Additional Problems For Self Practice (APSP)

PART-I : PRACTICE TEST PAPER

Max. Marks : 120 **Max. Time : 1 Hr.**

Important Instructions :

1. The test is of **1 hour** duration and max. marks 120.
2. The test consists **30** questions, **4 marks** each.
3. Only one choice is correct **1 mark** will be deducted for incorrect response. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.
4. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instructions 3 above.

1. A copper wire is held at the two ends by rigid supports. At 30ºC the wire is just taut, with negligible tension. The speed of transverse waves in this wire at 10ºC is :
($\alpha = 1.7 \times 10^{-5}$ / ºC, $Y = 1.3 \times 10^{11}$ N/m^2, $d = 9 \times 10^3$ kg/m^3).
($\alpha = 1.7 \times 10^{-5}$ / ºC, $Y = 1.3 \times 10^{11}$ N/m^2, $d = 9 \times 10^3$ kg/m^3).
(1) 80 m/sec (2) 90 m/sec (3) 100 m/sec (4) 70 m/sec

2. Two small boats are 10m apart on a lake. Each pops up and down with a period of 4.0 seconds due to wave motion on the surface of water. When one boat is at its highest point, the other boat is at its lowest point. Both boats are always within a single cycle of the waves. The speed of the waves is :
(1) 2.5 m/s (2) 5.0 m/s (3) 14 m/s (4) 40 m/s

3. A wave pulse, travelling on a two piece string, gets partially reflected and partially transmitted at the junction. The reflected wave is inverted in shape as compared to the incident one. If the incident wave has wavelength λ and the transmitted wave λ',
(1) $\lambda' > \lambda$ (2) $\lambda' = \lambda$ (3) $\lambda' < \lambda$
(4) nothing can be said about the relation of λ and λ'.

4. Equations of a stationary wave and a travelling wave are $y_1 = a \sin kx \cos \omega t$ and $y_2 = a \sin (\omega t - kx)$. The phase difference between two points $x_1 = \frac{\pi}{3k}$ and $x_2 = \frac{3\pi}{2k}$ are φ_1 and φ_2 respectively for the two waves. The ratio $\frac{\phi_1}{\phi_2}$ is :
(1) 1 (2) 5/6 (3) 3/4 (4) 6/7

5. An observer standing at the sea-coast observes 54 waves reaching the coast per minute. If the wavelength of wave is 10m, The velocity. of wave is
(1) 19 m/sec (2) 29 m/sec (3) 9 m/sec (4) 39 m/sec

6. Three waves of equal frequency having amplitudes 10 μm, 4 μm and 7 μm arrive at a given point with a successive phase difference of $\pi/2$. The amplitude of the resulting wave is μm in given by
(1) 7 (2) 6 (3) 5 (4) 4

7. A steel wire of length 1 m and mass 0.1 kg and having a uniform cross-sectional area of 10^{-6} m^2 is rigidly fixed at both ends. The temperature of the wire is lowered by 20°C. If the transverse waves are set up by plucking the string in the middle, the frequency of the fundamental note of vibration is
($Y_{steel} = 2 \times 10^{11}$ N/m^2, $\alpha_{steel} = 1.21 \times 10^{-5}$/°C)
(1) 44 Hz (2) 88 Hz (3) 22 Hz (4) 11 Hz

8. A 20 cm long rubber string obeys Hook's law. Initially when it is stretched to make its total length of 24 cm, the lowest frequency of resonance is υ_0. It is further stretched to make its total length of 26 cm. The lowest frequency of resonance will now be :
(1) the same as υ_0 (2) greater than υ_0
(3) lower than υ_0 (4) None of these

9. The wave–function for a certain standing wave on a string fixed at both ends is $y(x,t) = 0.5 \sin(0.025\pi x) \cos 500\,t$ where x and y are in centimeters and t is in seconds. The shortest possible length of the string is :

(1) 126 cm (2) 160 cm (3) 40 cm (4) 80 cm

10. A string of length 'ℓ' is fixed at both ends. It is vibrating in its 3rd overtone with maximum amplitude 'a'. The amplitude at a distance $\frac{\ell}{3}$ from one end is :

(1) a (2) 0 (3) $\frac{\sqrt{3}a}{2}$ (4) $\frac{a}{2}$

11. A wire having a linear density of 0.05 gm/cm is stretched between two rigid supports with a tension of 4.5×10^7 dynes. It is observed that the wire resonates at a frequency of 420 cycles/sec. The next higher frequency at which the same wire resonates is 490 cycles/sec. The length of wire is approximately.

(1) 314 cm (2) 254 cm (3) 214 cm (4) 354 cm

12. Two wave pulses travel in opposite directions on a string and approach each other. The shape of the one pulse in inverted with respect to the other.

(1) the pulses will collide with each other and vanish after collision
(2) the pulses will reflect from each other i.e., the pulse going towards right will finally move towards left and vice versa.
(3) the pulses will pass through each other but their shapes will be modified
(4) the pulses will pass through each other without any change in their shape

13. A wave moving with constant speed on a uniform string passes the point x = 0 with amplitude A_0, angular frequency ω_0 and average rate of energy transfer P_0. As the wave travels down the string it gradually loses energy and at the point $x = \ell$, the average rate of energy transfer becomes $\frac{P_0}{2}$. At the point $x = \ell$, angular frequency and amplitude are respectively :

(1) ω_0 and $A_0/\sqrt{2}$ (2) $\omega_0/\sqrt{2}$ and A_0 (3) less than ω_0 and A_0 (4) $\omega_0/\sqrt{2}$ and $A_0/\sqrt{2}$

14. A stretched string of length L, fixed at both ends can sustain stationary waves of wavelength λ given by (n is number of loop)

(1) $\lambda = n^2/2L$ (2) $\lambda = L^2/2n$ (3) $\lambda = 2L/n$ (4) $\lambda = 2L\,n$

15. A wave represented by the equation $y = a\cos(kx - \omega t)$ is superposed with another wave to form a stationary wave such that the point x = 0 is a node . The equation for other wave is :

(1) $a\sin(kx + \omega t)$ (2) $-a\cos(kx + \omega t)$ (3) $-a\cos(kx - \omega t)$ (4) $-a\sin(kx - \omega t)$

16. Four wires of same length and same material, whose diameters are in the ratio 4 : 3 : 2 : 1, are clamped in such a way that each wire produces note of frequency double that of the preceding wire. If the tension in the first wire is 2 Kg-wt, then tension in the second wire will be -

(1) 4.5 (2) 8 (3) 9 (4) 16

17. A wave travelling in positive X-direction with A = 0.2 m, velocity = 360 m/s and wavelength λ = 60 m, then correct expression for the wave is :-

(1) $y = 0.2\sin 2\pi\left(6t + \frac{x}{60}\right)$ (2) $y = 0.2\sin \pi\left(6t + \frac{x}{60}\right)$

(3) $y = 0.2\sin 2\pi\left(6t - \frac{x}{60}\right)$ (4) $y = 0.2\sin \pi\left(6t - \frac{x}{60}\right)$

18. A transverse wave propagating along x-axis is represented by

$y(x,t) = 8.0 \sin\left(0.5\pi x - 4\pi t - \frac{\pi}{4}\right)$

where x is in metres and t is in seconds. The speed of the wave is :-

(1) 4π m/s (2) 0.5π m/s (3) $\frac{\pi}{4}$ m/s (4) 8 m/s

19. A transverse wave is represented by $y = A\sin(\omega t - kx)$. For what value of the wavelength is the wave velocity equal to the maximum particle velocity?

(1) $\pi A/2$ (2) πA (3) $2\pi A$ (4) A

20. A heavy ball is suspended from the ceiling of a motor car through a light string. A transverse pulse travels at a speed of 60 cm/s on the string when the car is at rest and 62 cm/s when the car accelerates on a horizontal road. Tthen acceleration of the car is : (Take g = 10 m/s^2.)

(1) 2.7 m/s^2 (2) 3.7 m/s^2 (3) 2.4 m/s^2 (4) 1.4 m/s^2

21. Two particles of medium disturbed by the wave propagation are at $x_1 = 0$ and x_2 = 1cm. The respective displacements (in cm) of the particles can be given by the equations :

$y_1 = 2\sin 3\pi t$

$y_2 = 2\sin(3\pi t - \pi/8)$

The wave speed is :

$y_1 = 2\sin 3\pi t$

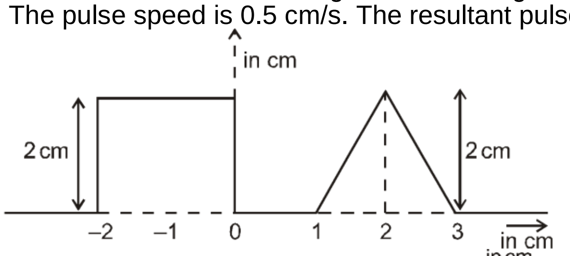
$y_2 = 2\sin(3\pi t - \pi/8)$

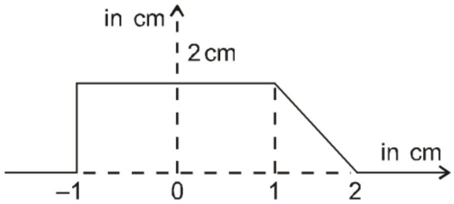
(1) 16 cm/sec (2) 24 cm/sec (3) 12 cm/sec (4) 8 cm/sec.

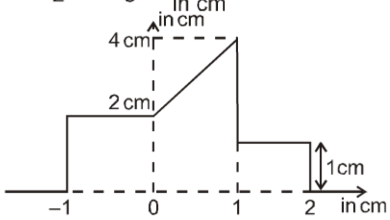
22. In the above question, the displacement of particle at t = 1 sec and x = 4 cm is :

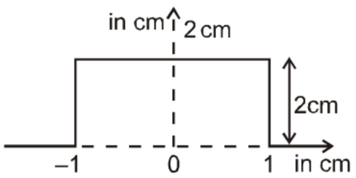
(1) 4 cm (2) 2 cm (3) 1 cm (4) zero

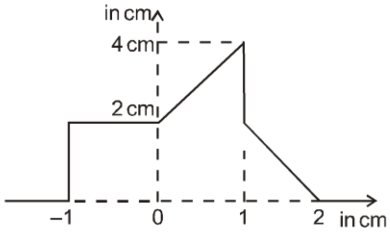
23. The figure shows at time t = 0 second, a rectangular and triangular pulse on a uniform wire are approaching each other. The pulse speed is 0.5 cm/s. The resultant pulse at t = 2 second is



(1)


(2)


(3)


(4)


24. The particle displacement (in cm) in a stationary wave is given by $y(x, t) = 2\sin(0.1\pi x)\cos(100\pi t)$. The distance between a node and the next antinode is :

(1) 2.5 cm (2) 7.5 cm (3) 5 cm (4) 10 cm

25. A wire of length ' ℓ ' having tension T and radius 'r' vibrates with fundamental frequency ' f '. Another wire of the same metal with length 2ℓ having tension 2 T and radius 2 r will vibrate with fundamental frequency:

(1) f (2) 2 f (3) $\frac{f}{2\sqrt{2}}$ (4) $\frac{f}{2}\sqrt{2}$

26. Two interferring waves have the same wavelength, frequency and amplitude. They are travelling in the same direction but 90^0 out of phase compared to individual waves. The resultant wave will have the same.
(1) amplitude and velocity but different wavelength(2) frequency and velocity but different wavelength
(3) wavelength and velocity but different amplitude(4) amplitude and frequency but different wavelength

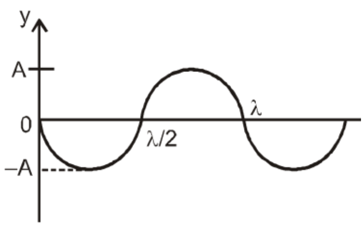
27. A travelling wave $y = A \sin (kx - \omega t + \theta)$ passes from a heavier string to a lighter string. The reflected wave has amplitude 0.5 A. The junction of the strings is at x = 0. The equation of the reflected wave is:

(1) $y' = 0.5 A \sin (kx + \omega t + \theta)$ (2) $y' = - 0.5 A \sin (kx + \omega t + \theta)$

(3) $y' = - 0.5 A \sin (\omega t - kx - \theta)$ (4) $y' = 0.5 A \sin (kx + \omega t - \theta)$

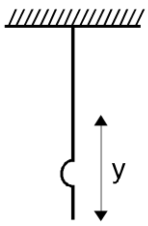
28. A transverse sinusoidal wave is generated at one end of a long horizontal string by a bar that moves the end up and down through a distance by 2.0 cm. The motion of bar is continuous and is repeated regularly 125 times per sec. If the distance between adjacent wave crests is observed to be 15.7 cm and the wave is moving along +ve x-direction, and at t = 0 the element of the string at x = 0 is at mean position y = 0 and is moving downwards, the equation of the wave is best described by : (use $\pi = 3.14$)
(1) y = (1 cm) sin [(40.0 rad/m) x – (785 rad/s) t] (2) y = (2 cm) sin [(40.0 rad/m) x – (785 rad/s) t]
(3) y = (1 cm) cos [(40.0 rad/m) x – (785 rad/s) t] (4) y = (2 cm) cos [(40.0 rad/m) x – (785 rad/s) t]

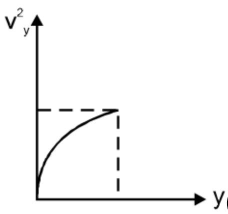
29. The snap shot of a progressive wave at $t = \frac{T}{2}$ having time period T is shown in figure. Then the equation of the wave, if wave is going in positive x-direction and if wave is going in negative x-direction will be respectively.

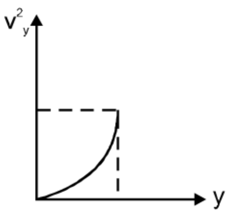


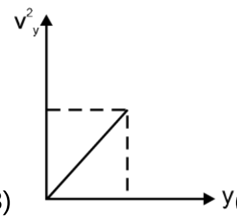
$\left(\text{Here,} \quad T = \frac{2\pi}{\omega}\right)$
(1) $y = A \sin (\omega t – kx)$, $y = A \sin (kx + \omega t)$
(2) $y = A \sin (kx – \omega t)$, $y = A \sin (kx + \omega t)$
(3) $y = A \cos (kx – \omega t)$, $y = A \cos (kx + \omega t)$
(4) $y = A \cos (kx – \omega t)$, $y = A \sin (kx + \omega t)$

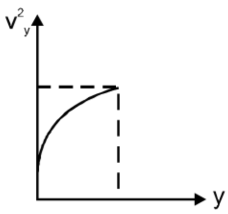
30. A non–uniform rope of length ℓ hangs from a ceiling. Mass per unit length of rope (μ) changes as $\mu = \mu_0 e^y$, where y is the distance along the string from its lowest point. Then graph between square of velocity of wave and y will be best represented as :



(1) 

(2) 

(3) 

(4) 

Practice Test (JEE-Main Pattern)

OBJECTIVE RESPONSE SHEET (ORS)

Que.	1	2	3	4	5	6	7	8	9	10
Ans.										
Que.	11	12	13	14	15	16	17	18	19	20
Ans.										
Que.	21	22	23	24	25	26	27	28	29	30
Ans.										

PART - II : PRACTICE QUESTIONS

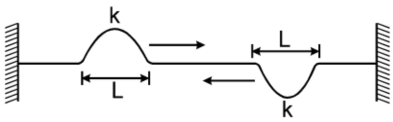
1. Three waveforms travelling along a straight line have the forms :

$2A\sin\left(kx-\omega t+\frac{\pi}{3}\right), \sqrt{3}A\cos\left(kx-\omega t-\frac{\pi}{3}\right),\ 2\sqrt{3}A\cos\left(kx-\omega t+\frac{\pi}{3}\right)$

the amplitude of the resulting waveform is

(1) $\left(2+3\sqrt{3}A\right)$ (2) $\sqrt{31}A$ (3) $\sqrt{19}A$ (4) $\left(2-\sqrt{3}A\right)A.$

2. Two identical pulses move in opposite directions with same uniform speeds on a stretched string. The width and kinetic energy of each pulse is L and k respectively. At the instant they completely overlap, the kinetic energy of the width L of the string where they overlap is :



(1) k (2) 2k

(3) 4k (4) 8 k

3. The equation of a plane progressive wave is y = 0.02 sin $8\pi\left[t-\frac{x}{20}\right]$. When it is reflected at a rarer medium (medium with higher velocity) at x = 0, its amplitude becomes 75% of its previous value. The equation of the reflected wave is

(1) y = 0.02 sin $8\pi\left[t-\frac{x}{20}\right]$ (2) y = 0.02 sin $8\pi\left[t+\frac{x}{20}\right]$

(3) y = +0.015 sin $8\pi\left[t+\frac{x}{20}\right]$ (4) y = –0.015 sin $8\pi\left[t+\frac{x}{20}\right]$

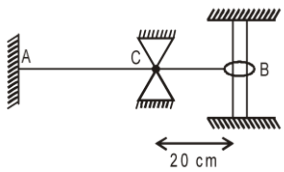
4. Travelling wave travels in medium '1' and enters into another medium '2' in which it's speed gets decreased to 25%.Then magnitude of ratio of Amplitude of transmitted to reflected wave is :

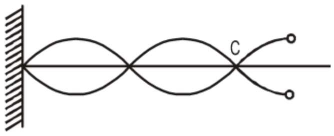
(1) $\frac{6}{5}$ (2) $\frac{2}{3}$ (3) $\frac{1}{7}$ (4) $\frac{5}{9}$

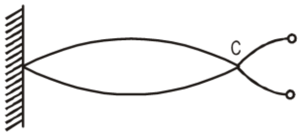
5. A string fixed at both ends has consecutive standing wave modes for which distances between adjacent nodes are 6 cm and 4 cm. The length of the string is :

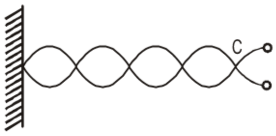
(1) 6 cm (2) 4 cm (3) 12 cm (4) 18 cm

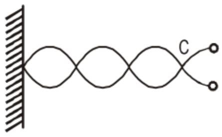
6. A 1m long wire having tension T is fixed at A and free at B. The point C, 20 cm from B is constrained to be stationary. What is shape of string for fundamental mode ?



(1) 

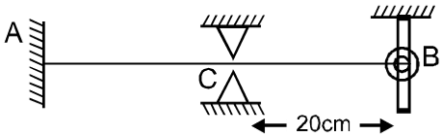
(2) 

(3) 

(4) 

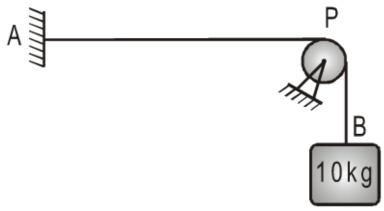
7. A string of length L fixed at both end vibrate in its second overtone.
(1) It contain 4 node and 4 antinode.
(2) It contain 3 node and 4 antinode.
(3) it's vibration frequency 5 time of fundament frequency
(4) Its wavelength is one third of the wavelength in its fundamental mode of vibration.

8. A 1m long wire having tension of 100 N and of linear mass density 0.01 kg/m is fixed at end A and free at end B. The point C which is 20 cm from end B is constrained to be stationary. To create resonance in this wire, the minimum frequency of the tuning fork will be :



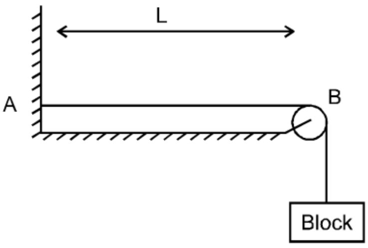
(1) 125 Hz (2) 150 Hz
(3) 300 Hz (4) 275 Hz

9. A 10kg weight is suspended with a wire AB of linear mass density 0.01 kg/m. Length of AP segment is 1 m and It is vibrated with a tuning fork in its second overtone. Now instead of 10kg, a 40kg weight is suspended. By what minimum distance should we displace the pulley forward to achieve the resonance with same tuning fork ($g = 10$ m/sec^2).



(1) 0.33 m (2) 0.67 m
(3) 1 m (4) 1.33 m

10. The string AB vibrates in two loops with a tuning fork when block hangs in air. Now block is completely immersed in water, the string vibrates in three loops with same tuning fork.
The specific gravity of block is :



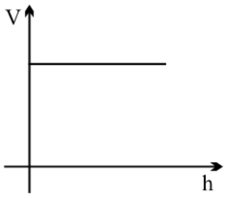
(1) 1.2 (2) 1.8
(3) 2 (4) 5/9

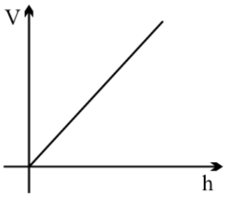
11. A wire of length L having linear density of 1×10^{-3} kg/m is stretched between two rigid supports with a tension of 40N. It is observed that the wire vibrating in P segments resonates at a frequency of 420Hz. The next higher frequency at which the wire resonates is 490Hz. The value of P and L are :

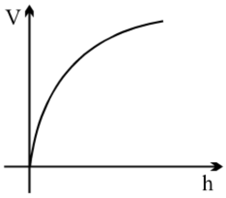
(1) P = 6, L = $\left(\frac{10}{7}\right)$ m (2) P = 7, L = $\left(\frac{60}{49}\right)$ m
(3) P = 6, L = $\left(\frac{60}{49}\right)$ m (4) P = 7, L = $\left(\frac{10}{7}\right)$ m

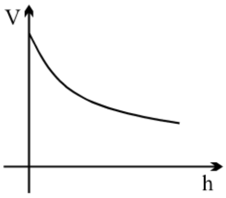
12. A sinusoidal travelling wave in a string has a velocity of propogation 300 m/sec. The time period of oscillations of the particles of the string is 0.04 sec. Then the phase difference between the oscillations of two points at distances 10 m and 16 m respectively from source of oscillation is :
(1) $\pi/2$ (2) 2π (3) $\pi/4$ (4) π

13. A uniform rope having uniformly distributed mass hanges vertically from a rigid support. A transverse wave pulse is produced at the lower end. The speed (v) of the wave pulse varies with height (h) from the lower end as:

(1) 

(2) 

(3) 

(4) 

APSP Answers

PART-I

1.	(4)	**2.**	(2)	**3.**	(3)	**4.**	(4)	**5.**	(3)	**6.**	(3)	**7.**	(4)
8.	(2)	**9.**	(3)	**10.**	(3)	**11.**	(3)	**12.**	(4)	**13.**	(1)	**14.**	(3)
15.	(2)	**16.**	(1)	**17.**	(3)	**18.**	(4)	**19.**	(3)	**20.**	(2)	**21.**	(2)
22.	(2)	**23.**	(4)	**24.**	(3)	**25.**	(3)	**26.**	(3)	**27.**	(4)	**28.**	(1)
29.	(2)	**30.**	(1)										

PART - II

1.	(3)	**2.**	(3)	**3.**	(3)	**4.**	(2)	**5.**	(3)	**6.**	(1)	**7.**	(4)
8.	(1)	**9.**	(1)	**10.**	(2)	**11.**	(1)	**12.**	(4)	**13.**	(3)		