3. Waves

3.1 General properties of waves

Paper 1 and 2

Question Paper

Paper 1

Questions are applicable for both core and extended candidates

1 Waves travel across the surface of water.

What is meant by the amplitude of the wave?

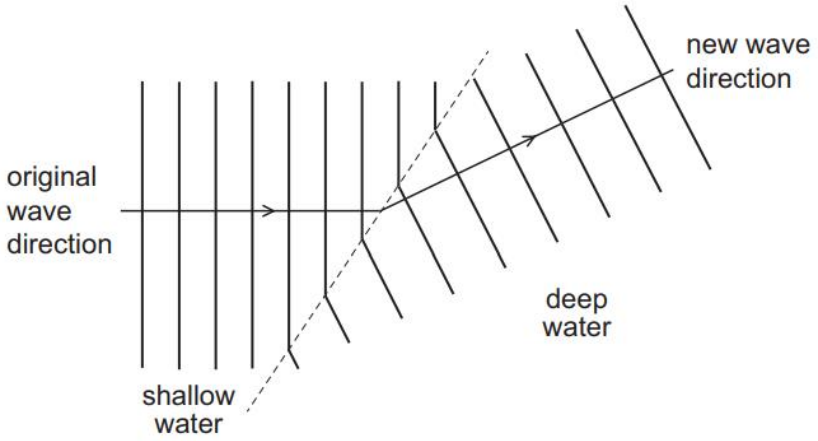
A the maximum distance of a water particle from its mean position

B how far the wave travels every second

C the number of waves passing a point every second

D the distance between the top of consecutive waves

2 Water waves change direction when they move from shallow water to deep water.



What is the name of this effect?

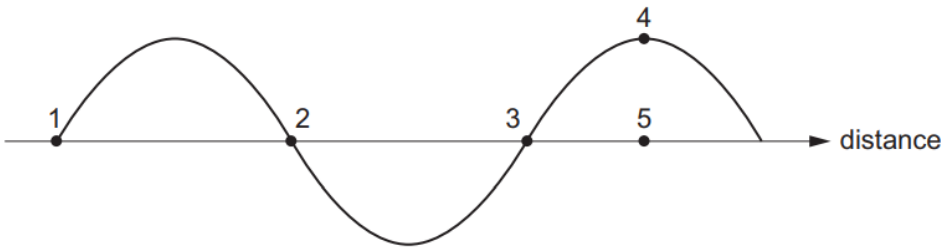
A diffraction

B dispersion

C reflection

D refraction

3 The diagram shows a transverse wave.



Which distance is equal to one wavelength?

A the distance between points 1 and 2

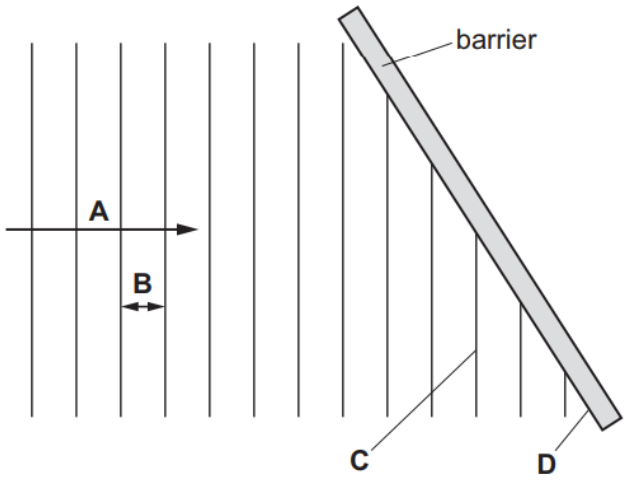
B the distance between points 1 and 3

C the distance between points 2 and 3

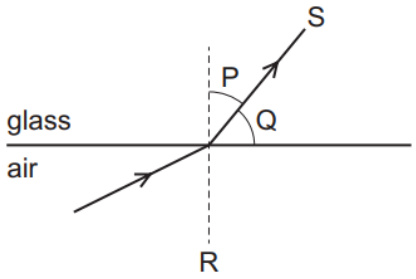
D the distance between points 4 and 5

4 The diagram shows a wave before it reflects from a barrier.

Which labelled section of the diagram represents a wavefront?



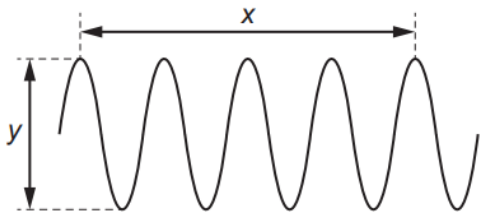
5 The diagram shows a ray of light as it passes from air into glass.



Which row shows the angle of refraction and the normal?

	angle of refraction	normal
A	P	R
B	P	S
C	Q	R
D	Q	S

6 The diagram represents a wave.



Which row gives the wavelength and the amplitude of the wave?

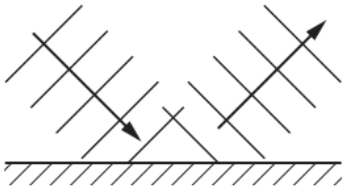
	wavelength	amplitude
A	x	y
B	y	x
C	x	$\frac{y}{2}$
D	$\frac{x}{4}$	$\frac{y}{2}$

7 Which row describes a seismic P-wave?

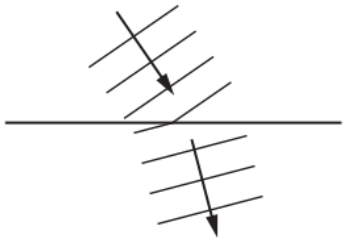
	type of wave	direction of vibration
A	longitudinal	parallel to the direction of propagation of the wave
B	longitudinal	perpendicular to the direction of propagation of the wave
C	transverse	parallel to the direction of propagation of the wave
D	transverse	perpendicular to the direction of propagation of the wave

8 Which diagram shows waves diffracting?

A



B



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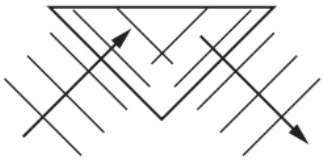

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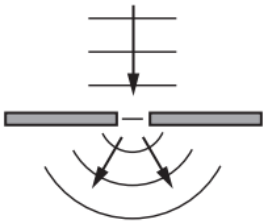


9 The radius of a circular pond is 3.0 m.

Circular waves are made at the centre of the pond.

There are 10 whole waves between the centre and the edge of the pond and it takes 5.0 s for all 10 waves to reach the edge.

What is the wavelength and the frequency of the waves?

	wavelength / m	frequency / Hz
A	0.30	0.50
B	0.30	2.0
C	0.60	0.50
D	0.60	2.0

10 Which statements about waves are correct?

1 Only longitudinal waves can undergo diffraction.

2 All waves can undergo refraction.

3 All waves can undergo reflection.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

11 Which quantities relating to a wave on the surface of water can **both** be measured in metres?

A amplitude and frequency

B amplitude and wavelength

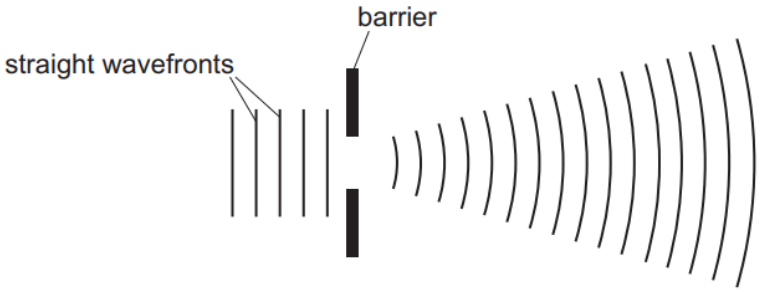
C amplitude and wave speed

D frequency and wavelength

12 Which description and example are correct for a transverse wave?

	description	example
A	The direction of vibration is parallel to the direction of propagation.	sound
B	The direction of vibration is parallel to the direction of propagation.	waves on a rope
C	The direction of vibration is at right angles to the direction of propagation.	sound
D	The direction of vibration is at right angles to the direction of propagation.	waves on a rope

13 Straight wavefronts on the surface of a ripple tank approach a gap in a barrier. The diagram shows how the wavefronts change shape as they pass through the gap.



What is the name of this effect?

A diffraction

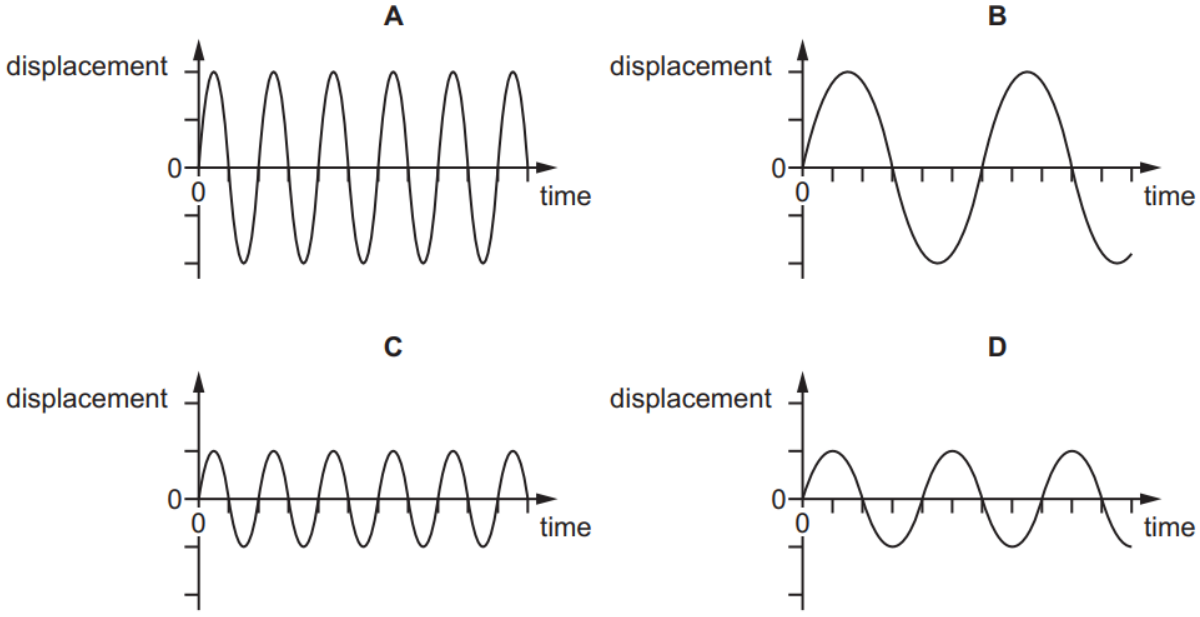
B propagation

C reflection

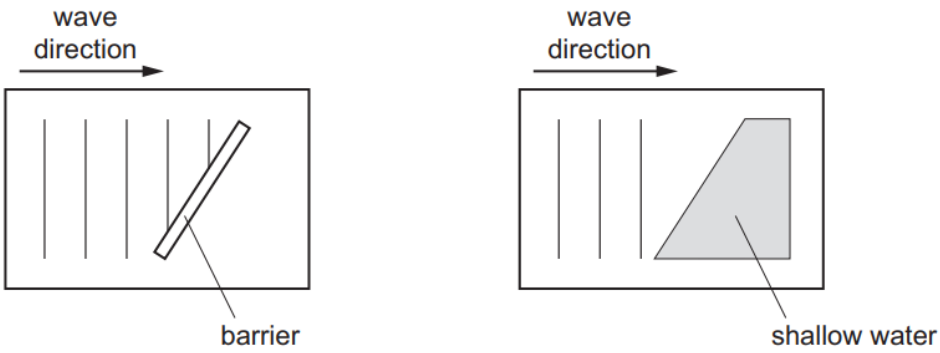
D refraction

14 The diagrams show graphs of displacement against time for four waves. All the graphs are drawn to the same scale.

Which wave has the largest amplitude and the highest frequency?



15 The diagrams show two sets of wavefronts in a ripple tank.



A student makes two statements about the waves.

1 When the waves reflect from the barrier the direction changes but the wavelength remains the same.

2 When the waves refract as they enter the shallow water the direction remains the same, but the wavelength changes.

Which statements are correct?

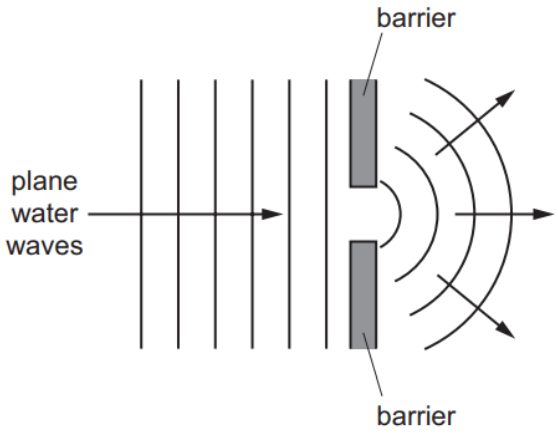
A statement 1 and statement 2

B statement 1 only

C statement 2 only

D neither statement 1 nor statement 2

16 The diagram shows plane water waves in a ripple tank passing through a gap between two barriers and spreading out.



Which name is given to this effect?

A diffraction

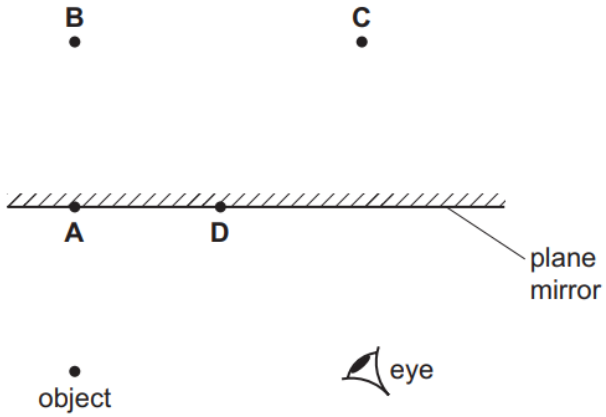
B reflection

C refraction

D total internal reflection

17 The diagram shows an object in front of a plane mirror.

At which labelled position is the image of the object formed?

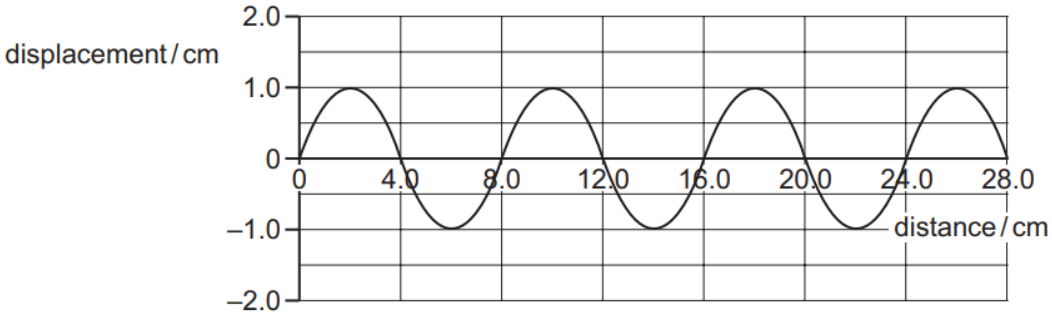


18 The angle between an incident ray and the surface of a plane mirror reflecting the ray is 70°.

What is the angle of incidence?

A 20° **B** 40° **C** 70° **D** 140°

19 The diagram shows a wave.



Which row is correct?

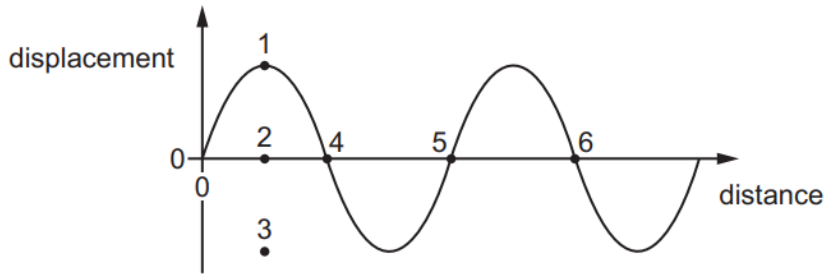
	amplitude of the wave / cm	wavelength of the wave / cm
A	1.0	4.0
B	1.0	8.0
C	2.0	4.0
D	2.0	8.0

20 A girl is sitting on a rock in the sea looking at passing waves. She notices that five complete wavelengths pass her in 20 s.

What is the frequency of this wave?

A 0.25 Hz **B** 4.0 Hz **C** 15 Hz **D** 100 Hz

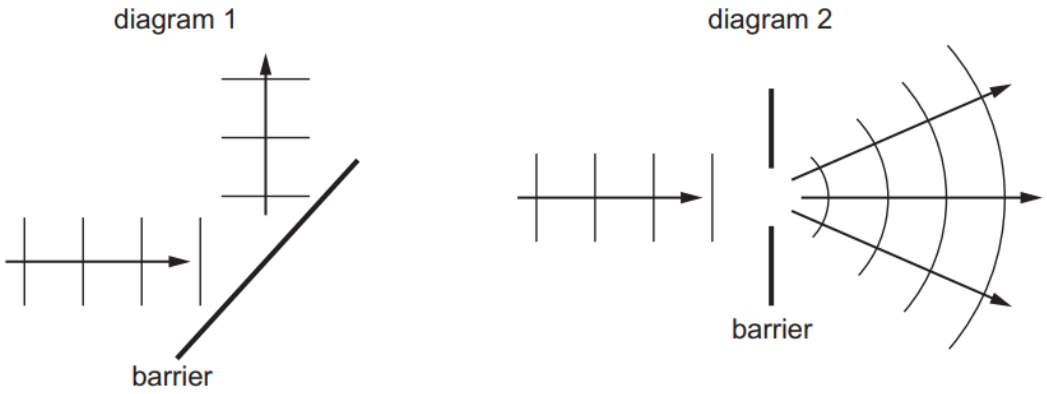
21 The diagram shows a wave.



Which row correctly indicates the amplitude and the wavelength of the wave?

	amplitude	wavelength
A	the distance between 1 and 2	the distance between 4 and 5
B	the distance between 1 and 2	the distance between 4 and 6
C	the distance between 1 and 3	the distance between 4 and 5
D	the distance between 1 and 3	the distance between 4 and 6

22 The diagrams show two patterns produced by water waves.



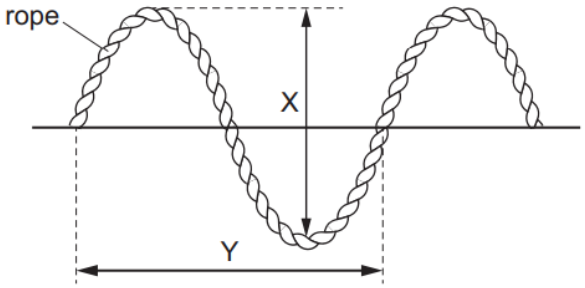
Which two effects are shown in the diagrams?

	diagram 1	diagram 2
A	reflection	diffraction
B	reflection	refraction
C	refraction	diffraction
D	refraction	reflection

23 Which row is **not** correct for a wave on the surface of water?

	quantity	usual unit
A	amplitude	m
B	frequency	Hz
C	wavelength	λ
D	speed	m / s

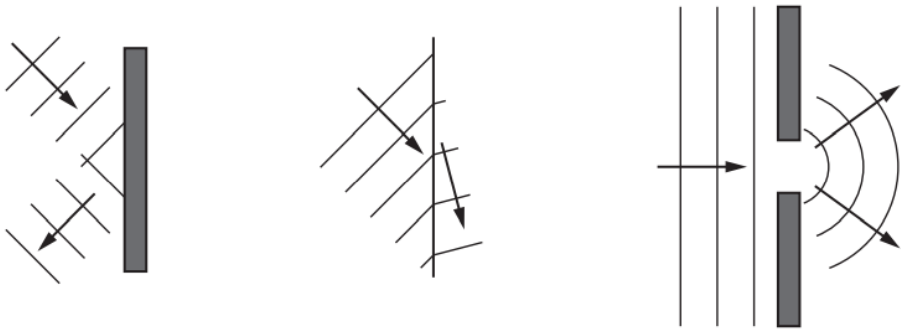
24 The diagram represents a wave on a rope.



Which type of wave is shown and which labelled arrow shows the wavelength of the wave?

	type of wave	wavelength
A	longitudinal	X
B	longitudinal	Y
C	transverse	X
D	transverse	Y

25 The diagrams show water waves in three different situations. The arrows show the direction of travel of the waves.



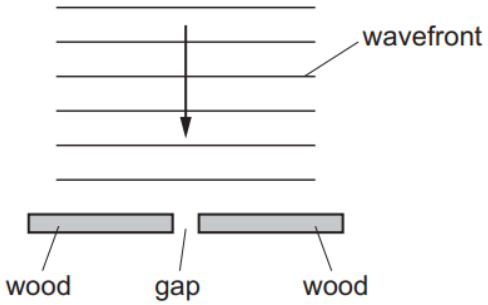
1 2 3

What does each diagram show?

	1	2	3
A	diffraction	reflection	refraction
B	diffraction	refraction	reflection
C	reflection	diffraction	refraction
D	reflection	refraction	diffraction

26 The diagram shows two pieces of wood resting in shallow water of constant depth.

Straight, parallel wavefronts approach the pieces of wood as indicated.



The gap between the pieces of wood is 2.0 cm wide.

The wavefronts are 3.0 cm apart.

What is the appearance of the wavefronts after they pass through the gap?

A semicircular and 2.0 cm apart

B semicircular and 3.0 cm apart

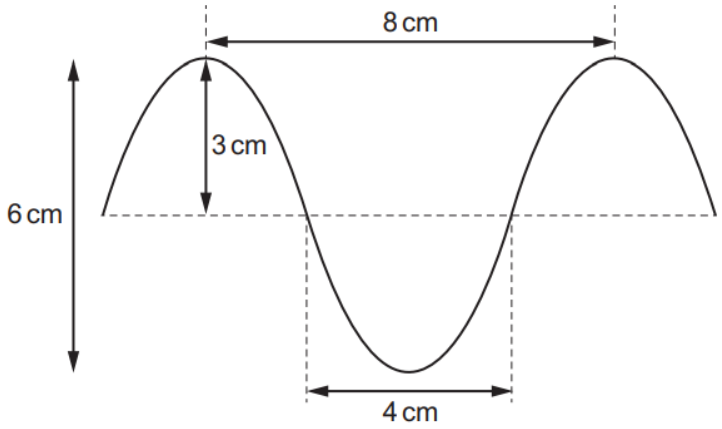
C straight and 2.0 cm apart

D straight and 3.0 cm apart

27 Which row correctly describes light waves?

	wave type	direction of vibrations
A	longitudinal	parallel to direction of wave travel
B	longitudinal	perpendicular to direction of wave travel
C	transverse	parallel to direction of wave travel
D	transverse	perpendicular to direction of wave travel

28 The diagram shows a wave.



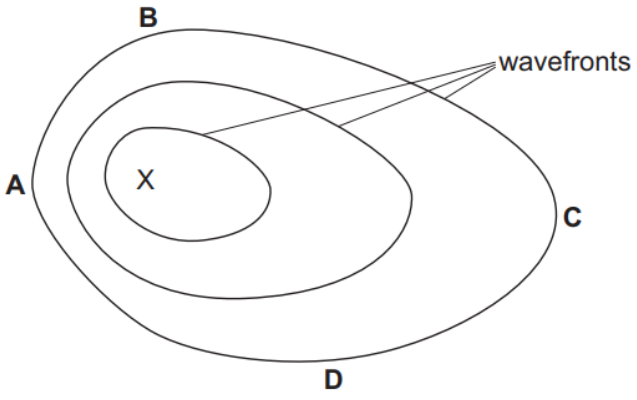
What are the amplitude and the wavelength of this wave?

	amplitude / cm	wavelength / cm
A	3	4
B	3	8
C	6	4
D	6	8

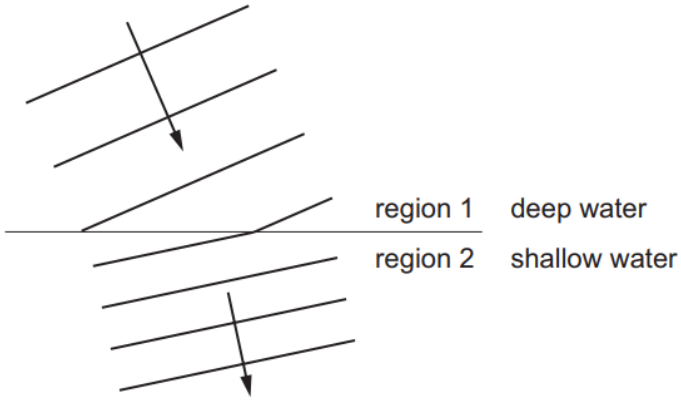
29 Waves travel more quickly on the surface of water when the water is deep.

A stone is dropped at point X into a pool of varying depth. The diagram shows the first three wavefronts on the surface of the pool.

The region between X and which labelled point is likely to be the deepest?



30 The diagram shows wavefronts on the surface of water, viewed from above.

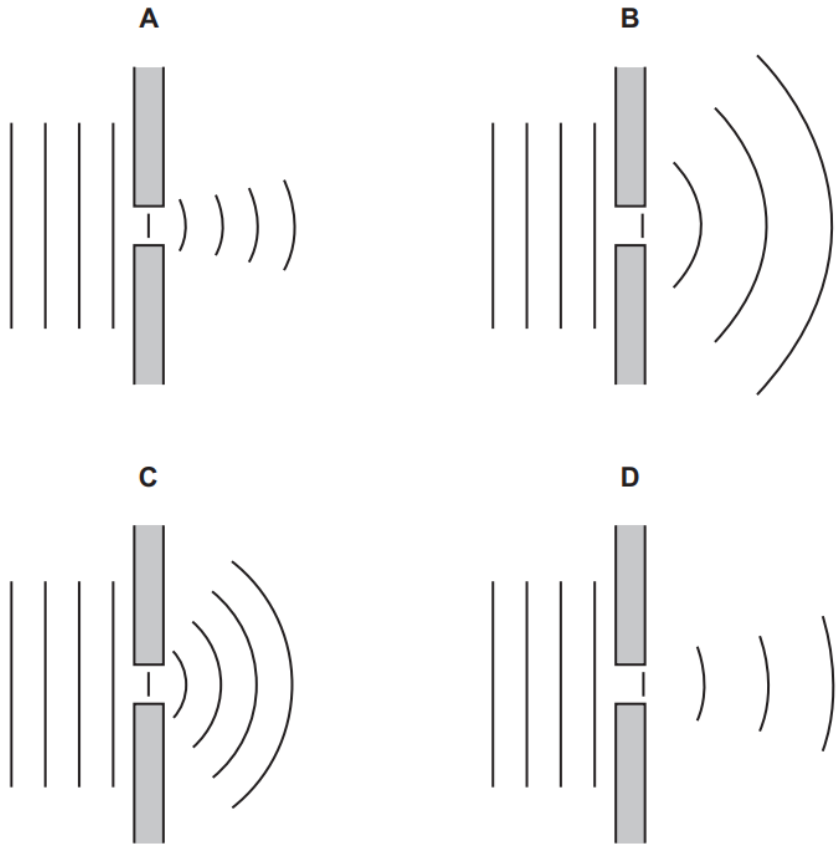


Which row is correct for the wavefronts moving from region 1 to region 2?

	name of process	the speeds of the wavefronts in regions 1 and 2 are
A	diffraction	different
B	diffraction	the same
C	refraction	different
D	refraction	the same

31 Plane water waves approach a narrow gap in a barrier.

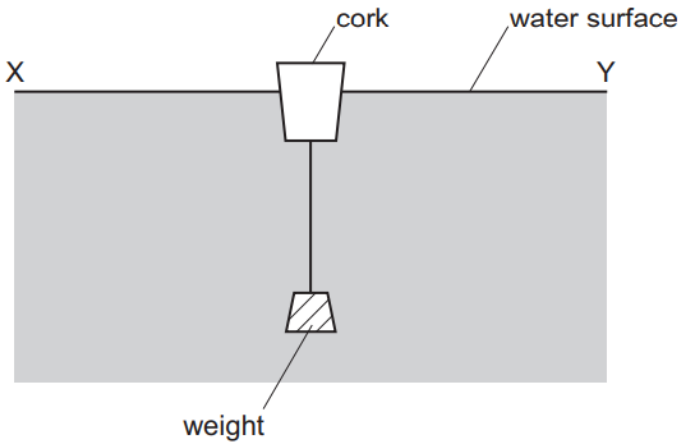
Which diagram shows the diffraction pattern that would occur?



32 Which row correctly describes the vibrations of a transverse wave and also gives a correct example of a transverse wave?

	description of vibration	example of a transverse wave
A	right-angles to the wave direction	sound
B	right-angles to the wave direction	water wave
C	parallel to the wave direction	sound
D	parallel to the wave direction	water wave

33 The diagram shows a cork with a weight attached so that the cork floats upright in water.



Transverse waves travel across the water from X to Y.

In which direction do the waves make the cork move?

A → ← right and left

B ↑↓ up and down

C → only to the right

D ← only to the left

34 A boat moves up and down repeatedly as a water wave passes it.

Which name is given to the number of up-and-down movements of the boat per unit time?

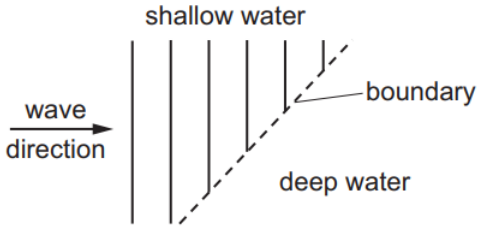
A amplitude

B frequency

C speed

D wavelength

35 Plane water waves travel from a shallow region into a deeper region. They travel more quickly in the deeper water.



Which diagram shows the wave pattern in the deeper water?

36 What is meant by the frequency of a water wave?

A the distance between consecutive crests of the wave

B the distance moved by the wave per unit time

C the maximum vertical displacement of the wave

D the number of crests passing a point per unit time

37 A tank contains water. Ripples are produced on the surface of the water.

What causes the ripples to refract?

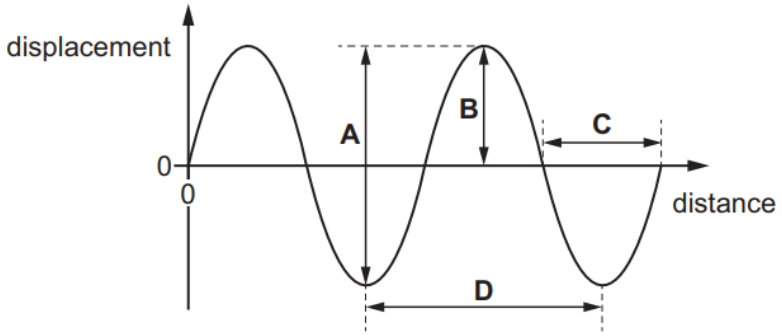
A The cold water in the tank is replaced by warm water.

B The ripples change speed as they move from deep to shallow water.

C The ripples hit the wall of the tank.

D The ripples pass through a narrow gap.

38 Which arrow on the graph shows the amplitude of the wave?



39 In which situation is the wavelength of the wave changed?

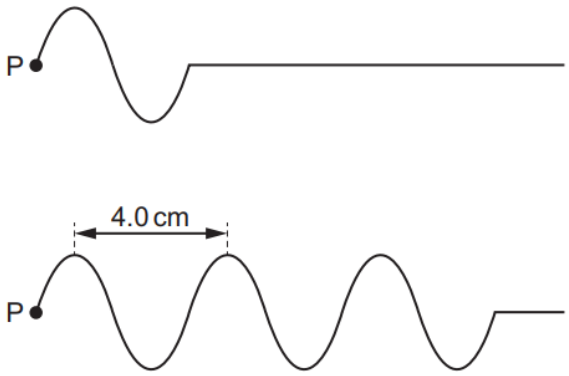
A light from the Sun passing from air into water

B radio waves travelling from an Earth satellite to the Moon

C sound reflecting from a wall

D water waves passing through a narrow gap

40 The diagrams show a wave on the surface of the water in a tank at times 1.0 s apart. The wave is produced at P and travels to the right.



Which row gives the frequency and the speed of this water wave?

	frequency / Hz	speed cm / s
A	2.0	4.0
B	2.0	8.0
C	4.0	4.0
D	4.0	8.0

Paper 2

Questions are applicable for both core and extended candidates unless indicated in the question

41 Water waves are reflected at a plane surface.

Which property of the waves is changed by the reflection?

A direction of propagation

B frequency

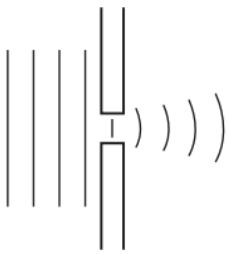
C speed

D wavelength

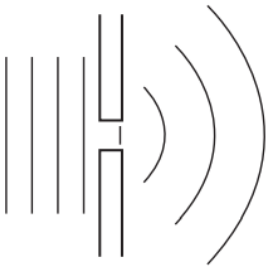
42 Plane water waves approach a narrow gap in a barrier.

Which diagram shows the diffraction pattern that would occur? **(extended only)**

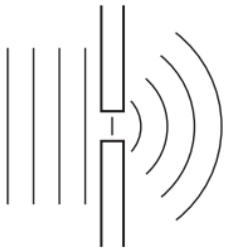
A



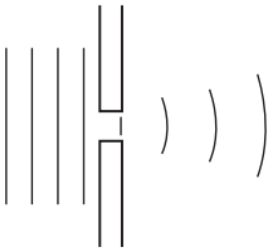
B



C



D



43 What is the number of wavefronts per second that pass a fixed point?

A the amplitude of the wave

B the frequency of the wave

C the speed of the wave

D the wavelength of the wave

44 An earthquake under the ocean can produce a dangerous water wave called a tsunami.

The table gives typical data for a tsunami.

ocean depth / m	velocity / km / h	wavelength / km
7000	948	285
2000	504	151

A student suggests three conclusions about the data.

1 The deeper the ocean, the faster the wave.

2 The longer the wavelength, the faster the wave.

3 The faster the wave, the higher the frequency.

Which conclusions are correct?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

45 Which statement about waves is correct?

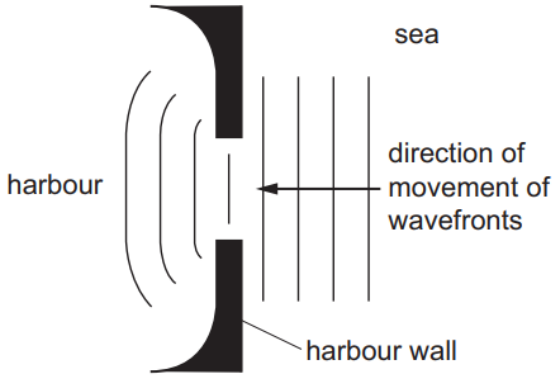
A Waves do not transfer either energy or matter.

B Waves transfer both energy and matter.

C Waves transfer energy without transferring matter.

D Waves transfer matter without transferring energy.

46 The diagram shows what happens to wavefronts at sea when they enter a harbour.



What causes the change in the shape of the wavefronts?

A diffraction

B dispersion

C reflection

D refraction

47 A student writes down some facts about two transverse waves.

Wave 1 has a frequency f and a velocity v.

Wave 2 has four times the frequency of wave 1 and is travelling at a velocity of $2v$.

What is the wavelength of wave 2 in terms of f and v?

A $\frac{2f}{v}$ **B** $8fv$ **C** $\frac{2v}{f}$ **D** $\frac{v}{2f}$

48 A wave source produces 3000 crests every minute. The wave has a speed of 300 m/s.

What is the wavelength of the wave?

A 0.10 m **B** 0.17 m **C** 6.0 m **D** 10.0 m

49 In which type of wave is the direction of vibration parallel to the direction of travel?

A electromagnetic waves

B seismic P-waves

C seismic S-waves

D water waves

50 Waves in a ripple tank are diffracted as they pass through a narrow gap. **(extended only)**

What can be done to make the spreading due to diffraction greater?

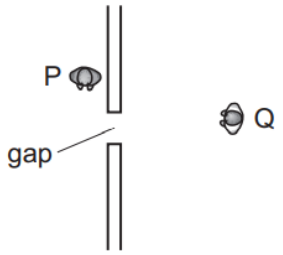
A Decrease the frequency of the waves and keep the speed constant.

B Decrease the speed of the waves and keep the frequency constant.

C Increase the frequency of the waves and keep the speed constant.

D Increase the frequency of the waves and decrease the speed.

51 Two men, P and Q, stand close to a gap in a wall, as shown. Man P cannot see man Q but man P can hear man Q speaking.



Which statement explains this?

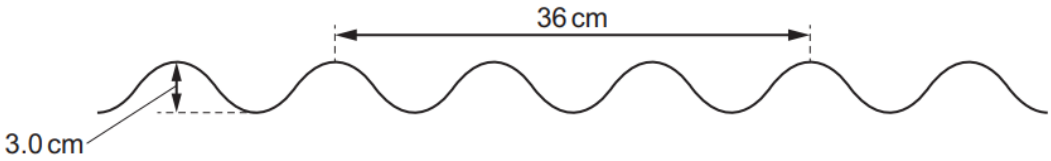
A Light waves do not diffract at all because they are electromagnetic waves.

B Light waves have a range of frequencies but sound has just one frequency.

C Sound waves are of a higher frequency than light waves.

D Sound waves diffract a lot because their wavelength is a similar size to the width of the gap.

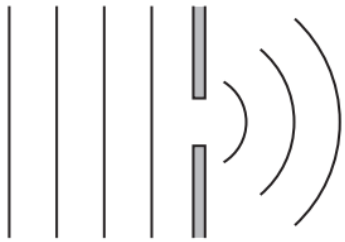
52 The water wave shown has a frequency of 4.0 Hz.



What is the speed of the wave?

A 3.0 cm/s **B** 12 cm/s **C** 48 cm/s **D** 72 cm/s

53 The diagram shows waves in a ripple tank containing water. **(extended only)**



The waves approach a barrier and pass through the gap in the barrier.

The size of the gap is about the same size as the wavelength of the ripples.

The gap size is increased.

What happens to the ripple pattern to the right of the barrier?

A The ripples are closer together.

B The ripples are further apart.

C The ripples are more curved.

D The ripples are less curved.

54 A radio transmitter broadcasts at a frequency of 200 kHz.

What is the wavelength of these radio waves?

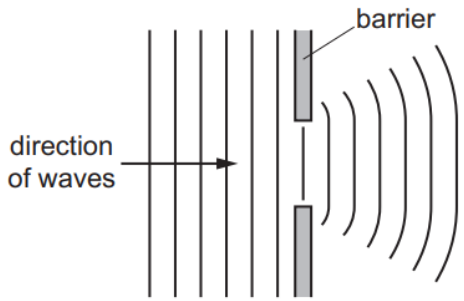
A 6.7×10^{-4} m **B** 1.5 m **C** 1.5×10^{3} m **D** 1.5×10^{6} m

55 A water wave passes into a region where the wave travels more slowly.

As it passes into the slow region, what happens to the frequency and what happens to the wavelength of the wave?

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

56 The diagram shows part of a diffracted wave pattern. **(extended only)**



Changes are made to the wavelength and to the gap size to produce a semicircular diffracted wave pattern.

Which row produces the required semicircular diffracted wave pattern?

	gap in barrier	wavelength
A	larger	same
B	larger	smaller
C	same	larger
D	same	smaller

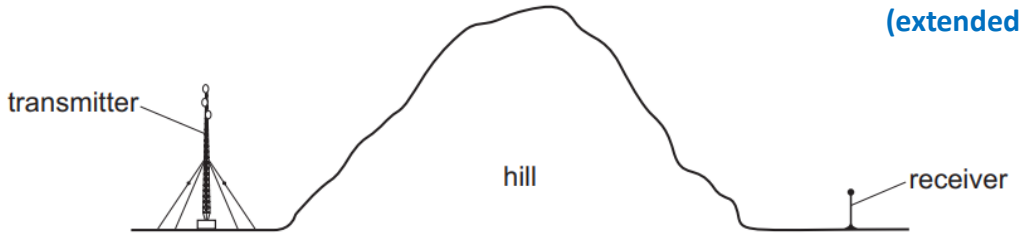
57 A wave of frequency 6600 Hz travels 1320 m in 4.0 s.

What is the wavelength?

A 0.050 m **B** 0.80 m **C** 1.3 m **D** 20 m

58 A large hill blocks the direct path between a transmitter of radio waves and a receiver, as shown.

(extended only)



The receiver picks up the signal from the transmitter even though the radio waves do not travel through the hill.

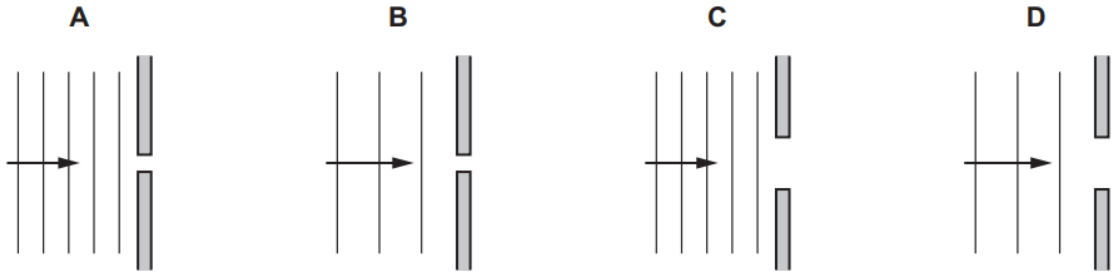
Which row is correct?

	A possible way for this to happen is	A stronger signal is received using
A	diffraction round the hill.	longer wavelengths.
B	diffraction round the hill.	shorter wavelengths.
C	refraction round the hill.	longer wavelengths.
D	refraction round the hill.	shorter wavelengths.

59 When water waves pass through a gap they diffract. **(extended only)**

The diagrams show wavefronts approaching a narrow gap.

In which diagram will the diffraction be least?



60 The frequency of the microwaves used in a microwave oven is 2400 MHz.

What is the wavelength of these microwaves?

A 0.125 m **B** 8.00 m **C** 125 m **D** 7200 m