8. Superposition

8.2 Diffraction

Paper 1

Question Paper

1 A loudspeaker is playing music in a room. The door to the room is open and has a width of 0.80 m.

Sound waves of many different frequencies pass through the doorway and diffract. The speed of sound in air is $340\,m\,s^{-1}$.

Which frequency of sound wave diffracts the most as it passes through the doorway?

A 2.4×10^{-3} Hz

B 8.0×10^{-1} Hz

C 2.7×10^{2} Hz

D 4.3×10^{2} Hz

2 An electromagnetic wave is diffracted as it passes through a single slit. The width of the slit is larger than the wavelength of the wave.

Which change will decrease the amount of diffraction of the wave?

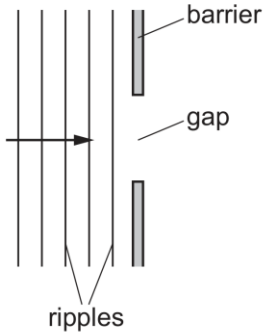
A Decrease the frequency of the wave.

B Decrease the time period of the wave.

C Decrease the width of the slit.

D Increase the wavelength of the wave.

3 A ripple tank and a barrier with a single gap are used to demonstrate the diffraction of surface ripples on water. Initially, the wavelength of the ripples is five times smaller than the gap in the barrier.



Which change increases the amount of diffraction observed?

A double the amplitude of the ripples

B double the width of the gap

C halve the frequency of the ripples

D halve the wavelength of the ripples

4 A continuous progressive water wave in a ripple tank passes through a gap in a barrier and diffracts.

The width of the gap is greater than the wavelength of the wave.

Which change causes the wave to spread over a larger angle as it passes through the gap?

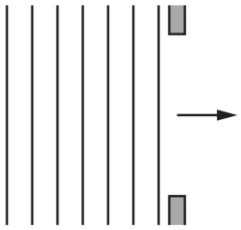
A a small decrease in the wavelength of the wave

B a small decrease in the width of the gap

C a small increase in the frequency of the wave

D a small increase in the height of the barrier

5 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.

6 A teacher is explaining diffraction to a group of students.

Which piece of apparatus is most appropriate for the teacher to use to demonstrate diffraction?

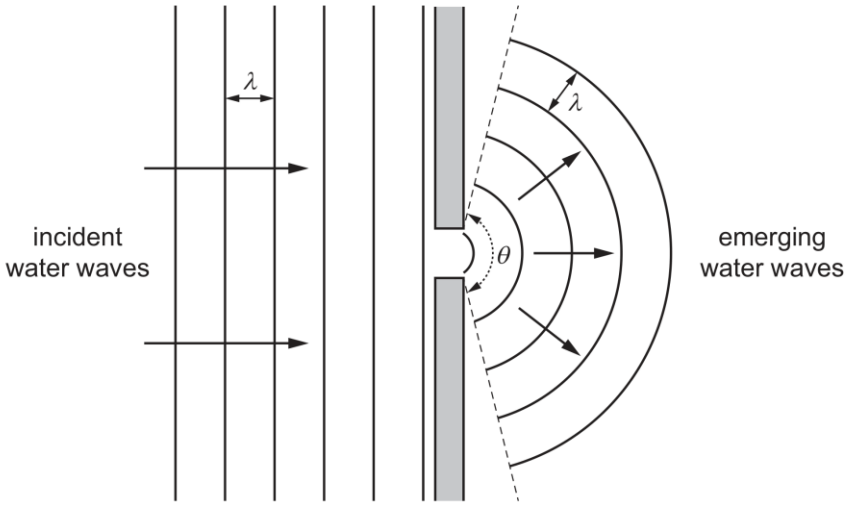
A a long spring

B a ripple tank

C a rope

D a stretched string

7 Water waves of wavelength λ are incident normally on an obstacle with a narrow gap. The width of the gap is equal to λ. The waves from the gap emerge over an angle θ, as shown.

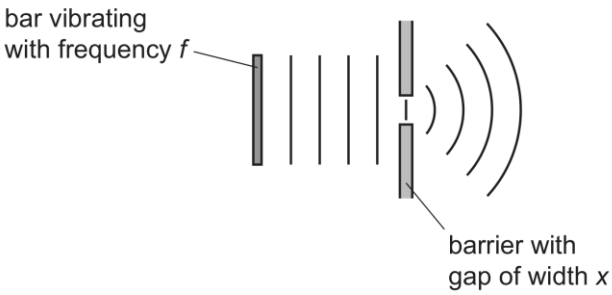


The gap is slowly widened.

Which changes, if any, occur to θ and to the wavelength of the emerging waves?

	θ	wavelength
A	decreases	remains the same
B	increases	remains the same
C	remains the same	decreases
D	remains the same	increases

8 A bar vibrates with frequency f to produce water waves in a ripple tank.

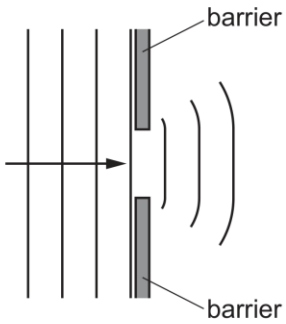


The waves pass through a gap of width x in a barrier so that diffraction occurs.

Which combination of vibration frequency and gap width will produce the smallest angle of diffraction?

	vibration frequency	gap width
A	$\frac{f}{2}$	$\frac{x}{2}$
B	$\frac{f}{2}$	$2x$
C	$2f$	$\frac{x}{2}$
D	$2f$	$2x$

9 A wave on the surface of water passes through a gap between two barriers and is diffracted, as shown.



What happens when the frequency of the wave is halved?

A Less diffraction is observed.

B More diffraction is observed.

C There is no diffraction.

D The same amount of diffraction is observed.

10 In which situation does diffraction occur?

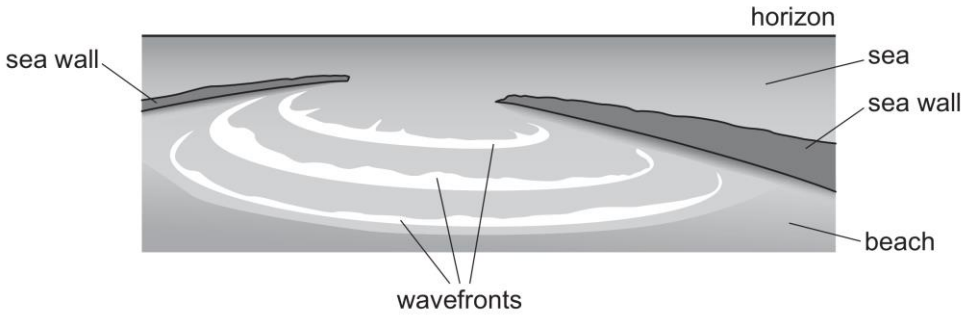
A A wave bounces back from a surface.

B A wave passes from one medium into another.

C A wave passes through a gap in a barrier.

D Waves from two identical sources are superposed.

11 Which wave behaviour is shown in the diagram?



A diffraction

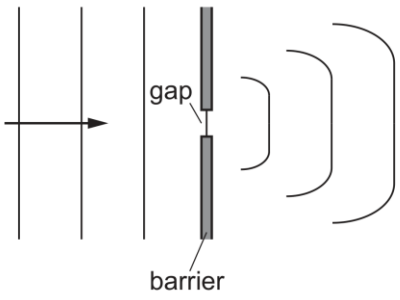
B Doppler shift

C interference

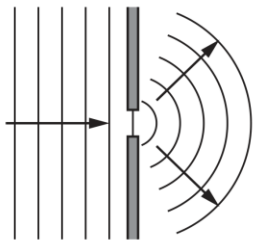
D superposition

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

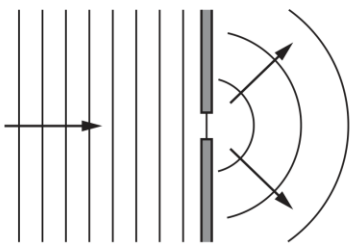
A



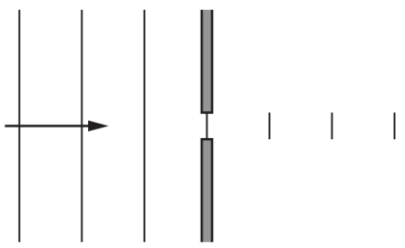
B



C



D



13 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?

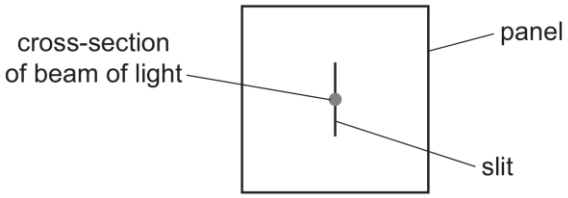
A the amplitude and frequency of the incident wave

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

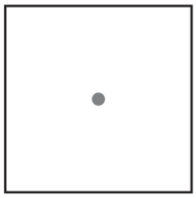
14 A beam of laser light is directed towards a narrow slit.



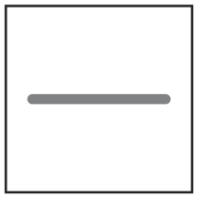
After emerging from the other side of the slit, the diffracted light then falls on a screen.

What is the pattern of light seen on the screen?

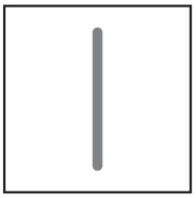
A



B



C



D



15 Which statement **must** be true for diffraction to occur when a wave passes through a gap?

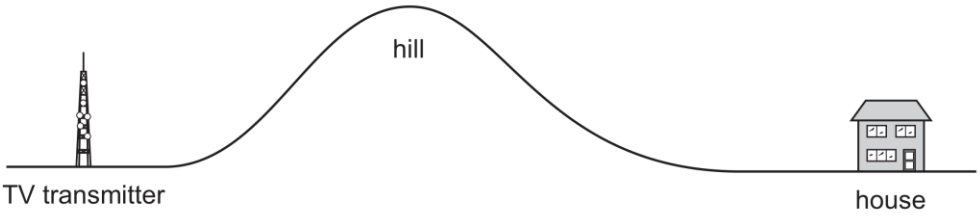
A The wave is able to travel in a vacuum.

B The wave is progressive.

C The wave has a large amplitude.

D The wave has a long wavelength.

16 A hill separates a television (TV) transmitter from a house. The transmitter cannot be seen from the house. However, the house has good TV reception.



By which wave effect at the hill could the TV signal reach the house?

A coherence

B diffraction

C interference

D reflection

17 Which waves would best demonstrate diffraction through a doorway?

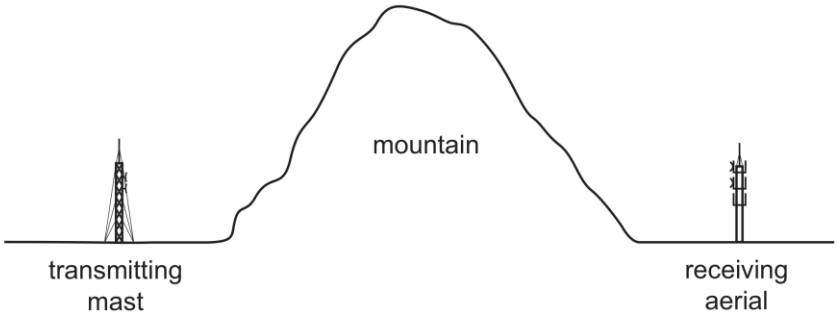
A sound waves

B ultraviolet waves

C visible light waves

D X-rays

18 A transmitting mast sends out microwaves of wavelength 1.5 cm and radio waves of wavelength 1.5 km.



NOT TO SCALE

A receiving aerial behind a mountain can detect the radio waves but not the microwaves.

What is the reason for this?

A The radio waves are coherent but the microwaves are not.

B The radio waves are diffracted around the mountain but the microwaves are not.

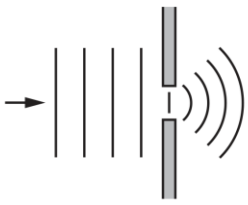
C The radio waves are reflected by the mountain but the microwaves are not.

D The radio waves travel at the speed of light but the microwaves do not.

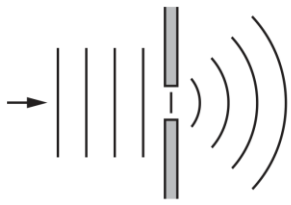
19 The diagrams show the diffraction of water waves in a ripple tank as they pass through a gap between two barriers.

Which diagram is correct?

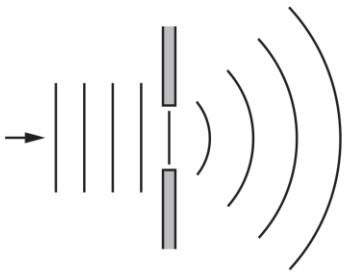
A



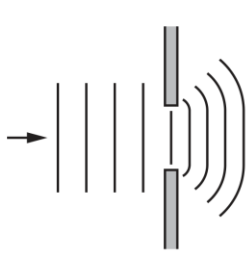
B



C



D



20 What is an example of the diffraction of a wave?

A laser light travelling along an optic fibre

B light waves forming images on a cinema screen

C microwaves passing the edge of a metal plate

D sound waves diverging as they pass through air

21 What happens when waves pass through a gap equal to their wavelength?

A There is diffraction and the wavelength decreases.

B There is diffraction and the wavelength stays the same.

C There is no diffraction and the wavelength decreases.

D There is no diffraction and the wavelength stays the same.