HSPTA MALAPPURAM

PHYSOL_*The solution for learning Physics*

Question Bank
15 Waves

Each question scores One

1	What is the relation between period (T) and frequency (ν) ? Ans:- $T=\frac{1}{\nu}$, $\nu=\frac{1}{T}$
2	Unit of frequency is Ans: hertz (Hz)
3	Unit of wave number k is Ans: m^{-1}
4	If two sound waves has a phase difference of 600, then find out the path difference between the two waves? Ans: 60^0
5	In transverse wave vibrations are.... to the direction of propogation. Ans: perpendicular
6	What is the distance between two consecutive crests or troughs? Ans:- One wave length (λ)
7	What is the distance between a crest and the neighbouring trough? Ans:- Half a wavelength $(\frac{\lambda}{2})$
8	What is the distance between two consecutive compressions or rarefactions? Ans:- One wavelength (λ)
9	What is the distance between a compression and the neighbouring rarefaction? Ans:- Half a wavelength
10	What type of wave is the sound wave through air? Ans:- Longitudinal waves
11	What type of wave is the wave on the surface of water? Ans:- Transverse
12	What type of wave is the wave through bulk solid like rock? Ans:- Longitudinal
13	What type of wave is the wave through a gas? Ans:- Longitudinal
14	Can electromagnetic waves pass through solid, liquid and gas? Ans:- Yes
15	Whether a medium is compulsory for an electromagnetic wave like UV Ans :- No
16	Write equation for velocity of a travelling wave Ans :- Velocity of travelling wave through a medium is v = νλ
17	Let a wave is moving along +X direction, what is the expression for representing it ?

	Ans :- $Y(x,t) = A \sin (kx-\omega t+\phi)$
18	Let a wave is moving along -X direction, what is the expression for representing it? Ans :- $Y(x,t) = A \sin (kx+\omega t+\phi)$
19	Write Newton –Laplace equation in terms of temperature Ans :- $V_{(\text{sound in gas})} = \sqrt{\frac{\gamma RT}{M}}$
20	What are factors effecting velocity of sound? Ans :- Pressure, temperature, humidity, density, wind
21	A crest and a trough produce.....wave Ans: Transverse wave.
22	A compression and a rarefaction produce.....wave Ans: Longitudinal.
23	Two wires of same length and thickness are tied between two points with one tightly and the other loosely. Through which wire velocity of wave will be greater? Ans: Through tightly connected wire.
24	A wave require a medium for propagation is called..... Ans: Mechanical wave.
25	Two wires of same length and different thickness are tied between two points with same tension. Through which wire velocity of wave will be greater? Ans: Through thin wire.
26	Two wires of same length and thickness,but of different densities are tied between two points with same tension. Through which wire velocity of wave will be greater? Ans: Through the wire with lower density
27	Transverse wave will be propagated through a medium having..... Ans: Rigidity modulus.
28	Transverse wave will be propagated through..... Ans : Solids and liquid surfaces.
29	Ocean wave consist of..... Waves. Ans: Both transverse and longitudinal.
30	Tuning fork produce.... Waves. Ans:Longitudinal waves.

Each question scores Two

1	Define wave motion. Ans:- Wave motion is the propagation of a disturbance from one point in an elastic medium to another point without the help of the translatory motion of its particles, but by the vibratory motion of its particles.
2	What are the requisites of a medium for the propagation of wave motion? Ans:- 1. Medium must be elastic 2. Medium must be capable of storing energy

	3. Frictional resistance offered by the medium must be small
3	What is meant by frequency of wave motion? Ans:- Frequency of a wave motion is the number of vibrations made by a particle of the medium in 1 second. Symbol ν Unit s^{-1} or Hz
4	What are crests & troughs? Ans:- Crests are regions of maximum upward (positive) displacement. Troughs are regions of maximum downward (negative) displacement
5	What are compressions & rarefactions?? Ans:- Compressions are regions of high pressure. Rarefactions are regions of low pressure.
6	What are electromagnetic waves? Ans:- Gamma rays, X-rays, Ultraviolet, visible light, IR (thermal radiations) microwaves and radio waves form the complete spectrum of electromagnetic waves
7	What is a mechanical wave? Give example Ans : A wave which requires a material medium to propagate Example :- A wave through a string or spring, sound
8	When a wave is called travelling or progressive? Ans : A wave is called travelling or progressive when it is unbounded & undamped
9	A woman is hearing a sound of 680 Hz. Calculate the wave length of sound heard by her (speed of sound in air 340 m/s) Ans :- $v = \nu\lambda$ $\lambda = \frac{v}{\nu}$ $\lambda = \frac{340}{680} = 0.5m$
10	A travelling wave in +X direction is representing as $Y(x,t) = A \sin(kx-\omega t+\phi)$.What are terms A,k,$\omega$,$\phi$ in it ? Ans :- A → amplitude k → wave number $k = \frac{2\pi}{\lambda}$ ω → Angular frequency $\omega = \frac{2\pi}{T} = 2\pi f$ ϕ is the Initial phase
11	If the tension of a string increases four times, how many times will the velocity increase? Ans:- $v \propto \sqrt{T}$ $v' \propto \sqrt{4T}$ $\frac{v'}{v} = 2$ $v' = 2v$
12	What is the temperature at which the velocity of sound in air is twice the velocity at 0^oC? Ans:- $v \propto \sqrt{T}$ Case (I) = $T=T_0 = 0^oC = 273K$ $v \propto \sqrt{273}$ --------- (1) Case (II) T =? Velocity = 2v $2v \propto \sqrt{T}$ ---------- (2) $\frac{2v}{v} = \sqrt{\frac{T}{273}}$

	$2=\sqrt{\frac{T}{273}}$ $4=\frac{T}{273}$ T = 4 x 273 K
13	Give general equation for velocity of a sound wave or longitudinal wave through a medium ? Ans :- $V=\sqrt{\frac{E}{\rho}}$ Where E → modulus of elasticity of medium ρ → Density of medium
14	Write equation for velocity of a sound wave or longitudinal wave through a solid , Ans :- $V_{(\text{sound in solid})}=\sqrt{\frac{Y}{\rho}}$ Where Y → young's modulus
15	Write expression for velocity of a sound wave or longitudinal wave through a liquid Ans: $V_{(\text{sound in liquid})}=\sqrt{\frac{B}{\rho}}$ Where B → bulk modulus
16	Write newton–laplace equation Ans :- $V_{(\text{sound in gas})}=\sqrt{\frac{\gamma P}{\rho}}$ Where $\gamma \rightarrow$ *specific heat ratio* P → pressure ρ → Density of medium
17	How pressure is effected on velocity of sound Ans :- We know that $V_{(\text{sound in gas})}=\sqrt{\frac{\gamma P}{\rho}}$ At constant temperature $\frac{P}{\rho}$ = constant So velocity of sound is independent on pressure
18	In dry air velocity of sound is larger than in humid air , true/ false justify? Ans :- False because We know that $V_{(\text{sound in gas})}=\sqrt{\frac{\gamma P}{\rho}}$ at constant pressure $V \alpha \frac{1}{\sqrt{\rho}}$ Density of dry air is greater than density of moist air, So velocity of sound in moist or humid air is greater than velocity of sound in dry air
19	Frequency is the most fundamental property of Wave, Why? Ans. When a wave passes through different media, velocity and wavelength change but frequency does not change.
20	Which property of the medium are responsible for propagation of Waves through it? Ans. Properties of elasticity and inertia.
21	A transverse wave travels along x-axis. The particles of the medium must move in Which direction? Ans. In the y-z plane or in plane perpendicular to x-axis.
22	The speed of sound does not depend upon its frequency. Give an example in support of this

	statement. Ans. If sounds are produced by different musical instruments simultaneously, then all these sounds are heard at the same time.
23	Why does sound travel faster in iron than in Water or air? Ans. Sound travel faster in iron or solids because iron or solid is highly elastic as compared to water (liquids) or air (gases).
24	What is the nature of the thermal change in air, when a sound wave propagates through it? Ans. When the sound wave travel through air adiabatic changes take place in the medium.
25	Given below are some functions of x and t to represent the displacement (transverse or longitudinal) of an elastic wave. State which of these represent (i) a travelling wave, (ii) a stationary wave or (iii) none at all (a) $y = 2\cos(3x)\sin(10t)$ (b) $y = 2\sqrt{x - vt}$ (c) $y = 3\sin(5x - 0.5t) + 4\cos(5x - 0.5t)$ (d) $y = \cos x \sin t + \cos 2x \sin 2t$ Ans: a) The given equation represents stationary wave because the harmonic therms *kx* and ωt appear separately in the equation b) The given equation does not contain any harmonic term. Therefore,it does not represent either a travelling wave or a stationary wave c) The given equation represents a travelling wave as the harmonic terms *kx* and ωt are in the combination of *kx*-ωt d) The given equation represents a stationary wave because the harmonic terms *kx* and ωt appear separately in the equation. This equation actually represents the superposition of two stationary waves
26	Explosions on other planets are not heard on earth. Why? Ans: This is because no material medium is present over a long distance between earth and planets and is absence of material medium for propagation, sound waves cannot travel.
27	The equation of a transverse wave travelling on a rope is given by y=10sinπ × (0.01x - 2.00t) where y and x are in cm and t in seconds. Calculate The maximum transverse speed of a particle in the rope Ans: given A = 10 cm ω = 2π Maximum particle Speed = A ω = 10 x 2 π = 62.8 cm/s

28	Why longitudinal waves are called pressure waves? Ans. Because propagation of longitudinal waves through a medium, involves changes in pressure and volume of air, when compressions and rarefactions are formed.
29	Why longitudinal waves are called pressure waves? Ans. Because propagation of longitudinal waves through a medium, involves changes in pressure and volume of air, when compressions and rarefactions are formed.
30	Velocity of sound increases on a cloudy day. Why? Ans. Since on a cloudy day, the air is wet i.e. it contains a lot of moisture, As a result of which the density of air is less and since velocity is inversely proportioned to density, hence velocity increases.

Each question scores Three

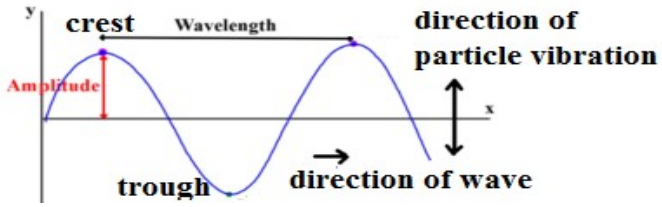
1 Distinguish between longitudinal wave and transverse wave ?

Ans :-

Transverse wave

A wave in which particles vibrate in perpendicular direction of its propagation

They produce crest and trough as shown below.



Region with positive displacement of particles is called crest and region with negative displacement of particles is called trough

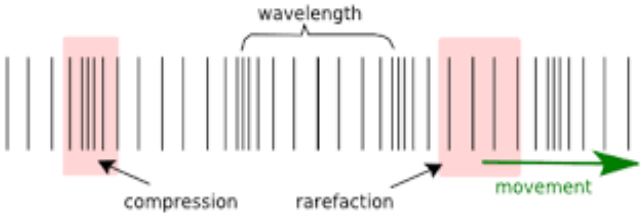
They can be polarized

Eg: a wave through a string, light wave

Longitudinal wave

A wave in which particle vibrate in parallel of its propagation

They produces compressions and rarefactions as shown below



Region with high pressure in medium is called compressions and Region with low pressure in medium is called rarefaction They can't be polarized

Eg: a wave through a spring, sound wave

2 A transverse harmonic wave on a string is described by $y(x,t) = 3.0 \sin (36t + 0.018x + \pi/4)$ where x and y are in cm. and t in s. The positive direction of x is from left to right.

where x and y are in centimetres and t in seconds. The positive direction of x is from left to right.

a)Is it is travelling or stationary wave?

b)What is the initial phase at the origin?

c)What are its amplitude and frequency?

d)If it is a travelling wave, what are the speed and direction of its propagation?

Ans :-

	a) Travelling b) $\frac{\pi}{4}$ c) Amplitude of the wave, A = 3 cm and frequency, $\omega = 2\pi f$ f = $\frac{\omega}{2\pi}$ = $\frac{36}{2\pi}$ = 5.73 Hz d) v = f λ k=0.018 k = $\frac{2\pi}{\lambda}$ $\lambda = \frac{2\pi}{k}$ = = $\frac{2 \times 3.14}{0.018}$ = 348.88 cm =3.48 m v = f λ v = 5.73 × 3.48 = 19.94 m/s
3	A wave travelling along a string is described by, $y_{(x,t)} = 0.005 \sin(80.0x - 3.0t)$ in which all the numerical constants are in SI units. Calculate the wavelength and frequency of the wave. Ans :- k= 80 k = $\frac{2\pi}{\lambda}$ $\lambda = \frac{2\pi}{k}$ = $\frac{2 \times 3.14}{80}$ = 0.078m $\omega = 3$ $\omega = 2\pi f$ $3 = 2\pi f$ f = $\frac{3}{2\pi}$ = 0.477 Hz
4	Give equation for Velocity of transverse wave through a string? Ans :- $V = \sqrt{\frac{T}{m_l}}$ Where T → tension force on string m_l → mass per length $m_l = \frac{M}{l}$ (linear mass density)
5	If the velocity of transverse waves is to be doubled, how many times should you increase the tension? Ans:- If the velocity is to be doubled the tension is to be made 4 times. Proof : $v \propto \sqrt{T}$ …(1) 2v ∝ $\sqrt{T^1}$ … (2) $\frac{(2)}{(1)} = 2 = \sqrt{\frac{T^1}{T}}$ $4 = \frac{T^1}{T}$ $T^1 = 4T$
6	A steel wire has a length of 12.0 m and a mass of 2.10 kg. What is the tension in the wire if speed of a transverse wave on the wire is 343 ms^{-1} Ans :-

	$V=\sqrt{\frac{T}{m_l}}$ so $v^2=\frac{T}{m_l}$ $T = v^2 \times m_l$ $T=(343)^2 \times \frac{2.10}{12}$ =20588 N
7	According to newton formation of compressions and rarefactions in medium when sound propagation is an…….(isothermal/adiabatic) process, later it was corrected by …….(galileo/laplace) as ……..(isothermal/adiabatic) process Ans :-isothermal,laplace ,adiabatic
8	If an explosion takes place at the bottom of lake or sea, will the shock waves in Water be longitudinal or transverse? Ans. Explosion at the bottom of lake or sea create enormous increase in pressure of medium (water). A shock Wave is thus a longitudinal wave travelling at a speed which is greater than that of ordinary Wave.

Each question scores Four

1	What is the explanation given by newton for velocity of sound in a gas ? explain with related equation ? Ans :- According to Newton, formation of compressions and rarefactions in medium when sound propagation is an isothermal process So isothermal elasticity (E) = pressure(P) E = P $V_{Sound\ in\ gas}=\sqrt{\frac{P}{\rho}}$ In STP P = 1 atm = 1.013×10^5 pa $\rho = 1.29\, kg/m3$ By substituting $V_{(sound\ in\ gas)}$= 280 m/s This theoretical value is 15 % lower than experimental value of velocity of sound in air. it was corrected by Laplace through his explanation
2	What was correction made by laplace in newtons equation Ans :- According to Laplace, formation of compressions and rarefactions in medium when sound propagation is a quick adiabatic process So adiabatic elasticity E = γ P Where $\gamma \rightarrow$ specific heat ratio in gas Then $V_{(sound\ in\ gas)}=\sqrt{\frac{\gamma P}{\rho}}$ In STP $\gamma = 1.4$ P= 1 atm = 1.013×10^5 pa $\rho = 1.29\, kg/m^3$ By substituting $V_{(sound\ in\ gas)}$= 330 m/s This theoretical value is same as experimental value of velocity of sound in air.This equation is called Newton's Laplace equation