Practice Problems

Problems based on Progressive waves

▶ *Basic level*

1. In a progressive wave, the distance between two consecutive crests is **[Orissa JEE 2004]**

(a) $\lambda/2$ (b) λ (c) $3/2\lambda$ (d) $\lambda/2$

2. The equation of a wave is $3\cos\pi(50t - x)$. The wavelength of the wave is **[Orissa JEE 2004]**

(a) 3 units (b) 2 units (c) 50 units (d) 47 units

3. If the wave equation $y = 0.08\sin\frac{2\pi}{\lambda}(200t - x)$ then the velocity of the wave will be **[BCECE 2004]**

(a) $400\sqrt{2}$ (b) $200\sqrt{2}$ (c) 400 (d) 200

4. A wave of frequency 500 *Hz* has velocity 360 *m/sec*. The distance between two nearest points 60° out of phase, is

[NCERT 1979; MP PET 1989; JIPMER 1997; CPMT 1979, 90, 2003]

(a) 0.6 *cm* (b) 12 *cm* (c) 60 *cm* (d) 120 *cm*

5. The equation of a transverse wave is given by $y = 10\sin\pi(0.01x - 2t)$

where *x* and *y* are in *cm* and *t* is in second. Its frequency is

(a) 10 sec^{-1} (b) 2 sec^{-1} (c) 1 sec^{-1} (d) 0.01 sec^{-1}

6. If the frequency of a wave is $360 s^{-1}$, the distance between two nearest compression & rarefaction is 1m. Then the velocity of wave is

[CPMT 2003]

(a) 720 *m/s* (b) 180*m/s* (c) 360*m/s* (d) 90*m/s*

7. It takes 2.0 seconds for a sound wave to travel between two fixed points when the day temperature is 10^{o} *C*. If the temperature rise to 30^{o} *C* the sound wave travels between the same fixed points in

(a) 1.9 *sec* (b) 2.0 *sec* (c) 2.1 *sec* (d) 2.2 *sec*

8. The equation of a wave is given as $y = 0.07\sin(12\pi x - 3000\pi t)$. Where x is in *metre* and t in sec, then the correct statement is

[UPSEAT 2003]

(a) $\lambda = 1/6m, v = 250m/s$ (b) $a = 0.07m, v = 300m/s$ (c) $n = 1500, v = 200m/s$ (d) None of these

9. The equation of the propagating wave is $y = 25\sin(20t + 5x)$, where y is displacement. Which of the following statement is not true

[MP PET 2003]

(a) The amplitude of the wave is 25 units (b) The wave is propagating in positive x -direction

(c) The velocity of the wave is 4 units (d) The maximum velocity of the particles is 500 units

10. In a plane progressive wave given by $y = 25\cos(2\pi t - \pi x)$, the amplitude and frequency are respectively **[BCECE 2003]**

(a) 25,100 (b) 25, 1 (c) 25, 2 (d) 50π, 2

11. If v_m is the velocity of sound in moist air, v_d is the velocity of sound in dry air, under identical conditions of pressure and temperature

[KCET 2003]

(a) $v_m > v_d$ (b) $v_m < v_d$ (c) $v_m = v_d$ (d) $v_m v_d = 1$

12. The displacement y of a wave travelling in the x-direction is given by $y = 10^{-4}\sin\left(600t - 2x + \frac{\pi}{3}\right)$ metres, where x is expressed in metres and t in seconds. The speed of the wave-motion, in ms^{-1}, is

(a) 200 (b) 300 (c) 600 (d) 1200

13. The equation $y = A\cos^2\left(2\pi nt - 2\pi\frac{x}{\lambda}\right)$ represents a wave with

(a) Amplitude $A/2$, frequency $2n$ and wavelength $\lambda/2$ (b) Amplitude $A/2$, frequency $2n$ and wavelength λ

(c) Amplitude A, frequency $2n$ and wavelength 2λ (d) Amplitude A, frequency n and wavelength λ

14. v_1 and v_2 are the velocities of sound at the same temperature in two monoatomic gases of densities ρ_1 and ρ_2 respectively. If $\rho_1/\rho_2 = \frac{1}{4}$ then the ratio of velocities v_1 and v_2 will be

(a) 1 : 2 (b) 4 : 1 (c) 2 : 1 (d) 1 : 4

15. The temperature at which the speed of sound in air becomes double of its value at $0^o C$ is

(a) $273^o K$ (b) $546^o K$ (c) $1092^o K$ (d) $0^o K$

16. A wave travelling in positive X-direction with $A = 0.2m$ has a velocity of 360 *m/sec*. if $\lambda = 60m$, then correct expression for the wave is

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

(c) $y = 0.2\sin\left[2\pi\left(6t - \frac{x}{60}\right)\right]$ (d) $y = 0.2\sin\left[\pi\left(6t - \frac{x}{60}\right)\right]$

17. The equation for spherical progressive wave is **[CPMT 2002]**

(a) $y = a\sin(\omega t - kx)$ (b) $y = \frac{a}{\sqrt{r}}\sin(\omega t - kx)$ (c) $y = \frac{a}{2}\sin(\omega t - kx)$ (d) $y = \frac{a}{r}\sin(\omega t - kx)$

18. A stone is dropped into a lake from a tower 500 *metre* high. The sound of the splash will be heard by the man approximately after

[CPMT 1992; JIPMER 2001, 2002]

(a) 11.5 *sec* (b) 21 *sec* (c) 10 *sec* (d) 14 *sec*

19. The equation of a plane progressive wave is given by $y = 0.25\sin(100t + 0.25x)$. The frequency of this wave would be

[CPMT 1993; JIPMER 2001, 2002]

(a) $\frac{50}{\pi}Hz$ (b) $\frac{100}{\pi}Hz$ (c) 100 *Hz* (d) 50 *Hz*

20. The equation of a sound wave is

$$y = 0.0015\sin(62.4x + 316t)$$

The wavelength of this wave is

(a) 0.2 unit (b) 0.1 unit (c) 0.3 unit (d) Cannot be calculated

21. The equation of a travelling wave is

$$y = 60\cos(1800t - 6x)$$

where y is in microns, t in seconds and x in meters. The ratio of maximum particle velocity to velocity of wave propagation is

[CBSE PMT 1997; JIPMER 2001, 2002]

(a) 3.6×10^{-11} (b) 3.6×10^{-6} (c) 3.6×10^{-4} (d) 3.6

22. The wave equation is $y = 0.30 \sin(314t - 1.57x)$ where *t, x* and *y* are in second, meter and centimeter respectively. The speed of the wave is **[CPMT 1997; AFMC 1999; CPMT 2001]**

(a) 100 *m/s* (b) 200 *m/s* (c) 300 *m/s* (d) 400 *m/s*

23. Transverse waves can propagate

(a) Both in a gas and a metal (b) In a gas but not in a metal

(c) Not in a gas but in a metal (d) Neither in a gas nor in a metal

24. The sound carried by air from a sitar to a listener is a wave of the following type

(a) Longitudinal stationary (b) Transverse progressive (c) Transverse stationary (d)

25. A tuning fork produces wave in medium. If the temperature of the medium changes then which of following will change

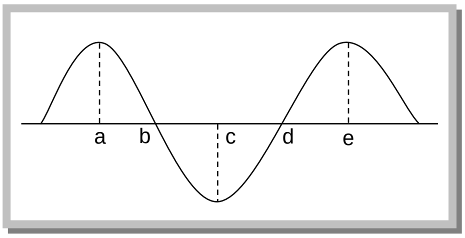
[MH CET 2001]

(a) Time period (b) Wavelength (c) Frequency (d) Amplitude

26. The equation of a longitudinal wave is represented as $y = 20 \cos \pi(50t - x)$. Its wavelength is

(a) 5 *m* (b) 2 *m* (c) 50 *m* (d) 20 *m*

27. The rope shown at an instant is carrying a wave travelling towards right, created by a source vibrating at a frequency n. Consider the following statements



I. The speed of the wave is $4n \times ab$

II. The medium at a will be in the same phase as d after $\frac{4}{3n}s$

III. The phase difference between b and e is $\frac{3\pi}{2}$

Which of these statements are correct **[AMU 2001]**

(a) I, II and III (b) II only (c) I and III (d) III only

28. To increase the frequency from 100 *Hz* to 400 *Hz* the tension in the string has to be changed by

(a) 4 times (b) 16 times (c) 20 times (d) None of these

29. Velocity of sound in air

I. Increases with temperature II. Decreases with temperature

III. Increase with pressure IV. Is independent of pressure

V. Is independent of temperature

Choose the correct answer.

(a) Only I and II are true (b) Only I and III are true (c) Only II and III are true (d) Only I and IV are true

30. The speed of a wave in a medium is 760 *m/s*. If 3600 waves are passing through a point, in the medium in 2 minutes, then its wavelength is

(a) 13.8 *m* (b) 25.3 *m* (c) 41.5 *m* (d) 57.2 *m*

31. A string of 7 *m* length has a mass of 0.035 *kg*. If tension in the string is 60.5*N*, then speed of a wave on the string is **[CBSE PMT 2001]**

(a) 77 *m/s* (b) 102 *m/s* (c) 110 *m/s* (d) 165 *m/s*

32. The relation between phase difference and path difference is

(a) $\Delta\phi = \frac{2\pi}{\lambda}\Delta x$ (b) $\Delta\phi = 2\pi\lambda\Delta x$ (c) $\Delta\phi = \frac{2\pi\lambda}{\Delta x}$ (d) $\Delta\phi = \frac{2\Delta x}{\lambda}$

33. The frequency of a rod is 200 *Hz*. If the velocity of sound in air is 340 ms^{-1}, the wavelength of the sound produced is

[EAMCET (Med.) 1995; Pb. PMT 1999; CPMT 2000]

(a) 1.7 *cm* (b) 6.8 *cm* (c) 1.7 *m* (d) 6.8 *m*

34. If the pressure amplitude in a sound wave is tripled, then the intensity of sound is increased by a factor of**[CPMT 1992;**

(a) 9 (b) 3 (c) 6 (d) $\sqrt{3}$

35. 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

(a) $\sqrt{\frac{m_1}{m_2}}$ (b) $\sqrt{\frac{m_2}{m_1}}$ (c) $\frac{m_1}{m_2}$ (d) $\frac{m_2}{m_1}$

36. A man is standing between two parallel cliffs and fires a gun. If he hears first and second echoes after 1.5 *s* and 3.5*s* respectively, the distance between the cliffs is (Velocity of sound in air = 340 ms^{-1})

(a) 1190 *m* (b) 850 *m* (c) 595 *m* (d) 510 *m*

37. When the temperature of an ideal gas is increased by 600 *K*, the velocity of sound in the gas becomes $\sqrt{3}$ times the initial velocity in it. The initial temperature of the gas is

(a) $-73^\circ C$ (b) $27^\circ C$ (c) $127^\circ C$ (d) $327^\circ C$

38. The frequency of a sound wave is *n* and its velocity is *v*. If the frequency is increased to $4n$, the velocity of the wave will be

[MP PET 2000]

(a) v (b) $2v$ (c) $4v$ (d) $v/4$

39. In a transverse progressive wave of amplitude A, the maximum particle velocity is four times of its wave velocity. The wavelength of the wave is

(a) $\frac{\pi A}{4}$ (b) $\frac{\pi A}{2}$ (c) πA (d) $2\pi A$

40. A man fires a bullet standing between two cliffs. First echo is heard after 3 seconds and second echo is heard after 5 *seconds*. If the velocity of sound is 330 *m/s*, then the distance between the cliffs is

(a) 1650 *m* (b) 1320 *m* (c) 990 *m* (d) 660 *m*

41. A string on a musical instrument is 50 *cm* long and its fundamental frequency is 270 *Hz*. If the desired frequency of 1000 *Hz* is to be produced, the required length of the string is

(a) 13.5 *cm* (b) 2.7 *cm* (c) 5.4 *cm* (d) 10.3 *cm*

42. Consider the following statements.

Assertion (*A*) : Like sound, light can not propagate in vacuum.

Reason (*R*) : Sound is a square wave. It propagates in a medium by a virtue of damping oscillation

Of these statements

(a) Both *A* and *R* are true and the *R* is a correct explanation of the *A*

(b) Both *A* and *R* are true but the *R* is not a correct explanation of the *A*

(c) *A* is true but the *R* is false

(d) Both *A* and *R* are false

(e) *A* is false but the *R* is true

43. Sound velocity is maximum in

(a) H_2 (b) N_2 (c) He (d) O_2

44. The minimum distance of reflector surface from the source for listening the echo of sound is **[KCET (Engg./Med.) 2000;**

(a) 28 *m* (b) 18 *m* (c) 19 *m* (d) 16.5 *m*

45. A transverse wave is described by the equation $Y = Y_0 \sin 2\pi\left(ft - \frac{x}{\lambda}\right)$. The maximum particle velocity is four times the wave velocity if

(a) $\lambda = \frac{\pi Y_0}{4}$ (b) $\lambda = \frac{\pi Y_0}{2}$ (c) $\lambda = \pi Y_0$ (d) $\lambda = 2\pi Y_0$

46. The equation of a wave travelling in a string can be written as $y = 3\cos \pi(100t - x)$. Its wavelength is

[MNR 1985; CPMT 1991; MP PMT 1994, 97]

(a) 100 *cm* (b) 2 *cm* (c) 5 *cm* (d) None of the above

47. Which of the property makes difference between progressive and stationary waves

(a) Amplitude (b) Frequency (c) Propagation of energy (d) Phase of the wave

48. Which of the following equation does not represent the progressive wave

(a) $y = A\sin\omega\left(t - \frac{x}{v}\right)$ (b) $y = A\sin 2\pi\left(\frac{t}{T} + \frac{x}{\lambda}\right)$ (c) $y = A\sin\frac{2\pi}{\lambda}(vt - x)$ (d) $y = A\sin 2\pi\left(\frac{t}{T} - \frac{x}{v}\right)$

Problems based on Superposition of waves

49. In an open organ pipe........wave is present **[Orissa JEE 2004]**

(a) Transverse standing wave (b) Longitudinal standing wave

(c) Longitudinal moving wave (d) Transverse moving wave

50. Two waves are propagating to the point *P* along a straight line produced by two sources *A* and *B* of simple harmonic and of equal frequency. The amplitude of every wave at *P* is '*a*' and the phase of *A* is ahead by $\frac{\pi}{3}$ than that of *B* and the distance *AP* is greater than *BP* by 50 *cm*. Then the resultant amplitude at the point *P* will be, if the wavelength is 1 meter **[BVP 2003]**

(a) 2*a* (b) $a\sqrt{3}$ (c) $a\sqrt{2}$ (d) *a*

51. Two tuning forks have frequencies 450 *Hz* and 454 *Hz* respectively. On sounding these forks together, the time interval between successive maximum intensities will be

(a) 1/4 sec (b) 1/2 sec (c) 1 sec (d) 2 sec

52. Two waves of lengths 50 *cm* and 51 *cm* produced 12 beats per second. The velocity of sound is

(a) 306 *m/s* (b) 331 *m/s* (c) 340 *m/s* (d) 360 *m/s*

53. In stationary longitudinal waves, nodes are points of **[SCRA 1994; MP PET 2003]**

(a) Minimum pressure (b) Maximum pressure

(c) Minimum pressure variation (d) Maximum pressure variation

54. A cylindrical tube, open at both ends, has a fundamental frequency f_0 in air. The tube is dipped vertically into water such that half of its length is inside water. The fundamental frequency of the air column now is

[RPET 1999; RPMT 2000; KCET (Engg.) 2002; BHU 2002; BCECE 2003]

(a) $3f_0/4$ (b) f_0 (c) $f_0/2$ (d) $2f_0$

55. Equation of motion in the same direction is given by $y_1 = A\sin(\omega t - kx)$, $y_2 = A\sin(\omega t - kx - \theta)$. The amplitude of the medium particle will be **[BHU 2003]**

(a) $2A\cos\frac{\theta}{2}$ (b) $2A\cos\theta$ (c) $f, 1.2\lambda$ (d) $1.2f, 1.2\lambda$

56. A closed organ pipe and an open organ pipe are tuned to the same fundamental frequency. What is the ratio of lengths **[BHU 2003]**

(a) 1 : 2 (b) 2 : 1 (c) 2 : 3 (d) 4 : 3

57. An open pipe resonates with a tuning fork of frequency 500 *Hz*. it is observed that two successive nodes are formed at distances 16 and 46 *cm* from the open end. The speed of sound in air in the pipe is

(a) 230 *m/s* (b) 300 *m/s* (c) 320 *m/s* (d) 360 *m/s*

58. 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 the first overtone. Calculate the end correction

(a) 0.012m (b) 0.025m (c) 0.05m (d) 0.024m

59. Two sound sources when sounded simultaneously produce four beats in 0.25 second. the difference in their frequencies must be

[BCECE 2003]

(a) 4 (b) 8 (c) 16 (d) 1

60. At nodes in stationary waves

(a) Change in pressure and density are maximum (b) Change in pressure and density are minimum

(c) Strain is zero (d) Energy is minimum

61. Find the fundamental frequency of a closed pipe, if the length of the air column is 42 m. (speed of sound in air = 332 m/sec)

[RPET 2003]

(a) 2 Hz (b) 4 Hz (c) 7 Hz (d) 9 Hz

62. If v is the speed of sound in air then the shortest length of the closed pipe which resonates to a frequency n **[KCET 200**

(a) $\frac{v}{4n}$ (b) $\frac{v}{2n}$ (c) $\frac{2n}{v}$ (d) $\frac{4n}{v}$

63. Two uniform strings A and B made of steel are made to vibrate under the same tension. if the first overtone of A is equal to the second overtone of B and if the radius of A is twice that of B, the ratio of the lengths of the strings is **[EAMCET 2003]**

(a) 1: 2 (b) 1 : 3 (c) 1 : 4 (d) 1 : 6

64. If the length of a stretched string is shortened by 40% and the tension is increased by 44%, then the ratio of the final and initial fundamental frequencies is

(a) 2 : 1 (b) 3 : 2 (c) 3 : 4 (d) 1 : 3

65. Two wires are fixed in a sonometer. Their tensions are in the ratio 8 : 1. The lengths are in the ratio 36 : 35. The diameters are in the ratio 4 : 1. Densities of the materials are in the ratio 1 : 2. If the higher frequency in the setting is 360 Hz. the beat frequency when the two wires are sounded together is

(a) 5 (b) 8 (c) 6 (d) 10

66. A metal wire of linear mass density of 9.8 g/m is stretched with a tension of 10 kg weight between two rigid supports 1 metre apart. The wire passes at its middle point between the poles of a permanent magnet, and it vibrates in resonance when carrying an alternating current of frequency n. The frequency n of the alternating source is **[AIEEE 2003]**

(a) 25 Hz (b) 50 Hz (c) 100 Hz (d) 200 Hz

67. 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

(a) 256 + 5 Hz (b) 256 + 2Hz (c) 256 – 2 Hz (d) 256 – 5Hz

68. The frequency of fundamental tone in an open organ pipe of length 0.48 m *is* 320 Hz. Speed of sound is 320 m/sec. Frequency of fundamental tone in closed organ pipe will be

(a) 153.8 Hz (b) 160.0 Hz (c) 320.0 Hz (d) 143.2 Hz

69. A sonometer wire resonates with a given tuning fork forming standing waves with five antinodes between the two bridges when a mass of 9 kg is suspended from the wire. When this mass is replaced by a mass M, the wire resonates with the same tuning fork forming three antinodes for the same positions of the bridges. The value of M is **[IIT-JEE (Screening) 2002]**

(a) 25 kg (b) 5 kg (c) 12.5 kg (d) 1/25 kg

70. The tension of a stretched string is increased by 69%. In order to keep its frequency of vibration constant, its length must be increased by

(a) 20% (b) 30% (c) $\sqrt{69}$% (d) 69%

71. 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

(a) 286 *cps* (b) 292 *cps* (c) 294 *cps* (d) 288 *cps*

72. Two wires are in unison. If the tension in one of the wires is increased by 2%, 5 beats are produced per second. The initial frequency of each wire is

(a) 200 *Hz* (b) 400 *Hz* (c) 500 *Hz* (d) 1000 *Hz*

73. Two closed organ pipes, when sounded simultaneously gave 4 beats per sec. If longer pipe has a length of 1*m*. Then length of shorter pipe will be, (v = 300 *m/s*)

(a) 185.5 *cm* (b) 94.9 *cm* (c) 90 *cm* (d) 80 *cm*

74. A source of sound placed at the open end of a resonance column sends an acoustic wave of pressure amplitude P_0 inside the tube. If the atmospheric pressure is p_A, then the maximum and minimum pressure at the closed end of the tube will be **[UPSEAT 2002]**

(a) $(P_A + P_0), (P_A - P_0)$ (b) $(P_A + 2P_0), (P_A - 2P_0)$ (c) P_A, P_A (d) $\left(P_A + \frac{1}{2}P_0\right), \left(P_A - \frac{1}{2}P_0\right)$

75. Ten tuning forks are arranged in increasing order of frequency in such a way that any two nearest tuning forks produce 4 beats/sec. The highest frequency is twice of the lowest. Possible highest and the lowest frequencies are **[MP PMT 1990; MH CET 2002]**

(a) 80 and 40 (b) 100 and 50 (c) 44 and 22 (d) 72 and 36

76. If two waves of same frequency and same amplitude respectively, on superimposition produced a resultant disturbance of the same amplitude, the waves differ in phase by

(a) π (b) $2\pi/3$ (c) $\pi/2$ (d) Zero

77. In stationary waves all particles between two nodes pass through the mean position

(a) At different times with different velocities (b) At different times with the same velocity

(c) At the same time with equal velocity (d) At the same time with different velocities

78. For production of beats, the two sources must have **[CBSE PMT 1992; DPMT 2000, 2001]**

(a) Different frequencies and same amplitude (b) Different frequencies

(c) Different frequencies, same amplitude and same phase (d) Different frequencies and same phase

79. Sixteen tuning forks are arranged in order of increasing frequencies. Adjacent successive forks, when sounded together, give 8 beats per second. If the frequency of the last tuning fork is twice that of the first fork, the frequency of the last fork is

[AMU 1999; MP PET 2001]

(a) 256 *Hz* (b) 240 *Hz* (c) 128 *Hz* (d) 120 *Hz*

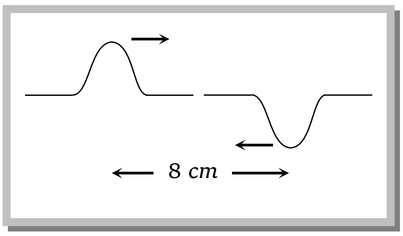
80. It is possible to hear beats from the two vibrating sources of frequency

(a) 100 *Hz* and 150 *Hz* (b) 20 *Hz* and 25 *Hz* (c) 400 *Hz* and 500 *Hz* (d) 1000 *Hz* and 1500 *Hz*

81. The ends of a stretched wire of length L are fixed at $x = 0$ and $x = L$. In one experiment, the displacement of the wire is $y_1 = A\sin(\pi x/L)\sin\omega t$ and energy is E_1, and in another experiment its displacement is $y_2 = A\sin(2\pi x/L)\sin 2\omega t$ and energy is E_2. Then

(a) $E_2 = E_1$ (b) $E_2 = 2E_1$ (c) $E_2 = 4E_1$ (d) $E_2 = 16E_1$

82. Two pulses in a stretched string whose centres are initially 8 *cm* apart are moving towards each other as shown in the figure. The speed of each pulse is 2 *cm/s*. After 2 seconds, the total energy of the pulses will be



(a) Zero

(b) Purely kinetic

(c) Purely potential

(d) Partly kinetic and partly potential

83. In order to double the frequency of the fundamental note emitted by a stretched string, the length is reduced to $\frac{3}{4}^{th}$ of the original length and the tension is changed. The factor by which the tension is to be changed, is

(a) $\frac{3}{8}$ (b) $\frac{2}{3}$ (c) $\frac{8}{9}$ (d) $\frac{9}{4}$

84. Two sound waves of wavelengths 5m and 6m formed 30 beats in 3 seconds. The velocity of sound is

(a) 300 ms^{-1} (b) 310 ms^{-1} (c) 320 ms^{-1} (d) 330 ms^{-1}

85. If the length of a closed organ pipe is 1m and velocity of sound is 330 m/s, then the frequency for the second note is **[AFMC 2001]**

(a) $4\times\frac{330}{4}Hz$ (b) $3\times\frac{330}{4}Hz$ (c) $2\times\frac{330}{4}Hz$ (d) $2\times\frac{4}{330}Hz$

86. The fundamental note produced by a closed organ pipe is of frequency f. The fundamental note produced by an open organ pipe of same length will be of frequency

(a) $\frac{f}{2}$ (b) f (c) $2f$ (d) $4f$

87. Two open organ pipes give 4 beats/sec, when sounded together in their fundamental notes. If the length of the pipes are 100 cm and 102.5 cm respectively, then the velocity of sound is

(a) 160 m/s (b) 240 m/s (c) 328 m/s (d) 496 m/s

88. A second harmonic has to be generated in a string of length l stretched between two rigid supports. The point where the string has to be plucked and touched are

(a) Plucked at $\frac{l}{4}$ and touch at $\frac{l}{2}$ (b) Plucked at $\frac{l}{4}$ and touch at $\frac{3l}{4}$

(c) Plucked at $\frac{l}{2}$ and touched at $\frac{l}{4}$ (d) Plucked at $\frac{l}{2}$ and touched at $\frac{3l}{4}$

89. If the velocity of sound in air is 336 m/s. The maximum length of a closed pipe that would produce a just audible sound will be

[KCET (Engg./Med.) 2001]

(a) 3.2 cm (b) 4.2 m (c) 4.2 cm (d) 3.2 m

90. A resonance air column of length 20 cm resonates with a tuning fork of frequency 250 Hz. The speed of the air is

[AFMC 1999; BHU 2000; CPMT 2001]

(a) 300 m/s (b) 200 m/s (c) 150 m/s (d) 75 m/s

91. Two waves are approaching each other with a velocity of 16 m/s and frequency n. The distance between two consecutive nodes is

[Pb. PMT 1999; CPMT 2001]

(a) $\frac{16}{n}$ (b) $\frac{8}{n}$ (c) $\frac{n}{16}$ (d) $\frac{n}{8}$

92. An organ pipe P_1 closed at one end vibrating in its first overtone and another pipe P_2 open at both ends vibrating in its third overtone are in resonance with a given tuning fork. The ratio of lengths of P_1 and P_2 is

(a) 1 : 2 (b) 1 : 3 (c) 3 : 8 (d) 3 : 4

93. 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 frequency of the last fork is twice the first, then the frequency of the first fork is **[CBSE PMT 2000; MP PET 2001]**

(a) 120 (b) 160 (c) 180 (d) 220

94. Two waves $y = 0.25$ sin $316t$ and $y = 0.25\sin 310\,t$ are travelling in same direction. The number of beats produced per second will be

[CPMT 1993; JIPMER 2000]

(a) 6 (b) 3 (c) $3/\pi$ (d) 3π

95. If the temperature increases, then what happens to the frequency of the sound produced by the organ pipe**[RPMT 1996; D**

(a) Increases (b) Decreases (c) Unchanged (d) Not definite

96. Standing waves are produced in a 10 *m* long stretched string. If the string vibrates in 5 segments and the wave velocity is 20 *m/s*, the frequency is

(a) 2 *Hz* (b) 4 *Hz* (c) 5 *Hz* (d) 10 *Hz*

97. An unknown frequency *x* produces 8 beats per seconds with a frequency of 250 *Hz* and 12 beats with 270 *Hz* source, then *x* is

[CPMT 1997; KCET (Engg./Med.) 2000]

(a) 258 *Hz* (b) 242 *Hz* (c) 262 *Hz* (d) 282 *Hz*

98. $y = a\cos(kx + \omega t)$ superimposes on another wave giving a stationary wave having node at *x* = 0. What is the equation of the other wave

(a) $-a\cos(kx + \omega t)$ (b) $a\cos(kx - \omega t)$ (c) $-a\cos(kx - \omega t)$ (d) $-a\sin(kx + \omega t)$

99. Two sound waves of slightly different frequencies propagating in the same direction produce beats due to**[MP PET 200**

(a) Interference (b) Diffraction (c) Polarization (d) Refraction

100. On sounding tuning fork *A* with another tuning fork *B* of frequency 384 *Hz*, 6 *beats* are produced per second. After loading the prongs of *A* with some wax and then sounding it again with *B*, 4 beats are produced per second. What is the frequency of the tuning fork *A*

[MP PMT 2000]

(a) 388 *Hz* (b) 380 *Hz* (c) 378 *Hz* (d) 390 *Hz*

101. Four wires of identical length, diameters and of the same material are stretched on a sonometre wire. If the ratio of their tensions is 1 : 4 : 9 : 16 then the ratio of their fundamental frequencies are

(a) 16 : 9 : 4 : 1 (b) 4 : 3 : 2 : 1 (c) 1 : 4 : 2 : 16 (d) 1 : 2 : 3 : 4

102. If you set up the ninth harmonic on a string fixed at both ends, what is its frequency compared to the seventh harmonic

[AMU (Engg.) 2000]

(a) Higher (b) Lower (c) Equal (d) None of the above

103. The frequency of a stretched uniform wire under tension is in resonance with the fundamental frequency of a closed tube. If the tension in the wire is increased by 8 *N*, it is in resonance with the first overtone of the closed tube. The initial tension in the wire is

[EAMCET (Engg.) 2000]

(a) 1 *N* (b) 4 *N* (c) 8 *N* (d) 16 *N*

104. Two waves $y_1 = A_1\sin(\omega t - \beta_1)$ and $y_2 = A_2\sin(\omega t - \beta_2)$ Superimpose to form a resultant wave whose amplitude is**[CPMT 19**

(a) $\sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos(\beta_1 - \beta_2)}$ (b) $\sqrt{A_1^2 + A_2^2 + 2A_1A_2\sin(\beta_1 - \beta_2)}$

(c) $A_1 + A_2$ (d) $|A_1 + A_2|$

105. In stationary wave **[MP PET 1987; BHU 1995]**

(a) Strain is maximum at nodes (b) Strain is maximum at antinodes

(c) Strain is minimum at nodes (d) Amplitude is zero at all the points

106. A wave of frequency 100 *Hz* is sent along a string towards a fixed end. When this wave travels back after reflection, a node is formed at a distance of 10 *cm* from the fixed end of the string. The speed of incident (and reflected) wave are **[CBSE PMT 1994]**

(a) 40 *m/s* (b) 20 *m/s* (c) 10 *m/s* (d) 5 *m/s*

107. The stationary wave $y = 2a\sin kx \cos \omega t$ in a closed organ pipe is the result of the superposition of $y = a\sin(\omega t - kx)$ and

[Roorkee 1994]

(a) $y = -a\cos(\omega t + kx)$ (b) $y = -a\sin(\omega t + kx)$ (c) $y = a\sin(\omega t - kx)$ (d) $y = a\cos(\omega t + kx)$

108. Out of the given four waves

$y = a\sin(kx + \omega t)$ .....(1) $y = a\sin(\omega t - kx)$ .....(2)

$y = a\cos(kx + \omega t)$ .....(3) $y = a\cos(\omega t - kx)$ .....(4)

Emitted by four different sources S_1, S_2, S_3 and S_4 respectively, interference phenomena would be observed in space under appropriate conditions when

(a) Source S_1 emits wave (1) and S_4 emits wave (4)

(b) Source S_2 emits wave (2) and S_4 emits wave (4)

(c) Source S_1 emits wave (1) and S_2 emits wave (3)

(d) Interference phenomenon cannot be observed by the combination of any of the above waves

109. The phase difference between the two particles situated on both the sides of a node is

(a) 0° (b) 90° (c) 180° (d) 360°

110. In large room, a person receives direct sound waves from a source 120 *meters* away from him. He also receive waves from the same source which reach him, being reflected from the 25 *meter* high ceiling at the point halfway between them. The two waves interfere constructively for wavelength of

(a) 20, 20/3, 20/5 *etc.* (b) 10, 5, 2.5 *etc.* (c) 10, 20, 30 *etc* (d) 15, 25, 35 *etc*

Problems based on Doppler's effect

111. Doppler effect is independent of **[Orissa JEE 2004]**

(a) Distance between source and listener (b) Velocity of source

(c) Velocity of listener (d) None of these

112. A source and an observer approach each other with same velocity 50 *m/s*. If the apparent frequency is 435 s^{-1}, then the real frequency is

(a) 320 s^{-1} (b) 360 s^{-1} (c) 390 s^{-1} (d) 420 s^{-1}

113. A source emits a sound of frequency of 400 *Hz*, but the listener hears it to be 390 *Hz*. Then

(a) The listener is moving towards the source (b) The source is moving towards the listener

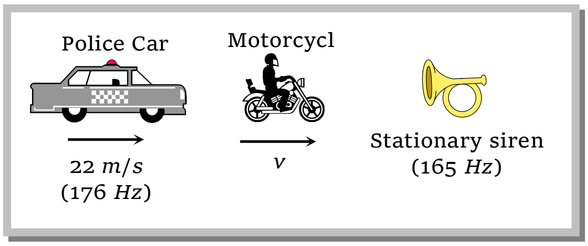
(c) The listener is moving away from the source (d) The listener has a defective ear

114. A source and an observer are moving towards each other with a speed equal to $\frac{v}{2}$ where v is the speed of sound. The source is emitting sound of frequency n. The frequency heard by the observer will be

(a) Zero (b) n (c) $\frac{n}{3}$ (d) $3n$

115. A police car moving at 22 *m/s*, chases a motorcyclist. The police man sounds his horn at 176 *Hz*, while both of them move towards a stationary siren of frequency 165 *Hz*. Calculate the speed of the motorcycle, if it is given that he does not observes any beats

[IIT-JEE (Screening) 2003]



(a) 33 *m/s*

(b) 22 *m/s*

(c) Zero

(d) 11 *m/s*

116. An observer moves towards a stationary source of sound with a speed $1/5^{th}$ of the speed of sound. The wavelength and frequency of the source emitted are λ and f respectively. The apparent frequency and wavelength recorded by the observer are respectively

[CBSE PMT 2003]

(a) $1.2\,f, \lambda$ (b) $f, 1.2\lambda$ (c) $0.8f, 0.8\lambda$ (d) $1.2f, 1.2\lambda$

117. When an engine passes near to a stationary observer then its apparent frequencies occurs in the ratio 5/3. If the velocity of engine is

[MP PMT 2003]

(a) 540 *m/s* (b) 270 *m/s* (c) 85 *m/s* (d) 52.5 *m/s*

118. 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 **[IIT-JEE (Screening) 2002]**

(a) 242/252 (b) 2 (c) 5/6 (d) 11/6

119. A racing car moving towards a cliff, sounds its horn. The driver observes that the sound reflected from the cliff has a pitch one octave higher than the actual sound of the horn. If v is the velocity of sound, then the velocity of the car is **[KCET 2002]**

(a) $v/\sqrt{2}$ (b) $v/2$ (c) $v/3$ (d) $v/4$

120. A person carrying a whistle emitting continuously a note of 272 *Hz* is running towards a reflecting surface with a speed of 18 *km/hour*. The speed of sound in air is $345 ms^{-1}$. The number of beats heard by him is

(a) 4 (b) 6 (c) 8 (d) 3

121. A bus is moving with a velocity of 5 *m/s* towards a huge wall. the driver sounds a horn of frequency 165 *Hz*. If the speed of sound in air is 355 *m/s*, the number of beats heard per second by a passenger on the bus will be

(a) 6 (b) 5 (c) 3 (d) 4

122. A car sounding a horn of frequency 1000 *Hz* passes an observer. The ratio of frequencies of the horn noted by the observer before and after passing of the car is 11 : 9. If the speed of sound is *v*, the speed of the car is

(a) $\frac{1}{10}v$ (b) $\frac{1}{2}v$ (c) $\frac{1}{5}v$ (d) v

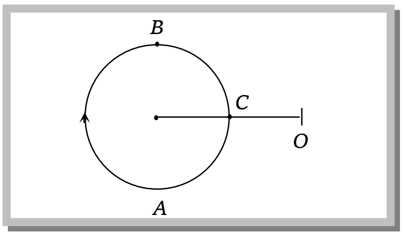
123. What should be the velocity of a sound source moving towards a stationary observer so that apparent frequency is double the actual frequency (Velocity of sound is *v*)

(a) v (b) $2v$ (c) $\frac{v}{2}$ (d) $\frac{v}{4}$

124. Two trains are moving towards each other at speeds of 20 *m/s* and 15 *m/s* relative to the ground. The first train sounds a whistle of frequency 600 *Hz*. the frequency of the whistle heard by a passenger in the second train before the train meets is (the speed of sound in air is 340 *m/s*)

(a) 600 *Hz* (b) 585 *Hz* (c) 645 *Hz* (d) 666 *Hz*

125. A small source of sound moves on a circle as shown in the figure and an observer is sitting on O. Let n_1, n_2 and n_3 be the frequencies heard when the source is at A, B and C respectively. Then



(a) $n_1 > n_2 > n_3$

(b) $n_2 > n_3 > n_1$

(c) $n_1 = n_2 > n_3$

(d) $n_2 > n_1 > n_3$

126. Two sirens situated one kilometer apart are producing sound of frequency 330 *Hz*. An observer starts moving from one siren to the other with a speed of 2 *m/s*. If the speed of sound be 330 *m/s*, what will be the beat frequency heard by the observer

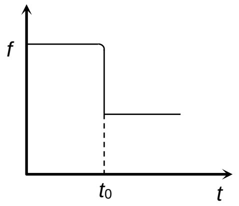
[RPMT 1996; CPMT 2002]

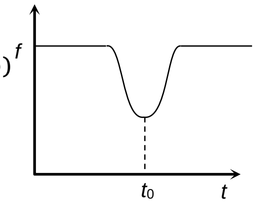
(a) 8 (b) 4 (c) 6 (d) 1

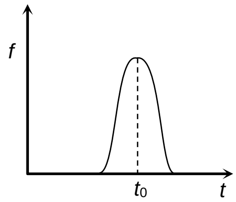
127. Suppose that the speed of sound in air at a given temperature is 400 *m/sec*. An engine blows a whistle at 1200 *Hz* frequency. It is approaching an observer at the speed of 100 *m/sec*. What is the apparent frequency as heard by the observer **[DPMT 2001]**

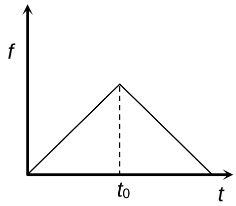
(a) 1600 *Hz* (b) 1500 *Hz* (c) 1200 *Hz* (d) 600 *Hz*

128. A man is standing on a railway platform listening to the whistle of an engine that passes the man at constant speed without stopping. If the engine passes the man at time t_0. How does the frequency f of the whistle as heard by the man changes with time **[AMU 2001]**

(a) 

(b) 

(c) 

(d) 

129. A source is moving towards an observer with a speed of 20 *m/s* and having frequency of 240 *Hz*. The observer is now moving towards the source with a speed of 20 *m/s*. Apparent frequency heard by observer, if velocity of sound is 340 *m/s*, is

[CPMT 2000; KCET (Engg./Med.) 2001]

(a) 240 *Hz* (b) 270 *Hz* (c) 280 *Hz* (d) 360 *Hz*

130. A source and an observer move away from each other with a velocity of 10 *m/s* with respect to ground. If the observer finds the frequency of sound coming from the source as 1950 *Hz*, then actual frequency of the source is (velocity of sound in air = 340 *m/s*)

[MH CET 2000; AFMC 2000; CBSE PMT 2001]

(a) 1950 *Hz* (b) 2068 *Hz* (c) 2132 *Hz* (d) 2486 *Hz*

131. Maximum number of beat frequency heard by a human being is

(a) 10 (b) 4 (c) 20 (d) 6

132. A source of sound of frequency 90 *vibrations/ sec* is approaching a stationary observer with a speed equal to 1/10 the speed of sound. What will be the frequency heard by the observer

(a) 80 *vibrations/sec* (b) 90 *vibrations/sec* (c) 100 *vibrations/sec* (d) 120 *vibrations/sec*

133. A train moves towards a stationary observer with speed 34 *m/s*. The train sounds a whistle and its frequency registered by the observer is f_1. If the train's speed is reduced to 17 *m/s*, the frequency registered is f_2. If the speed of sound is 340 *m/s* then the ratio f_1/f_2 is

[IIT-JEE (Screening) 2000]

(a) 18/19 (b) 1/2 (c) 2 (d) 19/18

134. The frequency of a whistle of an engine is 600 *cycles/sec* is moving with the speed of 30 *m/sec* towards an observer. The apparent frequency will be (velocity of sound = 330 *m/s*)

(a) 600 cps (b) 660 cps (c) 990 cps (d) 330 cps

135. A source of sound of frequency 450 cycles/sec is moving towards a stationary observer with 34 *m/sec* speed. If the speed of sound is 340 *m/sec*, then the apparent frequency will be

(a) 410 cycles/sec (b) 500 cycles/sec (c) 550 cycles/sec (d) 450 cycles/sec

136. When the source is moving towards the stationary observer, the apparent frequency is given by

(a) $n_1 = \frac{vn}{v - v_s}$ (b) $n_1 = \frac{vn}{v + v_s}$ (c) $n_1 = \frac{(v + v_o)n}{v}$ (d) $n_1 = \frac{v + v_o}{v - v_s}$

137. Two passenger trains moving with a speed of 108 *km/hour* cross each other. One of them blows a whistle whose frequency is 750 *Hz*. If sound speed is 330 *m/s*, then passengers sitting in the other train, after trains cross each other will hear sound whose frequency will be

(a) 900 *Hz* (b) 625 *Hz* (c) 750 *Hz* (d) 800 *Hz*

138. A boy is walking away from a wall towards an observer at a speed of 1 *meter/second* and blows a whistle whose frequency is 680 *Hz*. The number of beats heard by the observer per second is (Velocity of sound in air = 340 *meters/sec*) **[MP PMT 1995]**

(a) Zero (b) 2 (c) 8 (d) 4

Miscellaneous problems

139. If fundamental frequency of closed pipe is 50 *Hz* then frequency of 2nd overtone is

(a) 100 *Hz* (b) 50 *Hz* (c) 250 *Hz* (d) 150 *Hz*

140. The phase difference between two waves, represented by

$$y_1 = 10^{-6}\sin[100t + (x/50) + 0.5]m$$

$$y_2 = 10^{-6}\cos[100t + (x/50)]m$$

where x is expressed in meters and t is expressed in seconds, is approximately

(a) 1.07 radians (b) 2.07 radians (c) 0.5 radians (d) 1.5 radians

141. In forced oscillation of a particle the amplitude is maximum for a frequency ω_1 of the force, while the energy is maximum for a frequency ω_2 of the force, then

(a) $\omega_1 = \omega_2$

(b) $\omega_1 > \omega^2$

(c) $\omega_1 < \omega_2$ when damping is small and $\omega_1 > \omega_2$ when damping is large

(d) $\omega_1 < \omega_2$

142. A man x can hear only upto 10 *kHz* and another man y upto 20 *kHz*. A note of frequency 500 *Hz* is produced before them from a stretched string. Then

(a) Both will hear sounds of same pitch but different quality

(b) Both will hear sounds of different pitch but same quality

(c) Both will hear sounds of different pitch and different quality

(d) Both will hear sounds of same pitch and same quality

143. 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. If eight oscillations are counted when the plate falls through 10 *cm*, the frequency of the tuning fork is **[KCET 2002]**

(a) 360 *Hz* (b) 280 *Hz* (c) 560 *Hz* (d) 56 *Hz*

144. Consider the following statements

Assertion (*A*) : The flash of lightening is seen before the sound of thunder is heard.

Reason (*R*) : Speed of sound is greater than speed of light

Of these statements **[AIIMS 2002]**

(a) Both *A* and *R* are true and the *R* is a correct explanation of the *A*

(b) Both *A* and *R* are true but the *R* is not a correct explanation of the *A*

(c) *A* is true but the *R* is false

(d) Both *A* and *R* are false

(e) A is false but the R is true

145. Consider the following

I. Waves created on the surfaces of a pond water by a vibrating sources.

II. Wave created by an oscillating electric field in air.

III. Sound waves travelling under water.

Which of these can be polarized

(a) I and II (b) II only (c) II and III (d) I, II and III

146. An air column in a pipe, which is closed at one end, will be in resonance with a vibrating body of frequency 166 Hz, if the length of the air column is

(a) 2.00 m (b) 1.50 m (c) 1.00 m (d) 0.50 m

147. An empty vessel is partially filled with water, then the frequency of vibration of air column in the vessel **[KCET (Engg./**

(a) Remains same (b) Decreases

(c) Increases (d) First increases then decreases

148. It is desired to increase the fundamental resonance frequency in a tube which is closed at one end. This can be achieved by

[Roorkee 2000]

(a) Replacing the air in the tube by hydrogen gas (b) Increasing the length of the tube

(c) Decreasing the length of the tube (d) Opening the closed end of the tube

149. Quality of a musical note depends on **[KCET (Engg./Med.) 1999; RPET 2000]**

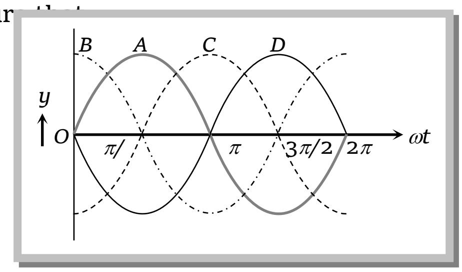
(a) Harmonics present (b) Amplitude of the wave

(c) Fundamental frequency (d) Velocity of sound in the medium

150. A wave is reflected from a rigid support. The change in phase on reflection will be

(a) $\pi/4$ (b) $\pi/2$ (c) π (d) 2π

151. The figure shows four progressive waves A, B, C, and D with their phases expressed with respect to the wave A. It can be concluded from the figur



(a) The wave C is ahead by a phase angle of $\pi/2$ and the wave B lags behind by a phase angle of $\pi/2$

(b) The wave C lags behind by a phase angle of $\pi/2$ and the wave B is ahead by a phase angle of $\pi/2$

(c) The wave C is ahead by a phase angle of π and the wave B lags behind by a phase angle of π

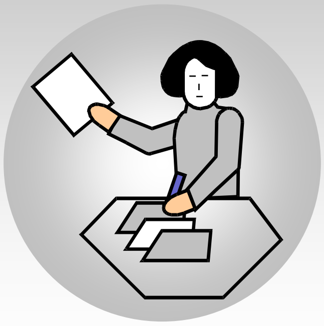
(d) The wave C lags behind by a phase angle of π and the wave B ahead by a phase angle of π

152. Amplitude of a wave is represented by

$$A = \frac{c}{a+b+c}$$

Then resonance will occur when

(a) $b = -c/2$ (b) $b = 0$ and $a = -c$ (c) $b = -a/2$ (d) None of these



Answer Sheet (Practice problems)

1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**
b	b	d	b	c	a	a	a	b	b
11.	**12.**	**13.**	**14.**	**15.**	**16.**	**17.**	**18.**	**19.**	**20.**
a	b	a	c	c	c	d	a	a	b
21.	**22.**	**23.**	**24.**	**25.**	**26.**	**27.**	**28.**	**29.**	**30.**
c	b	c	d	b	b	c	b	d	b
31.	**32.**	**33.**	**34.**	**35.**	**36.**	**37.**	**38.**	**39.**	**40.**
c	a	c	a	b	b	b	a	b	b
41.	**42.**	**43.**	**44.**	**45.**	**46.**	**47.**	**48.**	**49.**	**50.**
a	d	a	d	b	b	c	d	b	d
51.	**52.**	**53.**	**54.**	**55.**	**56.**	**57.**	**58.**	**59.**	**60.**
a	a	b	b	a	a	b	b	c	a
61.	**62.**	**63.**	**64.**	**65.**	**66.**	**67.**	**68.**	**69.**	**70.**
a	a	b	a	d	b	d	b	a	b
71.	**72.**	**73.**	**74.**	**75.**	**76.**	**77.**	**78.**	**79.**	**80.**
b	c	b	a	d	b	d	b	b	b
81.	**82.**	**83.**	**84.**	**85.**	**86.**	**87.**	**88.**	**89.**	**90.**
c	b	d	a	b	c	c	a	b	b
91.	**92.**	**93.**	**94.**	**95.**	**96.**	**97.**	**98.**	**99.**	**100.**
b	c	a	c	a	c	a	c	a	d
101.	**102.**	**103.**	**104.**	**105.**	**106.**	**107.**	**108.**	**109.**	**110.**
d	a	a	a	a	b	b	b	a	a
111.	**112.**	**113.**	**114.**	**115.**	**116.**	**117.**	**118.**	**119.**	**120.**
a	a	c	d	b	a	c	b	c	c
121.	**122.**	**123.**	**124.**	**125.**	**126.**	**127.**	**128.**	**129.**	**130.**
b	a	c	d	b	b	a	c	b	b
131.	**132.**	**133.**	**134.**	**135.**	**136.**	**137.**	**138.**	**139.**	**140.**
a	c	d	b	b	a	b	d	c	a
141.	**142.**	**143.**	**144.**	**145.**	**146.**	**147.**	**148.**	**149.**	**150.**
a	d	d	c	b	d	c	a, c, d	a	c
151.	**152.**								
b	b								