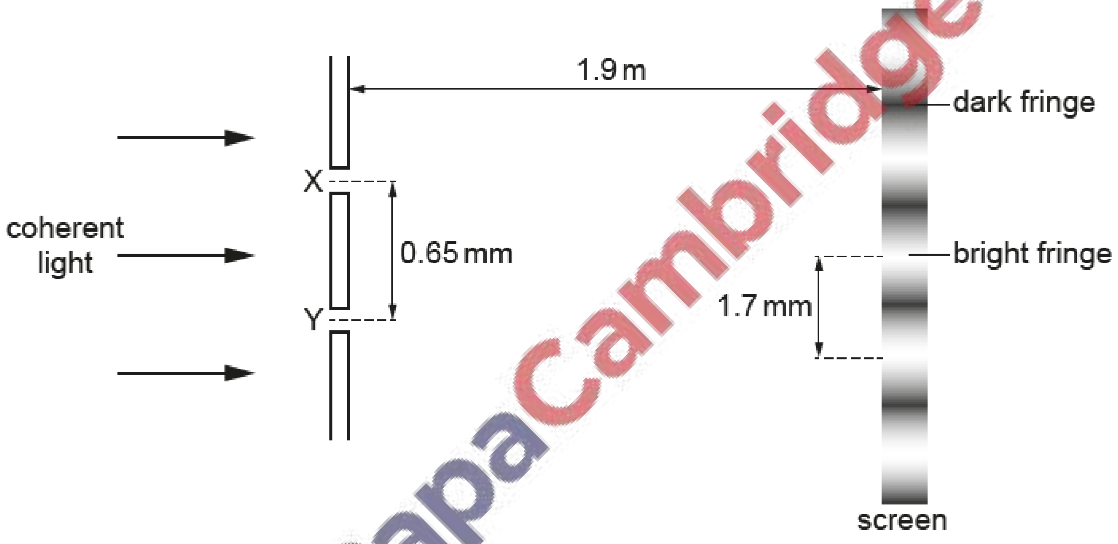


Fig. 4.1 (not to scale)

The separation of the slits is 0.65 mm. The distance between the centres of adjacent bright fringes is 1.7 mm.

Calculate the wavelength λ of the light.

λ = ... m [3]

(c) Light waves from slits X and Y in **(b)** arrive at a point between adjacent bright fringes on the screen. Fig. 4.2 shows the variation of displacement with time for the waves arriving at the point where they meet.

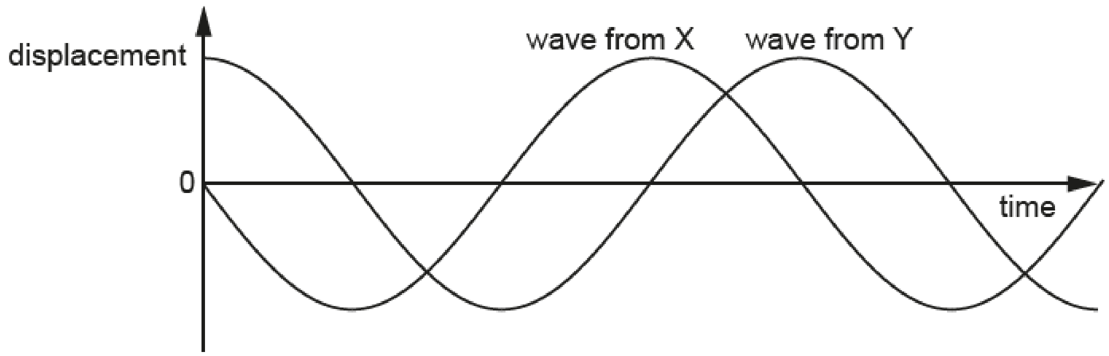


Fig. 4.2

A student makes two statements about the waves at this point:

Statement 1: 'The phase difference between the waves is 90°.'

Statement 2: 'The amplitude of the resultant wave is zero.'

(i) Explain how statement 1 is correct.

....

....

.... [1]

(ii) State and explain whether statement 2 is correct.

....

....

.... [1]

(d) The width of each slit in **(b)** is decreased by the same amount. There is no change to the separation of the slits.

Describe and explain the effect, if any, of this change on the appearance of the interference pattern.

....

....

.... [2]

[Total: 9]

9. Nov/2023/Paper_ 9702/22/No.5(b, c)

(b) State what is meant by the diffraction of a wave.

....

....

.... [2]

(c) A beam of light of wavelength 4.3×10^{-7} m is incident normally on a diffraction grating in air, as shown in Fig. 5.3.

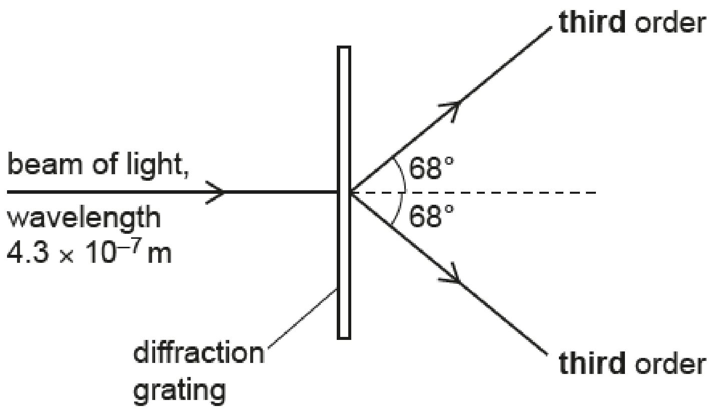


Fig. 5.3 (not to scale)

The **third**-order diffraction maximum of the light is at an angle of 68° to the direction of the incident light beam.

(i) Calculate the line spacing *d* of the diffraction grating.

d = ... m [2]

(ii) Determine a different wavelength of **visible** light that will also produce a diffraction maximum at an angle of 68°.

wavelength = ... m [2]

10. Nov/2023/Paper_ 9702/23/No.5

Two point sources, A and B, produce coherent electromagnetic waves. The waves from A and B are emitted in phase and have wavelength λ, as shown in Fig. 5.1.

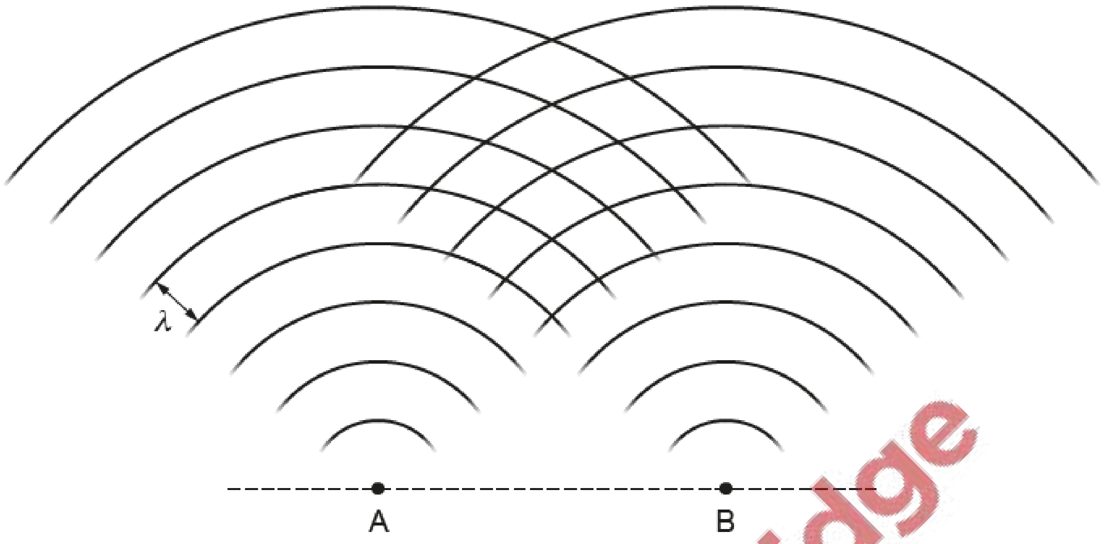


Fig. 5.1 (not to scale)

The lines on Fig. 5.1 represent wavefronts. All the points on a wavefront are in phase.

(a) On Fig. 5.1, mark with a cross (×):

(i) the position of an interference maximum (label this cross Y) [1]

(ii) the position of an interference minimum (label this cross Z). [1]

(b) The waves in air have a wavelength of 2.9×10^{-5} m.

An interference pattern is detected along a line parallel to AB and at a perpendicular distance of 140 m from AB. The spacing between adjacent interference maxima is 1.2 cm.

(i) Calculate the separation a of the sources A and B.

a = ... m [3]

(ii) State the principal region of the electromagnetic spectrum to which the waves belong.

.... [1]

[Total: 6]