Superposition – 2021 AS

1. June/2021/Paper_11/No.23

A stationary wave is formed from two identical sound waves.

A microphone is placed at a position of maximum loudness. It is then moved along the stationary wave from this first position of maximum loudness to the fourth position of maximum loudness. The microphone moves a distance of 12 cm.

The speed of sound is 330 $m\,s^{-1}$.

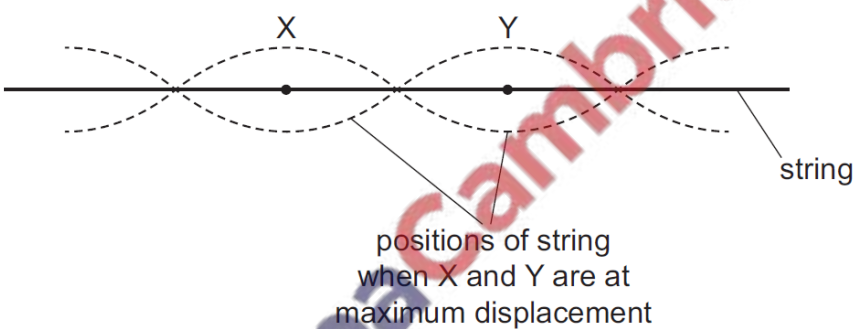
What is the frequency of the sound waves?

A 4100 Hz **B** 5500 Hz **C** 8300 Hz **D** 11 000 Hz

2. June/2021/Paper_11/No.26

The diagram shows part of a stationary wave on a string.

X and Y are points on the string. The vibrations at X and Y are 180° out of phase.



What is the distance between X and Y?

A one-quarter of a wavelength

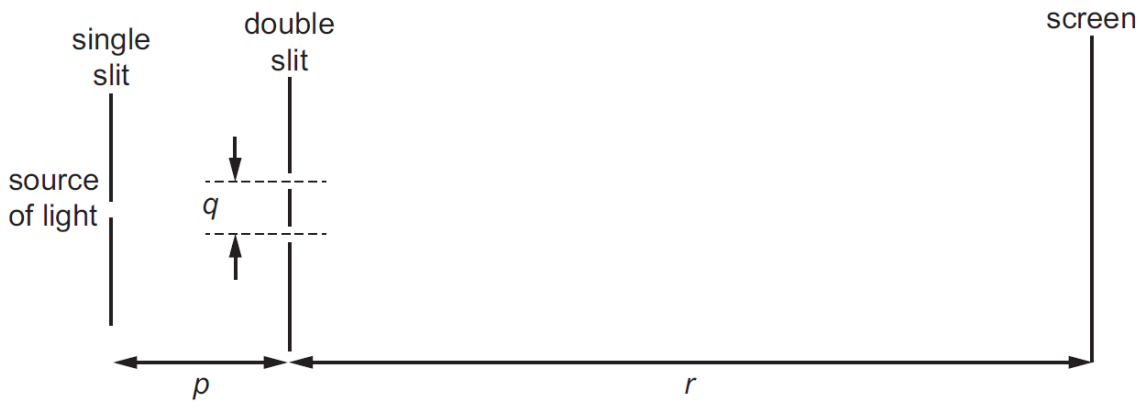
B half a wavelength

C one wavelength

D two wavelengths

3. June/2021/Paper_11/No.28

A teacher sets up the apparatus shown to demonstrate a double-slit interference pattern on a screen.



Which change to the apparatus will increase the fringe spacing?

A decrease the distance *p*

B decrease the distance *q*

C decrease the distance *r*

D decrease the wavelength of the light

4. June/2021/Paper_11/No.29

Light of a single unknown wavelength and blue light of a single wavelength are both incident normally on a diffraction grating. Two diffraction patterns are produced, one for each wavelength of light.

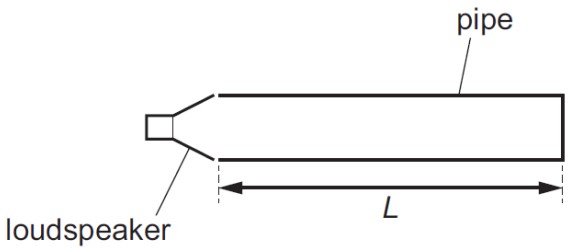
The third-order maximum for the blue light occurs at the same angle as the second-order maximum for the light of unknown wavelength. The wavelength of the blue light is 480 nm.

What is the unknown wavelength?

A 320 nm **B** 720 nm **C** 960 nm **D** 1440 nm

5. June/2021/Paper_12/No.26

A pipe of length L is open at one end and closed at the other end. A loudspeaker is at the open end and emits a sound wave into the pipe.



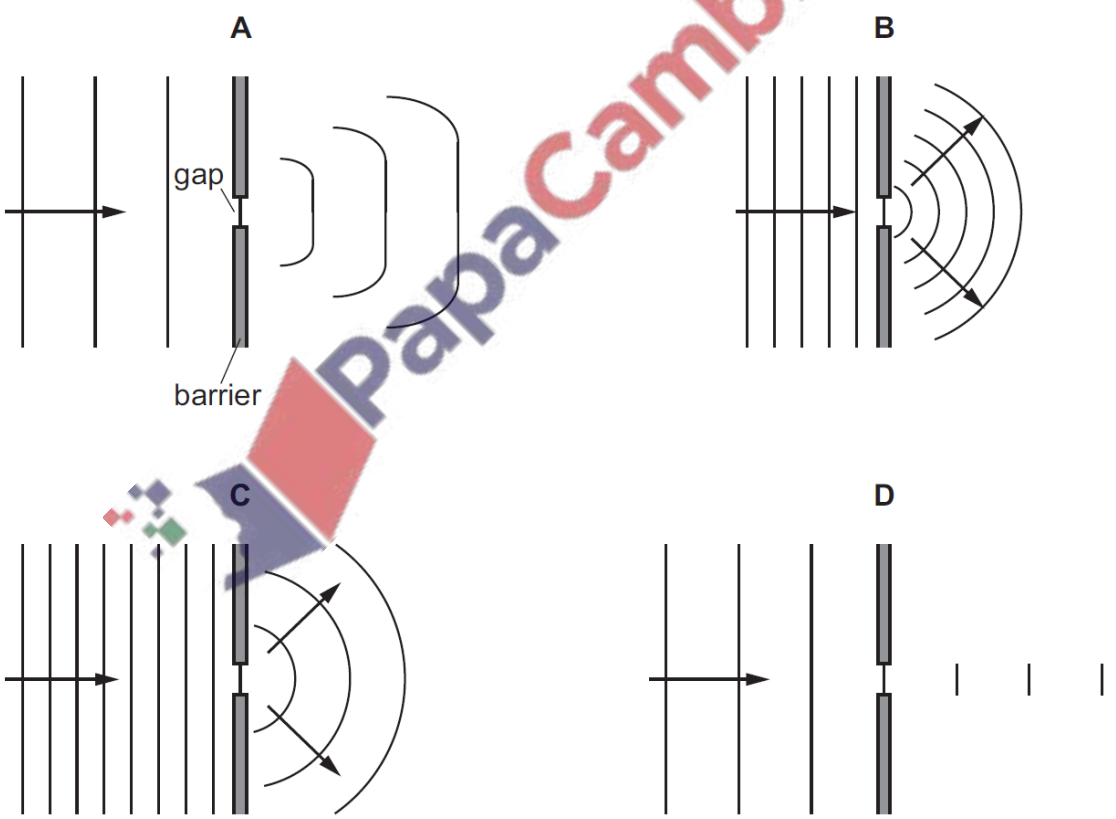
When a stationary wave is formed, there is an antinode at the open end of the pipe.

Which wavelength of sound could be used to produce a stationary wave?

A $\frac{2L}{3}$ **B** L **C** $\frac{4L}{3}$ **D** $2L$

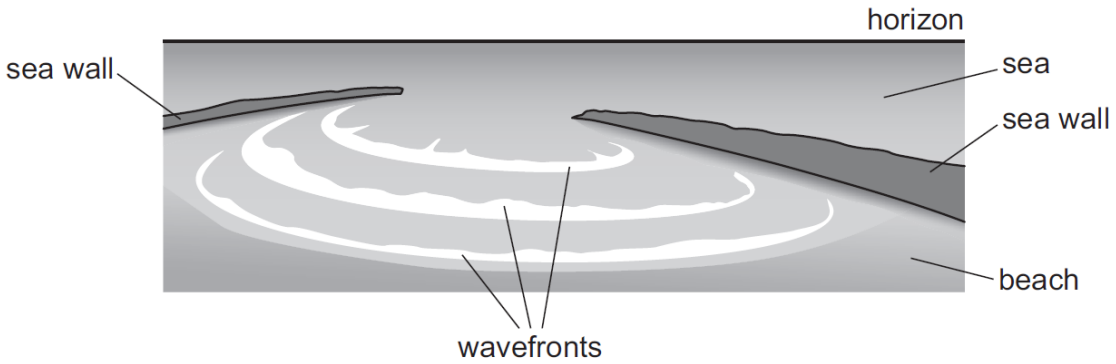
6. June/2021/Paper_12/No.27

Which diagram best shows how water waves diffract when they pass through a gap in a barrier?



7. June/2021/Paper_11/No.27

Which wave behaviour is shown in the diagram?



A diffraction

B Doppler shift

C interference

D superposition

8. June/2021/Paper_12/No.28

In a two-source interference experiment, light of a single frequency is incident on a double slit.

The light waves emerging from the slits are coherent.

What is meant by *coherent*?

A The waves are in phase.

B The waves have a constant phase difference.

C The waves have the same amplitude.

D The waves interfere constructively wherever they overlap.

9. June/2021/Paper_12/No.29

A parallel beam of light consists of light of wavelength 420 nm and light of wavelength 630 nm.

The light is incident normally on a diffraction grating.

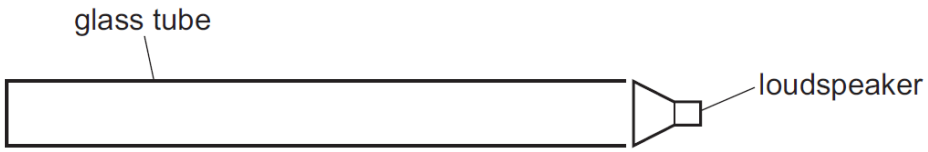
The diffraction maxima for the two wavelengths overlap only at an angle of 31° from the direction of the incident light beam.

What could be the line spacing of the diffraction grating?

A 1.2 μm **B** 1.6 μm **C** 2.4 μm **D** 3.7 μm

10. Nov/2021/Paper_11/No.23

A glass tube is closed at one end and has a loudspeaker at the other end.



A stationary wave is formed with a node at the closed end of the tube when the sound has frequency f_0. There are no other nodes.

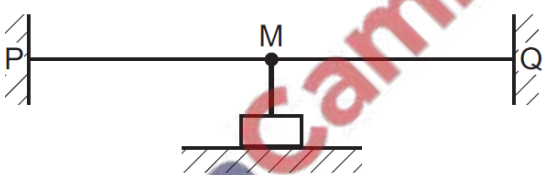
The frequency of the sound is then slowly increased.

What is the frequency of the sound that produces the next stationary wave?

A $1.25f_0$ **B** $1.50f_0$ **C** $2.00f_0$ **D** $3.00f_0$

11. Nov/2021/Paper_11/No.26

A string is fixed between point P and an oscillator M. Another string is fixed between M and point Q. M is midway between P and Q.

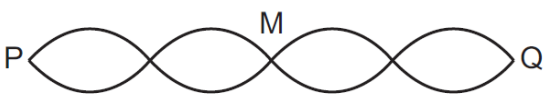


The frequency of the oscillator is adjusted until a stationary wave is formed on both strings. The speed of the wave between P and M is twice the speed of the wave between M and Q.

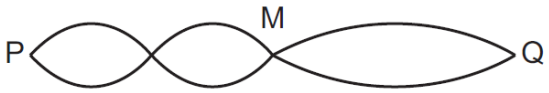
Which diagram could represent the stationary wave pattern?

A

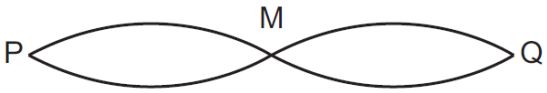
B



C



D



12. Nov/2021/Paper_11/No.27

A water wave in a ripple tank is diffracted as it passes through a gap in a barrier.

Which two factors affect the angle of diffraction of the wave?

A the amplitude and frequency of the incident wave

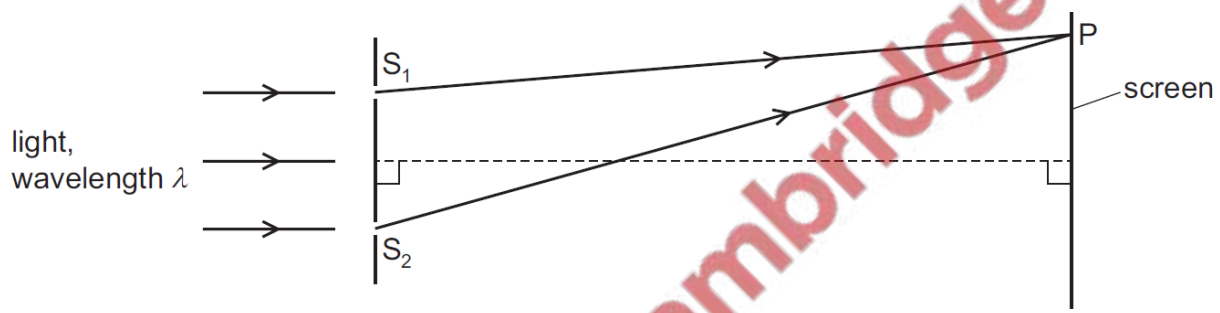
B the amplitude of the incident wave and the width of the gap

C the wavelength and amplitude of the incident wave

D the wavelength of the incident wave and the width of the gap

13. Nov/2021/Paper_11/No.28

Light of wavelength λ is incident normally on two narrow slits S_1 and S_2, a small distance apart. Bright and dark fringes are observed on a screen a long distance away from the slits.



The *n*th **dark** fringe from the central bright fringe is observed at point P on the screen.

Which equation is correct for all positive values of *n*?

A $S_2P - S_1P = \frac{n\lambda}{2}$

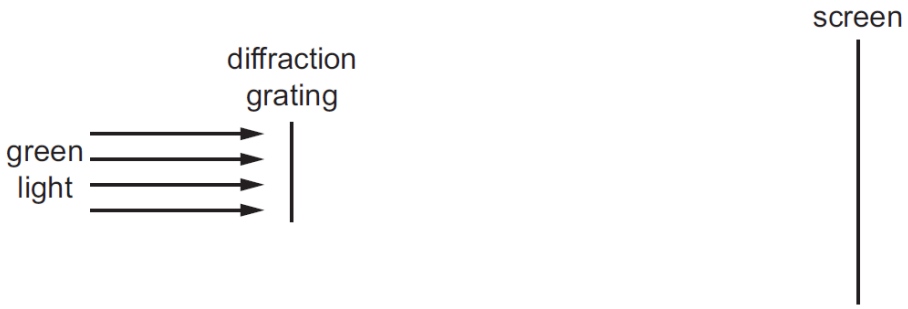
B $S_2P - S_1P = n\lambda$

C $S_2P - S_1P = (n - \frac{1}{2})\lambda$

D $S_2P - S_1P = (n + \frac{1}{2})\lambda$

14. Nov/2021/Paper_11/No.29

Green light is incident normally on a diffraction grating and forms a diffraction pattern on a distant screen.



Which change, on its own, would **decrease** the separation of the diffraction maxima on the screen?

A Increase the distance between the screen and the diffraction grating.

B Replace the diffraction grating with a grating that has a smaller separation between the slits.

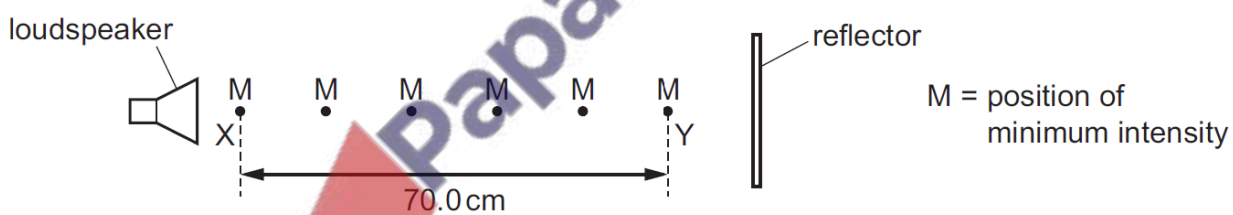
C Replace the diffraction grating with a grating that has fewer slits per unit length.

D Replace the green light with red light.

15. Nov/2021/Paper_12/No.24

A sound wave from a loudspeaker is reflected back along its original path by a reflector.

A microphone is initially at point X where the sound intensity is a minimum, as shown.



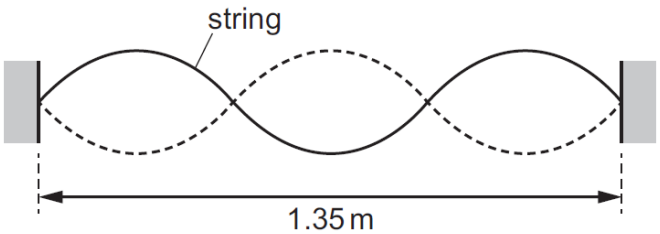
The microphone is moved towards the reflector and passes through four more intensity minima until reaching a fifth minimum at point Y. The distance XY is 70.0 cm.

What is the wavelength of the sound?

A 11.7 cm **B** 14.0 cm **C** 23.3 cm **D** 28.0 cm

16. Nov/2021/Paper_12/No.27

A stationary wave is produced on a string that is stretched between two fixed points that are a distance of 1.35 m apart, as shown.



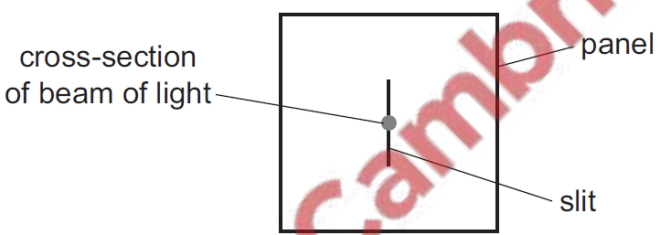
The speed of the waves on the string is 450 m s^{-1}.

What is the frequency of oscillation of the stationary wave?

A 333 Hz **B** 405 Hz **C** 500 Hz **D** 1000 Hz

17. Nov/2021/Paper_12/No.28

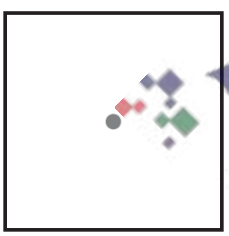
A beam of laser light is directed towards a narrow slit.



After emerging from the other side of the slit, the diffracted light then falls on a screen.

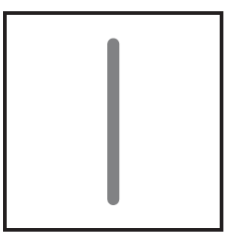
What is the pattern of light seen on the screen?

A

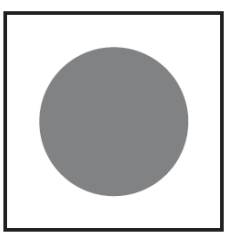


B

C



D



18. Nov/2021/Paper_12/No.29

Two waves, each with a constant amplitude, interfere and produce an interference pattern. The pattern has minima at fixed points where the displacement is zero at all times.

Which statement describes the two waves?

A They must be coherent and of the same amplitude.

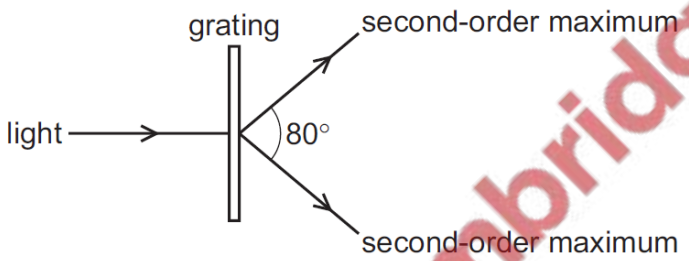
B They must be coherent but not necessarily of the same amplitude.

C They must be of the same amplitude but not necessarily coherent.

D They must not be coherent or of the same amplitude.

19. Nov/2021/Paper_12/No.30

Light of wavelength 5.5×10^{-7} m is incident normally on a diffraction grating.



The angle between the second-order diffraction maxima is 80°, as shown.

What is the number of lines per metre of the diffraction grating?

A 5.8×10^5 lines per metre

B 9.0×10^5 lines per metre

C 1.2×10^6 lines per metre

D 2.3×10^6 lines per metre

20. Nov/2021/Paper_13/No.24

A stationary sound wave is formed in a pipe that is closed at one end and open at the other end. The wave has two antinodes. One of these antinodes is at the open end of the pipe.

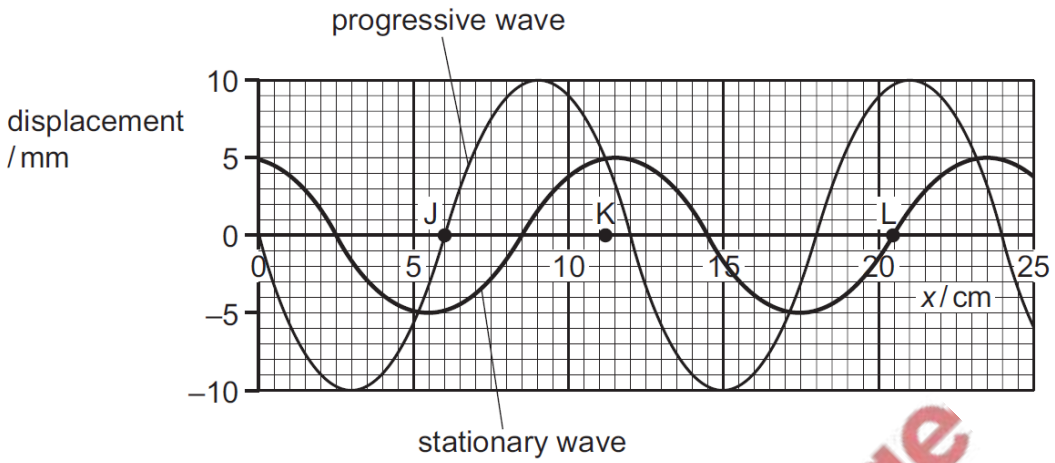
The length of the pipe is 0.600 m. The speed of sound in the air column in the pipe is 340 m s^{-1}.

What is the frequency of the sound wave?

A 425 Hz **B** 850 Hz **C** 1130 Hz **D** 2270 Hz

21. Nov/2021/Paper_13/No.27

Two progressive waves travel in opposite directions and form a stationary wave. The graph shows the variation with distance x of the displacement of the stationary wave and of one of the two progressive waves at the same instant in time.



What are the approximate displacements of the **other** progressive wave at the positions J, K and L?

	displacement / mm		
	J	K	L
A	–5	0	–10
B	–5	+5	0
C	0	+5	+10
D	+5	–5	0

22. Nov/2021/Paper_13/No.29

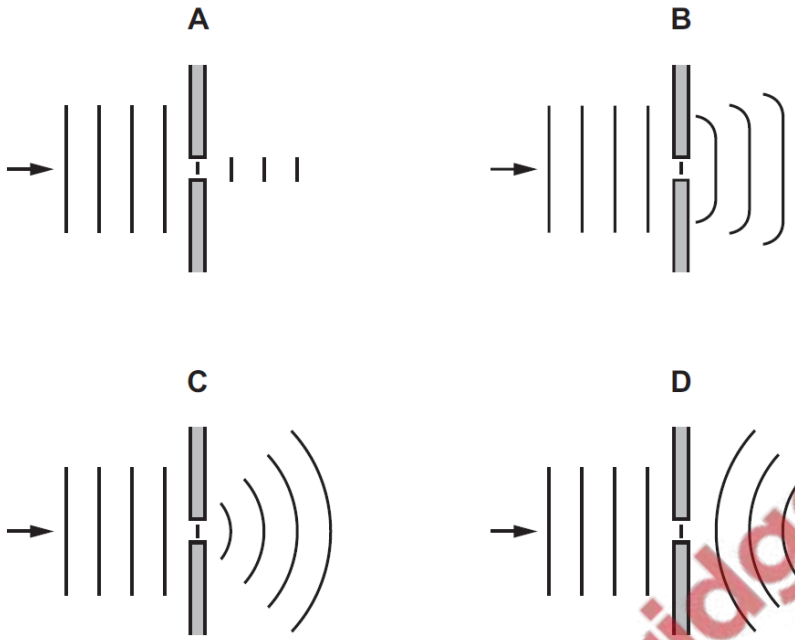
Interference fringes are produced on a screen by double-slit interference using light of wavelength 600 nm. The fringe separation is 4.0 mm and the separation of the slits is 0.60 mm.

What is the distance between the double slit and the screen?

A 0.25 m **B** 0.40 m **C** 2.5 m **D** 4.0 m

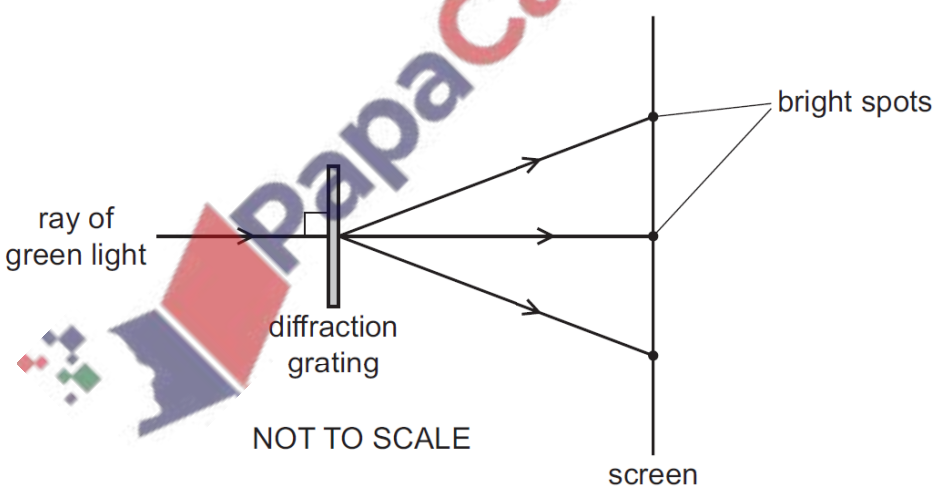
23. Nov/2021/Paper_13/No.28

Which diagram shows the diffraction of water waves in a ripple tank?



24. Nov/2021/Paper_13/No.30

A ray of green light is incident normally on a diffraction grating. Several bright spots are produced on a screen on the other side of the grating, as shown.



Which pair of changes could result in bright spots at exactly the same angles as previously?

A Use blue light and increase the distance between the grating and the screen.

B Use blue light and increase the number of lines per unit length in the grating.

C Use red light and increase the distance between the grating and the screen.

D Use red light and increase the number of lines per unit length in the grating.