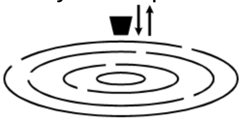
Exercise-1

ONLY ONE OPTION CORRECT TYPE

SECTION (A) : EQUATION OF SOUND WAVE, WAVELENGTH, FREQUENCY, PRESSURE AND DISPLACEMENT AMPLITUDE

1. When sound wave is refracted from air to water, which of the following will remain unchanged?
(1) wave number (2) wavelength (3) wave velocity (4) frequency

2. A piece of cork is floating on water in a small tank. The cork oscillates up and down vertically when small ripples pass over the surface of water. The velocity of the ripples being 0.21 ms^{-1}, wave length 15 mm and amplitude 5 mm, the maximum velocity of the piece of cork is

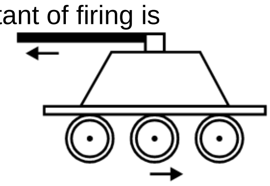


(1) 0.44 ms^{-1} (2) 0.24 ms^{-1} (3) 2.4 ms^{-1} (4) 4.4 ms^{-1}

3. The frequency of a man's voice is 300 Hz and its wavelength is 1 meter. If the wavelength of a child's voice is 1.5 m, then the frequency of the child's voice is:
(1) 200 Hz (2) 150 Hz (3) 400 Hz (4) 350 Hz.

4. Distance between successive compression and rarefaction is 1 m and velocity fo sound is 360 ms^{-1}. Find frequency : **[RPMT 2006]**
(1) 180 Hz (2) 45 Hz (3) 120 Hz (4) 90 Hz

5. A machine gun is mounted on an armoured car moving with a speed of 20 ms^{-1}. The gun can point against the direction of motion of car. The muzzle speed of bullet is equal to speed of sound in air i.e., 340 ms^{-1}. The time difference between bullets actually reaching and sound of firing reaching at a target 500 m away from car at the instant of firing is



(1) 1.2 s (2) 0.09 s (3) 0.9 s (4) 9 s

6. Sound waves from a tuning fork F reach a point P by two separate routes FAP and FBP (when FBP is greater than FAP by 12 cm there is silence at P). If the difference is 24 cm the sound becomes maximum at P but at 36 cm there is silence again and so on. If velocity of sound in air is 330 ms^{-1}, the least frequency of tuning fork is :
(1) 1537 Hz (2) 1735 Hz (3) 1400 Hz (4) 1375 Hz

7. In the case of sound waves, wind is blowing from source to receiver with speed U_W. Both source and receiver are stationary. If λ_0 is the original wavelength with no wind and V is speed of sound in air then wavelength as received by the receiver is given by :
(1) λ_0 (2) $\left(\frac{V+U_w}{V}\right)\lambda_0$ (3) $\left(\frac{V-U_w}{V}\right)\lambda_0$ (4) $\left(\frac{V}{V+V_w}\right)\lambda_0$

8. When we clap our hands, the sound produced is best described by
(1) $p = p_0 \sin (kx - \omega t)$ (2) $p = p_0 \sin kx \cos \omega t$
(3) $p = p_0 \cos kx \sin \omega t$ (4) $p = \Sigma\, p_{0n} \sin (k_n x - \omega_n t)$
Here p denotes the change in pressure from the equilibrium value.

9. Equation of a progressive sound wave is y = a sin $\left(400\,\pi\,t - \frac{\pi x}{0.85}\right)$ where x in (metre), t (second), then frequency of wave is : **[RPMT 1999]**
(1) 200 Hz (2) 400 Hz (3) 500 Hz (4) 600 Hz

10. Wavelength of the wave in the above question is : **[RPMT 1999]**
(1) 1.7 m (2) 8.5 m (3) 0.85 m (4) 0.17 m

11. Relation of wavelengths of sound and light is : **[RPMT 1999]**
(1) $\lambda_s < \lambda_L$ (2) $\lambda_s > \lambda_L$ (3) $\lambda_s = \lambda_L$ (4) None of these

12. The equation of a sound wave is y = 0.0015 sin (62.8x + 316t). Find the wavelength of this wave- **[CPMT-96]**
(1) 0.2 unit (2) 0.1 unit (3) 0.3 unit (4) cannot be calculated

13. A wave enters to water from air. In air frequency, wavelength, intensity and velocity are n_1, λ_1, I_1 and v_1 respectively. In water the corresponding quntities are n_2, λ_2, I_2 and v_2 respectively; then :**[AIPMT 2001]**
(1) $I_1 = I_2$ (2) $n_1 = n_2$ (3) $v_1 = v_2$ (4) $\lambda_1 = \lambda_2$

14. The equation of a wave is given by **[AIPMT 2001]**
y = a sin $\left(100t - \frac{x}{10}\right)$, where x and y are in metre and t in second; then velocity of wave is :
(1) 0.1 m/s (2) 10 m/s (3) 100 m/s (4) 1000 m/s

15. What will be the wave velocity, if the radar gives 5.4 waves per minute and wavelength of the given wave is 10m? **[RPMT 2000]**
(1) 4 m/s (2) 6 m/s (3) 0.9 m/s (4) 5 m/s

16. Velocity of a sound wave is 360 m/s and frequency is 50 Hz, then path difference will be at the phase difference of 60° is : **[RPMT 2001]**
(1) 10 cm (2) 1.2 cm (3) 15 cm (4) 100 cm

17. A source S having frequency 600 Hz is kept at rest at bottom of a flowing river. Find out the frequency detected by a stationary detector present above the river in air.[Velocity of sound in water = 1500 m/s ; velocity of sound in air = 300 m/s] **[JEE- 2004 (Screening), 3/84]**
(1) 1500 Hz (2) 600 Hz (3) 1200 Hz (4) 300 Hz

18. Which one of the following statements is true :- **[AIPMT 2006]**
(1) Both light and sound waves in air are transverse
(2) The sound waves in air are longitudinal while the light waves are transverse
(3) Both light and sound waves in air are longitudinal
(4) Both light and sound waves can travel in vacuum

19. Two points are located at a distance of 10 m and 15 m from the source of oscillation. The period of oscillation is 0.05 s and the velocity of the wave is 300 m/s. What is the phase difference between the oscillations of two points? **[AIPMT 2008]**
(1) $\frac{\pi}{3}$ (2) $\frac{2\pi}{3}$ (3) π (4) $\frac{\pi}{6}$

SECTION (B) : SPEED OF SOUND

1. The temperature in ºC at which the velocity of sound in air is half its value at 0ºC is -
(1) + 204.75 (2) 0.5 (3) –204.75 (4) – 273

2. The ratio of speed of sound in neon to that in water vapours at any temperature (when molecular weight of neon is 2.02×10^{-2} kg mol^{-1} and for water vapours is 1.8×10^{-2} kg mol^{-1})
(1) 1.06 (2) 1.60 (3) 6.10 (4) 15.2

3. Under similar conditions of temperature and pressure, In which of the following gases the velocity of sound will be largest.
(1) H_2 (2) N_2 (3) He (4) CO_2

4. If v_m is the velocity of sound in moist air and v_d is the velocity of sound in dry air, then -
(1) $v_d > v_m$ (2) $v_d = v_m$ (3) $v_d \neq v_m$ (4) $v_m > v_d$

5. An earthquake generates both transvere (S) and longitudinal (P) sound waves in the earth. The speed of S waves is about 4.5 km/s and that of P waves is about 8.0 km/s. A seismograph records P and S waves from an earthquake. The first P was arrives 4.0 min before the first S wave. The epicenter of the earthquake is located at a distance about **[AIIMS 2003]**
(1) 25 km (2) 250 km (3) 2500 km (4) 5000 km

6. On increasing the temperature by 1°C of sound, its velocity increases by : **[RPMT 2000]**
(1) 0.6 m/s (2) 1.2 m/s (3) 4 m/s (4) 0

7. At which temperature the speed of sound will be three times of its speed at 0°C ? **[RPMT 2003]**
(1) 1100°C (2) 1284°C (3) 1500°C (4) 2184°C

8. When temperature increases, the frequency of a tuning fork : **[AIEEE 2002]**
(1) increases (2) decreases
(3) remain same (4) increases or decreases depending on the material

9. The ratio of speed of sound in nitrogen gas to that in helium gas at 300 K is **[JEE - 99, 2/200]**
(1) $\sqrt{2/7}$ (2) $\sqrt{1/7}$ (3) $\sqrt{3}/5$ (4) $\sqrt{6/5}$

10. Two monoatomic ideal gases 1 and 2 of molecular masses m_1 and m_2 respectively are enclosed in separate containers kept at the same temperature. The ratio of the speed of sound in gas 1 to that in gas 2 is given by **[JEE (Scr) - 2000, 2/105]**
(1) $\sqrt{\frac{m_1}{m_2}}$ (2) $\sqrt{\frac{m_2}{m_1}}$ (3) $\frac{m_1}{m_2}$ (4) $\frac{m_2}{m_1}$

11. The speed of sound in oxygen (O_2) at a certain temperature is 460 ms^{-1}. The speed of sound in helium (He) at the same temperature will be (assume both gases to be ideal) : **[AIEEE 2008]**
(1) 500 ms^{-1} (2) 650 ms^{-1} (3) 330 ms^{-1} (4) 460 ms^{-1}

12. If v_{rms} = root mean square speed of molecules,
v_{av} = average speed of molecules.
v_{mp} = most probable speed of molecules,
v_s = speed of sound in a gas
Then, identify the correct relation between these speeds.
(1) $v_{rms} > v_{av} > v_{mp} > v_s$ (2) $v_{av} > v_{mp} > v_{rms} > v_s$ (3) $v_{mp} > v_{av} > v_{rms} > v_s$ (4) $v_{rms} > v_{av} > v_s > v_{mp}$

13. Bulk modulus of sea water should be approximately (ρ_{water} = 1000 kg/m^3) velocity of sound in water is 1050 m/s
(1) 10^8 N/m^2 (2) 10^9 N/m^2 (3) 10^{10} N/m^2 (4) 10^{11} N/m^2

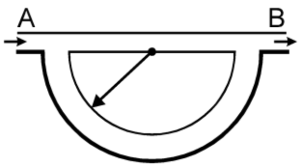
SECTION (C) : INTENSITY OF SOUND, DECIBEL SCALE AND INTERFERENCE

1. A person is talking in a small room and the sound intensity level is 60 dB everywhere within the room. If there are eight people talking simultaneously in the room, what is the sound intensity level ?
(1) 60 dB (2) 69 dB (3) 74 dB (4) 81 dB

2. When two waves with same frequency and constant phase difference interfere,
(1) there is a gain of energy
(2) there is a loss of energy

(3) the energy is redistributed and the distribution changes with time
(4) the energy is redistributed and the distribution remains constant in time

3. Sound signal is sent through a composite tube as shown in the figure. The radius of the semicircular portion of the tube is r. Speed of sound in air is v. The source of sound is capable of giving varied frequencies in the range of ν_1 and ν_2 (where $\nu_2 > \nu_1$). If n is an integer then frequency for maximum intensity is given by :



(1) $\frac{nv}{r}$ (2) $\frac{nv}{r(\pi-2)}$ (3) $\frac{nv}{\pi r}$ (4) $\frac{nv}{(r-2)\pi}$

4. The terms pitch, quality and loudness of sound are associated with the following, respectively-
(1) intensity, frequency and waveform (2) Frequency, intensity and waveform
(3) Frequency, waveform and intensity (4) Waveform, frequency and intensity

5. When beats are produced by two progressive waves of the same amplitude and of nearly the same frequency, the ratio of maximum loudness to one of the waves will be n, Where n is : **[RPMT 2005]**
(1) 3 (2) 1 (3) 4 (4) 2

6. A sound absorber attenuates the sound level by 20 dB. The intensity decreases by a factor of : **[RPMT 2008]**
(1) 1000 (2) 10000 (3) 10 (4) 100

7. Quality depends on **[AFMC 2003]**
(1) Intensity (2) Loudness (3) Timbre (4) Frequency

8. Decibel is the unit of : **[RPMT 2000]**
(1) intensity of light (2) radiating power of X-rays
(3) intensity of sound (4) energy of radiation

9. A point source emits sound equally in all directions in a non-absorbing medium, Two points P and Q are at distances of 2m and 3m respectively from the source. The ratio of the intensities of the waves at P and Q is – **[AIPMT2005]**
(1) 9 : 4 (2) 2 : 3 (3) 3 : 2 (4) 4 : 9

10. Two periodic waves of intensities I_1 and I_2 pass through a region at the same time in the same direction. The sum of the maximum and minimum intensities is – **[AIPMT2008]**
(1) $I_1 + I_2$ (2) $(\sqrt{I_1}+\sqrt{I_2})^2$ (3) $(\sqrt{I_1}-\sqrt{I_2})^2$ (4) $2(I_1+I_2)$

11. A sound absorber attenuates the sound level by 20 dB. The intensity decreases by a factor of : **[AIEEE 2007]**
(1) 1000 (2) 10000 (3) 10 (4) 100

12. A sound level I is greater by 3.0103 dB from another sound of intensity 10 nW cm^{-2}. The absolute value of intensity of sound level I in Wm^{-2} is :
(1) 2.5×10^{-4} (2) 2×10^{-4} (3) 2.0×10^{-2} (4) 2.5×10^{-2}

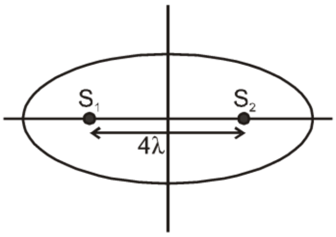
13. For a sound source of intensity I W/m^2, corresponding sound level is B_0 decibel. If the intensity is increased to 4I, new sound level becomes :
(1) $2B_0$ dB (2) $(B_0 + 3)$dB (3) $(B_0 + 6)$dB (4) $4B_0$ dB

14. The sound intensity is 0.008 W/m^2 at a distance of 10 m from an isotropic point source of sound. The power of the source is :
(1) 2.5 watt (2) 0.8 watt (3) 8 watt (4) 10 watt

15*. The energy per unit area associated with a progressive sound wave will be doubled if :
(1) the amplitude of the wave is doubled

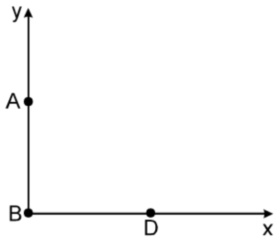
(2) the amplitude of the wave is increased by 50%
(3) the amplitude of the wave is increased by 41%
(4) the frequency of the wave is increased by 41%

16. S_1, S_2 are two coherent sources (having initial face difference zero) of sound located along x-axis separated by 4λ where λ is wavelength of sound emitted by them. Number of maxima located on the elliptical boundary around it will be :



(1) 16 (2) 12 (3) 8 (4) 4

17. An interference is observed due to two coherent sources 'A' & 'B' separated by a distance 4λ along the y–axis where λ is the wavelength of the source. A detector D is moved on the positive x–axis. The number of points on the x–axis excluding the points, $x = 0$ & $x = \infty$ at which maximum will be observed is -



(1) three (2) four (3) two (4) infinite

SECTION (D) : REFLECTION OF SOUND EQUATION OF STATIONARY WAVES

1. When a sound wave is reflected from a wall, the phase difference between the reflected and incident pressure wave is:
(1) 0 (2) π (3) $\pi/2$ (4) $\pi/4$

2. To hear the echo in 1 second, the minimum distance of the source from the reflecting surface should be: **[RPMT 1999]**
(1) 28 m (2) 18 m (3) 19 m (4) 165 m

3. A sound wave of frequency 660 Hz is incident normally at reflecting wall then minimum distance from wall at which particle's amplitude will be maximum **[RPMT 2002]**
(velocity of sound = 330 m/s) :
(1) 0.215 m (2) 0.125 m (3) 1 m (4) 0.25 m

SECTION (E) : ORGAN PIPES AND RESONANCE

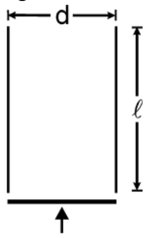
1. If λ_1, λ_2, λ_3 are the wavelengths of the waves giving resonance in the fundamental, first and second overtone modes respectively in a open organ pipe, then the ratio of the wavelengths $\lambda_1 : \lambda_2 : \lambda_3$, is :
(1) 1 : 2 : 3 (2) 1 : 3 : 5 (3) 1 : 1/2 : 1/3 (4) 1 : 1/3 : 1/5

2. An open organ pipe of length L vibrates in its fundamental mode. The pressure variation is maximum
(1) at the two ends (2) at the middle of the pipe
(3) at distance L/4 inside the ends (4) at distance L/8 inside the ends

3. The fundamental frequency of a closed organ pipe is same as the first overtone frequency of an open pipe. If the length of open pipe is 50 cm, the length of closed pipe is
(1) 25 cm (2) 12.5 cm (3) 100 cm (4) 200 cm

4. A cylindrical tube, open at both ends, has a fundamental frequency υ. The tube is dipped vertically in water so that half of its length is inside the water. The new fundamental frequency is
(1) $\upsilon/4$ (2) $\upsilon/2$ (3) υ (4) 2υ

5. A tube of diameter d and of length ℓ unit is open at both ends. Its fundamental frequency of resonance is found to be ν_1. The velocity of sound in air is 330 m/sec. One end of tube is now closed. The lowest frequency of resonance of tube is ν_2. Taking into consideration the end correction, $\frac{\nu_2}{\nu_1}$ is



(1) $\frac{(\ell+0.6d)}{(\ell+0.3d)}$ (2) $\frac{1}{2}\frac{(\ell+0.3d)}{(\ell+0.6d)}$ (3) $\frac{1}{2}\frac{(\ell+0.6d)}{(\ell+0.3d)}$ (4) $\frac{1}{2}\frac{(d+0.3\ell)}{(d+0.6\ell)}$

6. The lengths of two closed organ pipes are 0.750 m an 0.770 m. If they are sounded together, 3 beats per second are produced. The velocity of sound will be : **[RPMT 2004]**
(1) 330.5 m/sec (2) 340.5 m/sec (3) 346.5 m/sec (4) more than these

7. In case of a forced vibration, the resonance wave becomes very sharp when the : **[AIPMT 2003]**
(1) applied periodic force is small (2) quality factor is small
(3) damping force is small (4) restoring force is small

8. Minimum resonating length of a closed organ pipe is 50 cm, when it is vibrated by same frequency, then next resonating length will be : **[RPMT 2001]**
(1) 250 cm (2) 200 cm (3) 150 cm (4) 100 cm

9. An open organ pipe of length 33 cm, vibrates with frequency 1000 Hz. If velocity of sound in 330 m/s. Then its frequency is : **[RPMT 2002]**
(1) fundamental frequency (2) first overtone of pipe (3) second overtone (4) fourth overtone

10. An organ pipe open at both ends contains **[RPMT 2003]**
(1) longitudinal stationary waves (2) longitudinal progressive waves
(3) transverse stationary waves (4) transverse progressive waves

11. A tube closed at one end produces a note of frequency 512 Hz. If the tube is opened at both ends, the frequency will become **[RPMT 2003]**
(1) 512 Hz (2) 256 Hz (3) 128 Hz (4) 1024 Hz

12. Tube A has both ends open while tube B has one end closed, otherwise they are identical. The ratio of fundamental frequency of tubes A and B is : **[AIEEE 2002]**
(1) 1 : 2 (2) 1: 4 (3) 2 : 1 (4) 4 : 1

13. A closed pipe and an open pipe have their first overtones identical in frequency. Their lengths are in the ratio- **[JEE - 99]**
(1) 1 : 2 (2) 2 : 3 (3) 3 : 4 (4) 4 : 5

14. In the experiment for the determination of the speed of sound in air using the resonance column method, the length of the air column that resonates in the fundamental mode, with a tuning fork is 0.1 m. When this length is changed to 0.35 m, the same tuning fork resonates with first overtone. Calculate the end correction. **[JEE- 2003 (Screening), 3/84]**
(1) 0.012 m (2) 0.025 m (3) 0.05 m (4) 0.024 m

15. A closed pipe of length L contains gas of density ρ_1, another open pipe contains gas at density ρ_2. Both the gases have same compressibility factor and both pipes resonates with same frequency in their first overtone then the length of second pipe is : **[JEE- 2004 (Screening), 3/84]**

(1) $\frac{4L}{3}\sqrt{\frac{\rho_2}{\rho_1}}$ (2) $\frac{4L}{3}\sqrt{\frac{\rho_1}{\rho_2}}$ (3) $\frac{4L}{3}$ (4) $\frac{L}{2}$

16. An open pipe is in resonance in 2nd harmonic with frequency f_1. Now one end of the tube is closed and frequency is increased to f_2 such that the resonance again occurs in nth harmonic. Choose the correct option : **[JEE- 2005 (Screening), 3/84]**
(1) $n = 3, f_2 = \frac{3}{4} f_1$ (2) $n = 3, f_2 = \frac{5}{4} f_1$ (3) $n = 5, f_2 = \frac{3}{4} f_1$ (4) $n = 5, f_2 = \frac{5}{4} f_1$

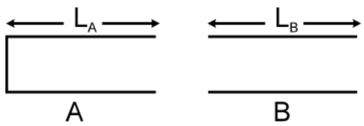
17. The second overtone of an open pipe A and a closed pipe B have the same frequencies at a given temperature. Both pipes contain air. The ratio of fundamental frequency of A to the fundamental frequency of B is:
(1) 3: 5 (2) 5: 3 (3) 5: 6 (4) 6: 5

18. A resonance tube is resonated with tuning fork of frequency 256 Hz. If the length of first and second resonating air columns are 32 cm and 100 cm, then end correction will be
(1) 1 cm (2) 2 cm (3) 4 cm (4) 6 cm

19. While measuring the speed of sound by performing a resonance column experiment, a student gets the first resonance condition at a column length of 18 cm during winter. Repeating the same experiment during summer, she measures the column length to be x cm for the second resonance. Then **[AIEEE 2008]**
(1) x > 54 (2) 54 > x > 36 (3) 36 > x > 18 (4) 18 > x

20. A closed pipe resonates at its fundamental frequency of 300 Hz. Which one of the following statements is wrong ?
(1) If the temperature rises, the fundamental frequency increases.
(2) If the pressure rises, the fundamental frequency increases.
(3) The first overtone is of frequency 900 Hz.
(4) An open pipe with the same fundamental frequency has twice the length. **[REE - 93]**

21. The two pipes are submerged in sea water, arranged as shown in figure. Pipe A with length L_A = 1.5 m and one open end, contains a small sound source that sets up the standing wave with the second lowest resonant frequency of that pipe. Sound from pipe A sets up resonance in pipe B, which has both ends open. The resonance is at the second lowest resonant frequency of pipe B. The length of the pipe B is :



(1) 1 m (2) 1.5 m (3) 2 m (4) 3 m

SECTION (F) : BEATS

1. If two tuning forks A & B give 4 beats/sec. with each other, on loading A with wax, 2 beats/sec. are given. If frequency of A is 256 Hz, then frequency of B is -
(1) 250 Hz (2) 252 Hz (3) 260 Hz (4) 262 Hz

2. 16 tuning forks are arranged in the order of increasing frequencies. Any two successive forks give 8 beats per sec when sounded together. If the last fork gives the octave of the first, then the frequency of the first fork is-
(1) n = 120 (2) n = 160 (3) n = 180 (4) n = 220

3. The frequency of a fork A is 3% more than the frequency of a standard fork whereas the frequency of fork B is 3% less. The forks A and B produce 6 beats per second. The frequency of stadard fork will be
(1) 100 Hz (2) 106 Hz (3) 103 Hz (4) 112 Hz

4. A tuning fork of frequency 512 Hz is vibrated with a sonometer wire and 6 beats per second are heard. The beat frequency reduces if the tension in the string is slightly increased. The original frequency of vibration of the string is

(1) 506 Hz (2) 512 Hz (3) 518 Hz (4) 524 Hz

5. Two tuning forks A & B produce notes of frequencies 256 Hz & 262 Hz respectively. An unknown note sounded at the sametime as A produces beats. When the same note is sounded with B, beat frequency is twice as large. The unknown frequency could be:
(1) 268 Hz (2) 250 Hz (3) 260 Hz (4) 280 Hz

6. A closed organ pipe and an open pipe of same length produce 4 beats when they are set into vibrations simultaneously. If the length of each of them were twice their initial lengths, the number of beats produced will be [Assume same mode of vibration in both cases]
(1) 2 (2) 4 (3) 1 (4) 8

7. A closed organ pipe and an open organ pipe are turned to the same fundamental frequency. What is the ratio of their lengths ? **[RPMT 2006]**
(1) 1 : 2 (2) 2 : 1 (3) 2 : 3 (4) 4 : 3

8. If two tuning forks A and B are sounded together, they produce 4 beats/s. A is then slightly loaded with wax, they produce 2 beats/s when sounded again. The frequency of A is 256 Hz. The frequency of B will be **[RPMT 2009]**
(1) 250 Hz (2) 252 Hz (3) 260 Hz (4) 262 Hz

9. There is a set of four tuning forks, one with the lowest frequency vibrating at 550 Hz. By using any two tuning forks at a time, the following beat frequencies are heard: 1, 2, 3, 5, 7, 8. The possible frequencies of the other three forks are:
(1) 552, 553, 560 (2) 557, 558, 560 (3) 552, 553, 558 (4) 551, 553, 558

10. A tuning fork produce 2 beats when sounded with one oscillator of frequency 514 Hz, and produces 6 beats with the other oscillator of frequency 510 Hz. The frequency of tuning fork is :**[RPMT 1999]**
(1) 516 Hz (2) 510 Hz (3) 514 Hz (4) 520 Hz

11. Two waves of lengths 50 cm and 51 cm produced 12 beats per second.The velocity of sound is- **[CPMT 1999]**
(1) 306 m/s (2) 331 m/s (3) 340 m/s (4) 360 m/s

12. Two identical flutes produce fundamental notes of frequency 300 Hz at 27°C. If the temperature of air in one flute is increased to 31°C, the number of the beats heard per second will be **[UPSEAT 2002]**
(1) 1 (2) 2 (3) 3 (4) 4

13. To obtain beats, the minimum difference in the frequencies of two sources is : **[RPMT 2000]**
(1) 4 Hz (2) 10 Hz (3) 20 Hz (4) 50 Hz

14. 26 tuning forks are arranged in a line having beat frequency of 4 between two successive tuning forks. If frequency of last tuning fork is 3 times that of 1st tuning fork then find the frequency of 1st tuning fork: **[RPMT 2002]**
(1) 7.5 Hz (2) 50 Hz (3) 100 Hz (4) 125 Hz

15. Two vibrating tuning forks produce waves given by $y_1 = 4 \sin 500 \pi t$, $y_2 = 2 \sin 506 \pi t$. If they are held near the ear of a person, the person will hear **[RPMT 2003]**
(1) 3 beats/second with intensity ratio of maxima to minima equal to 9
(2) 3 beats/second with intensity ratio of maxima to minima equal to 2
(3) 6 beats/second with intensity ratio of maxima to minima to equal to 2
(4) 6 beats/second with intensity ratio of maxima to minima equal to 9

16. A tuning fork arrangement (pair) produces 4 beats/sec with one fork of frequency 288 cps. A little Wax is placed on the unknown fork and it then produces 2 beats/sec. The frequency of the unknown fork is : **[AIEEE 2002]**
(1) 286 cps (2) 292 cps (3) 294 cps (4) 288 cps

17. A tuning fork of known frequency 256 Hz. makes 5 beats per second with the vibrating string of a piano. The beat frequency decreases to 2 beats per second when the tension in the piano string is slightly increased. The frequency of the piano string before increasing the tension was : **[AIEEE 2003]**
(1) (256 + 2) Hz. (2) (256 – 2) Hz (3) (256 – 5) Hz (4) (256 + 5) Hz

18. Two vibrating tuning forks produce progressive waves given by $y_1 = 4 \sin 500 \pi t$ and $y_2 = 2 \sin 506 \pi t$. Number of beats produced per minute is :- **[AIPMT 2005]**
(1) 360 (2) 180 (3) 3 (4) 60

19. Two sound waves with wavelengths 5.0 m and 5.5 m respectively, each propagate in a gas with velocity 330 m/s. We expect the following number of beats per second :- **[AIPMT 2006]**
(1) 12 (2) 0 (3) 1 (4) 6

20. When two tuning forks (fork 1 and fork 2) are sounded simultaneously, 4 beats per second are heard. Now, some tape is attached on the prong of the fork 2. When the tuning forks are sounded again, 6 beats per second are heard. If the frequency of fork 1 is 200 Hz, then what was the original frequency of fork 2? **[AIEEE 2005]**
(1) 200 Hz (2) 202 Hz (3) 196 Hz (4) 204 Hz

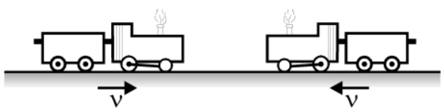
21. Two sound sources produce progressive waves given by $y_1 = 12 \cos 100\pi t$ and $y_2 = 4 \cos 102\pi t$ near the ear of an observer. When sounded together, the observer will hear
(1) 2 beats per second source with an intensity ratio of maximum to minimum nearly 4 : 1
(2) 1 beat per second with an intensity ratio of maximum to minimum nearly $\sqrt{2}$: 1
(3) 2 beats per second with an intensity ratio of maximum to minimum nearly 9 : 1
(4) 1 beat per second with an intensity ratio of maximum to minimum nearly 4 : 1

SECTION (G) : DOPPLER EFFECT

1. The change in frequency due to Doppler effect does not depend on
(1) the speed of the source (2) the speed of the observer
(3) the frequency of the source (4) separation between the source and the observer

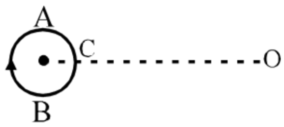
2. An engine driver moving towards a wall with velocity of 50 ms^{-1} emits a note of frequency 1.2 kHz. The frequency of note after reflection from the wall as heard by the engine driver when speed of sound in air is 350 ms^{-1} is :
(1) 1 kHz (2) 1.8 kHz (3) 1.6 kHz (4) 1.2 kHz

3. Two trains move towards each other with the same speed. Speed of sound is 340 ms^{-1}. If the pitch of the tone of the whistle of one when heard on the other changes by 9/8 times, then the speed of each train is :



(1) 2 ms^{-1} (2) 40 ms^{-1} (3) 20 ms^{-1} (4) 100 ms^{-1}

4. A small source of sound moves on a circle as shown in fig. and an observer is sitting at O. Let at $\upsilon_1, \upsilon_2, \upsilon_3$ be the frequencies heard when the source is at A, B, and C respectively.



(1) $\upsilon_1 > \upsilon_2 > \upsilon_3$ (2) $\upsilon_1 = \upsilon_2 > \upsilon_3$ (3) $\upsilon_2 > \upsilon_3 > \upsilon_1$ (4) $\upsilon_1 > \upsilon_3 > \upsilon_2$

5. When a source of sound crosses an observer then change in appearent frequency observed by the observer is 2% of its initial frequency. If the speed of sound in 350 m/s then the velocity of source will be –
(1) 3.5 m/s (2) 3.5 cm/s (3) 3.5 ft./s (4) zero

6. Two tuning forks, each of frquency 340 Hz, are moving with equal velocity with respect to an observer at rest. One fork is approaching andanother is receding away from the observer. The observer is listening beats of frequency 3Hz. If the velocity of sound is 340 m/s then the speed of fork will be -
(1) 0.4 m/s (2) 2.8 m/s (3) 4.2 m/s (4) 1.5 m/s

7. Two sound sources S_1 and S_2 of frequencies 324 Hz and 320 Hz are placed at certain separation. An observer is moving away from S_1 and towards S_2 on line joining them. If he hears no beats then speed of observer is (v = 344 m/sec) : **[RPMT 2004]**

(1) 20 m/s (2) 10 m/s (3) 5 m/s (4) 2.1 m/s

8. A traveller is running with velocity v_0 towards a stationary train. If the train sounds a horn of frequency n then the apparent frequency heard by the traveller will be : **[RPMT 2004]**

(1) $n' = n\left(\frac{v+v_0}{v}\right)$ (2) $n' = n\left(\frac{v-v_0}{v+v_s}\right)$ (3) $n' = n\left(\frac{v+v_0}{v}\right)$ (4) none of these

9. A train moving with 20 m/s towards a stationary observer produces frequency of 440 Hz. The apparent frequency heard will be (v = 330 m/s) **[RPMT 2004]**

(1) 448 Hz (2) 455 Hz (3) 440 Hz (4) 468 Hz

10. A source is approaching a stationary observer with velocity $\left(\frac{1}{10}\right)^{th}$ that of sound. Ratio of observed and real frequencies will be : **[RPMT 2006]**

(1) $\frac{9}{10}$ (2) $\frac{11}{10}$ (3) $\frac{10}{11}$ (4) $\frac{10}{9}$

11. A source and observer are approaching each other with 50 ms^{-1} velocity. What will be original frequency if the obsever recieves 400 cycle/s ? **[RPMT 2006]**

(1) 300 cycle/s (2) 320 cycle/s (3) 340 cycle/s (4) 330 cycle/s

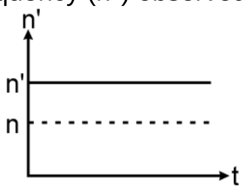
12. An observer moves towards a stationary source of sound, with a velocity one-fifth of the velocity of sound. What is the percentage increase in the apparent frequency ? **[RPMT 2008]**

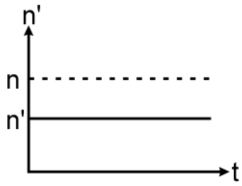
(1) Zero (2) 0.5% (3) 5% (4) 20%

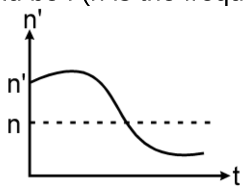
13. As the train crosses a stationary observer, the apparent change in frequency of sound is in the ratio 5 : 3. If velocity of sound in air is 332 m/s, the velocity of train is

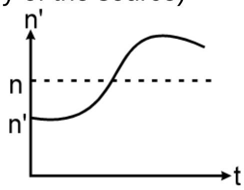
(1) 81 m/s (2) 83 m/s (3) 90 m/s (4) 87 m/s

14. Source and observer both start moving simultaneously from origin, one along X-axis and the other along Y-axis with speed of source equal to twice the speed of observer. The graph between the apparent frequency (n') observed by observer and time t would be : (n is the frequency of the source)

(1) 

(2) 

(3) 

(4) 

15. A train moving towards a tunnel in a huge mountain with a speed of 12 m/s sounds its whistle. If the driver hears 6 beats per second & speed of sound in air is 332 m/s, the frequency of the whistle is

(1) 80 Hz (2) 120 Hz (3) 160 Hz (4) 240 Hz

16. A fixed source of sound emitting a certain frequency appears as f_a when the observer is approaching the source with speed v and frequency f_r when the observer recedes from the source with the same speed. The frequency of the source is

(1) $\frac{f_r+f_a}{2}$ (2) $\frac{f_a-f_r}{2}$ (3) $\sqrt{f_a f_r}$ (4) $\frac{2f_r f_a}{f_r+f_a}$

17. Two sound sources each emitting sound of wavelength λ are fixed some distance apart. A listener moves with a velocity u along the line joining the two sources. The number of beats heard by him per second is

(1) $\frac{2u}{\lambda}$ (2) $\frac{u}{\lambda}$ (3) $\frac{u}{3\lambda}$ (4) 0

18. The apparent change in the pitch of sound due to relative motion between observer and the source is called- **[CPMT 1991]**

(1) doppler's effect (2) resonance of waves (3) interference (4) none of the above

19. When an engine passes near to a stationary observe then its apparent frequencies occurs in the ratio 5/3. If the velocity of sound is 340 m/s then speed of engine is : **[MP PMT 2003]**
(1) 540 m/s (2) 270 m/s (3) 85 m/s (4) 52.5 m/s

20. A police car horn emits a sound at a frequency 240 Hz. when the car is at rest. If the speed of the sound is 330 m/s the frequency heard by an observer who is approaching the car at a speed of 11 m/s, is : **[UPSEAT 2004]**
(1) 248 Hz (2) 244 Hz (3) 240 Hz (4) 230 Hz

21. A man is watching two trains, one leaving and the other coming in with equal speeds of 4 m/sec.. If they sound their whistles, each of frequency 240 Hz, the number of beats heard by the man (velocity of sound in air = 320 m/sec) will be equal to **[BHU 2005]**
(1) 6 (2) 3 (3) 0 (4) 12

22. A whistle revolves in a circle with angular speed ω = 20 rad/sec using a string of length 50 cm. If the frequency of sound from the whistle is 385 Hz, then what is the minimum frequency head by an observer which is far away from the centre :- (velocity of sound V_{sound}= 340m/s) **[AIPMT 2002]**
(1) 385 Hz (2) 374 Hz (3) 394 Hz (4) 333 Hz

23. An observer moves towards a stationary source of sound with a speed 1/5th of the speed of sound. The wavelength and frequency of the source emitted are λ and f respective. The apparent frequency and wavelength recorded by the observer are respectively :- **[AIPMT 2003]**
(1) f, 1.2λ (2) 0.8f, 0.8λ (3) 1.2f, 1.2λ (4) 1.2f, λ

24. A sound source producing waves of frequency 300 Hz and wavelength 1 m. Observer is stationary, while source is going away with the velocity 30 m/s, then apparent frequency heard by the observer : **[RPMT 2001]**
(1) 270 Hz (2) 273 Hz (3) 383 Hz (4) 300 Hz

25. A source emitting a note of frequency 240 Hz is moving towards an observer with a speed of 20 m/s. If the observer also moves with a speed of 20 m/s towards the source, the apparent frequency heard by observer is (velocity of sound = 340 m/s) **[RPMT 2003]**
(1) 270 Hz (2) 240 Hz (3) 268 Hz (4) 360 Hz

26. A train moves towards a stationary observer with speed 34m/s. The train sounds a whistle and its frequency registered by the observer is f_1. If the train's speed is reduced to 17m/s, the frequency registered is f_2. If the speed of sound is 340m/s then the ratio f_1/f_2 is **[JEE - 2000 Screening, 2/105]**
(1) 18/19 (2) 1/2 (3) 2 (4) 19/18

27. A siren placed at a railway platform is emitting sound of frequency 5 kHz. A passenger sitting in a moving train A records a frequency of 5.5 kHz, while the train approaches the siren. During his return journey in a different train B he records a frequency of 6.0 kHz while approaching the same siren. The ratio of the velocity of train B to that of train A is **[JEE - 2002 (Screening), 3/90]**
(1) $\frac{242}{252}$ (2) 2 (3) $\frac{5}{6}$ (4) $\frac{11}{6}$

28. A police van moving with velocity 22 m/s and emitting sound of frequency 176 Hz, follows a motorcycle which is moving towards a stationary car and away from the police van. The stationary car is emitting frequency 165 Hz. Speed of sound air is 330 m/s. If motorcyclist does not hear any beats, then his velocity is **[JEE- 2003 (Screening), 3/84]**
(1) 33 m/s (2) 22 m/s (3) 11 m/s (4) 0

29. A police car with a siren of frequency 8 kHz is moving with uniform velocity 36 km/hr towards a tall building which reflects the sound waves. The speed of sound in air is 320 m/s. The frequency of the siren heard by the car driver is **[JEE' 2011, 3/160, –1]**
(1) 8.50 kHz (2) 8.25 kHz (3) 7.75 kHz (4) 7.50 kHz

30. A car is moving towards a high cliff. The car driver sounds horn of frequency 'f' . The reflected sound heard by the driver has a frequency 2f. If 'v' be the velocity of sound then the velocity the car, in the same velocity units, will be :- **[AIPMT 2004]**

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

31. An observer moves towards a stationary source of sound, with a velocity one-fifth of the velocity of sound. What is the percentage increase in the apparent frequency? **[AIEEE 2005]**

(1) Zero (2) 0.5% (3) 5% (4) 20%

32. 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 300 ms^{-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: **[AIEEE 2006]**

(1) 30 ms^{-1} (2) $15\sqrt{2}$ ms^{-1} (3) $15\sqrt{2}$ ms^{-1} (4) 15 ms^{-1}

Exercise-2

ONLY ONE OPTION CORRECT TYPE

1. A hollow pipe of length 0.8 m is closed at one end. At its open end a 0.5 m long uniform string is vibrating in its second harmonic and it resonates with the fundamental frequency of the pipe. If the tension in the wire is 50 N and the speed of sound is 320 ms^{-1}, the mass of the string is :

[JEE' 2010, 5/163, –2]

(1) 5 grams (2) 10 grams (3) 20 grams (4) 40 grams

2. A student is performing the experiment of Resonance Column. The diameter of the column tube is 4cm. The distance frequency of the tuning fork is 512 Hz. The air temperature is 38°C in which the speed of sound is 336 m/s. The zero of the meter scale coincides with the top and of the Resonance column. When first resonance occurs, the reading of the water level in the column is

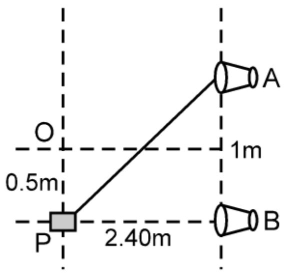
[IIT-JEE-2012, Paper-2; 3/66, –1]

(1) 14.0 (2) 15.2 (3) 16.4 (4) 17.6

3. A light pointer fixed to one prong of a tuning fork touches a vertical plate. The fork is set vibrating and the plate is allowed to fall freely. Eight complete oscillations are counted when the plate falls through 10 cm, then the frequency of the fork is :

(1) 65 Hz (2) 56 Hz (3) 46 Hz (4) 64 Hz

4. Two speakers A and B, placed 1 m apart, each produce sound waves of frequency 1800 Hz in phase. A detector moving parallel to line of speakers distant 2.4 m away detects a maximum intensity at O and then at P. Speed of sound wave is :

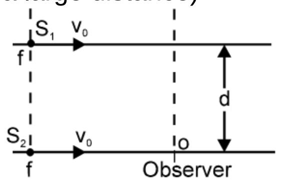


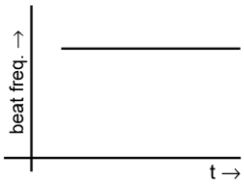
(1) 330 ms^{-1} (2) 360 ms^{-1} (3) 350 ms^{-1} (4) 340 ms^{-1}

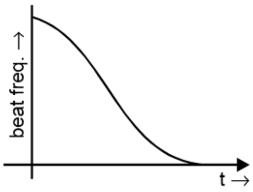
5. In a Hall, a person receives direct sound waves from a source 120m away. He also receives wave from the same source which reach him after being reflected from the 25m high ceiling at a point half way between them. The two waves interfere constructively for wave length (in meters).

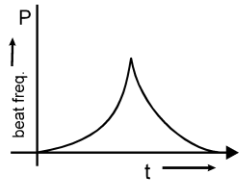
(1) 10, 10/2, 10/3, 10/4 (2) 20, 20/3, 20/5, 20/7,...........
(3) 30, 20, 10,............ (4) 10, 10/3, 10/5,10/7...........

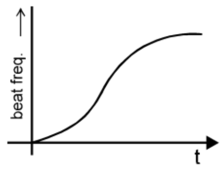
6. Two identical sources moving parallel to each other at separation ' d ' are producing sounds of frequency ' f ' and are moving with constant velocity v_0. A stationary observer ' O ' is on the line of motion of one of the sources. Then the variation of beat frequency heard by O with time is best represented by: (as they come from large distance and go to a large distance)



(1) 

(2) 

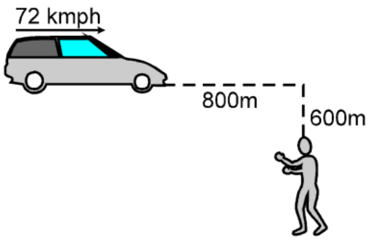
(3) 

(4) 

7. A train blowing its whistle moves with a constant velocity v away from an observer on the ground. The ratio of the natural frequency of the whistle to that measured by the observer is found to be 1.2. If the train is at rest and the observer moves away from it at the same velocity, this ratio would be given by: **[JEE - 93]**

(1) 0.51 (2) 1.25 (3) 1.52 (4) 2.05

8. A car is approaching a railway crossing at a speed of 72 kmph. It sounds a horn, when it is 800 m away, at 600 Hz. If velocity of sound in air is 330 ms^{-1}, the apparent frequency as received by a man at rest near the railway track perpendicular to the road at a distance of 600 m from the crossing is



(1) 653 Hz (2) 365.5 Hz (3) 630.5 Hz (4) 563.5 Hz

9. When a train approaches a stationary observer, the apparent frequency of the whistle is n' and when the same train recedes away from the observer, the apparent frequency is n''. Then the apparent frequency n when the observer sitting in the train is : **[REE' 97, 5]**

(1) $n = \frac{n' + n''}{2}$ (2) $n = \sqrt{n' n''}$ (3) $n = \frac{2n' n''}{n' + n''}$ (4) $n = \frac{2n' n''}{n' - n''}$

10. Two sources are at a finite distance apart. They emit sounds of wavelength λ. An observer situated between them on line joining approaches one source with speed u. Then the number of beats heard by observer will be: **[AIPMT 2000]**

(1) $\frac{2u}{\lambda}$ (2) $\frac{u}{\lambda}$ (3) $\frac{u}{2\lambda}$ (4) $\frac{\lambda}{u}$

11. A vibrating string of certain length ℓ under a tension T resonates with a mode corresponding to the first overtone (third harmonic) of an air column of length 75 cm inside a tube closed at one end. The string also generates 4 beats per second when excited along with a tuning fork of frequency n. Now when the tension of the string is slightly increased the number of beats reduces to 2 per second. Assuming the velocity of sound in air to be 340 m/s, the frequency n of the tuning fork in Hz is **[JEE' 2008, 3/163]**

(1) 344 (2) 336 (3) 117.3 (4) 109.3

Exercise-3

PART - I : NEET / AIPMT QUESTION (PREVIOUS YEARS)

1. A policemen buzz a whistle of frequency 400 Hz. A car driver is approaching the policemen. The speed of car is 72 kmh^{-1}. Find out the change in frequency experienced by the driver, when driver approaches the policemen and after he crosses the policemen.[Velocity of sound is 350 ms^{-1}].
[AIPMT-(Mains) 2009]
(1) 45.7 Hz (2) 55.7 Hz (3) 40 Hz (4) 50 Hz

2. A tuning fork of frequency 512 Hz makes 4 beats per second with the vibrating string of a piano. The beat frequency decreases to 2 beats per sec when the tension in the piano string is slightly increased. The frequency of the piano string before increasing the tension was **[AIPMT-2010]**
(1) 510 Hz (2) 514 Hz (3) 516 Hz (4) 508 Hz

3. Sound waves travel at 350 m/s through a warm air and at 3500 m/s through brass. The wavelength of a 700 Hz acoustic wave as it enters brass from warm air : **[AIPMT-2011]**
(1) decreases by a factor 10 (2) increases by a factor 20
(3) increases by a factor 10 (4) decreases by a factor 20

4. Two identical piano wires kept under the same tension T have a fundamental frequency of 600 Hz. The fractional increase in the tension of one of the wires which will lead to occurrence of 6 beats/s when both the wires oscillate together would be : **[AIPMT (MAINS) 2011]**
(1) 0.02 (2) 0.03 (3) 0.04 (4) 0.01

5. Two sources of sound placed close to each other are emitting progressive waves given by $y_1 = 4 \sin 600 \pi t$ and $y_2 = 5 \sin 608 \pi t$. An observer located near these two sources of sound will hear :
(1) 4 beats per second with intensity ratio 25 : 16 between waxing and waning.
(2) 8 beats per second with intensity ratio 25 : 16 between waxing and waning
(3) 8 beats per second with intensity ratio 81 : 1 between waxing and waning
(4) 4 beats per second with intensity ratio 81 : 1 between waxing and waning

6. A train moving at a speed of 220ms^{-1} towards a stationary object, emits a sound of frequency 1000 Hz . Some of the sound reaching the object gets reflected back to the train as echo. The frequency of the echo as detected by the of the train is : **[AIPMT 2012 (Mains)]**
(speed of sound in air is 330 ms^{-1})
(1) 3500 Hz (2) 4000 Hz (3) 5000 Hz (4) 3000 Hz

7. A source of unknown frequency gives 4 beats/s, when sounded with a source of known frequency 250 Hz. The second harmonic of the source of unknown frequency gives five beats per second, when sounded with a source of frequency 513 Hz. The unknown frequency is : **[NEET_2013]**
(1) 246 Hz (2) 240 Hz (3) 260 Hz (4) 254 Hz

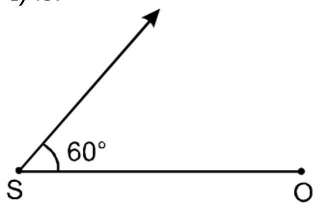
8. If we study the vibration of a pipe open at both ends, then the following statement is **not** true :
[NEET_2013]
(1) Odd harmonics of the fundamental frequency will be generated
(2) All harmonics of the fundamental frequency will be generated
(3) Pressure change will be maximum at both ends
(4) Open end will be antinode

9. The number of possible natural oscillations of air column in a pipe closed at one end of length 85 cm whose frequencies lies below 1250 Hz are: (velocity of sound = 340 ms^{-1}) **[AIPMT-2014]**
(1) 4 (2) 5 (3) 7 (4) 6

10. A speeding motorcyclist sees traffic jam ahead of him. He slows down to 36km/hour. He finds that traffic has eased and a car moving ahead of him at 18 km/hour is honking at a frequency of 1392 Hz. If the speed of sound is 343 m/s, the frequency of the horn as heard by him will be: **[AIPMT-2014]**
(1) 1332 Hz (2) 1372 Hz (3) 1412 Hz (4) 1454 Hz

11. The Fundamental frequency of a closed organ pipe of length 20 cm is equal to the second overtone of an organ pipe open at both the ends. The length of organ pipe open at both the ends is:**[AIPMT-2015]**
(1) 100 cm (2) 120 cm (3) 140 cm (4) 80 cm

12. A source of sound S emitting waves of frequency 100 Hz and an observor O are located at some distance from each other. The source is moving with a speed of 19.4 ms^{-1} at an angle of 60° with the source observer line as shown in the figure. The observor is at rest. The apparent frequency observod by the observer (velocity of sound in air 330 ms^{-1}) is: **[AIPMT-2015]**



(1) 103 Hz (2) 106 Hz (3) 97 Hz (4) 100 Hz

13. 4.0 g of a gas occupies 22.4 litres at NTP. The specific heat capacity of the gas at constant volume is $5.0 JK^{-1}$. IF the speed of sound in this gas at NTP is 952 ms^{-1}, then the heat capacity at constant pressure is (Take gas constant R = 8.3 JK^{-1} mol^{-1}) **[AIPMT-2015]**
(1) 7.5 JK^{-1} mol^{-1} (2) 7.0 JK^{-1} mol^{-1} (3) 8.5 JK^{-1} mol^{-1} (4) 8.0 JK^{-1} mol^{-1}

14. A siren emitting a sound of frequency 800 Hz moves away from an observer towards a cliff at a speed of 15 ms^{-1}. Then, the frequency of sound that the observer hears in the echo reflected from the cliff is : (Take velocity of sound in air = 330 ms^{-1}) **[AIPMT-2016]**
(1) 885 Hz (2) 765 Hz (3) 800 Hz (4) 838 Hz

15. An air column, closed at one end and open at the other, resonantes with a tuning fork when the smallest length of the column is 50 cm. The next larger length of the column resonating with the same tuning fork is: **[AIPMT-2016]**
(1) 200 cm (2) 66.7 cm (3) 100 cm (4) 150 cm

16. The second overtone of an open organ pipe has the same frequency as the first overtone of a closed pipe L meter long. The length of the open pipe will be **[NEET 2016]**
(1) 4L (2) L (3) 2L (4) $\frac{L}{2}$

17. Three sound waves of equal amplitudes have frequencies (n –1), n, (n + 1). They superimpose to give beats. The number of beats produced per second will be **[NEET 2016]**
(1) 2 (2) 1 (3) 4 (4) 3

18. The two nearest harmonics of a tube closed at one end and open at other end are 220 Hz and 260 Hz. What is the fundamental frequency of the system? **[NEET 2017]**
(1) 10 hz (2) 20 Hz (3) 30 Hz (4) 40 hz

19. Two cars moving in opposite directions approach each other with spped of 22 m/s and 16.5 m/s respectively. The driver of the first car blows a horn having a frequency 400 Hz. The frequency heard by the driver of the second car is [velocity of sound 340 m/s] : **[NEET 2017]**
(1) 350 Hz (2) 361 Hz (3) 411 Hz (4) 448 Hz

20. A tuning fork is used to produce resonance in a glass tube. The length of the air column in this tube can be adjusted by a variable piston. At room temperature of 27ºC two successive resonances are produced at 20 cm and 73 cm of column length. If the frequency of the tuning fork is 320 Hz, the velocity of sound in air at 27ºC is : **[NEET 2018]**
(1) 330 m/s (2) 300 m/s (3) 350 m/s (4) 339 m/s

21. The fundamental frequency in an open organ pipe is equal to the third harmonic of a closed organ pipe. If the length of the closed organ pipe is 20 cm, the length of the open organ pipe is **[NEET 2018]**
(1) 13.2 cm (2) 16 cm (3) 12.5 cm (4) 8 cm

PART - II : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

1. A motor cycle starts from rest and accelerates along a straight path at 2 m/s^2. At the starting point of the motor cycle there is a stationary electric siren. How far has the motor cycle gone when the driver hears the frequency of the siren at 94% of its value when the motor cycle was at rest? (Speed of sound = 330 ms^{-1}) **[AIEEE 2009]**

(1) 98 m (2) 147 m (3) 196 m (4) 49 m

2. Three sound waves of equal amplitudes have frequencies (v - 1), v, (v + 1). They superpose to give beats. The number of beats produced per second will be: **[AIEEE 2009]**

(1) 3 (2) 2 (3) 1 (4) 4

3. A train is moving on a straight track with speed 20 ms^{-1}. It is blowing its whistle at the frequency of 1000 Hz. The percentage change in the frequency heard by a person standing near the track as the train passes him is (speed of sound = 320 ms^{-1}) close to : **[JEE(Main)-2015; 4/120, –1]**

(1) 6% (2) 12% (3) 18% (4) 24%

4. A pipe open at both ends has a fundamental frequency f in air. The pipe is dipped vertically in water so that half of it is in water. The fundamental frequency of the air column is now : **[JEE Main 2016]**

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

5. An observer is moving with half the speed of light towards stationary microwave source emitting waves at frequency 10GHz. What is the frequency of the microwave measured by the observer?

(speed of light = $3 \times 10^8 ms^{-1}$) **[JEE Main 2017]**

(1) 15.3 GHz (2) 10.1 GHz (3) 12.1 GHz (4) 17.3 GHz

6. A granite rod of 60 cm length is clamped at its middle point and is set into longitudinal vibrations. The density of granite is 2.7×10^3 kg/m^3 and its Young's modulus is 9.27×10^{10} Pa. What will be the fundamental frequency of the longitudinal vibrations? **[JEE-Main-2018]**

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

7. A musician using an open flute of length 50 cm produces second harmonic sound waves. A person runs towards the musician from another end of a hall at a speed of 10 km/h. If the wave speed is 330 m/s, the frequency heard by the running person shall be close to : **[JEE-Main-2019]**

(1) 333 Hz (2) 753 Hz (3) 666 Hz (4) 500 Hz

8. A train moves towards a stationary observer with speed 34 m/s. The train sounds a whistle and its frequency registered by the observer if f_1. If the speed of the train is reduced to 17 m/s, the frequency registered is f_2. If speed of sound is 340 m/s, then the ratio f_1/f_2 is : **[JEE-Main-2019]**

(1) $\frac{20}{19}$ (2) $\frac{18}{17}$ (3) $\frac{19}{18}$ (4) $\frac{21}{20}$

9. A resonance tube is old an has jagged end. It is still used in the laboratory to determine velocity of sound in air. A tuning fork of frequency 512 Hz produces first resonance when the tube is filled with water to mark 11 cm below a reference mark, near the open end of the tube. The experiment is repeated with another fork of frequency 256 Hz which produces first resonance when water reaches a mark 27 cm below the reference mark. The velocity of sound in air, obtained in the experiment, is close to :

[JEE-Main-2019]

(1) 322 m/s^{-1} (2) 341 m/s^{-1} (3) 328 m/s^{-1} (4) 335 m/s^{-1}

10. A person standing on an open ground hears the sound of a jet aeroplane, coming from north at an angle 60° with ground level. But he finds the aeroplane right vertically above his position. If v is the speed of sound, speed of the plane is : **[JEE-Main-2019]**

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

Answers

EXERCISE # 1

SECTION (A)

1.	(4)	**2.**	(1)	**3.**	(1)	**4.**	(1)	**5.**	(2)	**6.**	(4)	**7.**	(2)
8.	(4)	**9.**	(1)	**10.**	(1)	**11.**	(2)	**12.**	(2)	**13.**	(2)	**14.**	(4)
15.	(3)	**16.**	(2)	**17.**	(2)	**18.**	(2)	**19.**	(2)				

SECTION (B)

1.	(3)	**2.**	(1)	**3.**	(1)	**4.**	(4)	**5.**	(3)	**6.**	(1)	**7.**	(4)
8.	(2)	**9.**	(3)	**10.**	(2)	**11.**	[BONUS] Correct ans. is 1419 m/s					**12.**	(1)
13.	(2)												

SECTION (C)

1.	(2)	**2.**	(4)	**3.**	(2)	**4.**	(3)	**5.**	(3)	**6.**	(4)	**7.**	(4)
8.	(3)	**9.**	(1)	**10.**	(4)	**11.**	(4)	**12.**	(2)	**13.**	(3)	**14.**	(4)
15*.	(3,4)	**16.**	(1)	**17.**	(1)								

SECTION (D)

1.	(1)	**2.**	(4)	**3.**	(4)

SECTION (E)

1.	(3)	**2.**	(2)	**3.**	(2)	**4.**	(3)	**5.**	(3)	**6.**	(3)	**7.**	(3)
8.	(3)	**9.**	(2)	**10.**	(1)	**11.**	(4)	**12.**	(3)	**13.**	(3)	**14.**	(2)
15.	(2)	**16.**	(4)	**17.**	(2)	**18.**	(2)	**19.**	(1)	**20.**	(2)	**21.**	(3)

SECTION (F)

1.	(2)	**2.**	(1)	**3.**	(1)	**4.**	(1)	**5.**	(2)	**6.**	(1)	**7.**	(1)
8.	(2)	**9.**	(4)	**10.**	(1)	**11.**	(1)	**12.**	(2)	**13.**	(2)	**14.**	(2)
15.	(1)	**16.**	(2)	**17.**	(3)	**18.**	(2)	**19.**	(4)	**20.**	(3)	**21.**	(4)

SECTION (G)

1.	(4)	**2.**	(3)	**3.**	(3)	**4.**	(4)	**5.**	(1)	**6.**	(4)	**7.**	(4)
8.	(1)	**9.**	(4)	**10.**	(4)	**11.**	(1)	**12.**	(4)	**13.**	(2)	**14.**	(2)
15.	(1)	**16.**	(1)	**17.**	(1)	**18.**	(1)	**19.**	(3)	**20.**	(1)	**21.**	(1)
22.	(2)	**23.**	(4)	**24.**	(2)	**25.**	(1)	**26.**	(4)	**27.**	(2)	**28.**	(2)
29.	(1)	**30.**	(1)	**31.**	(4)	**32.**	(4)						

EXERCISE # 2

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

EXERCISE # 3

PART - I

1.	(1)	**2.**	(4)	**3.**	(3)	**4.**	(1)	**5.**	(4)	**6.**	(3)	**7.**	(4)
8.	(3)	**9.**	(4)	**10.**	(3)	**11.**	(2)	**12.**	(1)	**13.**	(4)	**14.**	(4)
15.	(4)	**16.**	(3)	**17.**	(2)	**18.**	(2)	**19.**	(4)	**20.**	(4)	**21.**	(1)

PART - II

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