General wave Properties Describing wave motion

Wave terms

Wave behaviour

Describe what is meant by wave motion as illustrated by vibrations in ropes and springs and by experiments using a ripple tank.

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DESCRIBING WAVE MOTION

Describing Wave Motion

- A wave is a phenomenon in which energy is transferred through vibrations.
- A wave carried energy away from the wave source.

Hand





General Wave Properties

State what is meant by the term wavefront

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WAVE TERMS

Wave Terms

• Wave front is the line that joints all the peaks of a wave or all identical points on a wave.





Define the terms speed, requency, wavelength and amplitude and do calculations using velocity = frequency × wavelength

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WAVE TERMS

- The highest points of the wave are called crests or peaks while the lowest points are called troughs.
- The amplitude, *a*, is the maximum displacement from the rest point.
- The wavelength, λ , is the distance between two successive crests or two successive troughs. It also equal to the distance between any two identical points on a successive wave.



- The period, *T*, is the time taken to generate one complete wave. It is also the time taken for the crests, or any given point on the wave, to move a distance of one wavelength.
- The frequency, *f*, is the number of crests or (troughs) that pass a point per second. It is equivalent to the number of complete waves generated per second. The unit of the frequency is hertz (Hz).





$\boldsymbol{v} = \frac{\lambda}{\boldsymbol{\nabla}} \quad \boldsymbol{\nabla} \quad \boldsymbol{v} = \boldsymbol{f} \boldsymbol{\lambda}$



Displacement-Position Graph





Example

- 1. A vibrating system produces waves at a frequency of 25 Hz. If the wavelength of the waves is 1.0 cm, what is the wave speed?
- 2. Ahmad dropped a rock into a pool produces waves with a speed of 0.8 m/s and wavelength of 0.20 m. Calculate the frequency of the waves?
- 3. A tuning fork produces sound waves with a frequency of 170 Hz. If the speed of sound in air is 350 m/s, find the wavelength of the sound waves.

- 4. If 10 waves pass a point each second and their wavelength is 30 m, what is their speed?
- 5. Two waves pass a flag every second. If the wavelength of the wave is 2 m, calculate
 - a) its frequency,
 - b) its period,
 - c) the speed of the waves.

- 6. The length of a railway carriage is 28 m. A passenger at a station counts ten carriages passing him in 14 seconds. How fast is the train.
- 7. Wave pass an anchored yacht at a rate of five crests every 20 seconds. The crests are separated by a distance of 7 m. Calculate
 - a) the frequency of the waves.
 - b) the speed of the waves.

- 8. Ripple crests in a ripple tank are 4.0 cm apart and two complete waves leave the source every second. What is their speed?
- 9. Atlantic 252 broadcasts radio waves of wavelength 252 m. To what frequency must a receiver be tuned to receive this station. [Speed of light in vacuum = 3.0×10^8 m/s]

- 10. A wave frequency 2 Hz and wavelength 1.6 m travels along a stretch string. What is the wave velocity?
- 11. A radar wave is an electromagnetic wave whose speed is 3.00×10^8 m/s. If its frequency is 1.64 GHz, find its wavelength.
- 12. A pianist plays the note middle C, whose frequency is 264 Hz. What is the wavelength of the sound waves produced? (Speed of sound in air = 330 m/s)







- 2. What is meant by the term wavefront?
 - A. the distance between successive peaks of a wave
 - B. the distance between the trough and the peak of a wave
 - C. a line joining points along the peak of a wave
 - D. a line joining the trough and the peak of a wave

3. The diagram shows a section through a series of waves on water.

Which dotted line shows the position of the still water surface after the waves have passed?



 A vertical stick is dipped up and down in water at P. In two seconds, three wave crests are produced on the surface of the water.

wave crests

Which statement is true?

- A. Distance X is the amplitude of the waves.
- B. Distance Y is the wavelength of the waves.
- C. Each circle represents a wavefront.
- D. The frequency of the waves is 3 Hz.

- 5. Which is the best description of the speed of a water wave?
 - A. the distance between one wave crest and the next
 - B. the distance between the crest of a wave and a trough
 - C. the distance that a particle of water moves up and down in one second
 - D. the distance that a wavefront moves along the surface in one second

6. A woman tunes her radio to a station broadcasting on 200 m.

What does the 200 m tell her about the radio wave?

- A. its amplitude
- B. its frequency
- C. its speed
- D. its wavelength



7.



- The diagram shows waves travelling on the sea.
 Which points are one wavelength apart?
 - A. P and R
 - B. Q and S
 - C. Q and T
 - D. S and T



10. The diagram shows the cross-section of a water wave. Which distance is the amplitude of the wave?

С



Which quantities are shown by distances P and Q?

		7,
		S
	Р	Q
Α	amplitude	period
в	amplitude	wavelength
С	half the amplitude	period
D	half the amplitude	wavelength

A

12. The diagram shows the variation of the displacement of a wave with distance from the source.



What is the amplitude of the wave?

- A. 2.0 cm
- B. 4.0 cm
- C. 20 cm
- D. 40 cm
13. The diagram shows how displacement varies with time as a wave passes a fixed point.



What is the frequency of this wave?

- 0.25 Hz Α.
- 0.50 Hz Β.
- 1.0 Hz С.
- 2.0 Hz D.

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14. A surf-board moves at a speed of 5 m/s on the crest of a wave. The distance between wave crests is 10 m.

What is the frequency of the wave motion?

· DMM.

- A. 0.5 Hz
- B. 2 Hz
- C. 5 Hz
- D. 10 Hz

15. The dipper in a ripple tank vibrates at a frequency of 4.0 Hz and the resulting wave pattern is photographed.

The distance between the two crests shown is 20 cm.

What is the speed of the wave?

- A. 4 cm / s
- B. 5 cm / s
- C. 16 cm / s
- D. 20 cm / s



16. The diagram shows part of a spring that is shaken from side to side to produce a wave.





The distance between successive peaks is 0.60 m and the frequency is 2.5 Hz.

How long does it take for a wave to travel 3.0 m along the spring?

- A. 0.20 s
- B. 0.50 s
- C. 2.0 s
- D. 5.0 s



cross-section of wave

crests seen from above

Which letters represent a wavelength and a wavefront?

	wavelength	wavefront
Α	Р	R
в	Р	s
С	Q	R
D	Q	S

A

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Describe transverse and ongitudinal wave in such a way as to illustrate the differences between them.

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WAVE BEHAVIOUR

General Wave Properties

Transverse Waves

• **Transverse waves** are waves which travel in a direction perpendicular to the direction of the vibrations.

wave moves this way

Longitudinal Waves

• Longitudinal waves are waves which travel in a direction parallel to the direction of vibrations.

wavelength

wave moves this way

Coils vibrate along the wave direction



Examples

Transverse Waves

Longitudinal Waves

ElectromagneticwavesSound waveswhich include gamma rays,X-rays, ultraviolet, radiation,light, infrared-red radiation,microwaves and radio waves

Water waves

Describe the use of ripple tank to show

- 1. Reflection at a plane surface
- 2. Refraction due to change of speed at constant frequency

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WAVE BEHAVIOUR

Water Waves



Reflection of Water Wave



Refraction of Water Wave



Describe simple experiments to show the reflection and refraction of a sound waves

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WAVE BEHAVIOUR

Reflection of Sound Wave

- When sound waves meet the boundary between one medium and another, just like water waves, some energy is transmitted into the other medium, and some is reflected.
- The proportion of energy carried by the reflected sound wave is large if the surface is hard and smooth like stones and less if the surface is soft and irregular.
- Sound reflects from a smooth surface the same way that light does—the angle of incidence is equal to the angle of reflection.



General Wave Properties

- Refraction the change in direction of a wave as it crosses the boundary between two media
- Sound waves are refracted when parts of a wave front travel at different speeds
- This happens in uneven winds or temperatures
- Sound waves tend to bend away from warm ground, since it travels faster in warmer air
- On a cold night, the speed of sound is slower near the ground than above, so we can hear over larger distances



1. The diagram shows a cork with a weight attached so that the cork floats upright.



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Transverse waves travel across the water from X to Y. Which way do the waves make the cork move?

- A. $\rightarrow \leftarrow$ right and left
- B. $\uparrow \downarrow$ up and down
- C. \rightarrow only to the right
- D. \leftarrow only to the left

2. Sound waves travel from a point X to another point Y.

X Which diagram represents the movement of the air molecules, caused by the sound waves, in the region between X and Y. A B C D ↓ X Y B

Ceneral Wave Properties The diagram shows a wave on a string with two points P and

wave direction

- What will happen next?
- P will move to the right. Α.

marked. The wave is moving in the direction shown.

Q

P will move up. Β.

3.

- Q will not move. С.
- Q will move up. D.

General Wave Properties

	transverse wave	longitudinal wave
Α	light	water ripples
В	radio	sound
С	sound	light
D	water ripples	radio

Which of the following is an example of a transverse and a

longitudinal wave?

B

4.

5. Which line in the table correctly shows examples of transverse and longitudinal waves?

	transverse	longitudinal
A	gamma-rays	sound
в	infra-red	water waves
С	radio	light
D	sound	X-rays

A

6. Which diagram shows an example of a longitudinal wave?



D a water ripple caused by a dipper moving up and down



Β

General Wave Properties



С

7.

Which of these waves is longitudinal? 8. NSSIAN

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- light waves Α.
- sound waves Β.
- C. water waves
- X-ray waves D.

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How should the wave motions in X and Y be described?

	spring X	spring Y	
Α	longitudinal	longitudinal	
в	longitudinal	transverse	
С	transverse	longitudinal	
D	transverse	transverse	

10.	Which line gives an example of a longitudinal wave and describes its vibrations?				
			example of a longitudinal wave	vibrations	
		Α	light wave	at right angles to the direction the wave travels	
		в	light wave	in the same direction as the wave travels	
		С	sound wave	at right angles to the direction the wave travels	
		D	sound wave	in the same direction as the wave travels	

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D

11. The diagrams show examples of wave motion.



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Which are longitudinal waves?

- A. 1 only
- B. 1, 2 and 4
- C. 2 and 3 only
- D. 2 and 4 only

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12. Water waves are reflected at a plane surface. Which property of the waves is changed by the reflection?

PWW.

- A. direction
- B. frequency
- C. speed
- D. wavelength



What is the name of this effect?

- A. diffraction
- B. dispersion
- C. reflection
- D. refraction

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What causes this refraction?

- A. a change in frequency due to a change in depth
- B. a change in frequency due to a change in wavelength
- C. a change in speed due to a change in depth
- D. a change in speed due to a change in frequency



- 15. What causes refraction when light travels from air into glass?
 - A. The amplitude of the light waves changes.
 - B. The colour of the light changes.
 - C. The frequency of the light waves changes.
 - D. The speed of the light changes.

16. The diagram shows a wave moving into shallower water.



The wavelength of the waves is reduced because

- A. both the frequency and the speed decrease.
- B. both the frequency and the speed increase.
- C. only the frequency increases.
- D. only the speed decreases.

- 17. Water waves travel more slowly in shallow water than in deep water.
 - Which diagram shows what will happen to plane waves in deep water when they enter shallow water?



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









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Which quantity increases as the waves enter the deep water?

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- A. amplitude
- B. frequency
- C. wave energy
- D. wavelength

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20. The diagram represents water waves about to move into shallow water from deep water.

deep water

wavefront

shallow water

Which property of the waves remains the same after the waves move into shallow water?

- A. frequency
- B. speed
- C. wavefront direction
- D. wavelength

21. In an experiment using a ripple tank, plane wavefronts arrive at a plane surface.

λ plane surface Which of the following correctly describes the waves after

	speed of waves	wavelength λ	
Α	faster	shorter	
в	slower	longer	
С	slower	shorter	
D	the same	the same	

they are reflected from the surface?

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General Wave Properties

22. Waves move from deep water to shallow water where they are slower.

Which diagram shows what happens to the waves?



23. The diagram shows the refraction of water waves in a ripple tank. The water is shallower above the glass sheet.



When crossing into the shallower region, what is the effect on the frequency and on the speed of the waves?

	wave frequency	wave speed	
Α	changes	changes	
в	changes	unchanged	
С	unchanged	changes	
D	unchanged	unchanged	

С

Α





25. The diagrams show water waves that move more slowly after passing into shallow water at the broken line. Which diagram shows what happens to the waves?

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26. The diagram shows a water wave in a ripple tank.



The wave has a speed of 12 cm/s at R.

The wave crosses a boundary PQ where the distance between crests changes from 3.0 cm to 1.5 cm.

What is the velocity of the wave at point S?

- A. 3.0 cm/s
- B. 6.0 cm/s
- C. 12 cm/s
- D. 24 cm/s

27. Waves pass from deep water to shallow water and refraction occurs.

What is the speed of the waves in the shallow water?

- A. 0.2 m/s
- B. 0.8 m/s
- C. 2.0 m/s
- D. 5.0 m/s



0.4 m

28. A ripple tank is used to demonstrate refraction of plane water waves. deep water shallow water 9.6 cm/s 1.2 cm 0.8cm boundary

Waves in deep water have a wavelength of 1.2 cm and a speed of 9.6 cm/s. The wavelength of the waves in shallow water is 0.8 cm.

What is the speed of the waves in the shallow water?

- A. 6.4 cm/s
- B. 8.0 cm/s
- C. 9.6 cm/s
- D. 14.4 cm/s