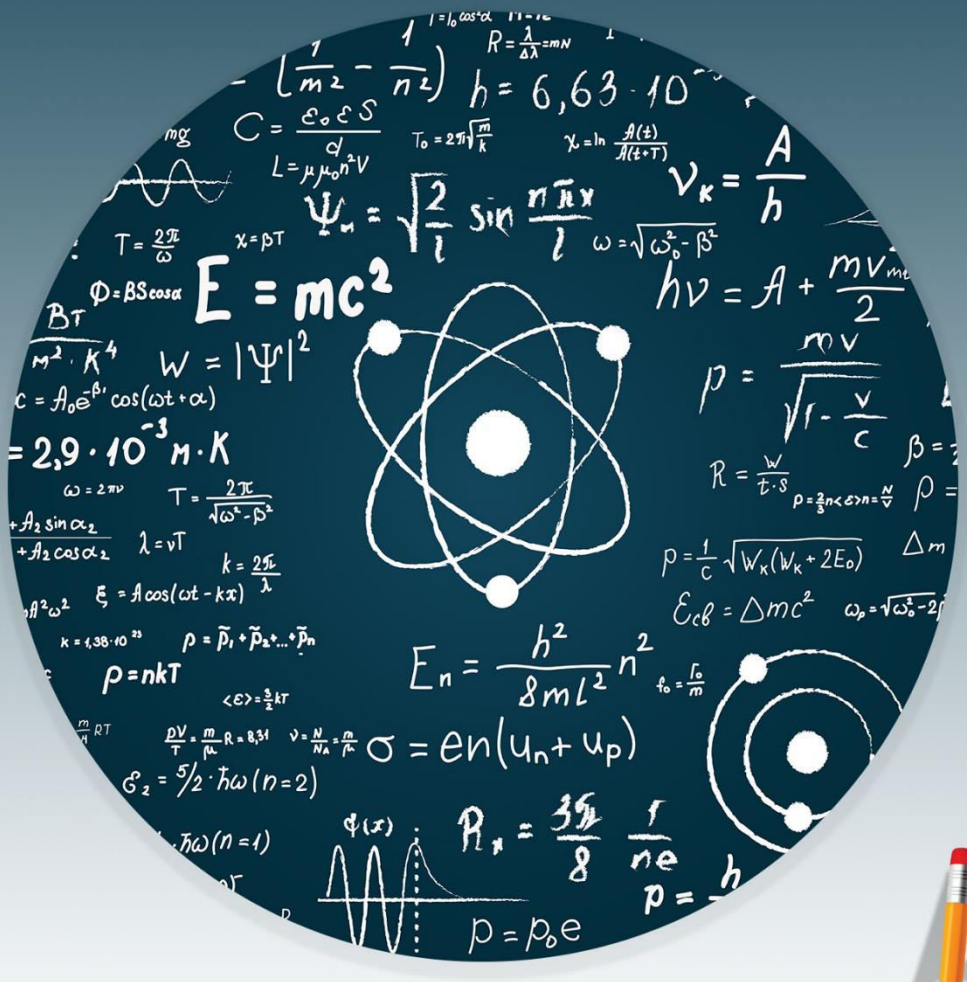
PHYSICS



WORKSHEET-16

STEP

A PROJECT BY PUNJAB GROUP

Worksheet-16

Topics:- Mechanical Waves, Stationary Waves in Air Columns and Stretched String, Doppler's Effect & its Applications, Principle of Superposition, Electromagnetic Spectrum

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Q.1 Doppler's effect applies to:

A) Sound wave only

B) Light wave only

C) Both sound and light waves

D) Neither sound nor light waves

Q.2 When the source of sound approaches the listener at rest, the frequency or pitch of sound received by him is:

A) Less than the frequency of sound produced by source

B) Greater than the frequency of sound produced by source

C) Same as that produced by source

D) Can't be predicted

Q.3 When the source of sound moves away from a stationary listener there is:

A) An apparent increase in wavelength

B) An apparent decrease in frequency

C) An apparent decrease in wavelength

D) Both "A" & "B"

Q.4 Which phenomenon can be applied to estimate the velocity of star with respect to earth:

A) Doppler's effect C) Stationary waves

B) Interference D) All of these

Q.5 The phase change of 180^o is equal to the path difference of:

A) λ C) 2λ

B) $\frac{\lambda}{2}$ D) 3λ

Q.6 In the following properties of a wave, the one that in independent of the others is:

A) Velocity C) Frequency

B) Amplitude D) Wavelength

Q.7 When you speak to your friend, and he speaks to you, which of following quantity is same in their sounds:

A) Amplitude C) Frequency

B) Speed D) Wavelength

Q.8 Wave motion cannot transfer:

A) Energy C) Mass

B) Momentum D) All of these

Q.9 The stationary waves produced in stretched string are _____ in nature.

A) Transverse C) Electromagnetic

B) Longitudinal D) None of these

Q.10 An explosion takes place on the surface of a planet, a person at surface of earth:

A) Can see only but can't hear explosion

B) Can't see but only hear explosion

C) Both see and hear explosion

D) Can't be predicted

Q.11 The waves which need medium for their propagation are called:

A) Electromagnetic waves C) Non-mechanical waves

B) Mechanical waves D) Matter waves

Q.12 The waves which do not require a material medium for their propagation are:

A) Electromagnetic waves C) Mechanical waves

B) Non-mechanical waves D) Both "A" and "B"

Q.13 Mechanical waves can be:

A) Longitudinal only

B) Transverse only

C) Both longitudinal and transverse

D) None of these

Q.14 The relation between phase difference ϕ and path difference x is:

A) $\phi = \frac{2\pi x}{\lambda}$ C) $\phi = \frac{2\pi}{x}$

B) $\phi = \frac{2\pi\lambda}{x}$ D) $\phi = \frac{2\pi}{\lambda}$

Q.15 If a wave is travelling at a speed of 130 m s^{-1} and has a wavelength of 5 m, then its frequency will be:

A) 650 Hz C) 26 Hz

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B) 20 Hz D) 380 Hz

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Q.16 When two identical waves moving in opposite direction reach at a point simultaneous such that they have same frequency then:

A) Interference takes place

B) Stationary waves are generated

C) Beats are produced

D) None of these

Q.17 We can produce stationary waves in:

A) Stretched string C) Both "A" and "B"

B) Air coloumn D) None of these

Q.18 In stationary waves generated on stretched string the relation for speed "v" of wave with tension "F" and mass per unit length "m" is:

A) $v \propto \sqrt{F}$ C) Both "A" and "B"

B) $v \propto \frac{1}{\sqrt{m}}$ D) None of these

Q.19 If for a stretched string tension is made from "F" to "4F" the speed of waves generated will be:

A) $v' = 4v$ C) $v' = \frac{v}{4}$

B) $v' = 2v$ D) $v' = \frac{v}{2}$

Q.20 To produce a single harmonic in a stretched string we will pluck it from:

A) $\frac{\ell}{4}$ C) $\frac{\ell}{6}$

B) $\frac{\ell}{2}$ D) $\frac{\ell}{8}$

Q.21 For stationary waves in a stretched string we always have _____ on two ends:

A) Node C) Trough

B) Anti-node D) Crest

Q.22 The distance between two nodes or anti-nodes is always:

A) $\frac{\lambda}{4}$ C) $\frac{\lambda}{6}$

B) $\frac{\lambda}{2}$ D) λ

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Q.23 The relation for fundamental frequency of stationary waves in stretched string is:

A) $f_1 = \frac{v}{2\ell}$ C) $f_1 = \frac{v}{\ell}$

B) $f_1 = \frac{v}{4\ell}$ D) $f_1 = \frac{3v}{4\ell}$

Q.24 The relation for fundamental wavelength of stationary waves generated in stretched string is:

A) $\lambda_1 = 2\ell$ C) $\lambda_1 = \frac{2\ell}{3}$

B) $\lambda_1 = 4\ell$ D) $\lambda_1 = \frac{4\ell}{3}$

Q.25 As the frequency for stationary waves in stretched string increases the value of:

A) Wavelength decreases

B) Speed remains same

C) Both "A" and "B"

D) Both wavelength & speed decreases

Q.26 What is true for first overtone?

A) $f_2 = 2f_1$ C) $\lambda_2 = \frac{\lambda_1}{2}$

B) $v = constant$ D) All of these

Q.27 A metallic wire of 2 m length hooked between two points has tension of 10 N. If mass per unit length of wire is 0.004 kg s^{-1} then fundamental frequency emitted by wire on vibration is:

A) 12.5 Hz C) 24 Hz

B) 48 Hz D) 6.25 Hz

Q.28 The minimum length of a tube, open at both ends, that resonates with a tuning fork of frequency 350 Hz is (where speed of sound is 350 m s^{-1}):

A) 0.25 m C) 0.5 m

B) 1 m D) 2 m

Q.29 The wavelength of fundamental mode of vibration of closed organ pipe is:

A) 2ℓ C) 4ℓ

B) ℓ D) $\frac{\ell}{2}$

Q.30 If two waves are superimposed to form a stationary wave, what will be speed of wave having frequency 300 Hz while the distance between the two nodes is 1.5 m:

A) 100 m s^{-1} C) 200 m s^{-1}

B) 450 m s^{-1} D) 900 m s^{-1}

Q.31 In Doppler effect change in frequency depends on:

A) Distance between source and listener

B) Speed of source and listener

C) Density of air

D) Frequency of source

Q.32 A sound source of frequency 600 Hz is moving towards an observer with velocity 20 m s^{-1}. The speed of sound is 340 m s^{-1}. The frequency heard by observer will be:

A) 565.5 Hz C) 725.5 Hz

B) 637.5 Hz D) 520.5 Hz

Q.33 If a sound source is moving toward a receiver at $\frac{1}{3}$ the speed of sound, what would be the resulting wavelength?

A) 6 times the emitted wavelength

B) $\frac{2}{3}$ times the emitted wavelength

C) $\frac{1}{3}$ times the emitted wavelength

D) Can't be found

Q.34 If the source of sound moves at the same speed or faster than the speed of wave then it results in:

A) Doppler effect C) Shock waves

B) Beats D) Refraction of sound

Q.35 Stars moving away from earth give:

A) Black shift C) Red shift

B) Blue shift D) Green shift

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Q.36 According to principle of superposition, two waves having same frequency and travelling in same direction super pose to given rise to:

A) Beats
B) Interference
C) Stationary waves
D) Progressive waves

Q.37 In electromagnetic spectrum, which waves have longest wavelength and which waves have most energy among given options:

A) Radio-waves, γ-rays
B) Microwaves, X-rays
C) Infrared, Visible
D) Ultraviolet, X-rays

ANSWER KEY (Worksheet-16)							
1	C	11	B	21	A	31	B
2	B	12	D	22	B	32	B
3	D	13	C	23	A	33	B
4	A	14	A	24	A	34	C
5	B	15	C	25	C	35	C
6	B	16	B	26	D	36	B
7	B	17	C	27	A	37	A
8	C	18	C	28	C		
9	A	19	B	29	C		
10	A	20	B	30	D		

SOLUTIONS

Unit – 4 (WS-16)

Q.1 Answer is "C"

Solution:- Doppler's effect is applicable to all types of waves i.e Mechanical and Electromagnetic waves.

Q.2 Answer is "B"

Solution:- When source of sound approaches the listener, apparent frequency is given as:

$$f_{apparent} = \left(\frac{v}{v - u_s}\right) f_{actual}$$

$f_{app} > f_{act}$ Also

Pitch $\propto f_{app}$

So both apparent frequency and pitch increase.

Q.3 Answer is "D"

Solution:- When source of sound moves away from listener, apparent frequency and apparent wavelength are given as;

$$f_{app} = \left(\frac{v}{v + u_s}\right) f_{act}$$

$f_{app} < f_{act}$

Also

$\lambda_{app} = \lambda_{act} + \Delta\lambda$

$\lambda_{app} > \lambda_{act}$

Q.4 Answer is "A"

Solution:- Doppler's effect can be applied to estimate the velocity of star with respect to earth.

Q.5 Answer is "B"

Solution:- Relation between phase difference and path difference is given as:

$$\frac{\text{Path Difference}}{\lambda} = \frac{\text{Phase Difference}}{2\pi}$$

Q.6 Answer is "B"

Solution:- Amplitude does not depend on other three given parameters.

Q.7 Answer is "B"

Solution:- Speed of sound in one medium remains same regardless of frequency, amplitude or wavelength of the sound waves.

Q.8 Answer is "C"

Solution:- Wave is defined as

"A disturbance in a medium which carries momentum and energy without carrying the matter."

Q.9 Answer is "A"

Solution:-Stationary waves produced in stretched string are transverse stationary waves while stationary waves produced in air column are longitudinal stationary waves.

Q.10 Answer is "A"

Solution:- Sound need medium but light does not.

Q.11 Answer is "B"

Solution:- Waves which need medium for their propagation are called mechanical waves.

Q.12 Answer is "D"

Solution:- Waves which do not require medium for their propagation (also these waves possess changing electric and magnetic fields) are called electromagnetic waves.

Q.13 Answer is "C"

Solution:- Mechanical waves can be both longitudinal as well as transverse.

Q.14 Answer is "A"

Solution:- Relation between phase difference and path difference is given as:

$$\frac{\text{Path Difference}}{\lambda} = \frac{\text{Phase Difference}}{2\pi}$$

Q.15 Answer is "C"

Solution:- Use the relation;

$$v = f\lambda$$

$$f = \frac{v}{\lambda} = \frac{130}{5} = 26Hz$$

Q.16 Answer is "B"

Solution:- Basic conditions to produce stationary waves.

Q.17 Answer is "C"

Solution:- Stationary waves can be produced both in stretched string as well as air column. In stretched string the stationary waves are transverse stationary waves while in air column the stationary waves are longitudinal stationary waves.

Q.18 Answer is "C"

Solution:- Speed of stationary wave is given as:

$$v = \sqrt{\frac{F}{m}}$$ Here

F = tension in the string

m = mass per unit length of string.

Q.19 Answer is "B"

Solution:- Speed of stationary wave is given as;

$$v = \sqrt{\frac{F}{m}} \quad \Rightarrow \quad v \propto \sqrt{F}$$

Making "F" four times will make "v" two times.

Q.20 Answer is "B"

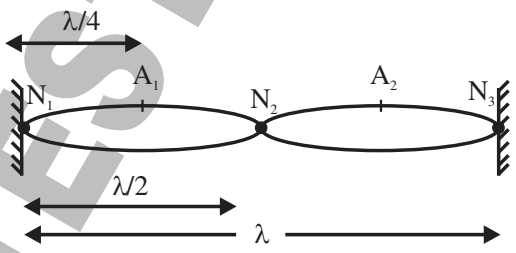
Solution:- Distance of point (from near end) from where string is to be plucked to vibrate in "n" loops is $= \frac{\ell}{2n}$.

Q.21 Answer is "A"

Solution:- On the ends of string particles of string can't move up & down, so nodes are formed on the ends always.

Q.22 Answer is "B"

Solution:-



Q.23 Answer is "A"

Solution:- For a stretched string:

$$f_n = \frac{nv}{2\ell}$$

For n=1

$$f_1 = \frac{v}{2\ell}$$

Q.24 Answer is "A"

Solution:- For a stretched string;

$$\lambda_n = \frac{2\ell}{n}$$

For n=1

$$\lambda_1 = \frac{2\ell}{1}$$

Q.25 Answer is "C"

Solution:- If the frequency of stationary wave in a stretched string increases, its wavelength decreases by same proportion, so according to formula.

$$v = \uparrow f\lambda \downarrow = \text{constant}$$

Speed remains constant.

Q.26 Answer is "D"

Solution:- First overtone means 2nd harmonic i.e n=2, so

$$f_n = nf_1 \qquad ;\lambda_n = \frac{\lambda_1}{n}$$

$$f_2 = 2f_1 \qquad ;\lambda_2 = \frac{\lambda_1}{2}$$

And

$$v = f_n\lambda_n = constant$$

Q.27 Answer is "A"

Solution:- Given

$$m = 0.004\ kg\,s^{-1}; F = 10\ N, \ell = 2\ m$$

$$f_1 = \frac{1}{2\ell}\sqrt{\frac{F}{m}} = \frac{1}{2\times 2}\sqrt{\frac{10}{0.004}}$$

$$f_1 = \frac{1}{4}\sqrt{\frac{10\times 10^3}{4}} = \frac{1}{4}\times\frac{10^2}{2}$$

$$f_1 = 12.5\ Hz$$

Q.28 Answer is "C"

Solution:- Use relation $f = \frac{v}{2\ell}$

Q.29 Answer is "C"

Solution:- For close ended pipe:

$$\lambda_n = \frac{4\ell}{n}$$

For fundamental mode

$$n = 1$$

So, $\lambda_1 = 4\ell$

Q.30 Answer is "D"

Solution:- Use relation; $v = f\lambda$ first find "λ" from distance between two nodes which is equal to $\frac{\lambda}{2}$.

Q.31 Answer is "B"

Solution:- In Doppler's effect the apparent change in frequency only depends on relative motion between source & observer (except the motion of source on a circular path making observer as center)

Q.32 Answer is "B"

Solution:- Apparent frequency when source moves towards observer is given as:

$$f_{app} = \left(\frac{v}{v - u_s}\right) f$$

$$f_{app} = \left(\frac{340}{340 - 320}\right) 600$$

$$f_{app} = \left(\frac{340}{320}\right) 600$$

$$f_{app} = 637.5\ Hz$$

Q.33 Answer is "B"

Solution:- When source moves towards observer, the apparent wavelength is given as:

$$\lambda_{app} = \lambda - \Delta\lambda$$

$$\lambda_{app} = \frac{v}{f} - \frac{u_s}{f}$$

$$\lambda_{app} = \frac{v}{f} - \frac{v}{3f}$$

$$\lambda_{app} == \frac{2}{3}\frac{v}{f} = \frac{2}{3}\lambda$$

Q.34 Answer is "C"

Solution:- If the sound source moves at or greater than the speed of sound wave then it results into shock waves.

Q.35 Answer is "C"

Solution:- Stars moving away from earth give red shift while moving towards earth give blue shift.

Q.36 Answer is "B"

Solution:- Read three points of principle of superposition in topic 8.4

Q.37 Answer is "A"

Solution:- Order of wavelength:

Radio waves > Microwaves > Infrared > Visible > U.V > X-rays > γ-rays

Order of Energy / Momentum / Frequency:

Radio waves < Microwaves < Infrared < Visible < U.V < X-rays < γ-rays

STEP

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