CHAPTER 2 NOTES OF PHYSICS WAVES MOTION

Answer the following questions

I) Circle the correct answer

1) Which of the following is not transferred by waves?

a) Matter

b) information

c) energy

d) All of them.

2) Which of the following waves are longitudinal?

a) Light

b) sound

c) seismic S-waves

d) None of them.

3) The number of complete waves passing a point on the rope each second the

a) period

b) frequency

c) amplitude

d) wavelength

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4) When the oscillations are at right angles to the direction of the energy transferred, the wave is:
a) longitudinal wave
b) sound wave
c) Transverse wave
d) standing wave

5) When two particles are moving exactly in the same way they are called
a) All of them
b) out phase
c) opposite phase
d) Same phase

6) When diffraction occurs, there is a change in
a) direction
b) velocity
c) Frequency
d) wavelength

7) The distance covered by the disturbance in one second is
a) Wavelength
b) Wave Velocity
c) Amplitude
d) Period

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8) Which of the below has the greatest wavelength
a) infrared
b) X-ray
c) visible light
d) microwave

9) A train emits sound of wavelength 0.6 m and frequency 550Hz. Then the velocity is
a) 916.6 m/s
b) 917 m/s
c) 300 m/s
d) 330 m/s.

10) The figure below shows a transverse wave on a rope. The wavelength of the wave on the is
a) 6 m
b) 3 m
c) 1.5 m
d) 2 m

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CHAPTER 2	NOTES OF PHYSICS WAVES MOTION

Fill in the blank space

#	Answer
1	Radio Waves
2	Harm (Havoc)
3	Out of Phase
4	Depth
5	Super positioned
6	Transmitter, Receiver
7	Picture ; sound
8	Oscillation, Oscillations
9	Constructive Waves
10	Direction

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CHAPTER 2	NOTES OF PHYSICS WAVES MOTION

SUBJECTIVE QUESTIONS

Question # 1

What is wave velocity?

Velocity is the distance covered by the disturbance in one second and its unit is meters per second.

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Question # 2

State two uses of microwaves.

1. Microwaves sent through the atmosphere will be absorb by water so they can used to monitor rain. The weaker the signal reaching the detector, the more rain the microwaves have passed through.
2. Microwave are also used in radar which used by ships, aircraft and weather forecasters.
   One of the types of radar works by sending out bursts of microwaves and detect "echoes" coming back from objects that the microwaves have it and so can find the distance of the objects by detecting the time it takes for the "echo" to be receive.

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Question # 3

Describe similarities and differences between gamma rays and X-rays.

Answer:

Similarities

1. Both are transverse waves.
2. Both obeys the laws of reflection and refraction.
3. Both are travelling with speed of $3 \times 10^8 \frac{m}{s}$
4. Both **x-rays** and **gamma rays** are forms **of** high-frequency ionizing **radiation**, which means they have enough energy **to** remove an electron from (ionize) an atom or molecule.

Differences:

1. Gamma rays cause more harm to human body than the X- rays.
2. Gamma rays have shorter wavelengths than the X-rays.
3. X rays are emitted by the electrons outside the nucleus, and gamma rays are emitted by the excited nucleus itself.
4. X rays are used in hospitals for taking X-rays but gamma rays are not.

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Question # 4

What is refraction and under what circumstances does it occur?

Answer:

Refraction is an effect that occurs when a light wave, incident at an angle away from the normal, passes a boundary from one medium into another in which there is change in velocity of light.

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Question # 5

What happens to the wavelength and frequency of a wave as it crosses into a different medium and speeds up?

Answer:

When sound waves travels from one medium to another, both its velocity and wavelength undergo changes. The velocity of sound is given by the equation $v = f\lambda$. Where f is the frequency of sound wave and λ is wavelength in that medium. Velocity of sound is directly proportional to the wavelength. Thus, if velocity of sound increases, when it travel from one medium to another, its wavelength also increase. The frequency of sound depends upon the source of sound, not the medium of propagation.

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Question # 6

State the equation linking wave speed wavelength and frequency?

Answer:

The speed with which waves pass a particular point is the product of the frequency and wavelength of the wave.

$$\boldsymbol{Speed = Frequency \times Wavelength}$$

$$\boldsymbol{v = f \times \lambda}$$

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Question # 7

Explain why satellite dishes are placed on the walls or roofs of houses.

Answer:

Satellite dishes are devices, which receive their signals from satellites in space. If we installed inside our building, it would not receive proper signals by the satellite dish receivers. To avoid bad or poor signals of transmission due to nearby trees and buildings, we should install satellite dishes on roofs of houses and walls. Secondly, for satellite transmission, satellite dishes need line of sight to transmit and receive the signals, so it would be better to install these devices on roof or outdoor walls of the house.

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Question # 8

The frequency of a wave triples and its wavelength doubles. What happens to its speed?

Answer:

Let frequency $f' = 3f$;

Wavelength $\lambda' = 2\lambda$

Speed $v' = f'\lambda'$

Now, $v' = 3f \times 2\lambda = 6f\lambda = 6v$

So, the speed will be SIX time the original.

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Question # 9

Why must great care be taken when using X-ray and gamma rays?

Answer:

Gamma rays and X-rays have the greatest penetration power. Gamma rays and X-rays exposure is injurious for human because exposure to this radiation harms biological molecules. They cause what is called diffuse damage throughout the body. An example can be radiation sickness, increasing the risk of cancer rather than skin burn.

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Question # 10

Do waves travel faster in deep water or shallow water? Explain your answer?

Answer:

The depth of water affects the speed of these waves directly without having anything to do with the density of the water. The deeper the water, the faster the waves travel, and so waves will refract (change direction) when they enter deeper or shallower water at an angle.



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CHAPTER 2	NOTES OF PHYSICS WAVES MOTION

Refraction→ Water Waves



Water waves refract if the **depth changes.**

Water waves travel **fastest** when the medium is the **deepest.** So, if water waves are passing from **deep** water into **shallow** water, they will **slow** down. This **decrease** in **speed** also leads to a **decrease** in **wavelength.**

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Question # 11

Do water waves cause water molecules to travel across the surface water? Describe an observation which supports your answer.

Answer:

The water waves are considered as transverse waves. In transverse waves, the direction of motion of particles in the medium of propagation of the wave is perpendicular to the direction of propagation of the wave. So, theoretically, the water molecules does not travel across the surface of water. We may observe this by placing a boat on the surface of the wave and by throwing a stone in water. We could observe that the boat moves mainly upward and downward.

But in the case of actual water waves (Sea waves), the wave is a combination of transverse and longitudinal waves. Here, there would be motion of water molecules across the surface of water.

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Question # 12

Which grouping in the electromagnetic spectrum has the highest frequency?

Answer:

Gamma rays have the highest energies, the shortest wavelengths, and the highest frequencies. Radio waves, on the other hand, have the lowest energies, longest wavelengths, and lowest frequencies of any type of EM radiation.

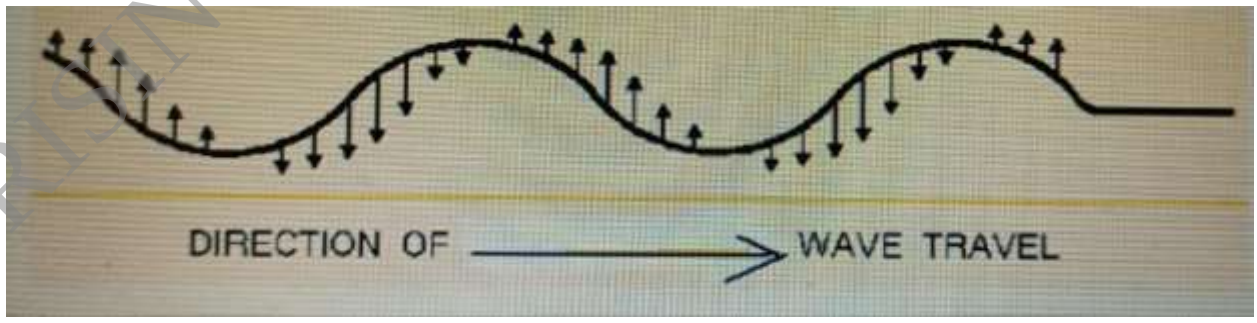
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Question # 13

What evidence do you have that suggests water waves are transverse waves?

Answer:

Water waves are known as Transverse waves because the motion of the water is up and down, or right angles to the direction in which the wave are travelling. You can see this by observing a cork bobbing up and down on water as the waves pass by the cork moves very little in a side-ways direction. From the figure below, the small arrows show the up and down direction, the cork moves as the transverse wave is set in motion.



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Question # 14

What type of wave is a) a P-wave? b) s-wave? Which type of wave travels faster, p-wave or s-wave?

Answer:

Seismic waves are fundamentally of two types, compressional, longitudinal waves or shear, transverse waves.

Through the body of the Earth these are called P-waves for primary waves because they are fastest and S-waves for secondary waves because they are slower.

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Question # 15

When a wave hits a material interface, it can be absorbed, reflected or transmitted by the second material. Describe what happens in each of these cases.

Answer:

A wave is considered as a disturbance in a medium. When a wave is reflected, the disturbance in one medium is not passed to the other medium, but is deflected towards the first medium itself.

In transmission, the disturbance in one medium is passed to the other medium as a disturbance.

In absorption, the energy of the wave in one medium is passed to the second medium, but the wave is not passed to the second medium.

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Question # 16

10 MHz radio waves will pass through the ionosphere without being reflected. Calculate the wavelength of these waves.

Solution:

$Freqeuncy = f = 10MHz = 1 \times 10^7 Hz$

$Speed\ of\ Radio\ wave = v = 3 \times 10^8\ \ m/s$

$Wavelenght = \lambda = ?$

Formula : $v = f\lambda$

$$\lambda = \frac{v}{f} = \frac{3 \times 10^8}{1 \times 10^7} = 30\ m$$

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Question # 17

Make a sketch of a transverse wave to explain what is meant by the terms

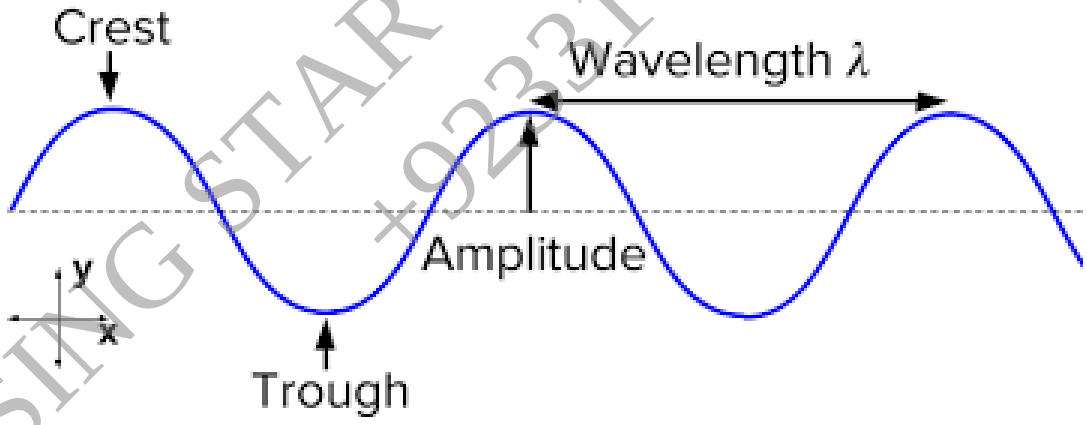
a) amplitude

b) wavelength

Solution:

Amplitude = Maximum displacement from mean position.

Wavelength = The distance between two consecutive crest or troughs.



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Question # 18

Calculate the frequency of radio waves of wave length 60 m sent out by a broadcasting station (Speed of electromagnetic waves is $3 \times 10^8 m/s$).

Solution:

$Wavelenght = \lambda = 60\ m$

$Speed\ of\ Radio\ wave = v = 3 \times 10^8\ m/s$

$Freqeuncy = f = ?$

Formula : $v = f\lambda$

$$f = \frac{v}{\lambda} = \frac{3 \times 10^8\ m/s}{60\ m} = 5 \times 10^6 Hz$$

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Question # 19

A vibrator generates water ripples which travel a distance of 36 cm in 1.8s across the surface of a shallow tank. The distance between successive wave crests is 4 cm. Calculate the frequency of the vibrator.

Solution:

$Wavelenght = \lambda = 4\ cm = 0.04\ m$

$distance = d = 36\ cm = \frac{36}{100} = 0.36\ m$

$time = t = 1.8\ sec$

$Speed\ of\ ripple = v = ?$

$Freqeuncy = f = ?$

$$\boldsymbol{Distane = speed \times time}$$

$$speed = \frac{distance}{time} = \frac{0.36}{1.8} = 0.2\ m/s$$

$$\boldsymbol{Speed = frequency \times wavelenght}$$

$$frequency = \frac{speed}{wavelength}$$

$$frequency = \frac{0.2}{0.04} = 5\ Hz$$

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Question # 20

A certain radio station broadcast at 1600 KHz. The speed of the radio wave is $3 \times 10^8 m/s$. On what meter band can you hear the broadcast?

Solution:

$Wavelenght = \lambda = ?$

$Speed\ of\ Radio\ wave = v = 3 \times 10^8\ m/s$

$Freqeuncy = f = 1600\ KHz = 1.6 \times 10^6\ Hz$

Formula : $v = f\lambda$

$$\lambda = \frac{v}{f} = \frac{3 \times 10^8\ m/s}{1.6 \times 10^6\ Hz} = 187.5\ m$$

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Question # 21

The distance between crest and the adjacent trough of water wave is 3m. They pass a given point at a rate of 5 m/sec What is:

(a) the frequency?

(b) the speed of the water waves?

Solution:

$$\text{Here from Crest to Adjacent Trough} => \frac{\lambda}{2}$$

$$\frac{\lambda}{2} = 3$$

$$Wavelenght = \lambda = 3 \times 2 = 6\ m$$

$$Speed\ of\ Radio\ wave = v = 5\ m/s$$

$$Freqeuncy = f = ?$$

Formula : $v = f\lambda$

(a) $f = \frac{v}{\lambda} = \frac{5\ m/s}{6\ m} = 0.833\ Hz$

(b) $v = \sqrt{\frac{g \times \lambda}{2\pi}} = \sqrt{\frac{9.8 \times 6}{2(3.142)}} = 3.05\ m/s$

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Question # 22

In the figure on the right which wave has the highest frequency: red one blue one?

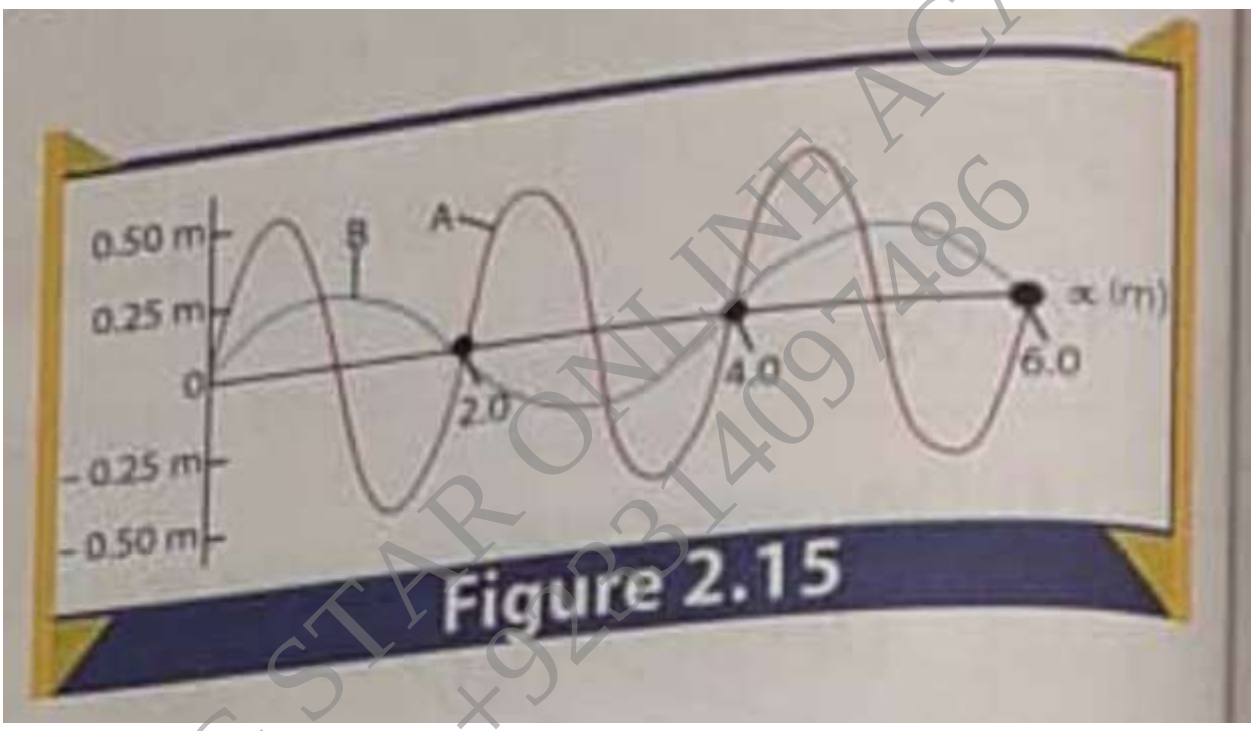


Figure 2.15

Solution:

In this figure, **Red Wave** has the highest frequency, Because it has **three** complete Cycles.

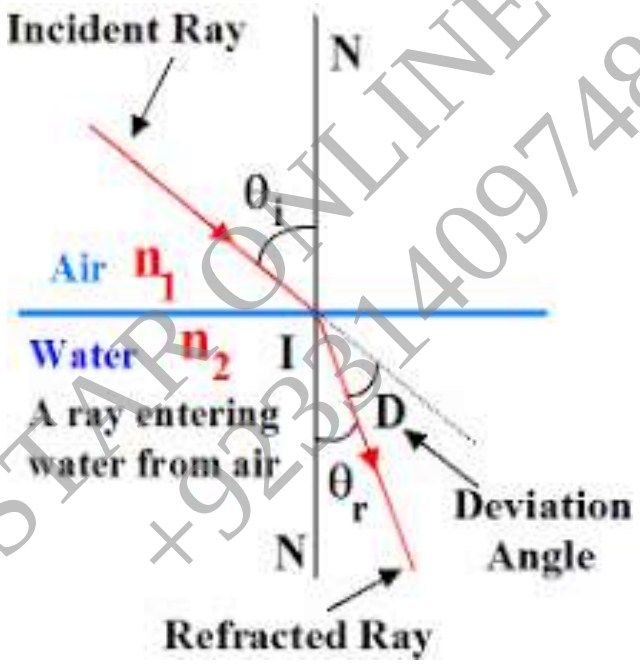
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Frequency is the number of waves passing in one second.

Question # 23

Draw a ray diagram to show a wave bending towards the normal. Mark the angles of incidence and refraction

Solution:



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Question # 24

An oscilloscope is used to display the wave on the right

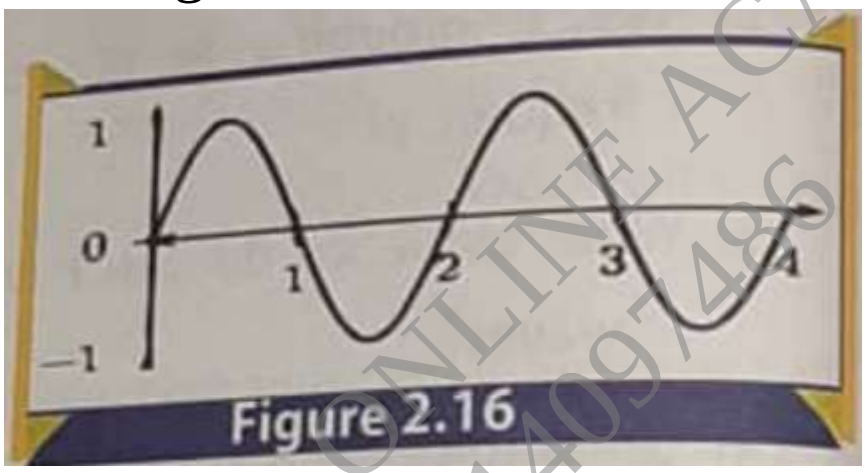


Figure 2.16

a) What is the amplitude and the period of the wave shown?

b) Calculate the frequency of the wave.

Solution:

a) Amplitude = 1 m ; Time Period = 2 sec

b) Frequency = 2 Hz

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Question # 25

A pulse of ultrasound takes 4.5 seconds to travel from a submarine to the seabed and back again. If the speed of sound in Seawater is 1500 m/s, how faraway is the submarine from the seabed?

Solution:

Time = 4.5 seconds

Speed = 1500 m/s

Distance = ?

$$\boldsymbol{Distance = Speed \times Time}$$

$$distance = 1500 \times 4.5 = 6750\ m$$

One way distance is the half of total distance.

So, $distance = \frac{6750}{2} = 3375\ m$

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