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Class: 11
Subject: Physics
Topic: Oscillation and Waves
No. of Questions: 20
Duration: 60 Min
Maximum Marks: 60

1. A wave in a stretched string is described by y = A sin (kx ωt). The maximum particle velocity is
   A. Aω
   B. ω/k
   C. x /t
   D. $\frac{d\omega}{dk}$

   Solution: A

2. A transverse wave travels along the Z-axis. The particles of the medium must vibrate along the
   A. X – axis
   B. Y –axis
   C. X – y plane
   D. y – z plane

   Solution: C

3. When an organ pipe is blown harder at the open end
   A. higher overtones are got
   B. higher fundamental frequency can be obtained
   C. shriller sound can be obtained
   D. no effect

   Solution: A

4. A 5.5m length of string has a mass of 0.035 kg. If the tension in the string is 77 N the speed of a wave on the string is
   A. 110 m/s
   B. 102 m/s
   C. 165 m/s
   D. 77 m/s

   Solution: A
   5.5 m → 0.035 Kg
   $m = \frac{0.035}{5.5} = \frac{0.35}{55}\ kg/\ m$
   $v = \sqrt{\frac{T}{m}} = \sqrt{\frac{77x55}{0.35}} = 11\sqrt{\frac{7x5}{0.35}}\,11\sqrt{100} = 110\ |m/s$

5. The intensity level of sound A and B differ by 5 bels. How many times more intense is the sound of A than B?
   A. 10^3
   B. 10
   C. 5
   D. 10^5

   Solution: D
   $$N_A = \log\frac{I_A}{I_O} bel, N_B = \log\frac{I_B}{I_O} bel \Rightarrow N_A - N_B = \log\frac{I_A}{I_O} - \log\frac{I_B}{I_O}$$
   $$5 = \log\left[\frac{I_A}{I_B}\right] \Rightarrow \frac{I_A}{I_B} = 10^5 \Rightarrow \therefore I_A : I_B = 10^5$$

6. A source of sound and a listener are approaching each other with a speed of 30 m/s. The apparent frequency of a note produced by the source is 300 CPS. Then its true frequency i (CPS). Velocity of sound in air = 360 m/s
   A. 320
   B. 300
   C. 355
   D. 254

   Solution: D
   $$f' = \frac{v+v_O}{v-v_S}.f \Rightarrow 300\frac{360+30}{360-30}.f$$
   $$f = \frac{300 \times 33}{39} = 253.8 = 254 \text{ cps}$$

7. When beats are produced by two progressive waves of same amplitude and of nearly of same frequency, then maximum loudness of the resultant sound is n-times the loudness of each of the component wavetrains. The value of n is
   A. 1
   B. 4
   C. 8
   D. 2

   Solution: B
   Resultant amplitude 2A ∴ Intensity a $4A^2$ ∴ Intensity increases by 4 times
   ∴ n = 4

8. A three loop pattern is observed in Melde's experiment performed in parallel position. When the other conditions are same, the experiment is performed in transverse position, the no. of loops formed is
   A. 3
   B. 6
   C. 4
   D. 2

   Solution: B

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9. A sonometer wire vibrates with a frequency n. It is replaced by another wire of two times the diameter, tension and other parameters are same, the frequency of vibration of the wire will be
   A. 4 n
   B. 2 n
   C. n/2
   D. n/4

   Solution: C

$$f = \frac{1}{2\ell}\sqrt{\frac{4T}{\pi d^2 \rho}} \Rightarrow f \ \alpha \ \frac{1}{d}$$

$$I \ case \ n \ \alpha \frac{1}{d}$$

$$I \ case \ n' \ \alpha \frac{1}{2d} \Rightarrow \frac{n'}{n} = \frac{1}{2} \Rightarrow n' = n/2$$

10. When both source and observer move in the same direction with a velocity equal to half the velocity of sound, the change in frequency of the sound as detected by the observer is
   A. Zero
   B. 25%
   C. 50%
   D. None of the above

   Solution: A

11. As there is no relative motion between source and observer, no change in frequency occur.
   A vibrating tuning fork tied to the end of a string is whirled such that the linear velocity is 25 m/s. If velocity of sound in air is 350 m/s, the ratio of maximum frequency to minimum frequency heard by a person standing outside circular path is
   A. $15/13$
   B. $\frac{15}{14}$
   C. $\frac{14}{15}$
   D. 4

   Solution: A

$$\frac{f_{max}}{f_{min}} = \frac{\frac{v}{v - v_s}.f}{\frac{v}{v + v_s}.f} = \frac{v + v_s}{v - v_s} = \frac{350 + 25}{350 - 25} = \frac{375}{325} = \frac{15}{13}$$

12. Quality of a musical note doesn’t depend on
   A. amplitude of the Wave
   B. relative intensity of harmonies
   C. number of harmonics
   D. order of harmonics present

   Solution: A

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13. A train moves towards a stationary listener with a speed of 34m/s. The train sounds a whistle and its frequency as heard by the listener is f1. If the velocity of the train reduces to 17 m/s, then the Frequency as heard by the listener is f2. If the velocity of sound in air is 340m/s then $\frac{f_1}{f_2}$ *is*

A. $\frac{18}{19}$
B. $\frac{19}{18}$
C. $\frac{2}{1}$
D. $\frac{10}{1}$

Solution: B

14. A whistle producing sound waves of frequencies 9500 Hz and above is approaching a stationary person with speed 'v' ms^{-1}. The velocity of sound in air is $300ms^{-1}$. If the person can hear frequencies upto a maximum of 10,000 Hz the maximum value of v upto which he can hear the whistle is

A. $\frac{15}{\sqrt{2}}\ ms^{-1}$
B. $15ms^{-1}$
C. $30ms^{-1}$
D. $15/\sqrt{2}\ ms^{-1}$

Solution: B

$$f = \left(\frac{v}{v - v_s}\right)f$$

Max. audible apparent frequency = 10,000

$$10{,}000 = \left(\frac{v}{v - v_s}\right)9500$$

$$\frac{v}{v - v_s} = \frac{19}{20} \Rightarrow 20v = 19v - 19v_s.$$

$$\therefore v = 19v_s \Rightarrow v_s = \frac{300}{19} \cong 15\text{m/s}$$

15. Waves which obey principle of super position are called

A. Linear waves
B. Non-linear waves
C. S.H. waves
D. Ripples

Solution: A

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16. Two closed pipes one filled with O2 and other with H2 have same fundamental frequency. Then ratio of their lengths is
    A. 4: 1
    B. 2: 1
    C. 1: 2
    D. 1: 4

    Solution: D

$$\frac{v_1}{4\ell_1} = \frac{v_2}{4\ell_2} \qquad \frac{\ell_1}{\ell_2} = \frac{v_1}{v_2} = \sqrt{\frac{d_2}{d_1}} = \sqrt{\frac{1}{16}} = \frac{1}{4} \qquad \ell_1 : \ell_2 : 1:4$$

17. When a source of sound moves towards a stationary observer with one tenth of the velocity of sound, the change in frequency of the sound as detected by the observer is
    A. 11%
    B. 25%
    C. 50%
    D. 0.1%

    Solutions: A

$$f' = \frac{v}{v-v_s} f \Rightarrow \frac{f'}{f} - 1 = \frac{v}{v-v_s} - 1 \Rightarrow \frac{f'-f}{f} = \frac{v_s}{v-v_s} \Rightarrow \left(\frac{f'-f}{f}\right) \times 100 = \frac{\frac{1}{10}v}{\frac{9}{10}v} \times 100$$
$$= \frac{1}{9} \times 100 = 11\%.$$

18. A particle on the crest of a wave at any instant will come to the mean position after
    A. T s
    B. 2T s
    C. $\frac{T}{2}\,s$
    D. $\frac{T}{4}\,s$

    Solution: D

19. The temperature at which the speed of sound in air becomes double of its value at 27ºC is
    A. 54°C
    B. 327°C
    C. 927°C
    D. -123°C

    Solution: C

$$\frac{v_t}{v_{27}} = \sqrt{\frac{T}{T_{27}}} \Rightarrow 2 = \sqrt{\frac{T}{27+273}} = \sqrt{\frac{T}{300}} \Rightarrow 4 = \frac{T}{300} \Rightarrow T = 1200^\circ K$$
$$1200 - 273 = 927^\circ C$$

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20. The equation of a progressive e wave is given by y = a sin π $\left[\frac{t}{3} - \frac{x}{6}\right]$ where t is in seconds & x is in m. The distance travelled in 10 seconds is

   A. 20 m
   B. 30 m
   C. 40 m
   D. 60 m

   Solution: A

   Comparing the equation w ith y = a sin 2π$\left(\frac{t}{T} - \frac{x}{\lambda}\right)$

   Equating coefficien ts of 't'

   $\frac{2\pi}{T} = \frac{\pi}{3}$ $\qquad T = 6s$

   Equating coefficient ts of 'x'

   $\frac{2\pi}{\lambda} = \frac{\pi}{6}$ $\qquad \lambda = 12m$

   $\therefore Velocity\ v = fcity\ v = f\lambda = \frac{1}{T}\lambda$

   $\frac{1}{6}x\ 12 = \frac{2m}{s} \therefore distance\ moved\ in\ 10s = 2\ x\ \ 10 = 20m$