N.B.Navale

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PHYSICS

13.AC CIRCUITS ,SOUND

Single Correct Answer Type

1. Sound waves of wavelength λ travelling in a medium with a speed of v m/s enter into another medium, where its speed is 2v m/s. Wavelength of sound waves in the second medium is
   a) λ b) $\frac{\lambda}{2}$
   c) 2λ d) 4λ

2. Sound waves of wavelength λ travelling in a medium with a speed of v m/s enter into another medium, where its speed is 2v m/s. Wavelength of sound waves in the second medium is
   a) λ b) $\frac{\lambda}{2}$
   c) 2λ d) 4λ

3. A sound wave is travelling with a frequency of 50 Hz. The phase difference between the two points in the path of a wave is π/3. The distance between those two points is (Velocity of sound in air = 330 m/s)
   a) 1.1 m b) 0.6 m
   c) 2.2 m d) 1.7 m

4. A sound wave is travelling with a frequency of 50 Hz. The phase difference between the two points in the path of a wave is π/3. The distance between those two points is (Velocity of sound in air = 330 m/s)
   a) 1.1 m b) 0.6 m
   c) 2.2 m d) 1.7 m

5. The equations of displacement of two waves are given as
$$y_1 = 10 \sin\left(3\pi t + \frac{\pi}{3}\right)$$
$$y_y = 5\left(\sin 5\pi t + \sqrt{3}\cos 5\pi t\right)$$
   Then, what is the ratio of their amplitudes?
   a) 1 : 2 b) 2 : 1
   c) 1 : 1 d) None of these

6. The equations of displacement of two waves are given as
$$y_1 = 10 \sin\left(3\pi t + \frac{\pi}{3}\right)$$
$$y_y = 5\left(\sin 5\pi t + \sqrt{3}\cos 5\pi t\right)$$
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   a) 1 : 2 b) 2 : 1
   c) 1 : 1 d) None of these

7. A wave of frequency 400 Hz has a wave velocity of 300 ms^{-1}. The phase difference between two displacements at a certain point at times $t = 10^{-3}$ s apart is
   a) 72° b) 102°
   c) 180° d) 144°

8. A wave of frequency 400 Hz has a wave velocity of 300 ms^{-1}. The phase difference between two displacements at a certain point at times $t = 10^{-3}$ s apart is
   a) 72° b) 102°
   c) 180° d) 144°

9. If a source emitting waves of frequency f moves towards an observer with a velocity $\frac{V}{4}$ and the observer moves away from the source with a veiocity $v/6$, the apparent frequency as heard by the observer will be (where, v = velocity of sound)
   a) $\frac{14}{15}f$ b) $\frac{14}{9}f$
   c) $\frac{10}{9}f$ d) $\frac{2}{3}f$

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   a) $\frac{14}{15}f$ b) $\frac{14}{9}f$
   c) $\frac{10}{9}f$ d) $\frac{2}{3}f$

11. A uniform metal of length 'L', mass 'M' and density 'ρ' is under a tension 'T'. If the speed of the transverse wave along the wire is 'V', then area of cross-section of the wire is
   a) $T^2\rho^1V^{-2}$ b) $T\rho^{-2}V^{-1}$
   c) $T\rho V^{-2}$ d) $T\rho^{-1}V^{-2}$

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   a) $T^2\rho^1V^{-2}$ b) $T\rho^{-2}V^{-1}$
   c) $T\rho V^{-2}$ d) $T\rho^{-1}V^{-2}$

13. A progressive wave in a medium is represented by the equation
$y = 0.1 \sin\left(10\pi t - \frac{5}{11}\pi x\right)$
where, y and x are in cm and t is in second. The maximum speed of a particle of the medium due to the wave is
a) $1\ cms^{-1}$ b) $10\ cms^{-1}$
c) $\pi\ cms^{-t}$ d) $10\ \pi cms^{-1}$

14. A progressive wave in a medium is represented by the equation
$y = 0.1 \sin\left(10\pi t - \frac{5}{11}\pi x\right)$
where, y and x are in cm and t is in second. The maximum speed of a particle of the medium due to the wave is
a) $1\ cms^{-1}$ b) $10\ cms^{-1}$
c) $\pi\ cms^{-t}$ d) $10\ \pi cms^{-1}$

15. Velocity of sound waves in air is 'V' m/s. For a particular sound wave in air, path difference of 'x' cm is equivalent to phase difference nπ. The frequency of this wave is
a) $\frac{Vn}{x}$ b) $\frac{V}{nx}$
c) $\frac{Vn}{2x}$ d) $\frac{2x}{V}$

16. Velocity of sound waves in air is 'V' m/s. For a particular sound wave in air, path difference of 'x' cm is equivalent to phase difference nπ. The frequency of this wave is
a) $\frac{Vn}{x}$ b) $\frac{V}{nx}$
c) $\frac{Vn}{2x}$ d) $\frac{2x}{V}$

17. Two monoatomic ideal gases A and B 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 A to that in gas B is given by
a) $\sqrt{\frac{m_1}{m_2}}$ b) $\frac{m_2}{m_1}$
c) $\sqrt{\frac{m_2}{m_1}}$ d) $\frac{m_1}{m_2}$

18. Two monoatomic ideal gases A and B 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 A to that in gas B is given by
a) $\sqrt{\frac{m_1}{m_2}}$ b) $\frac{m_2}{m_1}$
c) $\sqrt{\frac{m_2}{m_1}}$ d) $\frac{m_1}{m_2}$

19. Two tuning fork of frequencies 320 Hz and 480 Hz are sounded together to produce sound waves. The velocity of sound in air is $320\ ms^{-1}$. The difference between wavelengths of these waves is nearly
a) 48 cm b) 16.5 cm
c) 33 cm d) 42 cm

20. Two tuning fork of frequencies 320 Hz and 480 Hz are sounded together to produce sound waves. The velocity of sound in air is $320\ ms^{-1}$. The difference between wavelengths of these waves is nearly
a) 48 cm b) 16.5 cm
c) 33 cm d) 42 cm

21. A pulse of sound wave travels a distance l in hellum gas in time T at a particular temperature. If at the same temperature, a pulse of sound wave is propagated in oxygen gas, it will cover the same distance l in time
a) 4.36 T b) 0.23 T
c) 3 T d) 0.46T

22. A pulse of sound wave travels a distance l in hellum gas in time T at a particular temperature. If at the same temperature, a pulse of sound wave is propagated in oxygen gas, it will cover the same distance l in time
a) 4.36 T b) 0.23 T
c) 3 T d) 0.46T

23. The speed of sound in a mixture of 1 mole of helium and 2 mol of oxygen at 27°C is
a) $800\ ms^{-1}$ b) $400.8\ ms^{-1}$
c) $600\ ms^{-1}$ d) $1200\ ms^{-1}$

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a) $800\ ms^{-1}$ b) $400.8\ ms^{-1}$
c) $600\ ms^{-1}$ d) $1200\ ms^{-1}$

25. A train is moving towards a stationary observer with speed 33 m/s. The train sounds a whistle of frequency 450 Hz. If the speed of sound is 330 m/s, the frequency heard by the observer in Hz is
a) 500 b) 495
c) 517 d) 505

26. A train is moving towards a stationary observer with speed 33 m/s. The train sounds a whistle of frequency 450 Hz. If the speed of sound is 330 m/s, the frequency heard by the observer in Hz is
a) 500 b) 495
c) 517 d) 505

27. A sound is produced between two vertical parallel walls. The echo from one wall is heard after 2 s while from the other 2 s after the first echo. The speed of sound in air is 340 ms^{-1}. Choose the correct option.

a) The distance between two walls is 680 m.
b) The distance between two walls is 1020 m
c) The next echo will be heard after 8 s from the instant original sound was produce
d) None of the above

28. A sound is produced between two vertical parallel walls. The echo from one wall is heard after 2 s while from the other 2 s after the first echo. The speed of sound in air is 340 ms^{-1}. Choose the correct option.

a) The distance between two walls is 680 m.
b) The distance between two walls is 1020 m
c) The next echo will be heard after 8 s from the instant original sound was produce
d) None of the above

29. Sound level of a sound of intensity l is 30 dB. The ratio I/I_0 is (where, I_0 is the threshold of hearing).

a) 30
b) 300
c) 1000
d) 3000

30. Sound level of a sound of intensity l is 30 dB. The ratio I/I_0 is (where, I_0 is the threshold of hearing).

a) 30
b) 300
c) 1000
d) 3000

31. Change in temperature of the medium, changes

a) frequency of sound waves
b) amplitude of sound waves
c) wavelength of sound waves
d) loudness of sound waves

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a) frequency of sound waves
b) amplitude of sound waves
c) wavelength of sound waves
d) loudness of sound waves

33. Ultrasonic waves can be used to

a) detect submarines, icebergs
b) clean clothes and fine machinery parts
c) to kill smaller animals like rats, fish and frogs, etc.
d) All of the above

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a) detect submarines, icebergs
b) clean clothes and fine machinery parts
c) to kill smaller animals like rats, fish and frogs, etc.
d) All of the above

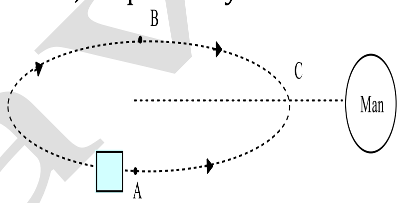
35. The equation of a simple harmonic progressive wave is given by $y = A\sin(100\,\pi t - 3x)$. Find the distance between 2 particles having a phase difference of $\frac{\pi}{3}$,

a) $\frac{\pi}{9}$ m
b) $\frac{\pi}{18}$ m
c) $\frac{\pi}{6}$ m
d) $\frac{\pi}{3}$ m

36. The equation of a simple harmonic progressive wave is given by $y = A\sin(100\,\pi t - 3x)$. Find the distance between 2 particles having a phase difference of $\frac{\pi}{3}$,

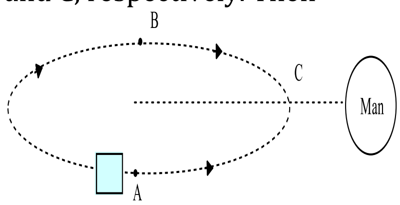
a) $\frac{\pi}{9}$ m
b) $\frac{\pi}{18}$ m
c) $\frac{\pi}{6}$ m
d) $\frac{\pi}{3}$ m

37. A small source of sound moves on a circle as shown in the figure and an observer is standing at 0. 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) $n_2 > n_1 > n_3$

38. A small source of sound moves on a circle as shown in the figure and an observer is standing at 0. 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) $n_2 > n_1 > n_3$

39. The apparent wavelength of the light from a star moving away from the earth is 0.01% more than its real wavelength. The speed of the star with respect to earth is

a) 10 km/s
b) 15 km/s
c) 30 km/s
d) 60 km/s

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a) 10 km/s
b) 15 km/s
c) 30 km/s
d) 60 km/s

41. The ratio of the speed of sound in nitrogen gas to that in helium gas at 300 K, is

a) $\sqrt{\frac{2}{7}}$ b) $\sqrt{\frac{1}{7}}$
c) $\frac{\sqrt{3}}{5}$ d) $\frac{\sqrt{6}}{5}$

42. The ratio of the speed of sound in nitrogen gas to that in helium gas at 300 K, is
a) $\sqrt{\frac{2}{7}}$ b) $\sqrt{\frac{1}{7}}$
c) $\frac{\sqrt{3}}{5}$ d) $\frac{\sqrt{6}}{5}$

43. Two monoatomic ideal gases A and B 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 A to that in gas B is given by
a) $\frac{m_1}{m_2}$ b) $\sqrt{\frac{m_1}{m_2}}$
c) $\frac{m_2}{m_1}$ d) $\sqrt{\frac{m_2}{m_1}}$

44. Two monoatomic ideal gases A and B 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 A to that in gas B is given by
a) $\frac{m_1}{m_2}$ b) $\sqrt{\frac{m_1}{m_2}}$
c) $\frac{m_2}{m_1}$ d) $\sqrt{\frac{m_2}{m_1}}$

45. In a medium, sound travels 2 km in 3 s and in air, it travels 3 km in 10 s. The ratio of the wavelengths of sound in the two media is
a) 1 : 8 b) 1 : 18
c) 8 : 1 d) 20 : 9

46. In a medium, sound travels 2 km in 3 s and in air, it travels 3 km in 10 s. The ratio of the wavelengths of sound in the two media is
a) 1 : 8 b) 1 : 18
c) 8 : 1 d) 20 : 9

47. A wave equation which gives the displacement along y-direction is given by $y = 10^{-4}\sin(60t + x)$, where x and y are in metre and t is time in second. This represents a wave
a) travelling with a velocity of 300 ms^{-1} in the negative x-direction b) of wavelength π metre
c) of frequency $\frac{30}{\pi}$ Hz d) of amplitude 10^4 m travelling along the positive x-direction'

48. A wave equation which gives the displacement along y-direction is given by $y = 10^{-4}\sin(60t + x)$, where x and y are in metre and t is time in second. This represents a wave
a) travelling with a velocity of 300 ms^{-1} in the negative x-direction b) of wavelength π metre
c) of frequency $\frac{30}{\pi}$ Hz d) of amplitude 10^4 m travelling along the positive x-direction'

49. A sound absorber attenuates the sound level by 20 dB. The intensity decreases by a factor of
a) 1000 b) 10000
c) 10 d) 100

50. A sound absorber attenuates the sound level by 20 dB. The intensity decreases by a factor of
a) 1000 b) 10000
c) 10 d) 100

51. If the frequency of sound produced by a siren increases from 400 Hz to 1200 Hz while the wave amplitude remains constant, the ratio of the intensity of the 1200 Hz to that of the 400 Hz wave will
a) 1:1 b) 1:3
c) 3:1 d) 9:1

52. If the frequency of sound produced by a siren increases from 400 Hz to 1200 Hz while the wave amplitude remains constant, the ratio of the intensity of the 1200 Hz to that of the 400 Hz wave will
a) 1:1 b) 1:3
c) 3:1 d) 9:1

53. A train blowing the whistle moves with a constant velocity 'V' away from an observer standing on the platform. The ratio of the natural frequency of the whistle 'n' to the apparent frequency is 1.2:1. If the train is at rest and the observer moves away from it at the same velocity 'V', the ratio of 'n' to the apparent frequency is
a) 1.52:1 b) 0.51:1
c) 2.05:1 d) 1.25:1

54. A train blowing the whistle moves with a constant velocity 'V' away from an observer standing on the platform. The ratio of the natural frequency of the whistle 'n' to the apparent frequency is 1.2:1. If the train is at rest and the observer moves away from it at the same velocity 'V', the ratio of 'n' to the apparent frequency is
a) 1.52:1 b) 0.51:1
c) 2.05:1 d) 1.25:1

55. Oxygen is 16 times heavier than hydrogen.

Equal volumes of hydrogen and oxygen are mixed. The ratio of speed of sound in the mixture to that in hydrogen is

a) $\sqrt{\frac{1}{8}}$ b) $\sqrt{\frac{32}{17}}$

c) $\sqrt{8}$ d) $\sqrt{\frac{2}{17}}$

56. Oxygen is 16 times heavier than hydrogen. Equal volumes of hydrogen and oxygen are mixed. The ratio of speed of sound in the mixture to that in hydrogen is

a) $\sqrt{\frac{1}{8}}$ b) $\sqrt{\frac{32}{17}}$

c) $\sqrt{8}$ d) $\sqrt{\frac{2}{17}}$

57. Two cars are moving on two perpendicular roads towards a crossing with uniform speeds of 72 kmh^{-1} and 36 kmh^{-1}. If first car blows horn of frequency 280 Hz, then the frequency of horn heard by the driver of second car when line joining the cars make 45° angle with the roads, will be (Take, v = 340 m/s)

a) 321 Hz b) 298 Hz

c) 289 Hz d) 280 Hz

58. Two cars are moving on two perpendicular roads towards a crossing with uniform speeds of 72 kmh^{-1} and 36 kmh^{-1}. If first car blows horn of frequency 280 Hz, then the frequency of horn heard by the driver of second car when line joining the cars make 45° angle with the roads, will be (Take, v = 340 m/s)

a) 321 Hz b) 298 Hz

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59. Frequency range of the audible sounds is

a) 0Hz-30 Hz b) 20 Hz-20 kHz

c) 20 kHz-20000 kHz d) 20 kHz-20 MHz

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a) 0Hz-30 Hz b) 20 Hz-20 kHz

c) 20 kHz-20000 kHz d) 20 kHz-20 MHz

61. How many times more intense is 90 dB sound than 40 dB sound?

a) 5 b) 50

c) 500 d) 10^5

62. How many times more intense is 90 dB sound than 40 dB sound?

a) 5 b) 50

c) 500 d) 10^5

63. A whistle emitting a sound of frequency 440 Hz is tied to a string of 1.5 m length and rotated with an angular velocity of 20 $rads^{-1}$ in the horizontal plane. Then, the range of frequencies hard by an observer stationed at a large distance from the whistle will be (Take, V = 330 ms^{-1})

a) 400.0 Hz to 484.0Hz b) 403.3 Hz to 480.0 Hz

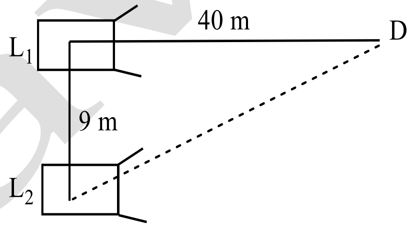
c) 400.0 Hz to 480.0 Hz d) 403.3 Hz to 484.0 Hz

64. A whistle emitting a sound of frequency 440 Hz is tied to a string of 1.5 m length and rotated with an angular velocity of 20 $rads^{-1}$ in the horizontal plane. Then, the range of frequencies hard by an observer stationed at a large distance from the whistle will be (Take, V = 330 ms^{-1})

a) 400.0 Hz to 484.0Hz b) 403.3 Hz to 480.0 Hz

c) 400.0 Hz to 480.0 Hz d) 403.3 Hz to 484.0 Hz

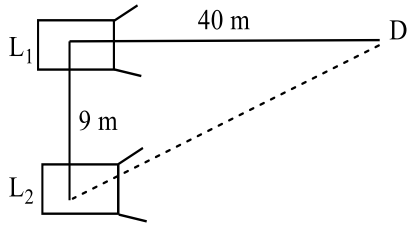
65. The loudspeakers L_1 and L_2 driven by a common oscillator and amplifier are set up as shown in the figure. As the frequency of the oscillator increases from zero, the detector at D recorded a series of maximum and minimum signals.
What is the frequency at which the first maximum is observed? (Take, speed of sound = 330 ms^{-1})



a) 165 Hz b) 330 Hz

c) 495 Hz d) 660 Hz

66. The loudspeakers L_1 and L_2 driven by a common oscillator and amplifier are set up as shown in the figure. As the frequency of the oscillator increases from zero, the detector at D recorded a series of maximum and minimum signals.
What is the frequency at which the first maximum is observed? (Take, speed of sound = 330 ms^{-1})



a) 165 Hz b) 330 Hz

c) 495 Hz d) 660 Hz

67. A transverse wave is propagating on the string. The linear density of a vibrating string is 10^3 kg/m. The equation of the wave is $y = 0.05 \sin(x + 15 t)$, where x and y are measured in metre and time in second. The tension force in the string is

a) 0.2 N b) 0.250 N

c) 0.225 N d) 0.325 N

68. A transverse wave is propagating on the string. The linear density of a vibrating string is 10^3 kg/m. The equation of the wave is $y = 0.05 \sin(x + 15t)$, where x and y are measured in metre and time in second. The tension force in the string is

a) 0.2 N b) 0.250 N
c) 0.225 N d) 0.325 N

69. The ratio of the speed of sound in helium gas to that in nitrogen gas at same temperature is $\left(\gamma_{He} = \frac{5}{3}, \gamma_{N_2} = \frac{7}{5}, M_{He} = 4, M_{N_2} = 28\right)$

a) $\sqrt{\frac{5}{3}}$ b) $\frac{5}{\sqrt{3}}$
c) $\sqrt{\frac{2}{7}}$ d) $\sqrt{\frac{7}{5}}$

70. The ratio of the speed of sound in helium gas to that in nitrogen gas at same temperature is $\left(\gamma_{He} = \frac{5}{3}, \gamma_{N_2} = \frac{7}{5}, M_{He} = 4, M_{N_2} = 28\right)$

a) $\sqrt{\frac{5}{3}}$ b) $\frac{5}{\sqrt{3}}$
c) $\sqrt{\frac{2}{7}}$ d) $\sqrt{\frac{7}{5}}$

71. The displacement y of a particle on a straight line is given by $y = f(x, t)$, as a function of time. Which of the following functions does not represent wave motion?

a) $y = A\sin(kx - \omega t)$ b) $y = A\sin^2(kx - \omega t)$
c) $y = A\sin(k^2x^2 - \omega^2t^2)$ d) $y = A\sin\left(kx + \omega t + \frac{\pi}{10}\right)$

72. The displacement y of a particle on a straight line is given by $y = f(x, t)$, as a function of time. Which of the following functions does not represent wave motion?

a) $y = A\sin(kx - \omega t)$ b) $y = A\sin^2(kx - \omega t)$
c) $y = A\sin(k^2x^2 - \omega^2t^2)$ d) $y = A\sin\left(kx + \omega t + \frac{\pi}{10}\right)$

73. The temperature in degree Celsius at which the velocity of sound in air will be double its velocity at 0°C is

a) 546°C b) 819°C
c) 1092°C d) 273°C

74. The temperature in degree Celsius at which the velocity of sound in air will be double its velocity at 0°C is

a) 546°C b) 819°C
c) 1092°C d) 273°C

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

a) −73°C b) 27°C
c) 127°C d) 327°C

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

a) −73°C b) 27°C
c) 127°C d) 327°C

77. The Doppler's effect is applicable for

a) Light waves b) Sound waves
c) Matter waves d) Both (a) and (b)

78. The Doppler's effect is applicable for

a) Light waves b) Sound waves
c) Matter waves d) Both (a) and (b)

79. A sound wave of frequency 160 Hz has a velocity of 320 m/s. When it travels through air, the particles having a phase difference of 90^0, are separately by a distance of

a) 50 cm b) 1 cm
c) 25 cm d) 75 cm

80. A sound wave of frequency 160 Hz has a velocity of 320 m/s. When it travels through air, the particles having a phase difference of 90^0, are separately by a distance of

a) 50 cm b) 1 cm
c) 25 cm d) 75 cm

81. The phase difference between two points is $\pi/3$. If the frequency of wave is 50 Hz, then what is the distance between two points? (Take, $v = 330\ ms^{-1}$)

a) 2.2 m b) 1.1 m
c) 0.6 m d) 1.7 m

82. The phase difference between two points is $\pi/3$. If the frequency of wave is 50 Hz, then what is the distance between two points? (Take, $v = 330\ ms^{-1}$)

a) 2.2 m b) 1.1 m
c) 0.6 m d) 1.7 m

83. Distance between a compression and adjoining rarefaction in a pressure wave is

a) λ b) $\frac{\lambda}{2}$
c) $\frac{\lambda}{4}$ d) $\frac{\lambda}{3}$

84. Distance between a compression and adjoining rarefaction in a pressure wave is

a) λ b) $\frac{\lambda}{2}$
c) $\frac{\lambda}{4}$ d) $\frac{\lambda}{3}$

85. The distance between two points differing in

phase by 60° on a wave having wave velocity $360\ ms^{-1}$ and frequency 500 Hz is

a) 0.36 m b) 0.18 m

c) 0.48 m d) 0.12 m

86. The distance between two points differing in phase by 60° on a wave having wave velocity $360\ ms^{-1}$ and frequency 500 Hz is

a) 0.36 m b) 0.18 m

c) 0.48 m d) 0.12 m

87. A tuning fork of frequency 220 Hz produces sound waves of wavelength 1.5 m in air at NTP. The increase in wavelength when temperature of air is 27°C, is

a) 0.07 m b) 0.08 m

c) 0.09 m d) 0.10 m

88. A tuning fork of frequency 220 Hz produces sound waves of wavelength 1.5 m in air at NTP. The increase in wavelength when temperature of air is 27°C, is

a) 0.07 m b) 0.08 m

c) 0.09 m d) 0.10 m

89. The velocity of sound in air is 'V_s'. If the density of air is doubled, then the velocity of sound will be

a) $2V_s$ b) V_s

c) $\frac{V_s}{\sqrt{2}}$ d) $\frac{\sqrt{2}}{V_s}$

90. The velocity of sound in air is 'V_s'. If the density of air is doubled, then the velocity of sound will be

a) $2V_s$ b) V_s

c) $\frac{V_s}{\sqrt{2}}$ d) $\frac{\sqrt{2}}{V_s}$

91. An observer is approaching a stationary source with a velocity $\left(\frac{1}{4}\right)$ th of the velocity of sound. Then, the ratio of the apparent frequency heard by the observer to the actual frequency of the source is

a) 5:4 b) 2:3

c) 3:2 d) 4:5

92. An observer is approaching a stationary source with a velocity $\left(\frac{1}{4}\right)$ th of the velocity of sound. Then, the ratio of the apparent frequency heard by the observer to the actual frequency of the source is

a) 5:4 b) 2:3

c) 3:2 d) 4:5

93. Two copper wires of radii 'r_1' and 'r_2' ($r_1 > r_2$) are subjected to same tension and are plucked. The transverse waves will

a) Travel faster in the thinner wire b) Travel faster in the thicker wire

c) Not travel through both the wires d) Travel with the same velocity in both the wires

94. Two copper wires of radii 'r_1' and 'r_2' ($r_1 > r_2$) are subjected to same tension and are plucked. The transverse waves will

a) Travel faster in the thinner wire b) Travel faster in the thicker wire

c) Not travel through both the wires d) Travel with the same velocity in both the wires

95. The velocity of sound is 340 m/s. A source of sound having frequency of 90 Hz is moving towards a stationary observer with a speed of one-tenth that of sound. The apparent frequency of sound as heard by the observer is

a) 50 Hz b) 45 Hz

c) 100 Hz d) 80 Hz

96. The velocity of sound is 340 m/s. A source of sound having frequency of 90 Hz is moving towards a stationary observer with a speed of one-tenth that of sound. The apparent frequency of sound as heard by the observer is

a) 50 Hz b) 45 Hz

c) 100 Hz d) 80 Hz

97. The velocity of sound hydrogen is $1224\ ms^{-1}$. Its velocity in mixture of hydrogen and oxygen containing 4 parts by volume of hydrogen and 1 part oxygen is

a) $1224\ ms^{-1}$ b) $612\ ms^{-1}$

c) $2448\ ms^{-1}$ d) $306\ ms^{-}$

98. The velocity of sound hydrogen is $1224\ ms^{-1}$. Its velocity in mixture of hydrogen and oxygen containing 4 parts by volume of hydrogen and 1 part oxygen is

a) $1224\ ms^{-1}$ b) $612\ ms^{-1}$

c) $2448\ ms^{-1}$ d) $306\ ms^{-}$

99. The observer is moving with velocity 'v_0' towards the stationary source of sound and then after crossing moves away from the source with velocity 'v_0'. Assume that the medium through which the sound waves travel is at rest. If 'v' is the velocity of sound and 'n' is the frequency emitted by the source then the difference between apparent frequencies heard by the observer is

a) $\frac{2nv_0}{v}$ b) $\frac{nv_0}{v}$

c) $\frac{v}{2nv_0}$ d) $\frac{v}{nv_0}$

100. The observer is moving with velocity 'v_0'

towards the stationary source of sound and then after crossing moves away from the source with velocity 'v_0'. Assume that the medium through which the sound waves travel is at rest. If 'v' is the velocity of sound and 'n' is the frequency emitted by the source then the difference between apparent frequencies heard by the observer is

a) $\frac{2nv_0}{v}$ b) $\frac{nv_0}{v}$
c) $\frac{v}{2nv_0}$ d) $\frac{v}{nv_0}$

101. A source of sound with frequency 256 Hz is moving with a velocity v towards a wall. When the observer is between source and the wall, he finds that the frequency of two waves received directly from the source is x and the frequency of the waves received after reflection from the wall is y, then
a) $x > y$ b) $x < y$
c) $x = y$ d) Nothing can be said

102. A source of sound with frequency 256 Hz is moving with a velocity v towards a wall. When the observer is between source and the wall, he finds that the frequency of two waves received directly from the source is x and the frequency of the waves received after reflection from the wall is y, then
a) $x > y$ b) $x < y$
c) $x = y$ d) Nothing can be said

103. What does not change when sound enters from one medium to another?
a) Wavelength b) Speed
c) Frequency d) None of these

104. What does not change when sound enters from one medium to another?
a) Wavelength b) Speed
c) Frequency d) None of these

105. A man standing between two parallel cliffs fires a gun and hears two echoes, first after one second and 2nd after four second. If the velocity of sound is 340 m/s, the distance between the cliffs is
a) 510 m b) 1020 m
c) 1700 m d) 850 m

106. A man standing between two parallel cliffs fires a gun and hears two echoes, first after one second and 2nd after four second. If the velocity of sound is 340 m/s, the distance between the cliffs is
a) 510 m b) 1020 m
c) 1700 m d) 850 m

107. If the equation of transverse wave is
$$y = 5\sin 2\pi\left(\frac{t}{0.04} - \frac{x}{40}\right)$$
where, distance is in *cm* and time in second, then the wavelength of the wave is
a) 60 cm b) 40 cm
c) 35 cm d) 25 cm

108. If the equation of transverse wave is
$$y = 5\sin 2\pi\left(\frac{t}{0.04} - \frac{x}{40}\right)$$
where, distance is in *cm* and time in second, then the wavelength of the wave is
a) 60 cm b) 40 cm
c) 35 cm d) 25 cm

109. Equation of a progressive wave is given by
$$y = 0.2\cos\pi\left(0.04\,t + 0.02x - \frac{\pi}{6}\right)$$
The distance is expressed in cm and time in second. What will be the minimum distance between two particles having the phase difference of $\frac{\pi}{2}$?
a) 4 cm b) 8 cm
c) 25 cm d) 12.5 cm

110. Equation of a progressive wave is given by
$$y = 0.2\cos\pi\left(0.04\,t + 0.02x - \frac{\pi}{6}\right)$$
The distance is expressed in cm and time in second. What will be the minimum distance between two particles having the phase difference of $\frac{\pi}{2}$?
a) 4 cm b) 8 cm
c) 25 cm d) 12.5 cm

111. The pitch of a sound wave is related to its
a) frequency b) amplitude
c) velocity d) beats

112. The pitch of a sound wave is related to its
a) frequency b) amplitude
c) velocity d) beats

113. A bus is moving with a velocity of 5 m/s towards a wall. The driver blows the horn of frequency 165 Hz. If the speed of sound in air is 335 m/s, then after reflection of sound wave, the number of beats per second heard by the passengers in the bus will be
a) 5 b) 6
c) 2 d) 4

114. A bus is moving with a velocity of 5 m/s towards a wall. The driver blows the horn of frequency 165 Hz. If the speed of sound in air is 335 m/s, then after reflection of sound wave, the number of beats per second heard by the passengers in the bus will be
a) 5 b) 6
c) 2 d) 4

115. A whistle of frequency 500 Hz tied to the end

of a string of length 1.2 m revolves at 400 rev/min. A listener standing some distance away in the plane of rotation of whistle hears frequencies in the range (Take, speed of sound = 340 m/s)

a) 436 to 586 b) 426 to 574
c) 426 to 584 d) 436 to 674

116. A whistle of frequency 500 Hz tied to the end of a string of length 1.2 m revolves at 400 rev/min. A listener standing some distance away in the plane of rotation of whistle hears frequencies in the range (Take, speed of sound = 340 m/s)

a) 436 to 586 b) 426 to 574
c) 426 to 584 d) 436 to 674

117. A sound wave of frequency 160 Hz has a velocity of 320 m/s. When it travels through air, the particles having a phase difference of 90^0, are separately by a distance of

a) 50 cm b) 1 cm
c) 25 cm d) 75 cm

118. A sound wave of frequency 160 Hz has a velocity of 320 m/s. When it travels through air, the particles having a phase difference of 90^0, are separately by a distance of

a) 50 cm b) 1 cm
c) 25 cm d) 75 cm

119. The intensity level of a sound wave is 4 dB. If the intensity of the wave is doubled, then the intensity level of the sound as expressed in dB, would be

a) 8 b) 16
c) 7 d) 14

120. The intensity level of a sound wave is 4 dB. If the intensity of the wave is doubled, then the intensity level of the sound as expressed in dB, would be

a) 8 b) 16
c) 7 d) 14

121. What is the ratio of the velocity of sound in hydrogen $\left(\gamma = \frac{7}{5}\right)$ to that in helium $\left(\gamma = \frac{5}{3}\right)$ at the same temperature? (Molecular weight of hydrogen and helium is 2 and 4 respectively.)

a) $\frac{\sqrt{42}}{5}$ b) $\frac{5}{\sqrt{42}}$
c) $\frac{\sqrt{21}}{5}$ d) $\frac{5}{\sqrt{21}}$

122. What is the ratio of the velocity of sound in hydrogen $\left(\gamma = \frac{7}{5}\right)$ to that in helium $\left(\gamma = \frac{5}{3}\right)$ at the same temperature? (Molecular weight of hydrogen and helium is 2 and 4 respectively.)

a) $\frac{\sqrt{42}}{5}$ b) $\frac{5}{\sqrt{42}}$
c) $\frac{\sqrt{21}}{5}$ d) $\frac{5}{\sqrt{21}}$

123. A transverse wave is travelling on a string with velocity 'V'. The extension in the string is 'x'. If the string is extended by 50%, the speed of the wave along the string will be nearly (Hooke's law is obeyed)

a) 0.9V b) 1.1V
c) 0.7V d) 1.22V

124. A transverse wave is travelling on a string with velocity 'V'. The extension in the string is 'x'. If the string is extended by 50%, the speed of the wave along the string will be nearly (Hooke's law is obeyed)

a) 0.9V b) 1.1V
c) 0.7V d) 1.22V

125. A progressive wave of frequency 50 Hz is travelling with velocity 350 m/s through a medium. The change in phase at a given time interval of 0.01 s is

a) $\frac{3\pi}{2}$ rad b) $\frac{\pi}{4}$ rad
c) π rad d) $\frac{\pi}{2}$ rad

126. A progressive wave of frequency 50 Hz is travelling with velocity 350 m/s through a medium. The change in phase at a given time interval of 0.01 s is

a) $\frac{3\pi}{2}$ rad b) $\frac{\pi}{4}$ rad
c) π rad d) $\frac{\pi}{2}$ rad

127. If the wave equation $y = 0.08 \sin \frac{2\pi}{\lambda}(200t - x)$, then the velocity of the wave (ms^{-1}) will be

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

128. If the wave equation $y = 0.08 \sin \frac{2\pi}{\lambda}(200t - x)$, then the velocity of the wave (ms^{-1}) will be

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

129. A source of sound is moving with constant velocity of 30 m/s emitting a note of frequency 256 Hz. The ratio of frequencies observed by a stationary observer while the source is approaching him and after it crosses him is speed of sound in air = 330 m/s

a) 6:5 b) 9:8
c) 5:6 d) 8:9

130. A source of sound is moving with constant

velocity of 30 m/s emitting a note of frequency 256 Hz. The ratio of frequencies observed by a stationary observer while the source is approaching him and after it crosses him is speed of sound in air = 330 m/s

a) 6:5 b) 9:8
c) 5:6 d) 8:9

131. Velocity of sound in air is
a) Inversely proportional to temperature
b) More in dry air than in moist air
c) Directly proportional to pressure
d) Independent of pressure of air

132. Velocity of sound in air is
a) Inversely proportional to temperature
b) More in dry air than in moist air
c) Directly proportional to pressure
d) Independent of pressure of air

133. The equation of wave motion is $y = 6\sin\left[12\pi t - 0.02\pi x + \frac{\pi}{2}\right]$, where x is in m and t in second. The velocity of the wave is
a) 400 m/s b) 200 m/s
c) 600 m/s d) 100 m/s

134. The equation of wave motion is $y = 6\sin\left[12\pi t - 0.02\pi x + \frac{\pi}{2}\right]$, where x is in m and t in second. The velocity of the wave is
a) 400 m/s b) 200 m/s
c) 600 m/s d) 100 m/s

135. A transverse sinusoidal wave of amplitude a, wavelength λ and frequency n is travelling on a stretched string. The maximum speed of particle is (1/10) th the speed of propagation of the wave. If $a = 10^{-3}$ m and $v = 10\ ms^{-1}$, then λ and n are given by
a) $\lambda = 2\pi \times 10^{-2}$ m b) $\lambda = 10^{-3}$ m
c) $n = \frac{10^4}{2\pi}$ Hz d) $n = 10^4$ Hz

136. A transverse sinusoidal wave of amplitude a, wavelength λ and frequency n is travelling on a stretched string. The maximum speed of particle is (1/10) th the speed of propagation of the wave. If $a = 10^{-3}$ m and $v = 10\ ms^{-1}$, then λ and n are given by
a) $\lambda = 2\pi \times 10^{-2}$ m b) $\lambda = 10^{-3}$ m
c) $n = \frac{10^4}{2\pi}$ Hz d) $n = 10^4$ Hz

137. Under the same conditions of pressure and temperature, the velocity of sound in oxygen and hydrogen gases are V_O and V_H, then
a) $v_H = 2v_0$ b) $v_H = 4v_O$
c) $v_0 = 4v_H$ d) $v_H = v_0$

138. Under the same conditions of pressure and temperature, the velocity of sound in oxygen and hydrogen gases are V_O and V_H, then
a) $v_H = 2v_0$ b) $v_H = 4v_O$
c) $v_0 = 4v_H$ d) $v_H = v_0$

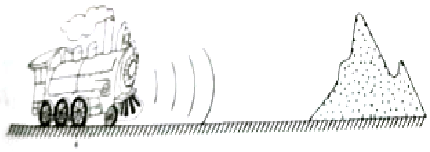
139. A wave travelling in the positive x-direction having displacement along y-direction as 1 m, wavelength 2π metre and frequency of $\frac{1}{\pi}$ Hz is represented by
a) $y = \sin(x - 2t)$ b) $y = \sin(2\pi x - 2\pi t)$
c) $y = \sin(10\pi x - 20\pi t)$ d) $y = \sin(2\pi x + 2\pi t)$

140. A wave travelling in the positive x-direction having displacement along y-direction as 1 m, wavelength 2π metre and frequency of $\frac{1}{\pi}$ Hz is represented by
a) $y = \sin(x - 2t)$ b) $y = \sin(2\pi x - 2\pi t)$
c) $y = \sin(10\pi x - 20\pi t)$ d) $y = \sin(2\pi x + 2\pi t)$

141. 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

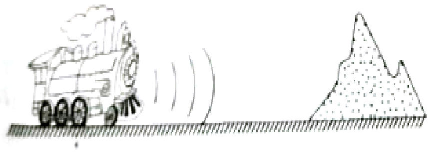
142. A source emits a sound of frequency of 400 Hz, but the listener hears it to be 390 Hz. Then,
a) the listener is moving towards the source
b) the source is moving towards the listener
c) the listener is moving away from the source
d) the listener has a defective ear

143. An engine approaches a hill with a constant speed. When it is at a distance of 0.9 km, it blows a whistle, whose echo is heard by the driver after 5 s. If speed of sound in air is 330 m/s, the speed of engine is



a) 10 m/s b) 20 m/s
c) 30 m/s d) 40 m/s

144. An engine approaches a hill with a constant speed. When it is at a distance of 0.9 km, it blows a whistle, whose echo is heard by the driver after 5 s. If speed of sound in air is 330 m/s, the speed of engine is



a) 10 m/s   b) 20 m/s
c) 30 m/s   d) 40 m/s

145. If wavelength of a wave is $\lambda = 6000\text{Å}$, then wave number will be
a) $166 \times 10^3\ m^{-1}$ b) $16.6 \times 10^1\ m^{-1}$
c) $1.66 \times 10^\circ\ m^{-1}$ d) $1.66 \times 10^7\ m^{-1}$

146. If wavelength of a wave is $\lambda = 6000\text{Å}$, then wave number will be
a) $166 \times 10^3\ m^{-1}$ b) $16.6 \times 10^1\ m^{-1}$
c) $1.66 \times 10^\circ\ m^{-1}$ d) $1.66 \times 10^7\ m^{-1}$

147. Which one of the following statements is true?
a) The sound waves in air are longitudinal while the light waves in air are transverse
b) Both light and sound waves in air are transverse
c) Both light and sound waves in air are longitudinal
d) The sound waves are transverse and light waves are longitudinal

148. Which one of the following statements is true?
a) The sound waves in air are longitudinal while the light waves in air are transverse
b) Both light and sound waves in air are transverse
c) Both light and sound waves in air are longitudinal
d) The sound waves are transverse and light waves are longitudinal

149. The loudness and pitch of a sound depends on
a) Intensity and velocity   b) Frequency and velocity
c) Intensity and frequency   d) frequency and number of harmonics

150. The loudness and pitch of a sound depends on
a) Intensity and velocity   b) Frequency and velocity
c) Intensity and frequency   d) frequency and number of harmonics

151. A source of sound of frequency 600 Hz is placed inside water. The speed of sound in water is $1500\ ms^{-1}$ and in air is $300\ ms^{-1}$. The frequency of sound recorded by an observer who is standing in air, is
a) 200 Hz   b) 3000 Hz
c) 120 Hz   d) 600 Hz

152. A source of sound of frequency 600 Hz is placed inside water. The speed of sound in water is $1500\ ms^{-1}$ and in air is $300\ ms^{-1}$. The frequency of sound recorded by an observer who is standing in air, is
a) 200 Hz   b) 3000 Hz
c) 120 Hz   d) 600 Hz

153. A source of sound is moving towards a stationary observer with velocity 'V_s' and then moves away with velocity 'V_s'. Assume that the medium through which the sound waves travel is at rest. If 'V' is the velocity of sound and 'n' is the frequency emitted by the source then the difference between the apparent frequencies heard by the observer is difficult
a) $\frac{2nVV_S}{(V^2 - V_S^2)}$ b) $\frac{n^2VV_S}{V^2 + V_S^2}$
c) $\frac{nVV_S}{(V^2 + V_S^2)}$ d) $\frac{nVV_S}{(V^2 - V_S^2)}$

154. A source of sound is moving towards a stationary observer with velocity 'V_s' and then moves away with velocity 'V_s'. Assume that the medium through which the sound waves travel is at rest. If 'V' is the velocity of sound and 'n' is the frequency emitted by the source then the difference between the apparent frequencies heard by the observer is difficult
a) $\frac{2nVV_S}{(V^2 - V_S^2)}$ b) $\frac{n^2VV_S}{V^2 + V_S^2}$
c) $\frac{nVV_S}{(V^2 + V_S^2)}$ d) $\frac{nVV_S}{(V^2 - V_S^2)}$

155. In sine wave, minimum distance between two particles always having same speed is
a) $\frac{\lambda}{2}$ b) $\frac{\lambda}{4}$
c) $\frac{\lambda}{3}$ d) λ

156. In sine wave, minimum distance between two particles always having same speed is
a) $\frac{\lambda}{2}$ b) $\frac{\lambda}{4}$
c) $\frac{\lambda}{3}$ d) λ

157. The extension in a wire obeying Hooke's law is x. The speed of sound in the stretched wire is V. If the extension in the wire is increased to 4x, then the speed of sound in a wire is
a) 2.5v   b) 2v
c) 1.5v   d) v

158. The extension in a wire obeying Hooke's law is x. The speed of sound in the stretched wire is V. If the extension in the wire is increased to 4x, then the speed of sound in a wire is
a) 2.5v   b) 2v

c) 1.5v   d) v

159. A source of sound emitting a note frequency 'n' is approaching a stationary listener. If the frequency of the note heard by the listener is '2n', the velocity of the source (V_s) is equal to [V = velocity of sound in air]

a) V   b) $\frac{V}{3}$

c) 2V   d) $\frac{V}{2}$

160. A source of sound emitting a note frequency 'n' is approaching a stationary listener. If the frequency of the note heard by the listener is '2n', the velocity of the source (V_s) is equal to [V = velocity of sound in air]

a) V   b) $\frac{V}{3}$

c) 2V   d) $\frac{V}{2}$

161. The ratio of intensities between two coherent sound sources is 4: 1. The difference of loudness in decibels (dB) between maximum and minimum intensities, on their interference in space is

a) 20 log 2   b) 10 log 2

c) 20 log 3   d) 10 log 3

162. The ratio of intensities between two coherent sound sources is 4: 1. The difference of loudness in decibels (dB) between maximum and minimum intensities, on their interference in space is

a) 20 log 2   b) 10 log 2

c) 20 log 3   d) 10 log 3

163. The frequencies of three tuning fork A, B and C are related as $n_A > n_B > n_C$. When the forks A and B are sounded together, the number of beats produced per second is 'n_1'. When forks A and C are sounded together the number of beats produced per second is 'n_2'. How may beats are produced per second when forks B and C are sounded together?

a) $n_1 - n_2$ b) $\frac{n_1 + n_2}{2}$

c) $n_2 - n_1$ d) $n_1 + n_2$

164. The frequencies of three tuning fork A, B and C are related as $n_A > n_B > n_C$. When the forks A and B are sounded together, the number of beats produced per second is 'n_1'. When forks A and C are sounded together the number of beats produced per second is 'n_2'. How may beats are produced per second when forks B and C are sounded together?

a) $n_1 - n_2$ b) $\frac{n_1 + n_2}{2}$

c) $n_2 - n_1$ d) $n_1 + n_2$

165. 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 equal to 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) $\lambda = 2\pi Y_0$

166. 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 equal to 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) $\lambda = 2\pi Y_0$

167. A man standing on a cliff claps his hand and hears its echo after 1s. If sound is reflected from mountain and velocity of sound in air is 340 ms^{-1}, then the distance between the man and reflection point is

a) 680 m   b) 340 m

c) 85 m   d) 170 m

168. A man standing on a cliff claps his hand and hears its echo after 1s. If sound is reflected from mountain and velocity of sound in air is 340 ms^{-1}, then the distance between the man and reflection point is

a) 680 m   b) 340 m

c) 85 m   d) 170 m

169. A string of mass 0.1 kg is under a tension 1.6 N. The length of the string is 1m. A transverse wave starts from one-end of the string. The time taken by the wave to reach the other end is

a) 0.50 s   b) 0.30 s

c) 0.25 s   d) 0.75 s

170. A string of mass 0.1 kg is under a tension 1.6 N. The length of the string is 1m. A transverse wave starts from one-end of the string. The time taken by the wave to reach the other end is

a) 0.50 s   b) 0.30 s

c) 0.25 s   d) 0.75 s

171. A progressive wave is represented by $y = 12 \sin(5t - 4x)$cm. On this wave, how far away are the two points having phase difference of 90° ?

a) $\frac{\pi}{2}$ cm   b) $\frac{\pi}{4}$ cm

c) $\frac{\pi}{8}$ cm   d) $\frac{\pi}{16}$ cm

172. A progressive wave is represented by $y = 12 \sin(5t - 4x)$cm. On this wave, how far

away are the two points having phase difference of 90° ?

a) $\frac{\pi}{2}$ cm b) $\frac{\pi}{4}$ cm
c) $\frac{\pi}{8}$ cm d) $\frac{\pi}{16}$ cm

173. If a star appearing yellow starts accelerating towards the earth, its color appears to be turned

a) Suddenly red b) Gradually red
c) Suddenly blue d) Gradually blue

174. If a star appearing yellow starts accelerating towards the earth, its color appears to be turned

a) Suddenly red b) Gradually red
c) Suddenly blue d) Gradually blue

175. Velocity of sound wave in air is 330 m/s for a particular sound in air ; a path difference of 40 cm is equivalent to a phase difference of 1.6 π. The frequency of this wave is

a) 165 Hz b) 150 Hz
c) 660 Hz d) 330 Hz

176. Velocity of sound wave in air is 330 m/s for a particular sound in air ; a path difference of 40 cm is equivalent to a phase difference of 1.6 π. The frequency of this wave is

a) 165 Hz b) 150 Hz
c) 660 Hz d) 330 Hz

177. Equation of a plane progressive wave is given by $y = 0.6 \sin 2\pi \left(t - \frac{x}{2}\right)$. On reflection from a denser medium, its amplitude becomes (2/3) of the amplitude of the incident wave. The equation of the reflected wave is

a) $y = 0.6 \sin 2\pi \left(t + \frac{x}{2}\right)$ b) $y = -0.4 \sin 2\pi \left(t + \frac{x}{2}\right)$
c) $y = 0.4 \sin 2\pi \left(t + \frac{x}{2}\right)$ d) $y = -0.4 \sin 2\pi \left(t - \frac{x}{2}\right)$

178. Equation of a plane progressive wave is given by $y = 0.6 \sin 2\pi \left(t - \frac{x}{2}\right)$. On reflection from a denser medium, its amplitude becomes (2/3) of the amplitude of the incident wave. The equation of the reflected wave is

a) $y = 0.6 \sin 2\pi \left(t + \frac{x}{2}\right)$ b) $y = -0.4 \sin 2\pi \left(t + \frac{x}{2}\right)$
c) $y = 0.4 \sin 2\pi \left(t + \frac{x}{2}\right)$ d) $y = -0.4 \sin 2\pi \left(t - \frac{x}{2}\right)$

179. Equation of a progressive wave is given by $y = a \sin \pi \left(\frac{t}{2} - \frac{x}{4}\right)$, where t is in second and x is in metre. The distance in metre through which the wave travels in 8 s is

a) 8 b) 16
c) 2 d) 4

180. Equation of a progressive wave is given by $y = a \sin \pi \left(\frac{t}{2} - \frac{x}{4}\right)$, where t is in second and x is in metre. The distance in metre through which the wave travels in 8 s is

a) 8 b) 16
c) 2 d) 4

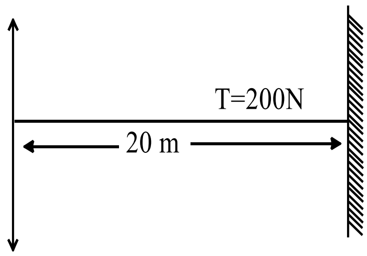
181. Two sinusoidal waves with same wavelengths and amplitudes travel in opposite directions along a string with a speed 10 ms^{-1}. If the minimum time interval between two instants when the string is flat is 0.5 s, the wavelength of the waves is

a) 25 m b) 20 m
c) 15 m d) 10 m

182. Two sinusoidal waves with same wavelengths and amplitudes travel in opposite directions along a string with a speed 10 ms^{-1}. If the minimum time interval between two instants when the string is flat is 0.5 s, the wavelength of the waves is

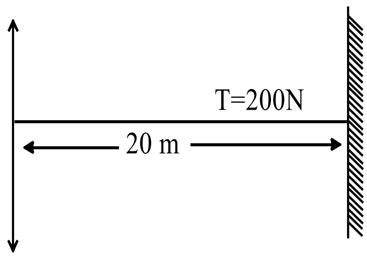
a) 25 m b) 20 m
c) 15 m d) 10 m

183. A string of mass 2.5 kg is under tension of 200 N. The length of the stretched string is 20.0 m. If the transverse jerk is struck at one end of the string, the disturbance will reach the other end in



a) 1 s b) 0.5 s
c) 2 s d) data given is insufficient

184. A string of mass 2.5 kg is under tension of 200 N. The length of the stretched string is 20.0 m. If the transverse jerk is struck at one end of the string, the disturbance will reach the other end in



a) 1 s b) 0.5 s
c) 2 s d) data given is insufficient

185. When the observer moves towards the

stationary source with velocity v_1, the apparent frequency of emitted note is f_1. When the observe moves away from the source with velocity v_1, the apparent frequency is f_2. If v is the velocity of sound in air and $\frac{f_1}{f_2} = 2$, then $\frac{v}{v_1}$ = ?

a) 2 b) 3
c) 4 d) 5

186. When the observer moves towards the stationary source with velocity v_1, the apparent frequency of emitted note is f_1. When the observe moves away from the source with velocity v_1, the apparent frequency is f_2. If v is the velocity of sound in air and $\frac{f_1}{f_2} = 2$, then $\frac{v}{v_1}$ = ?

a) 2 b) 3
c) 4 d) 5

187. Two strings of copper are stretched to the same tension. If their cross-section area are in the ratio 1: 4, then the respective wave velocities will be in the ratio

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

188. Two strings of copper are stretched to the same tension. If their cross-section area are in the ratio 1: 4, then the respective wave velocities will be in the ratio

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

189. A wave is represented by the equation
$y = A\sin\left(10\pi x + 15\pi t + \frac{\pi}{3}\right)$
where, x is in metre and t is in second. The expression represents

a) a wave travelling in positive x-direction with a velocity $1.5\ ms^{-1}$
b) a wave travelling in negative x-direction with a velocity $1.5\ ms^{-1}$
c) a wave travelling in the negative x-direction having a wavelength 0.4 m
d) a wave travelling in positive x-direction of wavelength 0.1 m

190. A wave is represented by the equation
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c) a wave travelling in the negative x-direction having a wavelength 0.4 m
d) a wave travelling in positive x-direction of wavelength 0.1 m

191. An obstacle is moving towards the source with velocity v. The sound is reflected from the obstacle. If c is the speed of sound and λ is the wavelength, then the wavelength of the reflected wave λ, is

a) $\lambda_, = \left(\frac{c-v}{c+v}\right)\lambda$ b) $\lambda_1 = \left(\frac{c+v}{c-v}\right)\lambda$
c) $\lambda_, = \left(\frac{c-v}{c}\right)\lambda$ d) $\lambda_, = \left(\frac{c+v}{c}\right)\lambda$

192. An obstacle is moving towards the source with velocity v. The sound is reflected from the obstacle. If c is the speed of sound and λ is the wavelength, then the wavelength of the reflected wave λ, is

a) $\lambda_, = \left(\frac{c-v}{c+v}\right)\lambda$ b) $\lambda_1 = \left(\frac{c+v}{c-v}\right)\lambda$
c) $\lambda_, = \left(\frac{c-v}{c}\right)\lambda$ d) $\lambda_, = \left(\frac{c+v}{c}\right)\lambda$

193. The speed of sound in air is v. Both the source and observer are moving towards each other with equal speed u. The speed of wind is w from source to observer. Then, then ratio $\left(\frac{f}{f_0}\right)$ of the apparent frequency to the actual frequency is given by

a) $\frac{v+u}{v-u}$ b) $\frac{v+w+u}{v+w-u}$
c) $\frac{v+w+u}{v-w-u}$ d) $\frac{v-w+u}{v-w-u}$

194. The speed of sound in air is v. Both the source and observer are moving towards each other with equal speed u. The speed of wind is w from source to observer. Then, then ratio $\left(\frac{f}{f_0}\right)$ of the apparent frequency to the actual frequency is given by

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c) $\frac{v+w+u}{v-w-u}$ d) $\frac{v-w+u}{v-w-u}$

195. In a medium in which a transverse progressive wave is travelling, the phase difference between two points with a separation of 1.25 cm is $\left(\frac{\pi}{3}\right)$. If the frequency of wave is 1000 Hz, its velocity will be

a) $75\ ms^{-1}$ b) $125\ ms^{-1}$
c) $100\ ms^{-1}$ d) $50\ ms^{-1}$

196. In a medium in which a transverse progressive wave is travelling, the phase difference between two points with a separation of 1.25 cm is $\left(\frac{\pi}{3}\right)$. If the frequency of wave is 1000 Hz, its velocity will be

a) $75\ ms^{-1}$ b) $125\ ms^{-1}$
c) $100\ ms^{-1}$ d) $50\ ms^{-1}$

197. The frequency of a tuning fork with an amplitude A = 1 cm is 250 Hz. The maximum velocity of any particle in air is equal to

a) $10\pi\ ms^{-1}$ b) $5\pi\ ms^{-1}$
c) 2π d) None of these

198. The frequency of a tuning fork with an amplitude $A = 1$ cm is 250 Hz. The maximum velocity of any particle in air is equal to

a) $10\pi\ ms^{-1}$ b) $5\pi\ ms^{-1}$
c) 2π d) None of these

199. The pitch of the whistle of an engine appears to drop by 20% of original value when it passes a stationary observer. If speed of sound in air is 350 m/s, then speed of engine in m/s is

a) 175 b) 87.5
c) 1050 d) 520.5

200. The pitch of the whistle of an engine appears to drop by 20% of original value when it passes a stationary observer. If speed of sound in air is 350 m/s, then speed of engine in m/s is

a) 175 b) 87.5
c) 1050 d) 520.5

201. The extension in a string obeying Hooke's law is x. The speed of transverse waves in the stretched string is v. If the extension in the string is increased to 1.5 x, the speed of transverse waves in it will be

a) 1.22 v b) 2 v
c) 15 v d) v

202. The extension in a string obeying Hooke's law is x. The speed of transverse waves in the stretched string is v. If the extension in the string is increased to 1.5 x, the speed of transverse waves in it will be

a) 1.22 v b) 2 v
c) 15 v d) v

203. Doppler shift in frequency does not depend upon

a) The frequency of the wave produced b) the velocity of the source
c) the velocity of the observer d) distance from the source to the listener

204. Doppler shift in frequency does not depend upon

a) The frequency of the wave produced b) the velocity of the source
c) the velocity of the observer d) distance from the source to the listener

205. Doppler's effect in sound is due to

a) Motion of source b) Motion of observer
c) Relative motion of source and observer d) None of the above

206. Doppler's effect in sound is due to

a) Motion of source b) Motion of observer
c) Relative motion of source and observer d) None of the above

207. A pulse of a wave train travels along a stretched string and reaches the fixed end of the string. It will be reflected with

a) a phase change of 180° with velocity reversed b) the same phase as the incident pulse with no reversal of velocity
c) a phase change of 180° with no reversal of velocity d) the same phase as the incident pulse but with velocity reversed

208. A pulse of a wave train travels along a stretched string and reaches the fixed end of the string. It will be reflected with

a) a phase change of 180° with velocity reversed b) the same phase as the incident pulse with no reversal of velocity
c) a phase change of 180° with no reversal of velocity d) the same phase as the incident pulse but with velocity reversed

209. Wavelength of wave is a distance between two particles which are differing in phase by

a) π b) 2π
c) $\frac{2\pi}{3}$ d) $\frac{\pi}{3}$

210. Wavelength of wave is a distance between two particles which are differing in phase by

a) π b) 2π
c) $\frac{2\pi}{3}$ d) $\frac{\pi}{3}$

211. A table is revolving on its axis at 5 revolutions per, second. A sound source of frequency 1000 Hz is fixed on the table at 70 cm from the axis. The minimum frequency heard by a listener standing at a distance very far from the table will be (Take, speed of sound $= 352\ ms^{-1}$)

a) 1000 Hz b) 1066 Hz
c) 941 Hz d) 352 Hz

212. A table is revolving on its axis at 5 revolutions per, second. A sound source of frequency 1000 Hz is fixed on the table at 70 cm from the axis. The minimum frequency heard by a listener standing at a distance very far from the table will be (Take, speed of sound $= 352\ ms^{-1}$)

a) 1000 Hz b) 1066 Hz
c) 941 Hz d) 352 Hz

213. Two Cu wires of radii R_1, and R_2 suoh that $(R_1 > R_2)$. Then, which of the following is true?

a) Transverse wave travels faster in thicker wire b) Transverse wave travels faster in thinner wire
c) Travels with the same speed in both the wires d) Does not travel

214. Two Cu wires of radii R_1, and R_2 suoh that $(R_1 > R_2)$. Then, which of the following is true?

a) Transverse wave b) Transverse wave

a) travels faster in thicker wire
b) travels faster in thinner wire
c) Travels with the same speed in both the wires
d) Does not travel

215. The velocity of sound through a diatomic gaseous medium of molecular weight M at 0°C, is

a) $\sqrt{\frac{R}{M}}$
b) $\sqrt{\frac{3R}{M}}$
c) $\sqrt{\frac{382R}{M}}$
d) $\sqrt{\frac{273R}{M}}$

216. The velocity of sound through a diatomic gaseous medium of molecular weight M at 0°C, is

a) $\sqrt{\frac{R}{M}}$
b) $\sqrt{\frac{3R}{M}}$
c) $\sqrt{\frac{382R}{M}}$
d) $\sqrt{\frac{273R}{M}}$

217. The wavelength of sound in any gas depends upon

a) Intensity of sound waves only
b) Density and elasticity of the gas
c) Wavelength of sound only
d) Amplitude and frequency of sound

218. The wavelength of sound in any gas depends upon

a) Intensity of sound waves only
b) Density and elasticity of the gas
c) Wavelength of sound only
d) Amplitude and frequency of sound

219. The frequency of a whistle is 300 Hz. It is approaching towards an observer with a speed 1/3 the apeed of sound. The frequency of sound as heard by the observer will be

a) 450 Hz
b) 300 Hz
c) 400 Hz
d) 425 Hz

220. The frequency of a whistle is 300 Hz. It is approaching towards an observer with a speed 1/3 the apeed of sound. The frequency of sound as heard by the observer will be

a) 450 Hz
b) 300 Hz
c) 400 Hz
d) 425 Hz

221. A stone dropped from the top of a tower of height 300 m high splashes into the water of a pond near the base of the tower. When is the splàsh heard at the top? (Take, that the speed of sound in air is 340 m/s and $g = 9.8 \text{ m/s}^2$)

a) 8.7 s
b) 9.7 s
c) 6.7 s
d) 10 s

222. A stone dropped from the top of a tower of height 300 m high splashes into the water of a pond near the base of the tower. When is the splàsh heard at the top? (Take, that the speed of sound in air is 340 m/s and $g = 9.8 \text{ m/s}^2$)

a) 8.7 s
b) 9.7 s
c) 6.7 s
d) 10 s

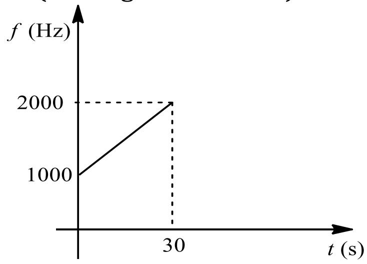
223. A uniform metal wire has length L, mass M and density p. It is under tension T and v is the speed of transverse wave along the wire. The area of cross-section of the wire is

a) $\frac{T}{v^2\rho}$
b) $\frac{v^2p}{T}$
c) T^2pv
d) Tv^2p

224. A uniform metal wire has length L, mass M and density p. It is under tension T and v is the speed of transverse wave along the wire. The area of cross-section of the wire is

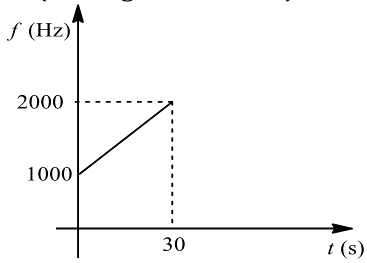
a) $\frac{T}{v^2\rho}$
b) $\frac{v^2p}{T}$
c) T^2pv
d) Tv^2p

225. A detector is released from rest over a source of sound of frequency $f_0 = 10^3$ Hz. The frequency observed by the detector at time t is plotted in the graph. The speed of sound in air is (Take, $g = 10 \text{ ms}^{-2}$)



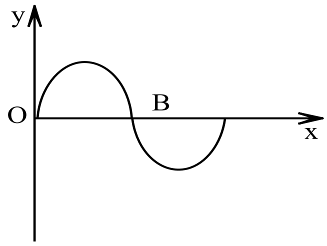
a) 330 ms^{-1}
b) 350 ms^{-1}
c) 300 ms^{-1}
d) 310 ms^{-1}

226. A detector is released from rest over a source of sound of frequency $f_0 = 10^3$ Hz. The frequency observed by the detector at time t is plotted in the graph. The speed of sound in air is (Take, $g = 10 \text{ ms}^{-2}$)



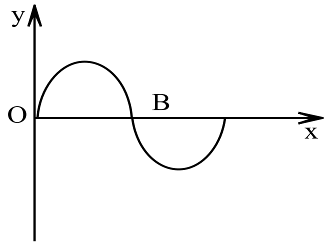
a) 330 ms^{-1}
b) 350 ms^{-1}
c) 300 ms^{-1}
d) 310 ms^{-1}

227. Figure shows the wave $y = A \sin(0 - kx)$. What is the magnitude of slope of the curve at B?



a) $\frac{\omega}{A}$ b) $\frac{k}{A}$
c) kA d) ωA

228. Figure shows the wave $y = A\sin(0 - kx)$. What is the magnitude of slope of the curve at B?



a) $\frac{\omega}{A}$ b) $\frac{k}{A}$
c) kA d) ωA

229. The pitch of the whistle of an engine appears to drop to $\left(\frac{5}{6}\right)$ th of original value when it passes a stationary observer. If the speed of sound in air is 350 ms^{-1}, then the speed of engine is
a) 35 ms^{-1} b) 70 ms^{-1}
c) 105 ms^{-1} d) 140 ms^{-1}

230. The pitch of the whistle of an engine appears to drop to $\left(\frac{5}{6}\right)$ th of original value when it passes a stationary observer. If the speed of sound in air is 350 ms^{-1}, then the speed of engine is
a) 35 ms^{-1} b) 70 ms^{-1}
c) 105 ms^{-1} d) 140 ms^{-1}

231. The phase difference between two points separated by 0.8 m in a wave of frequency 120 Hz is 0.5π. The velocity of wave will be
a) 720 ms^{-1} b) 384 ms^{-1}
c) 256 ms^{-1} d) 144 ms^{-1}

232. The phase difference between two points separated by 0.8 m in a wave of frequency 120 Hz is 0.5π. The velocity of wave will be
a) 720 ms^{-1} b) 384 ms^{-1}
c) 256 ms^{-1} d) 144 ms^{-1}

233. A wave of amplitude $A = 0.2$ m, velocity $v = 360\ ms^{-1}$ and wavelength 60 m is travelling along positive X-axis, then the correct expression for the wave is
a) $y = 0.2\sin 2\pi\left(6t + \frac{x}{60}\right)$ b) $y = 0.2\sin \pi\left(6t + \frac{x}{60}\right)$
c) $y = 0.2\sin 2\pi\left(6t - \frac{x}{60}\right)$ d) $y = 0.2\sin \pi\left(6t - \frac{x}{60}\right)$

234. A wave of amplitude $A = 0.2$ m, velocity $v = 360\ ms^{-1}$ and wavelength 60 m is travelling along positive X-axis, then the correct expression for the wave is
a) $y = 0.2\sin 2\pi\left(6t + \frac{x}{60}\right)$ b) $y = 0.2\sin \pi\left(6t + \frac{x}{60}\right)$
c) $y = 0.2\sin 2\pi\left(6t - \frac{x}{60}\right)$ d) $y = 0.2\sin \pi\left(6t - \frac{x}{60}\right)$

235. A source of sound is moving with constant velocity of 20 ms^{-1} emitting a note of frequency1000 Hz. The ratio of frequencies observed by a stationary observer while the source is approaching him and after it crosses him will be (Take, speed of sound $v = 340\ ms^{-1}$)
a) 9 : 8 b) 8 : 9
c) 1 : 1 d) 9 : 10

236. A source of sound is moving with constant velocity of 20 ms^{-1} emitting a note of frequency1000 Hz. The ratio of frequencies observed by a stationary observer while the source is approaching him and after it crosses him will be (Take, speed of sound $v = 340\ ms^{-1}$)
a) 9 : 8 b) 8 : 9
c) 1 : 1 d) 9 : 10

237. The temperature at which the speed of sound in air becomes double of its value at 0°C is
a) 273 K b) 546 K
c) 1092 K d) 0 K

238. The temperature at which the speed of sound in air becomes double of its value at 0°C is
a) 273 K b) 546 K
c) 1092 K d) 0 K

239. The wavelength is 120 cm when the source is stationary. If the source moving with relative velocity of 60 ms^{-1} towards the observer, then the wavelength of the sound wave reaching to the observer will be (Take, velocity of sound = 330 ms^{-1})
a) 98 cm b) 140 cm
c) 120 cm d) 1440 cm

240. The wavelength is 120 cm when the source is stationary. If the source moving with relative velocity of 60 ms^{-1} towards the observer, then the wavelength of the sound wave reaching to the observer will be (Take, velocity of sound = 330 ms^{-1})
a) 98 cm b) 140 cm

c) 120 cm d) 1440 cm

241. If a particle is travelling with a speed of 0.9 of the speed of sound and is emitting radiations of frequency $1 kHz$ and moving towards the observer. What is its apparent frequency (in)?
a) 1.1 b) 2.0
c) 0.1 d) 10

242. If a particle is travelling with a speed of 0.9 of the speed of sound and is emitting radiations of frequency $1 kHz$ and moving towards the observer. What is its apparent frequency (in)?
a) 1.1 b) 2.0
c) 0.1 d) 10

243. The number of waves contained in unit length of the medium is called
a) wave speed b) wave number
c) angular frequency d) wavelength

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a) wave speed b) wave number
c) angular frequency d) wavelength

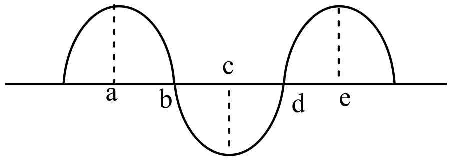
245. The frequency of a tuning fork is 'n' Hz and velocity of sound in air is 'V' m/s. When fork completes 'x' vibrations, the distance travelled by the wave is
a) $\frac{V}{xn}$ b) $\frac{Vn}{x}$
c) $\frac{xV}{n}$ d) $\frac{x}{Vn}$

246. The frequency of a tuning fork is 'n' Hz and velocity of sound in air is 'V' m/s. When fork completes 'x' vibrations, the distance travelled by the wave is
a) $\frac{V}{xn}$ b) $\frac{Vn}{x}$
c) $\frac{xV}{n}$ d) $\frac{x}{Vn}$

247. Two sources of sound A and B produces the wave of 350 Hz, in the same phase. The particle P is vibrating, under the influence of these two waves, if the amplitudes at the point P produces by the two waves is 0.3 mm and 0.4 mm, then the resultant amplitude of the point P will be (when $AP - BP = 25$ cm and the velocity of sound is $350\ ms^{-1}$)
a) 0.7 mm b) 0.1 mm
c) 0.2 mm d) 0.5 mm

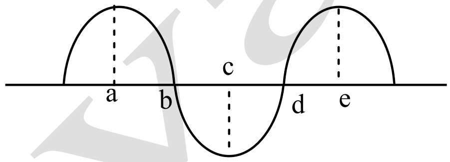
248. Two sources of sound A and B produces the wave of 350 Hz, in the same phase. The particle P is vibrating, under the influence of these two waves, if the amplitudes at the point P produces by the two waves is 0.3 mm and 0.4 mm, then the resultant amplitude of the point P will be (when $AP - BP = 25$ cm and the velocity of sound is $350\ ms^{-1}$)
a) 0.7 mm b) 0.1 mm
c) 0.2 mm d) 0.5 mm

249. 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:
a) The speed of the wave is $4n \times ab$ b) The phase difference between b and e is $\frac{3\pi}{2}$
c) Both (a) and (b) are correct d) Both (a) and (b) are incorreot

250. 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:
a) The speed of the wave is $4n \times ab$ b) The phase difference between b and e is $\frac{3\pi}{2}$
c) Both (a) and (b) are correct d) Both (a) and (b) are incorreot

251. With what velocity an observer should move relative to a stationary source so that a sound of double the frequency of source is heard by an observer?
a) Same as velocity of sound towards the source b) Twice the velocity of sound towards the source
c) Half the velocity of sound towards the source d) Same as velocity of sound away from the source

252. With what velocity an observer should move relative to a stationary source so that a sound of double the frequency of source is heard by an observer?
a) Same as velocity of sound towards the source b) Twice the velocity of sound towards the source
c) Half the velocity of sound towards the source d) Same as velocity of sound away from the source

253. A wave is represented by the equation $y = 0.5 \sin(10t + x)m$
It is a travelling wave propagating along +x-direction with velocity
a) $40\ ms^{-1}$ b) $20\ ms^{-1}$
c) $5\ ms^{-1}$ d) None of these

254. A wave is represented by the equation $y = 0.5 \sin(10t + x)m$
It is a travelling wave propagating along +x-direction with velocity

a) $40\ ms^{-1}$ b) $20\ ms^{-1}$
c) $5\ ms^{-1}$ d) None of these

255. The frequency of a tuning fork is 220 Hz and the velocity of sound in air is 330 m/s. When the tuning fork completes 80 vibrations, the distance travelled by the

a) 120 m b) 60 m
c) 53 m d) 100 m

256. The frequency of a tuning fork is 220 Hz and the velocity of sound in air is 330 m/s. When the tuning fork completes 80 vibrations, the distance travelled by the

a) 120 m b) 60 m
c) 53 m d) 100 m

257. Two waves are propagating to the point P by two sources A and B 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. If the wavelength is 1 m, then the resultant amplitude at the point P will be

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

258. Two waves are propagating to the point P by two sources A and B 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. If the wavelength is 1 m, then the resultant amplitude at the point P will be

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

259. In a mixture of gases, the average number of degrees of freedom per molecules is 6. The rms speed of the molecule of the gas is c. The velocity of sound in the gas is

a) $\frac{c}{\sqrt{3}}$ b) $\frac{c}{\sqrt{2}}$
c) $\frac{2c}{3}$ d) $\frac{3c}{4}$

260. In a mixture of gases, the average number of degrees of freedom per molecules is 6. The rms speed of the molecule of the gas is c. The velocity of sound in the gas is

a) $\frac{c}{\sqrt{3}}$ b) $\frac{c}{\sqrt{2}}$
c) $\frac{2c}{3}$ d) $\frac{3c}{4}$

261. A stone is dropped in to a well 80 m deep. The splash of sound is heard 4.25 second after the stone is dropped. The speed of sound in air is $(g = 10\ m/s^2)$

a) 340 m/s b) 320 m/s
c) 300 m/s d) 330 m/s

262. A stone is dropped in to a well 80 m deep. The splash of sound is heard 4.25 second after the stone is dropped. The speed of sound in air is $(g = 10\ m/s^2)$

a) 340 m/s b) 320 m/s
c) 300 m/s d) 330 m/s

263. A person speaking normally produces a sound intensity of 40 dB at a distance of 1 m. If the threshold intensity for reasonable audibility is 20 dB, the maximum distance at which person can be heard clearly is

a) 4 m b) 5 m
c) 10 m d) 20 m

264. A person speaking normally produces a sound intensity of 40 dB at a distance of 1 m. If the threshold intensity for reasonable audibility is 20 dB, the maximum distance at which person can be heard clearly is

a) 4 m b) 5 m
c) 10 m d) 20 m

265. 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

266. 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

267. The angle between particle velocity and wave velocity in a transverse wave is

a) Zero b) $\pi/4$
c) $\pi/2$ d) π

268. The angle between particle velocity and wave velocity in a transverse wave is

a) Zero b) $\pi/4$
c) $\pi/2$ d) π

269. A train approaching a hill at a speed of 40 km/h sounds a whistle of frequency 580 Hz when it is at a distance of 1 km from a hill. A wind with a speed of 40 km/h is blowing in the direction of motion of the train. Find the frequency of the whistle as heard by an observer on the hill. (Take, speed of sound in

air $= 1200$ km/h)

a) 400 Hz b) 500 Hz
c) 600 Hz d) 350 Hz

270. A train approaching a hill at a speed of 40 km/h sounds a whistle of frequency 580 Hz when it is at a distance of 1 km from a hill. A wind with a speed of 40 km/h is blowing in the direction of motion of the train. Find the frequency of the whistle as heard by an observer on the hill. (Take, speed of sound in air $= 1200$ km/h)

a) 400 Hz b) 500 Hz
c) 600 Hz d) 350 Hz

271. A source of sound emits waves with frequency f (in Hz) and has speed v ms^{-1}. Two observers move away from this source in opposite directions each with a speed 0.2v relative to the source. The ratio 0 trequencies heard by the two observers will be

a) 3:2 b) 2:3
c) 1:1 d) 4:10

272. A source of sound emits waves with frequency f (in Hz) and has speed v ms^{-1}. Two observers move away from this source in opposite directions each with a speed 0.2v relative to the source. The ratio 0 trequencies heard by the two observers will be

a) 3:2 b) 2:3
c) 1:1 d) 4:10

273. The equation of a transverse wave on a stretched string is given by $y = 0.05 \sin 2\pi \left(\frac{t}{0.002} - \frac{x}{0.1}\right)$, where x and y are expressed in metre and t in second. The speed of the wave is

a) 100 ms^{-1} b) 50 ms^{-1}
c) 200 ms^{-1} d) 400 ms^{-1}

274. The equation of a transverse wave on a stretched string is given by $y = 0.05 \sin 2\pi \left(\frac{t}{0.002} - \frac{x}{0.1}\right)$, where x and y are expressed in metre and t in second. The speed of the wave is

a) 100 ms^{-1} b) 50 ms^{-1}
c) 200 ms^{-1} d) 400 ms^{-1}

275. The equation of sound wave is $y = 0.0015 \sin(62.4x + 316\,t)$. Find the wavelength of this wave

a) 0.2 unit b) 0.1 unit
c) 0.3 unit d) None of these

276. The equation of sound wave is $y = 0.0015 \sin(62.4x + 316\,t)$. Find the wavelength of this wave

a) 0.2 unit b) 0.1 unit
c) 0.3 unit d) None of these

277. A car sounding its horn at 480 Hz moves towards a high wall at a speed of 20 ms^{-1}, the frequency of the reflected sound heard by the man sitting in the car will be nearest to (Take, speed of sound $= 330$ ms^{-1})

a) 480 Hz b) 510 Hz
c) 540 Hz d) 570 Hz

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c) 540 Hz d) 570 Hz

279. A star is moving away from the earth with a velocity of 100 km/s. If the velocity of light is 3×10^3 m/s, then the shift of its spectral line of wavelength 5700 Å due to Doppler effect is

a) 0.63 Å b) 1.90 Å
c) 3.80 Å d) 5.70 Å

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281. If the temperature is raised by 1 K from 300 K, the percentage change in the speed of sound in the gaseous mixture is (Take, $R = 8.31$ J/mol − K)

a) 0.167% b) 0.334%
c) 1% d) 2%

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c) 1% d) 2%

283. A source is moving towards observer with a speed of 20 ms^{-1} and having frequency 240 Hz and observer is moving towards source with a velocity of 20 ms^{-1}. What is the apparent frequency heard by observer, if velocity of sound is 340 ms^{-1} ?

a) 270 Hz b) 240 Hz
c) 268 Hz d) 360 Hz

284. A source is moving towards observer with a speed of 20 ms^{-1} and having frequency 240 Hz and observer is moving towards source with a velocity of 20 ms^{-1}. What is the apparent frequency heard by observer, if velocity of sound is 340 ms^{-1} ?

a) 270 Hz b) 240 Hz
c) 268 Hz d) 360 Hz

285. If the temperature of the gaseous medium drops by 1%, the velocity of sound in that medium

a) increases by 5% b) remains unchanged
c) decreases by 0.5% d) decreases by 2%

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287. A sound has an intensity of 2×10^{-8} Wm^{-2}. Its intensity level (in decibels) is (Take, $\log_{10} 2 = 0.3$)
a) 23 b) 4.3
c) 43 d) None of these

288. A sound has an intensity of 2×10^{-8} Wm^{-2}. Its intensity level (in decibels) is (Take, $\log_{10} 2 = 0.3$)
a) 23 b) 4.3
c) 43 d) None of these

289. A stretched rope having linear mass density 5×10^{-2}kgm^{-1} is under a tension of 80 N. The power that has to be supplied to the rope to generate harmonic waves at a frequency of 60 Hz and an amplitude of 6 cm is
a) 362 W b) 251 W
c) 511 W d) 416 W

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291. 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?
a) Zero b) 0.5%
c) 5% d) 20%

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c) 5% d) 20%

293. In the given progressive wave
$y = 5\sin(100\pi t - 0.4\pi x)$
What is the wave velocity (in ms^{-1}) ?
a) 350 b) 250
c) 200 d) 180

294. In the given progressive wave
$y = 5\sin(100\pi t - 0.4\pi x)$
What is the wave velocity (in ms^{-1}) ?
a) 350 b) 250
c) 200 d) 180

295. A bat flies at a steady speed of 4 m/s emitting a sound of $= 90 \times 10^3$ Hz. It is flying horizontally towards a vertical wall. The frequency of the reflected sound as detected by the bat will be (Take, velocity of sound in air is 330 m/s)
a) 88.1×10^3 Hz b) 87.1×10^3 Hz
c) 92.2×10^3 Hz d) 89.1×10^3 Hz

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297. An observer moves towards a stationary source of sound with a velocity one fifth of the velocity of sound. The percentage increase in the apparent frequency heard by the observer will be
a) 20% b) 0.5%
c) 10% d) 5%

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a) 20% b) 0.5%
c) 10% d) 5%

299. Two copper wires A and B have radii 'r_1' and 'r_2' respectively, where $r_1 > r_2$. If same tension is applied to both wires, transverse waves
a) Will travel faster in thicker wire b) Will not travel through both the wires
c) Will travel with same velocity in both the wire d) Will travel faster in thinner wire

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a) Will travel faster in thicker wire b) Will not travel through both the wires
c) Will travel with same velocity in both the wire d) Will travel faster in thinner wire

301. The equation of a progressive wave is
$$y = 8\,sin\left[\pi\left(\frac{t}{10} - \frac{x}{4}\right) + \frac{\pi}{3}\right]$$
The wavelength of the wave is
a) 8 m b) 4 m
c) 2 m d) 10 m

302. The equation of a progressive wave is

$y = 8\ sin\left[\pi\left(\frac{t}{10} - \frac{x}{4}\right) + \frac{\pi}{3}\right]$
The wavelength of the wave is
a) 8 m b) 4 m
c) 2 m d) 10 m

303. A transverse wave $y = 0.05\ \sin(20\pi x - 50\pi t)$ in metre, is propagating along + ve X-axis on a string. A light insect starts crawling on the string with the velocity of 5 cms $^{-1}$ at $t = 0$ along the + ve X-axis from a point, where $x = 5$ cm. After 5 s, the difference in the phase of its position is equal to
a) 150 π b) 250 π
c) 10 π d) 5 π

304. A transverse wave $y = 0.05\ \sin(20\pi x - 50\pi t)$ in metre, is propagating along + ve X-axis on a string. A light insect starts crawling on the string with the velocity of 5 cms $^{-1}$ at $t = 0$ along the + ve X-axis from a point, where $x = 5$ cm. After 5 s, the difference in the phase of its position is equal to
a) 150 π b) 250 π
c) 10 π d) 5 π

305. 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 5.5kHz while train approaches the siren. During his return journey in a different train d, he records a frequency of 6 kHz while approaching the same siren. The ratio of the velocity of train B to that of train A is
a) 4/3 b) 2
c) 5/3 d) 8/5

306. 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 5.5kHz while train approaches the siren. During his return journey in a different train d, he records a frequency of 6 kHz while approaching the same siren. The ratio of the velocity of train B to that of train A is
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c) 5/3 d) 8/5

307. Sound waves take 3 minutes to travel between two stations, when the temperature of air is 27°C. If the temperature of air increases to 37°C, the sound waves will take how much time (in minutes) to travel between two same stations?
a) $3\sqrt{\frac{31}{30}}$ b) $2\sqrt{\frac{31}{30}}$
c) $2\sqrt{\frac{30}{31}}$ d) $3\sqrt{\frac{30}{31}}$

308. Sound waves take 3 minutes to travel between two stations, when the temperature of air is 27°C. If the temperature of air increases to 37°C, the sound waves will take how much time (in minutes) to travel between two same stations?
a) $3\sqrt{\frac{31}{30}}$ b) $2\sqrt{\frac{31}{30}}$
c) $2\sqrt{\frac{30}{31}}$ d) $3\sqrt{\frac{30}{31}}$

309. A train moves towards stationary observer with a speed 34 ms^{-1}. The train sounds a whistle and its frequency registered by the observer is f_1. If the train's speed is reduced to 17 ms^{-1}, the frequency registered is f_2. If the speed of sound is 340 ms^{-1}, then ratio $\frac{f_1}{f_2}$ is
a) $\frac{18}{19}$ b) $\frac{17}{18}$
c) $\frac{18}{17}$ d) $\frac{19}{18}$

310. A train moves towards stationary observer with a speed 34 ms^{-1}. The train sounds a whistle and its frequency registered by the observer is f_1. If the train's speed is reduced to 17 ms^{-1}, the frequency registered is f_2. If the speed of sound is 340 ms^{-1}, then ratio $\frac{f_1}{f_2}$ is
a) $\frac{18}{19}$ b) $\frac{17}{18}$
c) $\frac{18}{17}$ d) $\frac{19}{18}$

311. At what temperature will the speed of sound be nearly 1.5 times its value at N. T. P.?
a) 409°C b) 136°C
c) 614°C d) 341°C

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a) 409°C b) 136°C
c) 614°C d) 341°C

313. When source of sound moves towards a stationary observer, the wavelength of sound received by him
a) decreases while frequency increases
b) remains the same, whereas frequency increases
c) increases and frequency also increases
d) decreases while frequency remains the same

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a) decreases while frequency increases
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c) increases and frequency also increases
d) decreases while frequency remains the same

315. In a travelling wave

$y = 0.1 \sin \pi \left(x - 330\,t + \frac{2}{3}\right)$ (SI units)

The phase difference between $x_1 = 3$ m and $x_2 = 3.5$ m is

a) $\frac{\pi}{2}$
b) π
c) $\frac{3\pi}{2}$
d) 2π

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The phase difference between $x_1 = 3$ m and $x_2 = 3.5$ m is

a) $\frac{\pi}{2}$
b) π
c) $\frac{3\pi}{2}$
d) 2π

317. A rocket is receding away from earth with velocity = 0.2 c. The rocket emits signal or frequency 4×10^7 Hz. The apparent frequency of the signal produced by the rocket observed by the observer on earth will be

a) 3×10^6 Hz
b) 4×10^6 Hz
c) 2.4×10^7 Hz
d) 5×10^7 Hz

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d) 5×10^7 Hz

319. What is the effect of pressure on the speed of sound in a medium, if pressure is doubled at constant temperature?

a) Remains same
b) Reduced to half
c) Gets doubled
d) Becomes 4 times

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321. A simple harmonic progressive wave is represented as $y = 0.03 \sin \pi(2t - 0.01x)$ m. At a given instant of time, the phase difference between two particles 25 m apart is

a) π rad
b) $\frac{\pi}{2}$ rad
c) $\frac{\pi}{4}$ rad
d) $\frac{\pi}{8}$ rad

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323. An engine sounding a whistle of frequency 1152 Hz is receding from a stationary observer at 72 km/hour. If velocity of sound in air is 340 m/s, then the frequency of note heard by the observer is

a) 612 Hz
b) 544 Hz
c) 1224 Hz
d) 1088 Hz

324. An engine sounding a whistle of frequency 1152 Hz is receding from a stationary observer at 72 km/hour. If velocity of sound in air is 340 m/s, then the frequency of note heard by the observer is

a) 612 Hz
b) 544 Hz
c) 1224 Hz
d) 1088 Hz

325. The equation of wave is represented by $y = 10^{-1} \sin\left(100t - \frac{x}{10}\right)$ m, then the velocity of wave will be

a) $100\ \text{ms}^{-1}$
b) $4\ \text{ms}^{-1}$
c) $1000\ \text{ms}^{-1}$
d) Zero

326. The equation of wave is represented by $y = 10^{-1} \sin\left(100t - \frac{x}{10}\right)$ m, then the velocity of wave will be

a) $100\ \text{ms}^{-1}$
b) $4\ \text{ms}^{-1}$
c) $1000\ \text{ms}^{-1}$
d) Zero

327. A source of sound is moving towards a stationary observer with velocity 'V_s' and then moves away with velocity 'V_s'. Assume that the medium through which the sound waves travel is at rest, if 'V' is the velocity of sound and 'n' is the frequency emitted by the source, then the difference between the apparent frequencies heard by the observer is

a) $2nV\,V_s/(V_s^2 - V^2)$
b) $nV\,V_s/(V^2 - V_s^2)$
c) $nV\,V_s/(V_s^2 - V^2)$
d) $2nV\,V_s/(V^2 - V_s^2)$

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c) $nV\,V_s/(V_s^2 - V^2)$
d) $2nV\,V_s/(V^2 - V_s^2)$

329. The equation of simple harmonic progressive wave is given by $y = a \sin 2\pi(bt - cx)$. The maximum particle velocity will be twice the wave velocity, if

a) $c = \pi a$ b) $c = \frac{1}{2\pi a}$

c) $c = \frac{1}{\pi a}$ d) $c = 2\pi a$

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c) $c = \frac{1}{\pi a}$ d) $c = 2\pi a$

331. 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 $\frac{\rho_1}{\rho_2} = \frac{1}{4}$, then the ratio of velocities v_1 and v_2 will be

a) 1:2 b) 4:1

c) 2:1 d) 1:4

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a) 1:2 b) 4:1

c) 2:1 d) 1:4

333. The speed of wave in a medium is 60 m/s. If 1200 waves are passing through a point in the medium in 1 min, then wavelength is

a) 4.0m b) 6.0m

c) 3.0m d) 7.0m

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a) 4.0m b) 6.0m

c) 3.0m d) 7.0m

335. The equation of the progressive wave is $y = 3 \sin\left[\pi\left(\frac{t}{3} - \frac{x}{5}\right) + \frac{\pi}{4}\right]$, where x and y are in metre and time in second. Which of the following is correct?

a) Velocity $v = 1.5$ m/s b) Amplitude $A = 4$ cm

c) Frequency $= 0.2$ Hz. d) Wavelength $\lambda = 10$ m

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a) Velocity $v = 1.5$ m/s b) Amplitude $A = 4$ cm

c) Frequency $= 0.2$ Hz. d) Wavelength $\lambda = 10$ m

337. A source of sound emitting a 1200 Hz note travels along a straight line at a speed of 170 m/s. A detector is placed at a distance of 200 m from the line of motion of the source. Find the frequency of sound received by the detector at the instant when the source gets closest to it. (Take, speed of sound in air = $340\ ms^{-1}$)

a) 1600 Hz b) 1000 Hz

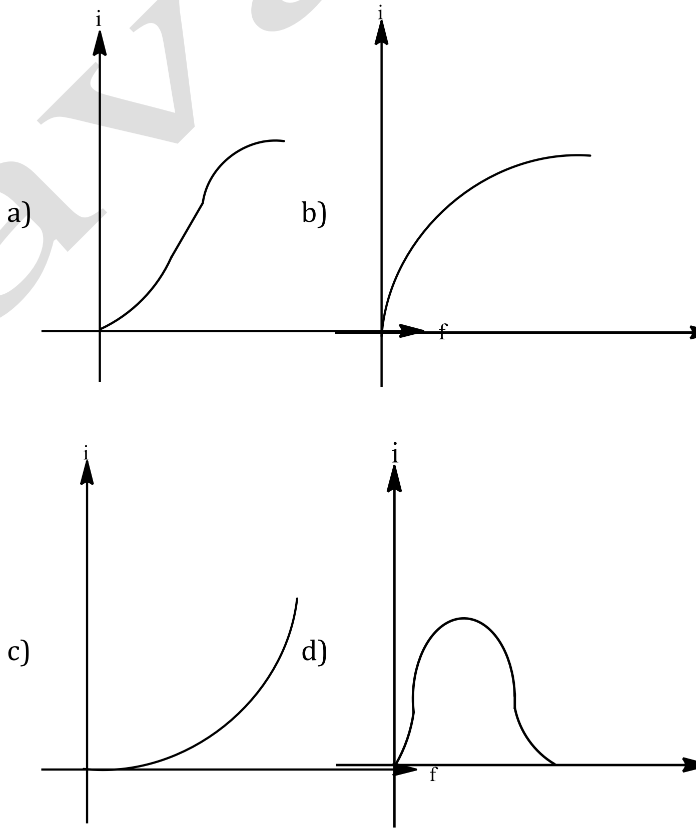
c) 1700 Hz d) 1200 Hz

338. A source of sound emitting a 1200 Hz note travels along a straight line at a speed of 170 m/s. A detector is placed at a distance of 200 m from the line of motion of the source. Find the frequency of sound received by the detector at the instant when the source gets closest to it. (Take, speed of sound in air = $340\ ms^{-1}$)

a) 1600 Hz b) 1000 Hz

c) 1700 Hz d) 1200 Hz

339. An AC circuit of variable frequency f is connected to an L-C-R series circuit. Which one of the graphs in the figure, represents the variation of current i in the circuit with frequency?

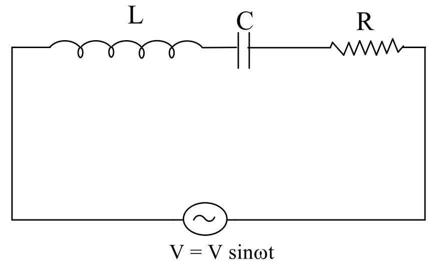


340. The reactance of a coil when used in the AC power supply (220 V, 50 cycle s^{-1}) is 50 Ω. The inductance of the coil is nearly

a) 0.16 H b) 0.22 H

c) 2.2 H d) 1.6 H

341. For the $L - C - R$ circuit shown here, the current is observed to lead the applied voltage. An additional capacitor C′, when joined with the capacitor C present in the circuit, makes the power factor of the circuit unity. The capacitor C′ must have been connected in



a) series with C and has a magnitude $\frac{C}{(\omega^2LC-1)}$
b) series with C and has a magnitude $\frac{(1-\omega^2LC)}{\omega^2L}$
c) parallel with C and has a magnitude $\frac{(1-\omega^2LC)}{\omega^2L}$
d) parallel with C and has a magnitude $\frac{C}{(\omega^2LC-1)}$

342. In a $L-R$ circuit of 3 mH inductance and 4Ω resistance, emf $E=(4\cos 1000t)$V is applied. The amplitude of current is
a) 0.8 A
b) $\frac{4}{7}$ A
c) 1 A
d) $\frac{4}{\sqrt{7}}$ A

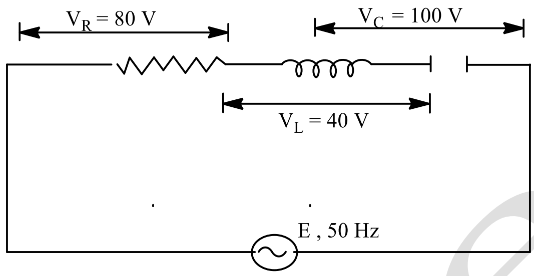
343. An alternating voltage $V=200\sqrt{2}\sin(100\,t)$ volt is connected to 1μF capacitor through AC ammeter. The reading of ammeter is
a) 5 mA
b) 10 mA
c) 15 mA
d) 20 mA

344. In an electrical circuit R, L, C and an AC voltage source all connected in series. When L is removed from the circuit, the phase difference between the voltage and the current in the circuit is $\frac{\pi}{3}$. If instead C is removed from the circuit, the phase difference is again $\frac{\pi}{3}$. The power factor of the circuit is
a) $\frac{1}{2}$
b) $\frac{1}{\sqrt{2}}$
c) 1
d) $\frac{\sqrt{3}}{2}$

345. The instantaneous values of current and voltage in an AC circuit are given by $i=6\sin\left(100\,\pi t+\frac{\pi}{4}\right)$, $V=5\sin\left(100\,\pi t-\frac{\pi}{4}\right)$, then
a) current leads the voltage by 45°
b) voltage leads the current by 90°
c) current leads the voltage by 90°
d) voltage leads the current by 45°

346. Alternating current cannot be measured by DC ammeter because
a) AC cannot pass through DC ammeter
b) AC changes direction
c) average value of current for complete cycle is zero
d) DC ammeter will get damaged

347. The value of alternating emf E in the given circuit will be



a) 220 V
b) 140 V
c) 100 V
d) 20 V

348. A coil of self-inductance L is connected in series with a bulb B and an AC source. Brightness of the bulb decreases when
a) frequency of the AC source is decreased
b) number of turns in the coil is reduced
c) a capacitance of reactance X_C-X_L is included in the same circuit
d) an iron rod is inserted in the coil

349. An alternating current is given by the equation $i=i_1\cos\omega t+i_2\sin\omega t$. The rms current is given by
a) $\frac{1}{\sqrt{2}}(i_1+i_2)$
b) $\frac{1}{\sqrt{2}}(i_1+i_2)^2$
c) $\frac{1}{\sqrt{2}}(i_1^2+i_2^2)^{1/2}$
d) $\frac{1}{2}(i_1^2+i_2^2)^{1/2}$

350. A coil of 0.01 H inductance and 1Ω resistance is connected to 200 V, 50 Hz AC supply. The impedance of the circuit and time lag between maximum alternating voltage and current would be
a) 3.3 Ω and $\frac{1}{250}$ s
b) 3.9 kΩ and $\frac{1}{160}$ s
c) 4.2 kΩ and $\frac{1}{100}$ s
d) 2.8 kΩ and $\frac{1}{120}$ s

351. The peak value of alternating current is $5\sqrt{2}$ A. The root-mean-square value of current will be
a) 5 A
b) 2.5 A
c) $5\sqrt{2}$ A
d) None of these

352. A 15.0 μF capacitor is connected to a 220 V, 50 Hz source. The capacitive reactance is
a) 220 Ω
b) 215 Ω
c) 212 Ω
d) 204 Ω

353. An inductance of negligible resistance, whose reactance is 120 Ω at 200 Hz is connected to a 240 V, 60 Hz, power line. The current in the inductor is
a) 6.66 A
b) 6.60 A

c) 5.45 A d) 54.5 A

354. For high frequency ,capacitor offers
a) more resistance b) less resistance
c) zero resistance d) None of these

355. An AC circuit contains resistance of 12Ω and inductive reactance 5Ω. The phase angle between current and potential difference, will be
a) $\sin^{-1}\left(\frac{12}{13}\right)$ b) $\cos^{-1}\left(\frac{5}{12}\right)$
c) $\sin^{-1}\left(\frac{5}{12}\right)$ d) $\cos^{-1}\left(\frac{12}{13}\right)$

356. An alternating voltage $E = 200\sqrt{2}\sin(100\,t)$ is connected to 1μF capacitor through AC ammeter. The reading of ammeter shall be
a) 10 mA b) 20 mA
c) 40 mA d) 80 mA

357. The peak value of AC voltage on a 220 V mains is
a) $240\sqrt{2}$ V b) $230\sqrt{2}$ V
c) $220\sqrt{2}$ V d) $200\sqrt{2}$ V

358. A capacitor 50μF is connected to a power source $V = 220\sin 50t$ (V in volt, t in second). The value of rms current (in ampere) is
a) $\frac{\sqrt{2}}{0.55}$ A b) 0.55 A
c) $\sqrt{2}$ A d) $\frac{0.55}{\sqrt{2}}$ A

359. If the inductance and capacitance are both doubled in L-C-R circuit, the resonant frequency of the circuit will
a) decrease to one-half the original value b) decrease to one-fourth the original value
c) increase to twice the original value d) decrease to twice the original value

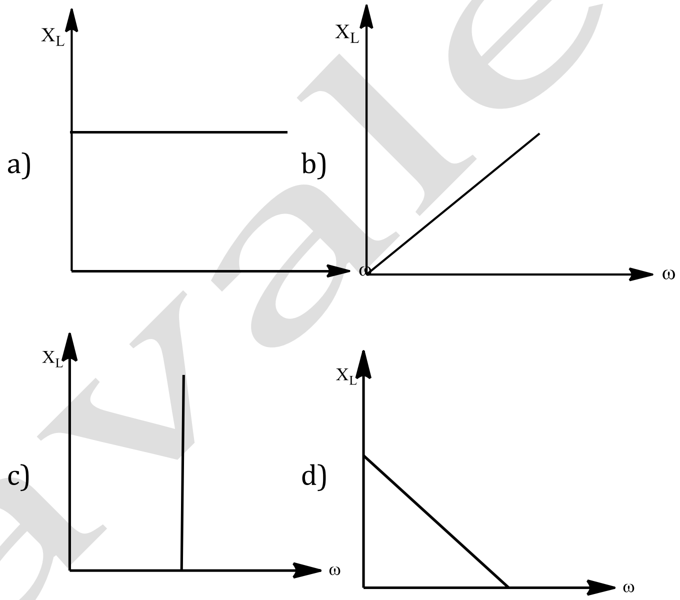
360. The rms value of current i_{rms} is
a) $\frac{i_0}{2\pi}$ b) $\frac{i_0}{\sqrt{2}}$
c) $\frac{2i_0}{\pi}$ d) $\sqrt{2}i_0$ (where, i_0 is the value of peak current)

361. Which of the following represents the value of voltage and current at that instant?
a) $V_m \sin\omega t, i_m \sin\omega t$ b) $V_m \cos\omega t, i_m \cos\omega t$
c) $-V_m \sin\omega t, -i_m \sin\omega$ d) $-V_m \cos\omega t, -i_m \cos$

362. If the power factor changes from $\frac{1}{2}$ to $\frac{1}{4}$, then what is the increase in impedance in AC?
a) 20% b) 50%
c) 25% d) 100%

363. A bulb is connected first with DC and then AC of same voltage, then it will shine brightly with
a) AC b) DC
c) brightness will be in ratio 1/1.4 d) equally with both AC and DC supply

364. Which of the following graphs represents the correct variation of inductive reactance X_L with angular frequency ω?



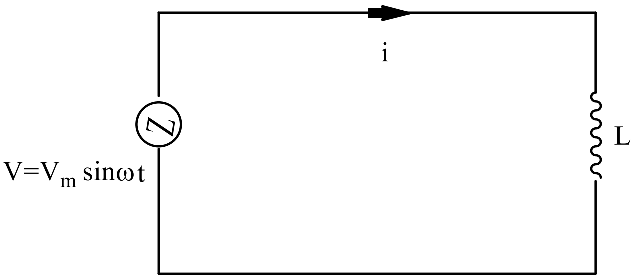
365. AC measuring instruments measures
a) peak value b) rms value
c) any value d) average value

366. When a capacitor of 36μF is connected to a 240 V, 50 Hz supply the currents (rms and peak) in the circuit are
a) 1.47 A, 2.04 A b) 1.95 A, 2.73 A
c) 2.73 A, 3.85 A d) 2.4 A, 1.08 A

367. Same current is flowing in two AC circuit, First contains only inductance and second contains only capacitance. If frequency of AC is increased for both, the current will
a) increase in first circuit and decrease in second b) increase in both circuits
c) decrease in both circuits d) decrease in first circuit and increase in second

368. What is the value of inductance L for which the current is a maximum in a series L − C − R circuit with C = 10μF and $\omega = 1000\ s^{-1}$?
a) 100mH b) 1mH
c) Cannot be calculated unless R is known d) 10mH

369. When an alternating voltage is applied to an inductor as shown in the figure, then



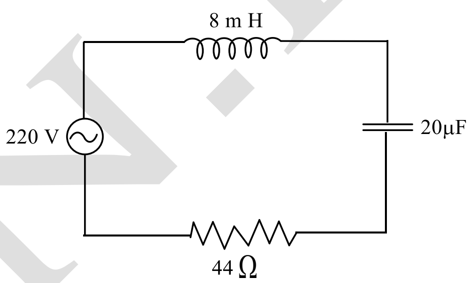
a) $V + L\frac{di}{dt} = 0$ b) $V - L\frac{di}{dt} = 0$
c) $L + V\frac{di}{dt} = 0$ d) $L - V\frac{di}{dt} = 0$

370. In an AC circuit, $i = 100 \sin 200\,\pi t$. The time required for the current to achieve its peak value will be
a) $\frac{1}{100}$ s b) $\frac{1}{200}$ s
c) $\frac{1}{300}$ s d) $\frac{1}{400}$ s

371. A coil has inductance 2 H. The ratio of its reactance, when it is connected first to an AC source and then to DC source, is
a) zero b) 1
c) less than 1 d) infinity

372. In an L-C circuit, angular frequency at resonance is ω. What will be the new angular frequency when inductor's inductance is made two times and capacitor's capacitance is made four times?
a) $\frac{\omega}{2\sqrt{2}}$ b) $\frac{\omega}{\sqrt{2}}$
c) 2ω d) $\frac{2\omega}{\sqrt{2}}$

373. For the series L-C-R circuit shown in the figure, what is the angular resonant frequency and amplitude of the current at the resonating frequency?



a) 2500 rads^{-1} and $5\sqrt{2}$ A b) 2500 rads^{-1} and 5 A
c) 2500 rads^{-1} and $\frac{5}{\sqrt{2}}$ A d) 25 rads^{-1} and $5\sqrt{2}$ A

374. The instantaneous voltage through a device of impedance 20Ω is $V = 80 \sin 100\,\pi t$. The effective value of the current is
a) 3 A b) 2.828 A
c) 1.732 A d) 4 A

375. In an L − C − R ciruit, if V is the effective value of the applied voltage, V_R is the voltage across R, V_L is the effective voltage across L, V_C is the effective voltage across C, then
a) $V = V_R + V_L + V_C$ b) $V^2 = V_R^2 + V_L^2 + V_C^2$
c) $V^2 = V_R^2 + (V_L - V_C)^2$ d) $V^2 = V_L^2 + (V_R - V_C)^2$

376. A resistance of 20Ω is connected to a source of an alternating potential, $V = 220 \sin(100\pi\, t)$. The time taken by current to change from its peak value to rms value is
a) 0.2 s b) 0.25 s
c) 25×10^{-3} s d) 2.5×10^{-3} s

377. Which current do not change direction with time?
a) DC current b) AC current
c) Both (a) and (b) d) Neither (a) nor (b)

378. The current in the series L − C − R circuit is
a) $i = i_m \sin(\omega t + \phi)$ b) $i = \frac{V_m}{\sqrt{R^2 + (X_C - X_L)^2}}$ s $+ \phi)$
c) $i = 2i_m \cos(\omega t + \phi)$ d) Both (a) and (b)

379. In a circuit, the current lags behind the voltage by a phase difference of $\pi/2$, the circuit will contain which of the following?
a) only R b) only C
c) R and C d) only L

380. The impedance of a circuit, when a resistance R and an inductor of inductance are connected in series in an AC circuit of frequency f, is
a) $\sqrt{R + 2\pi^2 f^2 L^2}$ b) $\sqrt{R + 4\pi^2 f^2 L^2}$
c) $\sqrt{R^2 + 4\pi^2 f^2 L^2}$ d) $\sqrt{R^2 + 2\pi^2 f^2 L^2}$

381. An AC source is 120 V − 60 Hz. The value of voltage after $\frac{1}{720}$ s from start will be
a) 20.2 V b) 42.4 V
c) 84.8 V d) 106.8 V

382. An alternating voltage, $V = 200\sqrt{2} \sin(100\, t)$ is connected to a 1μF, capacitor through an AC ammeter. The reading of the ammeter shall be
a) 10 mA b) 20 mA
c) 40 mA d) 80 mA

383. A coil of inductive reactance 31 Ω has a resistance of 8 Ω. It is placed in series with a condenser of capacitive reactance 25 Ω. The combination is connected to an AC source of 110 V. The power factor of the circuit is

a) 0.56 b) 0.64
c) 0.80 d) 0.33

384. The average value of AC voltage given by $V = V_m \sin \omega t$ over time interval $t = 0$ to $t = \frac{\pi}{\omega}$ is
a) 0 b) $\frac{2V_m}{\pi}$
c) $\frac{V_m}{\pi}$ d) V_m

385. If the frequency is doubled, what happen to the capacitive reactance and the current?
a) Capacitive reactance is halved, the current is doubled
b) Capacitive reactance is doubled, the current is halved
c) Capacitive reactance and the current are halved
d) Capacitive reactance and the current are doubled

386. When an alternating voltage source of $V = 200 \sin\left(100\pi t - \frac{\pi}{3}\right)$ is applied to a pure capacitor of capacitance 2μF, then the instantaneous value of current through the capacitor is
a) $200 \sin\left(100\pi t + \frac{\pi}{6}\right)$ b) $0.04\pi \sin\left(100\pi t + \frac{\pi}{6}\right)$
c) $200 \sin\left(100\pi t - \frac{\pi}{6}\right)$ d) $0.04\pi \sin\left(100\pi t - \frac{\pi}{6}\right)$

387. An L − C circuit contains 10 mH inductor and a 25 μF capacitor. The ratio of the time periods for the energy to be completely magnetic, is
a) 0, 1.57, 4.71 b) 1.57, 3.14, 4.71
c) 1.57, 4.71, 7.85 d) None of the above

388. In an AC circuit, the current lags behind the voltage by π /3. The components of the circuit are
a) R and L b) L and C
c) R and C d) only R

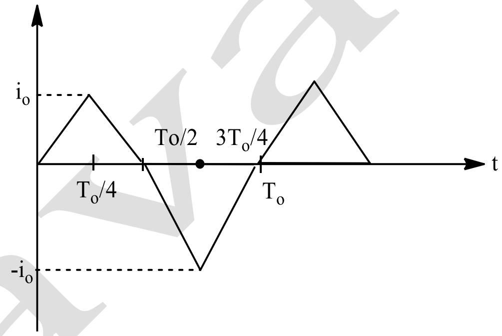
389. In terms of q, the voltage equation for series L − C − R circuit is given by
a) $L\frac{dq}{dt} + R\frac{dq}{dt} + \frac{q}{C} = V_m \sin \omega t$
b) $L\frac{d^2q}{dt^2} + R\frac{dq}{dt} + \frac{q}{C} = V_m \sin \omega t$
c) $L\frac{d^2q}{dt} - R\frac{dq}{dt} + \frac{q}{C} = V_m \sin \omega t$
d) $L\frac{d^2q}{dt} - R\frac{dq}{dt} - \frac{q}{C} = V_m \sin \omega t$

390. A charged 30μF capacitor is connected to a 27 mH inductor. What is the angular frequency of free oscillations of the circuit?
a) $1.1\ s^{-1}$ b) $1.1 \times 10^3\ s^{-1}$
c) $1\ s^{-1}$ d) $1 \times 10^{-3}\ s^{-1}$

391. A charged 40 μF capacitor is connected to a 16 mH inductor. What is the angular frequency of free oscillations of the circuit?
a) 1.1 s b) $1.25 \times 10^3\ s^{-1}$
c) $2 \times 10^3\ s^{-1}$ d) $2.5 \times 10^3\ s^{-1}$

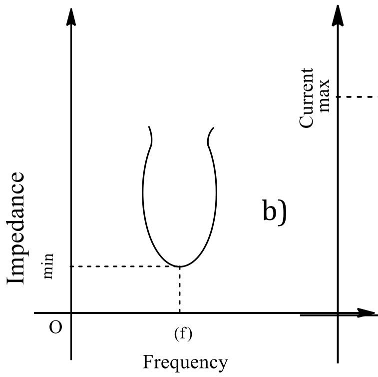
392. An inductive coil has a resistance of 100 Ω. When an AC signal of frequency 1000 Hz is applied to the coil, the voltage leads the current by 45°. The inductance of the coil is
a) $\frac{1}{10\pi}$ b) $\frac{1}{20\pi}$
c) $\frac{1}{40\pi}$ d) $\frac{1}{60\pi}$

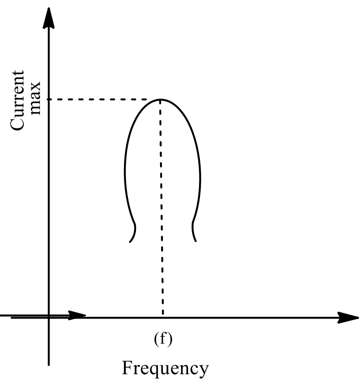
393. The average current in terms of i_0 for the waveform shown is

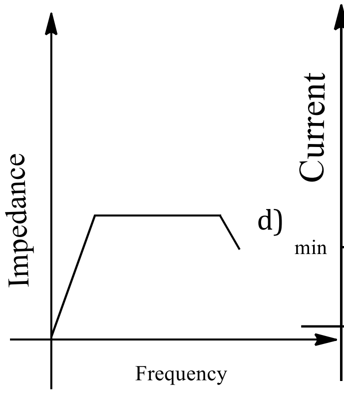


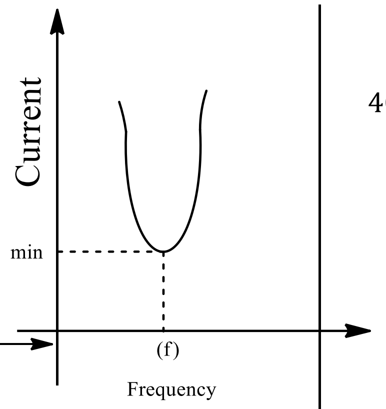
a) i_0 b) $\frac{i_0}{3}$
c) $\frac{i_0}{2}$ d) $\frac{i_0}{4}$

394. Out of the following graphs, which graphs shows the correct relation (graphical representation) for LC parallel resonant circuit?

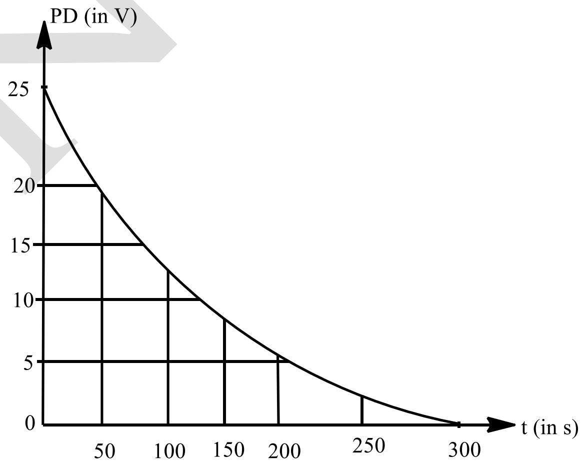
a) 

b) 

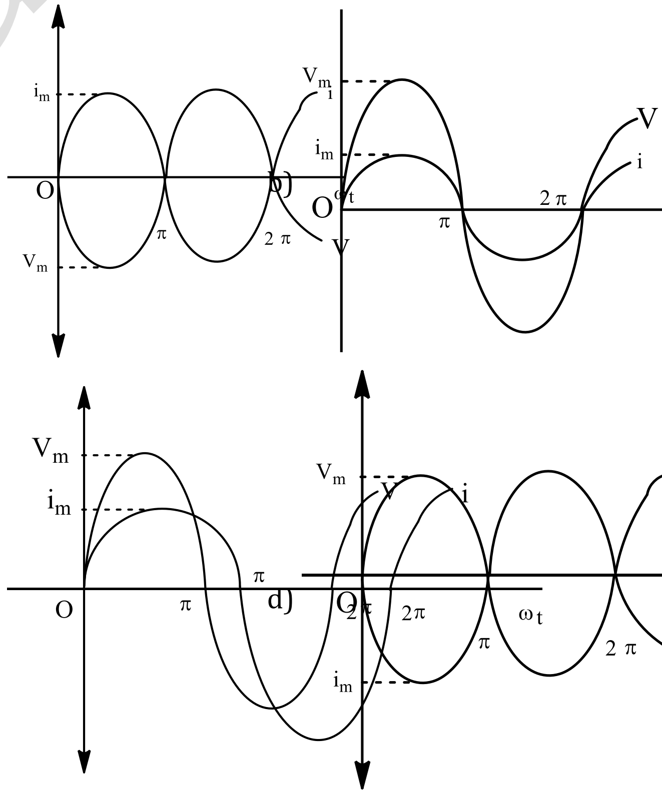
c) 

d) 

395. In series L-C-R circuit, the capacitance is changed from C to 2 C. The inductance should be changed from L to .. to obtain same resonance frequency.
   a) 4L b) L/2
   c) L/4 d) 2L
396. in L-C-R circuit, power factor at resonance is
   a) less than one b) greater than one
   c) unity d) Can't predicted
397. In a series $L-C-R$ circuit, $R = 300\ \Omega, L = 0.9H, C = 2\mu F, \omega = 1000$ rad/s. The impedance of the circuit is
   a) $500\ \Omega$ b) $1300\ \Omega$
   c) $400\ \Omega$ d) $900\ \Omega$
398. The frequency of an alternating voltage is 50 cycles/s and its amplitude is 120 V. Then, the rms value of voltage is
   a) 101.3 V b) 84.8 V
   c) 70.7 V d) 56.5 V
399. If an AC main supply is given to be 220 V. What would be the average emf during a positive half cycle?
   a) 198 V b) 386 V
   c) 256 V d) None of these
400. Figure shows an experimental plot for discharging of a capacitor in an $R-C$ circuit. The time constant τ of this circuit lies between



   a) 150 s and 200 s b) 0 s and 50 s
   c) 50 s and 100 s d) 100 s and 150 s
401. In a series resonant $R-L-C$ circuit, the voltage across R is 100 V and the value of $R = 1000\ \Omega$. The capacitance of the capacitor is 2×10^{-6} F, angular frequency of AC is 200 rad s^{-1}. Then, the potential difference across the inductance coil is
   a) 100 V b) 40 v
   c) 250 V d) 400 V
402. An arc lamp requires a direct current of 10 A at 80 V to function. If it is connected to a 220 V (rms), 50 Hz AC supply, the series inductor needed for it to work is close to
   a) 80 H b) 0.08 H
   c) 0.044 H d) 0.065 H
403. The maximum voltage in DC circuit is 282 V. The effective voltage in AC circuit will be
   a) 200 V b) 300 V
   c) 400 V d) 564 V
404. Which of the following is the graphical representation of alternating current and voltage for a purely resistive circuit



405. A pure inductor of inductance 25.0 mH is connected to a source of 220 V. Find the inductive reactance, if the frequency of the source is 50 Hz.
   a) $785\ \Omega$ b) $6.50\ \Omega$
   c) $7.85\ \Omega$ d) $8.75\ \Omega$

406. A generator produces a voltage that is given by $V = 240 \sin 120\,t$, where t is in second. The frequency and rms voltage are
a) 60 Hz and 240 V   b) 19 Hz and 120 V
c) 19 Hz and 170 V   d) 754 Hz and 70 V

407. An alternating voltage $V(t) = 220 \sin 100\pi t$ volt is applied to a purely resistive load of 50Ω. The time taken for the current to rise from half of the peak value to the peak value is
a) 5 ms   b) 2.2 ms
c) 7.2 ms   d) 3.3 ms

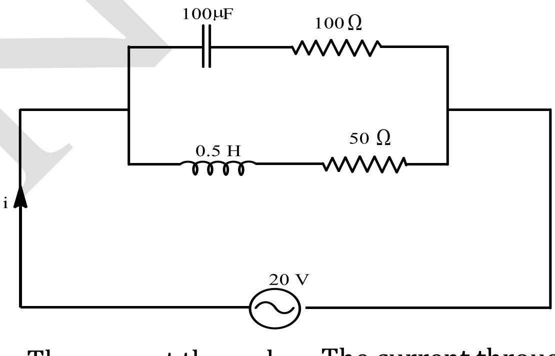
408. A resistance of 200Ω and capacitor of $15\mu F$ are connected in series to a 220 V, 50 Hz AC source. The voltage (rms) across the resistor and capacitor is that
a) 151 V, 160.4 V   b) 150 V, 100.3 V
c) 220 V, 91.8 V   d) 145 V, 311.3 V

409. An alternating emf of 0.2 V is applied across an $L - C - R$ series circuit having $R = 4\Omega$, $C = 80\mu F$ and $= 200$ mH. At resonance the voltage drop across the inductor is
a) 10 V   b) 2.5 V
c) 1 V   d) 5 V

410. The rms current in the circuit containing a pure inductor of 40 mH, connected to a source 200 V, 50 Hz is
a) 25 A   b) 16 A
c) 11 A   d) 28 A

411. To express AC power in the same form as DC power, a special value of current is defined and used, is called
a) root-mean-square current (i_{rms})   b) effective current
c) induced current   d) Both (a) and (b)

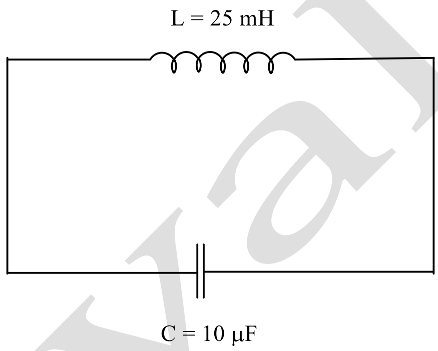
412. In the given circuit, the AC source has $\omega = 100$ rad/s. Considering the inductor and capacitor to be ideal, the correct choice(s) is (are)



a) The current through the circuit = 0.3 A   b) The current through the circuit $= 0.3\sqrt{2}$ A
c) The voltage across 100 Ω resistor = $30\sqrt{2}$ V   d) The voltage across 50 Ω resistor = 10 V

413. A 10 μF capacitor is charged to 25 V of potential. The battery is then disconnected and a pure 100 mH coil is connected across the capacitor, so that $L - C$ oscillations are set up. The maximum current in the coil is
a) 0.25 A   b) 0.01 A
c) 2.5 A   d) 1.6 A

414. If maximum energy is stored in a capacitor at t=0, then find the time after which, current in the circuit will be maximum?



a) $\frac{\pi}{2}$ ms   b) $\frac{\pi}{4}$ ms
c) πms   d) 2 ms

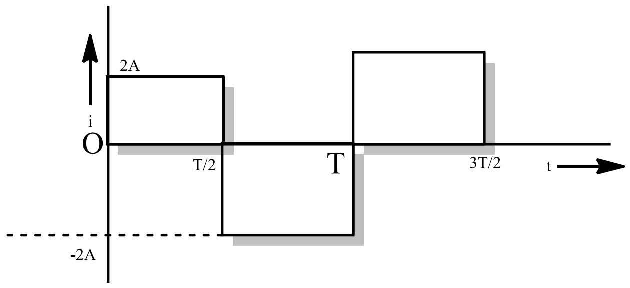
415. In non-resonant circuit, what will be the nature of the circuit for frequencies higher than the resonant frequency?
a) Resistive   b) Capacitive
c) Inductive   d) None of these

416. A 1.5 mH inductor in an $L - C$ circuit stores a maximum energy of 30ωJ. The rms value of current in the circuit is
a) $\frac{1}{\sqrt{2}} \times 10^{-1}$ A   b) $\sqrt{2} \times 10^{-2}$ A
c) $\frac{1}{\sqrt{2}} \times 10^{-2}$ A   d) $\sqrt{2} \times 10^{-1}$ A

417. The natural frequency of an $L - C$ circuit is 125000 cycle/s. Then, the capacitor C is replaced by another capacitor with a dielectric medium of dielectric constant K. In this case, the frequency decreases by 25 kHz. The value of K is
a) 3.0   b) 2.1
c) 1.56   d) 1.7

418. The maximum value of AC in a circuit is 707 V. Its rms value is
a) 70.7 V   b) 100 V
c) 500 V   d) 707 V

419. The r m s value of the alternating current shown in figure is

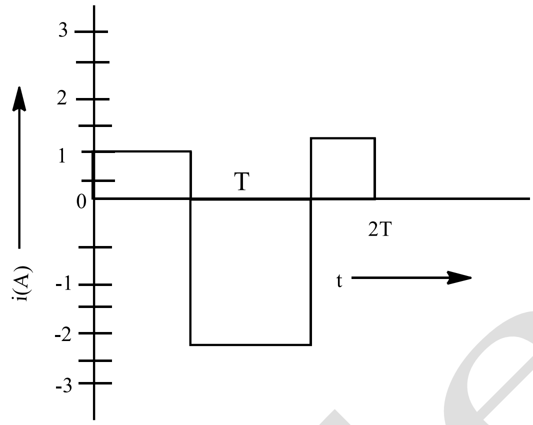


a) 2A b) -2A
c) 4A d) 1A

420. An alternating voltage (in volts) given by $V = 200\sqrt{2}\sin(100t)$ is connected to a 1μF capacitor through an AC ammeter.
The reading of the ammeter will be
a) 10 mA b) 20 mA
c) 40 mA d) 80 mA

421. If reading of an ammeter is 10 A, the peak value of current is
a) $\frac{10}{\sqrt{2}}$ A b) $\frac{5}{\sqrt{2}}$ A
c) $20\sqrt{2}$ A d) $10\sqrt{2}$ A

422. The alternating current in a circuit is described by graph shown in figure. The rms current obtained from graph would be



a) 1.4 A b) 2.2 A
c) 1.9 A d) 2.6 A

423. Alternating current of peak value $\left(\frac{2}{\pi}\right)$ ampere flows through the primary coil of the transformer. The coefficient of mutual inductance between primary and secondary coil is 1H. The peak emf induced in secondary coil is (frequency of AC = 50 Hz)
a) 100 V b) 200 v
c) 300 V d) 400 V

424. The electric mains in the house is marked 220 V, 50 Hz. Write down the equation for instantaneous voltage.
a) 3.1 sin(100π)t b) 31.1 cos(100π)t
c) 311.1 sin(100π)t d) 311.1 cos(100π)t

N.B.Navale

Date : 28.03.2025
Time : 06:21:36
Marks : 424

TEST ID: 35
PHYSICS

13.AC CIRCUITS ,SOUND

: ANSWER KEY :

1) c	2) c	3) a	4) a	165) b	166) b	167) d	168) d
5) c	6) c	7) d	8) d	169) c	170) c	171) c	172) c
9) c	10) c	11) d	12) d	173) d	174) d	175) c	176) c
13) c	14) c	15) c	16) c	177) b	178) b	179) b	180) b
17) c	18) c	19) c	20) c	181) d	182) d	183) b	184) b
21) c	22) c	23) b	24) b	185) b	186) b	187) b	188) b
25) a	26) a	27) b	28) b	189) b	190) b	191) a	192) a
29) c	30) c	31) c	32) c	193) b	194) b	195) a	196) a
33) d	34) d	35) a	36) a	197) b	198) b	199) b	200) b
37) b	38) b	39) c	40) c	201) a	202) a	203) d	204) d
41) c	42) c	43) d	44) d	205) c	206) c	207) a	208) a
45) d	46) d	47) c	48) c	209) b	210) b	211) c	212) c
49) d	50) d	51) d	52) d	213) b	214) b	215) c	216) c
53) d	54) d	55) d	56) d	217) b	218) b	219) a	220) a
57) b	58) b	59) b	60) b	221) a	222) a	223) a	224) a
61) d	62) d	63) d	64) d	225) c	226) c	227) c	228) c
65) b	66) b	67) c	68) c	229) b	230) b	231) b	232) b
69) b	70) b	71) c	72) c	233) c	234) c	235) a	236) a
73) b	74) b	75) b	76) b	237) c	238) c	239) a	240) a
77) d	78) d	79) a	80) a	241) d	242) d	243) b	244) b
81) b	82) b	83) b	84) b	245) c	246) c	247) d	248) d
85) d	86) d	87) a	88) a	249) c	250) c	251) a	252) a
89) c	90) c	91) a	92) a	253) d	254) d	255) a	256) a
93) a	94) a	95) c	96) c	257) d	258) d	259) c	260) c
97) b	98) b	99) a	100) a	261) b	262) b	263) c	264) c
101) c	102) c	103) c	104) c	265) a	266) a	267) c	268) c
105) d	106) d	107) b	108) b	269) c	270) c	271) c	272) c
109) c	110) c	111) a	112) a	273) b	274) b	275) b	276) b
113) a	114) a	115) a	116) a	277) b	278) b	279) b	280) b
117) a	118) a	119) c	120) c	281) a	282) a	283) a	284) a
121) a	122) a	123) d	124) d	285) c	286) c	287) c	288) c
125) c	126) c	127) d	128) d	289) c	290) c	291) d	292) d
129) a	130) a	131) d	132) d	293) b	294) b	295) c	296) c
133) c	134) c	135) a	136) a	297) a	298) a	299) d	300) d
137) b	138) b	139) a	140) a	301) a	302) a	303) d	304) d
141) c	142) c	143) c	144) c	305) b	306) b	307) d	308) d
145) c	146) c	147) a	148) a	309) d	310) d	311) d	312) d
149) c	150) c	151) d	152) d	313) a	314) a	315) a	316) a
153) a	154) a	155) a	156) a	317) c	318) c	319) a	320) a
157) b	158) b	159) d	160) d	321) c	322) c	323) d	324) d
161) c	162) c	163) c	164) c	325) c	326) c	327) d	328) d

329)	c	330)	c	331)	c	332)	c
333)	c	334)	c	335)	d	336)	d
337)	a	338)	a	339)	d	340)	a
341)	c	342)	a	343)	d	344)	c
345)	c	346)	c	347)	c	348)	d
349)	c	350)	a	351)	a	352)	c
353)	a	354)	b	355)	d	356)	b
357)	c	358)	b	359)	a	360)	b
361)	a	362)	d	363)	d	364)	b
365)	b	366)	c	367)	d	368)	a
369)	b	370)	d	371)	d	372)	a
373)	a	374)	b	375)	c	376)	d
377)	a	378)	d	379)	d	380)	c

381)	c	382)	b	383)	c	384)	b
385)	a	386)	b	387)	b	388)	a
389)	b	390)	b	391)	b	392)	b
393)	c	394)	d	395)	b	396)	c
397)	a	398)	b	399)	a	400)	d
401)	c	402)	d	403)	a	404)	b
405)	c	406)	c	407)	d	408)	a
409)	b	410)	b	411)	d	412)	a
413)	a	414)	b	415)	c	416)	d
417)	c	418)	c	419)	a	420)	b
421)	d	422)	a	423)	b	424)	c

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: HINTS AND SOLUTIONS :

Single Correct Answer Type

1 **(c)**

In the first medium, frequency, $v = \frac{v}{\lambda}$

It remains the same in second medium, i.e. $V = V$

$\because \frac{v'}{\lambda'} = \frac{2v}{\lambda'}$

$\therefore \frac{2v}{\lambda'} = \frac{v}{\lambda} \Rightarrow \lambda' = 2\lambda$

2 **(c)**

In the first medium, frequency, $v = \frac{v}{\lambda}$

It remains the same in second medium, i.e. $V = V$

$\because \frac{v'}{\lambda'} = \frac{2v}{\lambda'}$

$\therefore \frac{2v}{\lambda'} = \frac{v}{\lambda} \Rightarrow \lambda' = 2\lambda$

3 **(a)**

Phase difference $\phi = \frac{2\pi}{\lambda} x$

$\lambda = \frac{v}{f} = \frac{330}{50} = 6.6$

$\therefore x = \frac{\lambda\phi}{2\pi} = \frac{6.6}{2\pi} \times \frac{\pi}{3} = \frac{6.6}{6} = 1.1 \text{ m}$

4 **(a)**

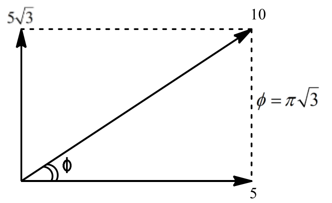
Phase difference $\phi = \frac{2\pi}{\lambda} x$

$\lambda = \frac{v}{f} = \frac{330}{50} = 6.6$

$\therefore x = \frac{\lambda\phi}{2\pi} = \frac{6.6}{2\pi} \times \frac{\pi}{3} = \frac{6.6}{6} = 1.1 \text{ m}$

5 **(c)**

Given, $y_2 = 5(\sin 5\pi t + \sqrt{3}\cos 5\pi t)$



This can also be written as $y_2 = 10 \sin\left(5\pi t + \frac{\pi}{3}\right)$

Now, $A_1 = 10$ and $A_2 = 10$

$\therefore \quad \frac{A_1}{A_2} = \frac{1}{1}$

6 **(c)**

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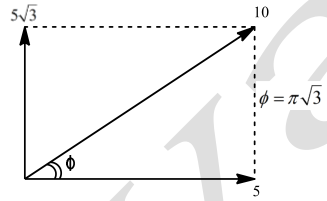

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7 **(d)**

Phase difference,

$\Delta\phi = \left(\frac{2\pi}{T}\right)(\Delta t) = \left(\frac{2\pi}{1/400}\right)(10^{-3}) = 0.8\,\pi = 144$

8 **(d)**

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9 **(c)**

When source and observer both are moving in the same direction and observer is ahead of source, then apparent frequency,

$f' = \frac{v - v_o}{v - v_s} f = \frac{v - \frac{v}{6}}{v - \frac{v}{4}} = \frac{\frac{5v}{6}}{\frac{3v}{4}} f = \frac{10}{9} f$

10 **(c)**

When source and observer both are moving in the same direction and observer is ahead of source, then apparent frequency,

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11 **(d)**

The speed of transverse wave in a wire is given by

$V = \sqrt{\frac{T}{m}}$

where $m = \frac{M}{L} = \frac{AL\rho}{L} = A\rho$

$\therefore V = \sqrt{\frac{T}{A\rho}}$

$\therefore V^2 = \frac{T}{A\rho}$

$\therefore A = \frac{T}{V^2\rho} = T\rho^{-1}V^{-2}$

12 **(d)**
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13 **(c)**
Maximum particle speed,
$(v_p)_{max} = \omega A = (10\pi)(0.1) = \pi \text{ cm s}^{-1}$

14 **(c)**
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15 **(c)**
Phase difference $\phi = \frac{2\pi x}{\lambda}$

Given $\phi = n\pi$

$\lambda = \frac{v}{f}$

$\therefore n\pi = \frac{2\pi xf}{v}$

$\therefore f = \frac{nV}{2x}$

16 **(c)**
Phase difference $\phi = \frac{2\pi x}{\lambda}$

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17 **(c)**
Speed of sound in a gas is given by

$V = \sqrt{\frac{\gamma RT}{M}}$

When M is the molecular mass and T is the temperature.

$\frac{V_1}{V_2} = \sqrt{\frac{m_2}{m_1}}$

18 **(c)**
Speed of sound in a gas is given by

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When M is the molecular mass and T is the temperature.

$\frac{V_1}{V_2} = \sqrt{\frac{m_2}{m_1}}$

19 **(c)**
$\lambda_1 - \lambda_2 = \frac{V}{f_1} - \frac{V}{f_2} = \frac{320}{320} - \frac{320}{450} = 1 - \frac{2}{3} = \frac{1}{3}\text{m}$
$= 0.33 \text{ m} = 33 \text{ cm}$

20 **(c)**
$\lambda_1 - \lambda_2 = \frac{V}{f_1} - \frac{V}{f_2} = \frac{320}{320} - \frac{320}{450} = 1 - \frac{2}{3} = \frac{1}{3}\text{m}$
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21 **(c)**
Ratio of velocity, $\frac{v_{O_2}}{v_{He}} = \frac{\sqrt{\frac{7/5\ RT}{32}}}{\sqrt{\frac{5/3\ RT}{4}}} = 0.32.$

or $V_{O_2} = 0.32 v_{He}$

Time taken $= \frac{1}{0.32}T = 3T$

22 **(c)**
Ratio of velocity, $\frac{v_{O_2}}{v_{He}} = \frac{\sqrt{\frac{7/5\ RT}{32}}}{\sqrt{\frac{5/3\ RT}{4}}} = 0.32.$

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23 **(b)**

Molecular weight of mixture,

$$M_{mix} = \frac{n_1M_1 + n_2M_2}{n_1 + n_2}$$

$$= \frac{1 \times 4 + 2 \times 32}{1+2} = \frac{68}{3}\ \text{g mol}^{-1}$$

$$= \frac{68}{3} \times 10^{-3}\ \text{kg mol}^{-1}$$

For helium, $C_{V_1} = \frac{3}{2}R$

For oxygen, $C_{V_2} = \frac{5}{2}R$

$$(C_V)_{mix} = \frac{n_1C_{V_1} + n_2C_{V_2}}{n_1 + n_2}$$

$$= \frac{1 \times \frac{3R}{2} + 2 \times \frac{5R}{2}}{1+2} = \frac{13R}{6}$$

Now, $(C_p)_{mix} = (C_v)_{mix} + R$

$$= \frac{13R}{6} + R = \frac{19R}{6}$$

$$\Rightarrow \gamma_{mix} = \frac{(C_p)_{mix}}{(C_V)_{mix}} = \frac{19}{13}$$

Speed of Sound, $v = \sqrt{\frac{\gamma_{mix}RT}{M_{mix}}} = \sqrt{\frac{19}{13} \times \frac{8.31 \times 300}{\frac{68}{3} \times 10^{-3}}}$

$= 400.8\ \text{ms}^{-1}$

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25 **(a)**

$V_s = 33\frac{m}{s}, V = 300\frac{m}{s}, n = 450\ \text{Hz}$

$$n' = \frac{nV}{V - V_s} = \frac{450 \times 330}{330 - 33} = \frac{450 \times 330}{297} = 500\ \text{Hz}$$

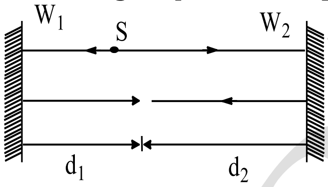
26 **(a)**

$V_s = 33\frac{m}{s}, V = 300\frac{m}{s}, n = 450\ \text{Hz}$

$$n' = \frac{nV}{V - V_s} = \frac{450 \times 330}{330 - 33} = \frac{450 \times 330}{297} = 500\ \text{Hz}$$

27 **(b)**

According to question, $2d_1 = 340 \times t_1$



$\therefore d_1 = 340\text{m}$ $(\because t_1 = 2\ \text{s})$

$\therefore 2d_2 = 340 \times t_2$

$\because d_2 = 680\ \text{m}$ $(\because t_2 = t_1 + 2 = 4\ \text{s})$

$\Rightarrow$ Distance between walls $= d_1 + d_2 = 1020\ \text{m}$

Next echo will be heard at 6 s not at 8 s. Because sound wave reflected from W_2 will be reflected by W_1 in next 2 s.

28 **(b)**

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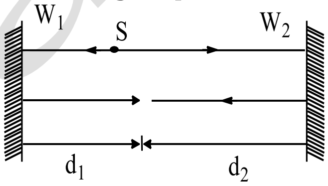

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29 **(c)**

Sound level $= 10 \log\left(\frac{I}{I_0}\right)$

$30 = 10 \log\left(\frac{I}{I_0}\right)$

Or $3 = \log\left(\frac{I}{I_0}\right)$

$\therefore \frac{I}{I_0} = 10^3$

30 **(c)**

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$30 = 10 \log\left(\frac{I}{I_0}\right)$

Or $3 = \log\left(\frac{I}{I_0}\right)$

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31 **(c)**

Speed of sound wave in a medium, $v \propto \sqrt{T}$
(where, T is temperature of the medium)
Clearly, when temperature Changes, speed also change
As, $v = v\lambda$
where, v is frequensy and λ is wavelength.
Frequency (v) remains fixed $\Rightarrow v \propto \lambda$ or $\lambda \propto v$
As, frequency does not change, so wavelength (λ) changes

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33 **(d)**

(i) Ultrasonic waves can be used to detect submarines, icebergs, etc.
(ii) Ultrasonic waves can be used to clean clothes, fine machinery parts, etc.
(iii) Ultrasonic waves can be used to kill smaller animals like rats, fish and frogs, etc.

34 **(d)**

(i) Ultrasonic waves can be used to detect submarines, icebergs, etc.
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(iii) Ultrasonic waves can be used to kill smaller animals like rats, fish and frogs, etc.

35 **(a)**

Given, $y = A\sin(100\,\pi t - 3x)$
The general equation, $y = A\sin(\omega t - kx)$
$k = 3$ and $k = \frac{2\pi}{\lambda}$
or $\lambda = \frac{2\pi}{k} = \frac{2\pi}{3}$
Phase difference, $\phi = \frac{2\pi}{3}$
$\therefore$ Phase difference, $\Delta\phi = \frac{2\pi}{\lambda} \cdot \Delta x$
$\frac{2\pi}{\lambda} \cdot x = \frac{\pi}{3}$ or $x = \frac{\pi}{3} \times \frac{\lambda}{2\pi}$
$= \frac{\pi}{3} \times \frac{2\pi}{3 \times 2\pi}$
Distance, $x = \frac{\pi}{9}$ m

36 **(a)**

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The general equation, $y = A\sin(\omega t - kx)$
$k = 3$ and $k = \frac{2\pi}{\lambda}$
or $\lambda = \frac{2\pi}{k} = \frac{2\pi}{3}$
Phase difference, $\phi = \frac{2\pi}{3}$
$\therefore$ Phase difference, $\Delta\phi = \frac{2\pi}{\lambda} \cdot \Delta x$
$\frac{2\pi}{\lambda} \cdot x = \frac{\pi}{3}$ or $x = \frac{\pi}{3} \times \frac{\lambda}{2\pi}$
$= \frac{\pi}{3} \times \frac{2\pi}{3 \times 2\pi}$
Distance, $x = \frac{\pi}{9}$ m

37 **(b)**

At point A, source is moving away from observer, so apparent frequency $n_1 < n$ (actual frequency). At point B, source is coming towards observer, so apparent frequency $n_2 > n$ and point C source is moving perpendicular to observer, so $n_3 = n$.
Hence,
$n_2 > n_3 > n_1$

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Hence,
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39 **(c)**

$\therefore \frac{\Delta\lambda}{\lambda} = \frac{v}{c} \Rightarrow \frac{0.01}{100} = \frac{v}{3\times10^8}$
$\Rightarrow v = 3 \times 10^4$ m/s $= 30$ km/s

40 **(c)**

$\therefore \frac{\Delta\lambda}{\lambda} = \frac{v}{c} \Rightarrow \frac{0.01}{100} = \frac{v}{3\times10^8}$
$\Rightarrow v = 3 \times 10^4$ m/s $= 30$ km/s

41 **(c)**

Velocity of sound in gas,

$$v = \sqrt{\frac{\gamma RT}{M}} \Rightarrow v \propto \sqrt{\frac{\gamma}{M}}$$

$$\Rightarrow \frac{v_{N_2}}{v_{He}} = \sqrt{\frac{\gamma_{N_2}}{\gamma_{He}} \times \frac{M_{H_e}}{M_{N_2}}} = \sqrt{\frac{\frac{7}{5} \times 4}{\frac{5}{3} \times 28}} = \frac{\sqrt{3}}{5}$$

42 **(c)**

Velocity of sound in gas,

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43 **(d)**

Speed of sound in a gas

$$V = \sqrt{\frac{\gamma RT}{M}}$$

$$\therefore \frac{V_A}{V_B} = \sqrt{\frac{m_2}{m_1}}$$

44 **(d)**

Speed of sound in a gas

$$V = \sqrt{\frac{\gamma RT}{M}}$$

$$\therefore \frac{V_A}{V_B} = \sqrt{\frac{m_2}{m_1}}$$

45 **(d)**

Velocity, $v = n\lambda$

$\Rightarrow \quad v \propto \lambda$

$$\Rightarrow \because \quad \frac{\lambda_1}{\lambda_2} = \frac{v_1}{v_2} = \frac{2/3}{3/10} = \frac{20}{9}$$

46 **(d)**

Velocity, $v = n\lambda$

$\Rightarrow \quad v \propto \lambda$

$$\Rightarrow \because \quad \frac{\lambda_1}{\lambda_2} = \frac{v_1}{v_2} = \frac{2/3}{3/10} = \frac{20}{9}$$

47 **(c)**

Angular velocity, $\omega = 2\pi f$ or $60 = 2\pi f$

$\therefore$ Frequency, $f = \frac{30}{\pi}$ Hz

48 **(c)**

Angular velocity, $\omega = 2\pi f$ or $60 = 2\pi f$

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49 **(d)**

$$B_1 = 10 \log_e \left(\frac{l}{l_0}\right)$$

$$B_2 = 10 \log_e \left(\frac{l'}{l_0}\right)$$

Given, $B_2 - B_1 = 20$ dB

$$\because \; 20 = 10 \; L \left(\frac{l'}{1}\right)$$

$$l' = 100l$$

50 **(d)**

$$B_1 = 10 \log_e \left(\frac{l}{l_0}\right)$$

$$B_2 = 10 \log_e \left(\frac{l'}{l_0}\right)$$

Given, $B_2 - B_1 = 20$ dB

$$\because \; 20 = 10 \; L \left(\frac{l'}{1}\right)$$

$$l' = 100l$$

51 **(d)**

Intensity, $I = \frac{1}{2}\rho\omega^2 A^2 v$ or $l \propto \omega^2$ or $l \propto 1^2$

$$\because \; \frac{I_2}{I_1} = \left(\frac{f_2}{f_1}\right)^2 = \left(\frac{1200}{400}\right)^2 = 9:1$$

52 **(d)**

Intensity, $I = \frac{1}{2}\rho\omega^2 A^2 v$ or $l \propto \omega^2$ or $l \propto 1^2$

$$\because \; \frac{I_2}{I_1} = \left(\frac{f_2}{f_1}\right)^2 = \left(\frac{1200}{400}\right)^2 = 9:1$$

53 **(d)**

In the 1st case the apparent frequency is given by

$$n_1 = n\left(\frac{V_s}{V_s + V}\right)$$

Where V_s is the velocity of sound.

$$\therefore \frac{n}{n_1} = 1.2 = \frac{V_s + V}{V_s}$$

$$\therefore 1.2V_s = V_s + V$$

$$\therefore 1.2V_s - V_s = V$$

$$V = 0.2V_s$$

In the second case,

$$n_2 = n\left(\frac{V_s - V}{V_s}\right)$$

$$\therefore \frac{n}{n_2} = \frac{V_s}{V_s - V}$$

$$= \frac{V_s}{V_s - 0.2V_s}$$

$$= \frac{1}{0.8} = 1.25$$

54 **(d)**

In the 1st case the apparent frequency is given by

$$n_1 = n\left(\frac{V_s}{V_s + V}\right)$$

Where V_s is the velocity of sound.

$$\therefore \frac{n}{n_1} = 1.2 = \frac{V_s + V}{V_s}$$

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$$= \frac{V_s}{V_s - 0.2V_s}$$

$$= \frac{1}{0.8} = 1.25$$

55 **(d)**

Density of mixture, $P_{mix} = \frac{V_{O2}P_{O_2} + V_{H_2}P_{H_2}}{V_{O_2} + V_{H_2}}$

$$= \frac{v(\rho_{O_2} + \rho_{H_2})}{2v}$$

$$= \frac{\rho_{O_2} + \rho_{H_2}}{2} \ (\text{since}, v_{O_2} = v_{H_2} = v)$$

$$\frac{(\rho_{H_2} + 16\rho_{H_2})}{2} = 8.5\rho_{H_2} \ (\text{given}, \rho_{O_2} = 16\rho_{H_2})$$

As, $v \propto \frac{1}{\sqrt{\rho}}$

$$\frac{v_{mix}}{v_{H_2}} = \sqrt{\frac{\rho_{H_2}}{\rho_{mix}}} = \sqrt{\frac{\rho_{H_2}}{8.5\rho_{H_2}}} = \sqrt{\frac{2}{17}}$$

56 **(d)**

Density of mixture, $P_{mix} = \frac{V_{O2}P_{O_2} + V_{H_2}P_{H_2}}{V_{O_2} + V_{H_2}}$

$$= \frac{v(\rho_{O_2} + \rho_{H_2})}{2v}$$

$$= \frac{\rho_{O_2} + \rho_{H_2}}{2} \ (\text{since}, v_{O_2} = v_{H_2} = v)$$

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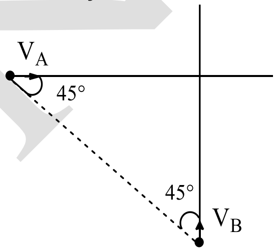
As, $v \propto \frac{1}{\sqrt{\rho}}$

$$\frac{v_{mix}}{v_{H_2}} = \sqrt{\frac{\rho_{H_2}}{\rho_{mix}}} = \sqrt{\frac{\rho_{H_2}}{8.5\rho_{H_2}}} = \sqrt{\frac{2}{17}}$$

57 **(b)**

Velocity, V_A = 72 km h^{-1} = 20 ms^{-1}
Velocity, V_B = 36 km h^{-1} = 10 ms^{-1}



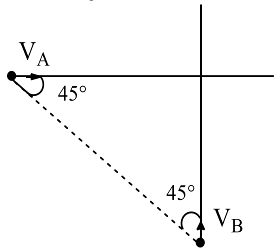
Frequency of horn heard by the driver,

$$n' = n\left(\frac{v + v_B \cos 45°}{v - v_A \cos 45°}\right)$$

$$= 280\left(\frac{340 + 10/\sqrt{2}}{340 - 20/\sqrt{2}}\right) = 298 \text{ Hz}$$

58 **(b)**

Velocity, V_A = 72 km h^{-1} = 20 ms^{-1}
Velocity, V_B = 36 km h^{-1} = 10 ms^{-1}



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59 **(b)**

Frequency of sound in audible region is 20 Hz – 20kHz.

60 **(b)**

Frequency of sound in audible region is 20 Hz – 20kHz.

61 **(d)**

We have, $90 - 40 = 10 \log \frac{I_1}{I_0} - 10 \log \frac{I_2}{I_0}$

or $\quad 50 = 10 \log\left(\frac{l_1}{I_2}\right)]$

$\therefore \quad \frac{l_1}{l_2} = 10^5$

62 **(d)**

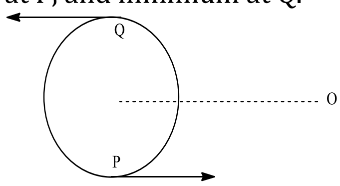
We have, $90 - 40 = 10 \log \frac{I_1}{I_0} - 10 \log \frac{I_2}{I_0}$

or $\quad 50 = 10 \log\left(\frac{l_1}{I_2}\right)]$

$\therefore \quad \frac{l_1}{l_2} = 10^5$

63 **(d)**

Velocity of source (or whistle), $v_s = R\omega = 30 \text{ ms}^{-1}$.
Maximum frequency will be heard when whistle is at P, and minimum at Q.



At P, $f_{max} = f\left(\frac{v}{v - v_s}\right) = 440\left(\frac{330}{330 - 30}\right) = 484 \text{ Hz}$

At Q, $f_{min} = f\left(\frac{v}{v + v_s}\right) = 440\left(\frac{330}{330 + 30}\right) = 403.3 \text{ Hz}$

64 **(d)**

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Maximum frequency will be heard when whistle is

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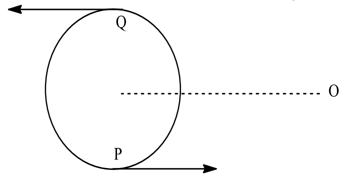

At P, $f_{max} = f\left(\frac{v}{v - v_s}\right) = 440\left(\frac{330}{330-30}\right) = 484$ Hz

At Q, $f_{min} = f\left(\frac{v}{v + v_s}\right) = 440\left(\frac{330}{330+30}\right) = 403.3$ Hz

65 **(b)**

We have, $L_2D = \sqrt{(40)^2 + (9)^2} = 41$ m

Path difference, $\Delta X = L_2D - L_1D = 1$ m

For maximum, $\Delta X = 2n\frac{\lambda}{2}$

For n = 1, $2(1)\frac{\lambda}{2} = 1 \Rightarrow \lambda = 1 \text{ m} \Rightarrow f = \frac{v}{\lambda} = 330$ Hz

66 **(b)**

We have, $L_2D = \sqrt{(40)^2 + (9)^2} = 41$ m

Path difference, $\Delta X = L_2D - L_1D = 1$ m

For maximum, $\Delta X = 2n\frac{\lambda}{2}$

For n = 1, $2(1)\frac{\lambda}{2} = 1 \Rightarrow \lambda = 1 \text{ m} \Rightarrow f = \frac{v}{\lambda} = 330$ Hz

67 **(c)**

Given, linear mass density,

$m = 10^{-3}$ kg/m

and $y = 0.05 \sin(x + 15t)$ ...(i)

since, the general equation of wave,

$y = a \sin(kx + \omega t)$ ....(ii)

Now, comparing the Eqs. (i) and (ii), we get

$k = 1, \lambda = 2\pi$ $\left(\because k = \frac{2\pi}{\lambda}\right)$

and $\omega = 15 \Rightarrow f = \frac{15}{2\pi}$ $(\because \omega = 2\pi f)$

Velocity of the wave, $v = \lambda f = 2\pi \times \frac{15}{2\pi} = 15$ m/s

As we know, the tension force in the string,

$T = v^2 m$ $\left(\because v = \sqrt{\frac{T}{m}}\right)$

So, by substituting the values in the above relation, we get

$T = (15)^2 \times 10^{-3} = 0.225$ N

Hence, the tension force in the string is 0.225 N.

68 **(c)**

Given, linear mass density,

$m = 10^{-3}$ kg/m

and $y = 0.05 \sin(x + 15t)$ ...(i)

since, the general equation of wave,

$y = a \sin(kx + \omega t)$ ....(ii)

Now, comparing the Eqs. (i) and (ii), we get

$k = 1, \lambda = 2\pi$ $\left(\because k = \frac{2\pi}{\lambda}\right)$

and $\omega = 15 \Rightarrow f = \frac{15}{2\pi}$ $(\because \omega = 2\pi f)$

Velocity of the wave, $v = \lambda f = 2\pi \times \frac{15}{2\pi} = 15$ m/s

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Hence, the tension force in the string is 0.225 N.

69 **(b)**

The speed of sound in a gas is given by

$$V = \sqrt{\frac{\gamma RT}{M}}$$

At the same temperature $\frac{V_{He}}{V_{N_2}} = \sqrt{\frac{\gamma_{He}}{\gamma_{N_2}} \cdot \frac{M_{N_2}}{M_{He}}}$

$$= \sqrt{\frac{5/3 \times 28}{\frac{7}{5} \times 4}} = \frac{5}{\sqrt{3}}$$

70 **(b)**

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At the same temperature $\frac{V_{He}}{V_{N_2}} = \sqrt{\frac{\gamma_{He}}{\gamma_{N_2}} \cdot \frac{M_{N_2}}{M_{He}}}$

$$= \sqrt{\frac{5/3 \times 28}{\frac{7}{5} \times 4}} = \frac{5}{\sqrt{3}}$$

71 **(c)**

All functions of x and t of type $(ax \pm bt)$ represent a wave.

So, function, $y = A \sin(k^2x^2 - \omega^2t^2)$

does not represent wave motion.

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So, function, $y = A \sin(k^2x^2 - \omega^2t^2)$

does not represent wave motion.

73 **(b)**

$V \propto \sqrt{T}$ where T is the absolute temperature

$$\therefore \frac{V_2}{V_1} = \sqrt{\frac{T_2}{T_1}}$$

$T_1 = 0°C = 273$ K

$\frac{V_2}{V_1} = 2$

$$\therefore 2=\sqrt{\frac{T_2}{273}}$$

$$\therefore 4=\frac{T_2}{273}$$

$$\therefore T_2=273\times 4=1092-273=819°C$$

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75 **(b)**

Velocity, $V=\sqrt{\frac{FFT}{M}}\Rightarrow v\propto\sqrt{T}$

$$\because \frac{v_2}{v_1}=\sqrt{\frac{T_2}{T_1}}=\sqrt{\frac{T+600}{T}}=\sqrt{3}$$

The initial temperature of the gas, $T=300\text{ K}=27°C$

76 **(b)**

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$$\because \frac{v_2}{v_1}=\sqrt{\frac{T_2}{T_1}}=\sqrt{\frac{T+600}{T}}=\sqrt{3}$$

The initial temperature of the gas, $T=300\text{ K}=27°C$

77 **(d)**

The Doppler's effect is applicable for both light and sound waves.

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79 **(a)**

$f=160\text{ Hz}, v=320\text{ m/s}$

$$\lambda=\frac{v}{f}=\frac{320}{160}=2\text{ m}=200\text{ cm}$$

Phase difference $\phi=\frac{2\pi x}{\lambda}$

$$\therefore x=\frac{\phi\lambda}{2\pi}=\frac{\pi}{2}.\frac{\lambda}{2\pi}$$

$$\left[\because \phi=\frac{\pi}{2}\right]$$

$$=\frac{\lambda}{4}=\frac{200}{4}=50\text{ cm}$$

80 **(a)**

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Phase difference $\phi=\frac{2\pi x}{\lambda}$

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$$\left[\because \phi=\frac{\pi}{2}\right]$$

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81 **(b)**

Phase difference $=\frac{2\pi}{\lambda}\times$ Path difference

From relation, $\Delta\phi=\frac{2\pi}{\lambda}\times\Delta x$

$\Rightarrow \quad \Delta x=\frac{\lambda}{2\pi}\times\Delta\phi \quad$ ...(i)

Also, $\quad \lambda=\frac{v}{n} \quad$ ...(ii)

Now, from Eqs. (i) and (ii), we get

$$\Delta x=\frac{v}{2\pi n}\times\Delta\phi$$

$$=\frac{330}{2\pi\times 50}\times\frac{\pi}{3}=1.1\text{ m}$$

82 **(b)**

Phase difference $=\frac{2\pi}{\lambda}\times$ Path difference

From relation, $\Delta\phi=\frac{2\pi}{\lambda}\times\Delta x$

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83 **(b)**

Distance between a compression and adjoining reaction in pressure wave is $\frac{\lambda}{2}$.

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85 **(d)**

Phase, $\Delta\phi = \frac{2\pi}{\lambda} \cdot \Delta x$

The distance between two points,

$$\Delta x = \frac{(\Delta\phi)(\lambda)}{2\pi} = \frac{(\Delta\phi)(v/f)}{2\pi} = \frac{(\pi/3)(360/500)}{2\pi}$$

$$= 0.12 \text{ m}$$

86 **(d)**

Phase, $\Delta\phi = \frac{2\pi}{\lambda} \cdot \Delta x$

The distance between two points,

$$\Delta x = \frac{(\Delta\phi)(\lambda)}{2\pi} = \frac{(\Delta\phi)(v/f)}{2\pi} = \frac{(\pi/3)(360/500)}{2\pi}$$

$$= 0.12 \text{ m}$$

87 **(a)**

Given, $v = 220 \text{ Hz}, \lambda_1 = 1{,}5 \text{ m}$,

$T_1 = 0°C = 273 \text{ K}$

Velocity, $v_1 = v\lambda_1 = 220 \times 1.5 = 330 \text{ m s}^{-1}$

$T_2 = 27°C = 27 + 273 = 300 \text{ K}$

Velocity, $v_2 = v_1\sqrt{\frac{T_2}{T_1}} = 330\sqrt{\frac{300}{273}} = 345.9 \text{ ms}^{-1}$

Wavelength, $\lambda_2 = \frac{v_2}{v} = \frac{345.9}{220} = 1.57 \text{ m}$

Increase in wavelength $= \lambda_2 - \lambda_1 = 1.57 - 1.5 = 0.07 \text{ m}$

88 **(a)**

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$T_1 = 0°C = 273 \text{ K}$

Velocity, $v_1 = v\lambda_1 = 220 \times 1.5 = 330 \text{ m s}^{-1}$

$T_2 = 27°C = 27 + 273 = 300 \text{ K}$

Velocity, $v_2 = v_1\sqrt{\frac{T_2}{T_1}} = 330\sqrt{\frac{300}{273}} = 345.9 \text{ ms}^{-1}$

Wavelength, $\lambda_2 = \frac{v_2}{v} = \frac{345.9}{220} = 1.57 \text{ m}$

Increase in wavelength $= \lambda_2 - \lambda_1 = 1.57 - 1.5 = 0.07 \text{ m}$

89 **(c)**

The velocity of sound is given by

$$V = \sqrt{\frac{\gamma P}{\rho}} \ldots \frac{V'}{V} = \sqrt{\frac{\rho}{\rho'}}$$

If $\rho' = 2\rho$ then

$$\therefore V' = \frac{V}{\sqrt{2}}$$

90 **(c)**

The velocity of sound is given by

$$V = \sqrt{\frac{\gamma P}{\rho}} \ldots \frac{V'}{V} = \sqrt{\frac{\rho}{\rho'}}$$

If $\rho' = 2\rho$ then

$$\therefore V' = \frac{V}{\sqrt{2}}$$

91 **(a)**

$$n' = n\left(\frac{v_0 + v}{v}\right)n$$

$$= n\left(\frac{\frac{v}{4} + v}{v}\right)$$

$$= n\left(\frac{1}{4} + 1\right)$$

$$= \frac{5}{4}n$$

$$\therefore n' = n = \frac{5}{4}$$

92 **(a)**

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$$= \frac{5}{4}n$$

$$\therefore n' = n = \frac{5}{4}$$

93 **(a)**

Speed of wave in a wire is given by

$$V = \sqrt{\frac{T}{m}}$$

Where m is mass per unit length. Value of m will smaller for thinner wire and hence speed will be greater.

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Where m is mass per unit length. Value of m will smaller for thinner wire and hence speed will be greater.

95 **(c)**

$$n' = n\left(\frac{V}{V - V_s}\right) = n\left(\frac{V}{V - \frac{V}{10}}\right) = \frac{n \times 10}{9} = \frac{90 \times 10}{9}$$
$$= 100 \text{ Hz}$$

96 **(c)**

$$n' = n\left(\frac{V}{V - V_s}\right) = n\left(\frac{V}{V - \frac{V}{10}}\right) = \frac{n \times 10}{9} = \frac{90 \times 10}{9}$$
$$= 100 \text{ Hz}$$

97 **(b)**

If $\rho_H = 1$, then $p_{mix} = \frac{4 \times 1 + 1 \times 16}{(4+1)} = 4$

$$\Rightarrow \frac{v_{mix}}{v_H} = \sqrt{\frac{\rho_H}{\rho_{mix}}} = \sqrt{\frac{1}{4}} = \frac{1}{2}$$

$$\therefore\ v_{mix} = \frac{v_H}{2} = \frac{1224}{2} = 612 \text{ ms}^{-1}$$

98 **(b)**

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$$\therefore\ v_{mix} = \frac{v_H}{2} = \frac{1224}{2} = 612 \text{ ms}^{-1}$$

99 **(a)**

$$V' = v\left(\frac{v + V_0}{v}\right)$$

$$V^n = v\left(\frac{v - V_0}{v}\right)$$

$$V' - V^n = \frac{V}{V}(v + V_0 - v + V_0) = \frac{2vV_0}{v}$$

100 **(a)**

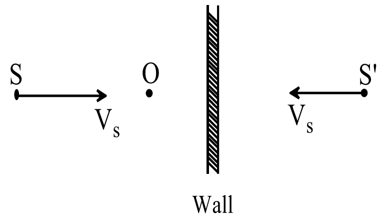
$$V' = v\left(\frac{v + V_0}{v}\right)$$

$$V^n = v\left(\frac{v - V_0}{v}\right)$$

$$V' - V^n = \frac{V}{V}(v + V_0 - v + V_0) = \frac{2vV_0}{v}$$

101 **(c)**

Both S and S' are moving towards observer. So, both the observed frequencies will be more than the actual, but both will be equal. Hence, x = y



102 **(c)**

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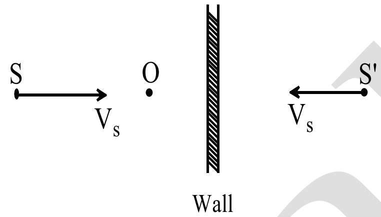

103 **(c)**

When a sound wave changes medium, its frequency does not changes but wavelength changes and phase velocity v or c changes.

104 **(c)**

When a sound wave changes medium, its frequency does not changes but wavelength changes and phase velocity v or c changes.

105 **(d)**

For the 1st echo travelled by sound= $340 \times 1 = 340$ m

Distance of the cliff

$$= \frac{340}{2} = 170 \text{ m}$$

For the 2nd echo distance travelled by sound

$$= 340 \times 4 = 1360$$

Distance of the cliff $= \frac{1360}{2} = 680$ m

$\therefore$ Distance between the two cliffs= $680 + 170 = 850$ m

106 **(d)**

For the 1st echo travelled by sound= $340 \times 1 = 340$ m

Distance of the cliff

$$= \frac{340}{2} = 170 \text{ m}$$

For the 2nd echo distance travelled by sound

$$= 340 \times 4 = 1360$$

Distance of the cliff $= \frac{1360}{2} = 680$ m

$\therefore$ Distance between the two cliffs= $680 + 170 = 850$ m

107 **(b)**

Standard transverse equation of wave,

$y = a \sin 2\pi \left(\frac{t}{T} - \frac{x}{\lambda}\right)$ ...(i)

Given equation is,

$y = 5 \sin 2\pi \left(\frac{t}{0.04} - \frac{x}{40}\right)$ ...(ii)

Comparing the given Eqs. (i) and (ii), we get

$\frac{x}{\lambda} = \frac{x}{40}$

$\Rightarrow \lambda = 40$ cm

108 **(b)**

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$y = a \sin 2\pi \left(\frac{t}{T} - \frac{x}{\lambda}\right)$ ...(i)

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Comparing the given Eqs. (i) and (ii), we get

$\frac{x}{\lambda} = \frac{x}{40}$

$\Rightarrow \lambda = 40$ cm

109 **(c)**

Comparing with $y = a\cos(\omega t + kx - \phi)$, we get

$k = \frac{2\pi}{\lambda} = 0.02\pi \Rightarrow \lambda = 100 \text{ cm}, \Delta\phi = \frac{\pi}{2}$

Hence, path difference between them,

$\Delta x = \frac{\lambda}{2\pi} \times \Delta\phi = \frac{\lambda}{2\pi} \times \frac{\pi}{2} = \frac{\lambda}{4} = \frac{100}{4} = 25$ cm

110 **(c)**

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$k = \frac{2\pi}{\lambda} = 0.02\pi \Rightarrow \lambda = 100 \text{ cm}, \Delta\phi = \frac{\pi}{2}$

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111 **(a)**

The pitch is the highness or lowness of a tone, related to wave frequency.

112 **(a)**

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113 **(a)**

Frequency received by the wall v_1

$$= 165\left(\frac{335}{335 - 5}\right)$$

$= \frac{165 \times 335}{330} = 167.5$ Hz

Frequency of the reflected wave received by the driver

$v_2 = 167.5 \left(\frac{335 + 5}{335}\right)$

$= \frac{167.5 \times 340}{335} = 170$ Hz

$\therefore$ Beat frequency $= 170 - 165 = 5$ Hz

114 **(a)**

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$$= 165\left(\frac{335}{335 - 5}\right)$$

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$v_2 = 167.5 \left(\frac{335 + 5}{335}\right)$

$= \frac{167.5 \times 340}{335} = 170$ Hz

$\therefore$ Beat frequency $= 170 - 165 = 5$ Hz

115 **(a)**

The linear velocity of whistle,

$v_s = r_\omega = 1.2 \times 2\pi \frac{400}{60} = 50$ m/s

When whistle approaches the listener, heard frequency will be maximum and when listener recedes away, heard frequency will be minimum.

So, $n_{max} = n\left(\frac{v}{v - v_s}\right) = 500\left(\frac{340}{290}\right) = 586$ Hz

and $n_{min} = n\left(\frac{v}{v + v_s}\right) = 500\left(\frac{340}{390}\right) = 436$ Hz

116 **(a)**

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117 **(a)**

$f = 160 \text{ Hz}, v = 320$ m/s

$\lambda = \frac{v}{f} = \frac{320}{160} = 2 \text{ m} = 200$ cm

Phase difference $\phi = \frac{2\pi x}{\lambda}$

$\therefore x = \frac{\phi\lambda}{2\pi} = \frac{\pi}{2} \cdot \frac{\lambda}{2\pi} \quad \left[\because \phi = \frac{\pi}{2}\right]$

$= \frac{\lambda}{4} = \frac{200}{4} = 50$ cm

118 **(a)**

$f = 160\ \text{Hz}, v = 320\ \text{m/s}$

$\lambda = \frac{v}{f} = \frac{320}{160} = 2\ \text{m} = 200\ \text{cm}$

Phase difference $\phi = \frac{2\pi x}{\lambda}$

$\therefore x = \frac{\phi\lambda}{2\pi} = \frac{\pi}{2}.\frac{\lambda}{2\pi} \quad \left[\because \phi = \frac{\pi}{2}\right]$

$= \frac{\lambda}{4} = \frac{200}{4} = 50\ \text{cm}$

119 **(c)**

We have, $L_2 - L_1 = 10\log\frac{I_2}{I_0} - 10\log\frac{I_1}{I_0} = 10\log\left(\frac{I_2}{I_1}\right)$

$L_2 - 4 = 10\log(2) \qquad \left(\because \frac{I_2}{I_4} = 2\right)$

$\therefore L_2 = 7\ \text{dB}$

120 **(c)**

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$L_2 - 4 = 10\log(2) \qquad \left(\because \frac{I_2}{I_4} = 2\right)$

$\therefore L_2 = 7\ \text{dB}$

121 **(a)**

$V = \sqrt{\frac{\gamma RT}{M}}$

$\therefore \frac{V_H}{V_{He}} = \sqrt{\frac{\gamma_H}{\gamma_{He}}.\frac{M_{He}}{M_H}}$ (T is the same for both)

$= \sqrt{7/5 \times 3/5 \times 4/2} = \frac{\sqrt{42}}{5}$

122 **(a)**

$V = \sqrt{\frac{\gamma RT}{M}}$

$\therefore \frac{V_H}{V_{He}} = \sqrt{\frac{\gamma_H}{\gamma_{He}}.\frac{M_{He}}{M_H}}$ (T is the same for both)

$= \sqrt{7/5 \times 3/5 \times 4/2} = \frac{\sqrt{42}}{5}$

123 **(d)**

$V = \sqrt{\frac{T}{m}}$

$\therefore \frac{v_2}{v_1} = \sqrt{T_2/T_1} = \sqrt{1.5} = 1.22$

124 **(d)**

$V = \sqrt{\frac{T}{m}}$

$\therefore \frac{v_2}{v_1} = \sqrt{T_2/T_1} = \sqrt{1.5} = 1.22$

125 **(c)**

$f = 50\ \text{Hz}$

$\therefore T = \frac{1}{50} = 0.02\text{s},$

$t = 0.01\ \text{s}$

phase change $\phi = \frac{2\pi t}{T} = 2\pi \times \frac{0.01}{0.02} = \pi$ rad

126 **(c)**

$f = 50\ \text{Hz}$

$\therefore T = \frac{1}{50} = 0.02\text{s},$

$t = 0.01\ \text{s}$

phase change $\phi = \frac{2\pi t}{T} = 2\pi \times \frac{0.01}{0.02} = \pi$ rad

127 **(d)**

Comparing with standard wave equation

$y = a\sin\frac{2\pi}{\lambda}(vt - x)$, we get

$v = 200\ \text{m/s}$

128 **(d)**

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$y = a\sin\frac{2\pi}{\lambda}(vt - x)$, we get

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129 **(a)**

$V_s = 30\frac{m}{s}$

$n_0 = 256\ \text{Hz}$

$n_1 = n_0\frac{V}{V - V_s}$

$$n_2 = n_0 \frac{V}{V + V_s}$$

$$\therefore \frac{n_1}{n_2} = \frac{(V + V_s)}{V - V_s} = \frac{360}{300} = \frac{6}{5}$$

130 **(a)**

$$V_s = 30 \frac{m}{s}$$

$$n_0 = 256 \text{ Hz}$$

$$n_1 = n_0 \frac{V}{V - V_s}$$

$$n_2 = n_0 \frac{V}{V + V_s}$$

$$\therefore \frac{n_1}{n_2} = \frac{(V + V_s)}{V - V_s} = \frac{360}{300} = \frac{6}{5}$$

131 **(d)**

Velocity of sound in air is independent of pressure of air.

132 **(d)**

Velocity of sound in air is independent of pressure of air.

133 **(c)**

$$y = 6 \sin\left[12\pi t - 0.02\pi x + \frac{\pi}{2}\right]$$

$$\omega t = 12\pi t$$

$$\therefore \omega = 12\pi$$

$$\therefore \frac{2\pi}{T} = 12\pi$$

$$\therefore \frac{1}{T} = n = 6$$

$$\frac{2\pi}{\lambda} = 0.02\pi$$

$$\therefore \lambda = \frac{2}{0.02} = 100$$

$$v = n\lambda = 6 \times 100 = 600 \text{ m/s}$$

134 **(c)**

$$y = 6 \sin\left[12\pi t - 0.02\pi x + \frac{\pi}{2}\right]$$

$$\omega t = 12\pi t$$

$$\therefore \omega = 12\pi$$

$$\therefore \frac{2\pi}{T} = 12\pi$$

$$\therefore \frac{1}{T} = n = 6$$

$$\frac{2\pi}{\lambda} = 0.02\pi$$

$$\therefore \lambda = \frac{2}{0.02} = 100$$

$$v = n\lambda = 6 \times 100 = 600 \text{ m/s}$$

135 **(a)**

Maximum velocity, $v_{max} = a\,\omega = \frac{v}{10} = \frac{10}{10} = 1 \text{ ms}^{-1}$

$\Rightarrow a\,\omega = a \times 2\pi\, n = 1 \Rightarrow n = \frac{10^3}{2\pi}$ $(\because a = 10^{-3} \text{ m})$

Since, $v = n\lambda$

$\Rightarrow \lambda = \frac{v}{n} = \frac{10}{10^3/2\pi} = 2\pi \times 10^{-2} \text{ m}$

136 **(a)**

Maximum velocity, $v_{max} = a\,\omega = \frac{v}{10} = \frac{10}{10} = 1 \text{ ms}^{-1}$

$\Rightarrow a\,\omega = a \times 2\pi\, n = 1 \Rightarrow n = \frac{10^3}{2\pi}$ $(\because a = 10^{-3} \text{ m})$

Since, $v = n\lambda$

$\Rightarrow \lambda = \frac{v}{n} = \frac{10}{10^3/2\pi} = 2\pi \times 10^{-2} \text{ m}$

137 **(b)**

Both are diatomic. Hence, $\gamma = \frac{C_p}{C_V}$ for both are same,

$$v = \sqrt{\frac{\gamma RT}{M}}$$

$$\therefore \frac{v_H}{v_O} = \sqrt{\frac{M_O}{M_H}} = \sqrt{\frac{32}{2}} = 4 \Rightarrow v_H = 4v_O$$

138 **(b)**

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$$v = \sqrt{\frac{\gamma RT}{M}}$$

$$\therefore \frac{v_H}{v_O} = \sqrt{\frac{M_O}{M_H}} = \sqrt{\frac{32}{2}} = 4 \Rightarrow v_H = 4v_O$$

139 **(a)**

Given, $a = 1$ m

As, $y = a\sin(kx - \omega t) = \sin\left(\frac{2\pi}{2\pi}x - 2\pi \times \frac{1}{\pi}t\right)$

$y = \sin(x - 2t)$

140 **(a)**

Given, $a = 1$ m

As, $y = a\sin(kx - \omega t) = \sin\left(\frac{2\pi}{2\pi}x - 2\pi \times \frac{1}{\pi}t\right)$

$y = \sin(x - 2t)$

141 **(c)**

Since, apparent frequency is lesser than the actual frequency, hence the listener is moving away from the source.

142 **(c)**

Since, apparent frequency is lesser than the actual frequency, hence the listener is moving away from the source.

143 **(c)**

If the speed of engine is v, the distance travelled by engine in 5 s will be 5v, and hence, the distance travelled by sound in reaching the hill and coming back to the moving driver $= 900 + (900 - 5v) = 1800 - 5v$. So, the time interval between original sound and its echo,

$$t = \frac{(1800 - 5v)}{330} = 5 \Rightarrow v = 30 \text{ m/s}$$

144 **(c)**

If the speed of engine is v, the distance travelled by engine in 5 s will be 5v, and hence, the distance travelled by sound in reaching the hill and coming back to the moving driver $= 900 + (900 - 5v) = 1800 - 5v$. So, the time interval between original sound and its echo,

$$t = \frac{(1800 - 5v)}{330} = 5 \Rightarrow v = 30 \text{ m/s}$$

145 **(c)**

Using the relation,

$$\text{wave number} = \frac{1}{\text{wavelength}} = \frac{1}{6000 \times 10^{-10}} = 1.66 \times 10^6 \text{ m}^{-1}$$

146 **(c)**

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149 **(c)**

Loudness depends upon intensity while pitch depends upon frequency.

150 **(c)**

Loudness depends upon intensity while pitch depends upon frequency.

151 **(d)**

Frequency of sound does not change with medium, because it is characteristic of source.

152 **(d)**

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153 **(a)**

When the source of sound in moving towards the observer, the apparent frequency is given by

$$n_1 = n\left(\frac{V}{V - V_s}\right)$$

When the source of sound is moving away from the observer the apparent frequency is given by

$$n_2 = n\left(\frac{V}{V + V_s}\right)$$

$\therefore n_1 - n_2$

$$= nV\left[\frac{1}{V - V_s} - \frac{1}{V + V_s}\right]$$

$$= nv\left[\frac{2V_s}{V^2 - V_S^2}\right]$$

$$= \frac{2nVV_S}{(V^2 - V_S^2)}$$

154 **(a)**

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$$n_1 = n\left(\frac{V}{V - V_s}\right)$$

When the source of sound is moving away from the observer the apparent frequency is given by

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$$= nV\left[\frac{1}{V - V_s} - \frac{1}{V + V_s}\right]$$

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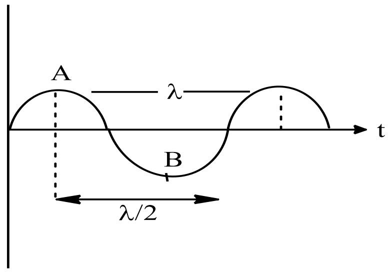
$$= \frac{2nVV_S}{(V^2 - V_S^2)}$$

155 **(a)**

Sine wave,

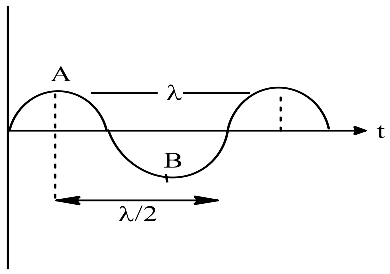


Particle velocity, $v_p = \frac{dy}{dt}$ = slope of wave at that point

As, slope at A and B is zero. Hence, the velocity at A and B will be same. Distance between A and B is $\frac{\lambda}{2}$.

156 **(a)**

Sine wave,



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As, slope at A and B is zero. Hence, the velocity at A and B will be same. Distance between A and B is $\frac{\lambda}{2}$.

157 **(b)**

The speed of sound in a stretched wire is given by

$$v = \sqrt{\frac{T}{m}} \text{ or } v \propto \sqrt{T}$$

According to Hooke's law,

Tension (T)∝ extension (X)

$\therefore \quad \frac{V'}{V} = \frac{\sqrt{T'}}{\sqrt{T}}$

Given, T = 4x and T = x

$\Rightarrow \quad \frac{V'}{V} = \frac{\sqrt{4x}}{\sqrt{x}} = 2 \text{ or } v' = 2v$

158 **(b)**

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159 **(d)**

$n' = 2n = n\left(\frac{V}{V - V_s}\right)$

$\therefore 2V - 2V_s = V$

$\therefore V_s = \frac{V}{2}$

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161 **(c)**

As, $\frac{l_1}{l_2} = \frac{4}{1} = \frac{a^2}{b^2}$ (where, l_1 and l_2 are intensities)

$\therefore \ \frac{a}{b} = \frac{2}{1}$

$\therefore \ \frac{I_{max}}{I_{min}} = \frac{(a+b)^2}{(a-b)^2}$

$= \frac{(2+1)^2}{(2-1)^2} = 9$

Now, $\quad L - L_2 = 10 \log \frac{I_{max}}{I_0} - 10 \log \frac{I_{min}}{I_0}$

$= 10 \log \frac{I_{max}}{I_{min}} = 10 \log 9$

$\therefore L_1 - L_2 = 10 \log 3^2$

$= 20 \log 3$

162 **(c)**

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$= 20 \log 3$

163 **(c)**

$n_A - n_B = n_1 \quad \ldots \text{(i)}$

$n_A - n_C = n_2 \quad \ldots \text{(ii)}$

Subtracting Eq. (ii) from Eq. (i)

$n_C - n_B = n_1 - n_2$

or $n_B - n_C = n_2 - n_1$

164 **(c)**

$n_A - n_B = n_1 \quad \ldots \text{(i)}$

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Subtracting Eq. (ii) from Eq. (i)

$n_C - n_B = n_1 - n_2$

or $n_B - n_C = n_2 - n_1$

165 **(b)**

We have, $(V_p)_{max} = 4v$

or $Y_0\omega = 4(f\lambda)$ or $Y_0(2\pi f) = 4f\lambda$

$\therefore$ Wavelength, $\lambda = \frac{\pi Y_0}{2}$

166 **(b)**

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or $Y_0\omega = 4(f\lambda)$ or $Y_0(2\pi f) = 4f\lambda$

$\therefore$ Wavelength, $\lambda = \frac{\pi Y_0}{2}$

167 **(d)**

If d is the distance between man and reflecting surface of sound, then for hearing echo,

$2d = v \times t \Rightarrow d = \frac{340 \times 1}{2} = 170$ m

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169 **(c)**

Mass per unit length of the string

$$m = \frac{M}{L} = \frac{0.1}{1} = 0.1 \text{ kg/m}$$

Speed of the wave

$$V = \sqrt{\frac{T}{m}} = \sqrt{\frac{1.6}{0.1}} = \sqrt{16} = 4 \text{ m/s}$$

Time required to travel a distance of 1 m is

$$t = \frac{\text{distance}}{\text{speed}} = \frac{1}{4} = 0.25 \text{ s}$$

170 **(c)**

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171 **(c)**

According to question, the progressive wave is represented by $y = 12\sin(5t - 4x)$cm

Comparing this equation with standard equation of progressive wave,

$y = A\sin(\omega t - kx)$

So, we have = 12 cm.

$\omega = 5 \Rightarrow k = 4$

Here, $(\omega t - kx)$ is phase difference $= \frac{\pi}{2}$

$\therefore \quad 5t - 4x = \frac{\pi}{2}$

When $t = 0$, $4x = \frac{\pi}{2}$

$x = \frac{\pi}{8}$ cm

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173 **(d)**

Blue shift for coming closer.

174 **(d)**

Blue shift for coming closer.

175 **(c)**

As, phase difference $= \frac{2\pi}{\lambda} \times$ path difference

$\Rightarrow 1.6\pi = \frac{2\pi}{\lambda} \times 40$

$\Rightarrow \lambda = 50$ cm $= 0.5$ m

Now, $v = \lambda f \Rightarrow f = \frac{v}{\lambda} = \frac{330}{0.5} = 660$ Hz

176 **(c)**

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Now, $v = \lambda f \Rightarrow f = \frac{v}{\lambda} = \frac{330}{0.5} = 660$ Hz

177 **(b)**

Amplitude of reflected wave,

$A_r = \frac{2}{3} \times A_l = \frac{2}{3} \times 0.6 = 0.4$ units

Given equation of incident wave,

$Y_l = 0.6\sin 2\pi\left(t - \frac{x}{2}\right)$

Equation of reflected wave,

$Y_r = A_r \sin 2\pi\left(t + \frac{x}{2} + \pi\right)$

(∵ at denser medium, phase changes by π
The positive sign is due to reversal of direction of propagation.

So, $y_r = -0.4 \sin 2\pi\left(t + \frac{x}{2}\right)$ [∵ $\sin(\pi + \theta) = -\sin\theta$]

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So, $y_r = -0.4 \sin 2\pi\left(t + \frac{x}{2}\right)$ [∵ $\sin(\pi + \theta) = -\sin\theta$]

179 **(b)**

Velocity, $v = \frac{\text{Coefficient of t}}{\text{Coefficient of x}} = \frac{1/2}{1/4} = 2 \text{ ms}^{-1}$

The distance through which the wave travels in 8 s,

$d = vt = 2 \times 8 = 16$ m

180 **(b)**

Velocity, $v = \frac{\text{Coefficient of t}}{\text{Coefficient of x}} = \frac{1/2}{1/4} = 2 \text{ ms}^{-1}$

The distance through which the wave travels in 8 s,

$d = vt = 2 \times 8 = 16$ m

181 **(d)**

Minimum time interval between two instants when the string is flat $= \frac{T}{2} = 0.5 \text{ s} \Rightarrow T = 1\text{s}$

Hence. $\lambda = v \times T = 10 \times 1 = 10$ m

182 **(d)**

Minimum time interval between two instants when the string is flat $= \frac{T}{2} = 0.5 \text{ s} \Rightarrow T = 1\text{s}$

Hence. $\lambda = v \times T = 10 \times 1 = 10$ m

183 **(b)**

Mass, $m = 2.5$ kg

Mass per unit length, μ

$$= \frac{m}{1} = \frac{2.5 \text{ kg}}{20} = \frac{1.25}{10} = 0.125 \text{ kgm}^{-1}$$

Speed, $v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{200}{0.125}}$

$$\therefore l = v \times t \Rightarrow 20 = \sqrt{\frac{200}{0.125}} \times t$$

$$\Rightarrow t = 20 \times \sqrt{\frac{125}{2 \times 10^5}} = 20 \times \sqrt{\frac{25 \times 5}{2 \times 10^5}}$$

$$= 20 \times \sqrt{25 \times \frac{1}{0.4 \times 10^5}}$$

$$= 20 \times 5\sqrt{\frac{1}{4 \times 10^4}} = \frac{20 \times 5}{2 \times 10^2} = \frac{1}{2} = 0.5 \text{ s}$$

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$$= 20 \times \sqrt{25 \times \frac{1}{0.4 \times 10^5}}$$

$$= 20 \times 5\sqrt{\frac{1}{4 \times 10^4}} = \frac{20 \times 5}{2 \times 10^2} = \frac{1}{2} = 0.5 \text{ s}$$

185 **(b)**

According to question.

$\frac{t_1}{t_2} = 2$ (given)

(where, f_1 = apparent frequency when velocity v_1 is towards the observer and

t_2 = apparent frequency when velocity v_1 is away from the observer)

Now, the apparent frequency of sound when observer moves towards the source is given by

$f_1 = \left(\frac{v}{v - v_1}\right) f_0$ ...(i)

(symbols have their usual meanings)

Similarly, when observer moves away from the source, apparent frequency is given by

$f_2 = \left(\frac{v}{v + v_1}\right) f_0$ ...(ii)

On dividing Eq. (i) by Eq. (ii), we get

$$\frac{f_1}{f_2} = \frac{\left(\frac{v}{v - v_1}\right) f_0}{\left(\frac{v}{v + v_1}\right) f_0} = \frac{v + v_1}{v - v_1}$$

$$\Rightarrow \frac{v + v_1}{v - v_1} = 2 \Rightarrow 2v - 2v_1 = v + v_1$$

$$\Rightarrow v = 3v_1 \Rightarrow \frac{v}{v_1} = 3$$

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187 **(b)**

$$v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{T}{\rho s}} \text{ or } v \propto \frac{1}{\sqrt{s}}$$

$$\therefore \frac{v_1}{v_2} = \sqrt{\frac{s_2}{s_1}} = \sqrt{\frac{4}{1}} \Rightarrow \frac{v_1}{v_2} = \frac{2}{1}$$

188 **(b)**

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189 **(b)**

We have, $\omega = 15\pi, k = 10\pi$

$$\therefore \quad v = \frac{\omega}{k} = 1.5 \text{ ms}^{-1}$$

$$\Rightarrow \lambda = \frac{2\pi}{k} = \frac{2\pi}{10\pi} = 0.2 \text{ m}$$

Positive sign between kx and ωt means wave is travelling in negative x-direction.

190 **(b)**

We have, $\omega = 15\pi, k = 10\pi$

$$\therefore \quad v = \frac{\omega}{k} = 1.5 \text{ ms}^{-1}$$

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Positive sign between kx and ωt means wave is travelling in negative x-direction.

191 **(a)**

The frequency of reflected sound wave is

$$f_r = f\left(\frac{c+v}{c-v}\right)$$

∵ No change in velocity occurs due to reflection of sound wave.

Hence, $\frac{c}{\lambda_r} = \frac{c}{\lambda}\left(\frac{c+v}{c-v}\right) \Rightarrow \frac{1}{\lambda_r} = \frac{1}{\lambda}\left(\frac{c+v}{c-v}\right)$

$$\lambda_r = \left(\frac{c-v}{c+v}\right)\lambda$$

192 **(a)**

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$$\lambda_r = \left(\frac{c-v}{c+v}\right)\lambda$$

193 **(b)**

When wind blows at a speed w from the source to the observer, take $v \to v + w$ in equation,

$$f' = \left(\frac{v+v_0}{v-v_s}\right) f_0$$

$$f' = \left(\frac{v+w+u}{v+w-u}\right) f_0 \qquad (\because v_0 = v_s = u)$$

$$\therefore \frac{f}{f_0} = \frac{v+w+u}{v+w-u}$$

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$$f' = \left(\frac{v+w+u}{v+w-u}\right) f_0 \qquad (\because v_0 = v_s = u)$$

$$\therefore \frac{f}{f_0} = \frac{v+w+u}{v+w-u}$$

195 **(a)**

Phase difference, $\Delta\phi = \frac{2\pi}{\lambda} \cdot \Delta x$

or $\lambda = \frac{2\pi}{\Delta\phi} \cdot \Delta x = \frac{2\pi}{(\pi/3)} \times 1.25 \times 10^{-2} = 7.5 \times 10^{-2}$ m

Velocity, $v = f\lambda = 1000 \times 7.5 \times 10^{-2} = 75 \text{ ms}^{-1}$

196 **(a)**

Phase difference, $\Delta\phi = \frac{2\pi}{\lambda} \cdot \Delta x$

or $\lambda = \frac{2\pi}{\Delta\phi} \cdot \Delta x = \frac{2\pi}{(\pi/3)} \times 1.25 \times 10^{-2} = 7.5 \times 10^{-2}$ m

Velocity, $v = f\lambda = 1000 \times 7.5 \times 10^{-2} = 75 \text{ ms}^{-1}$

197 **(b)**

Maximum particle velocity, $(V_P)_{max} = \omega A = 2\pi f A$
$= 2\pi\,(250)(10^{-2}) = 5\,\pi \text{ ms}^{-1}$

198 **(b)**

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199 **(b)**

If n is the original (actual) frequency and n′ is the frequency as it passes the stationary observer, then

$$n' = n\left(\frac{V}{v+V_s}\right)$$

$$\frac{n'}{n} = \left(\frac{V_s}{v+V_s}\right), (n') = 0.8n$$

$$\therefore 0.8 = \frac{V_s}{350 + V_s}$$

Solving we get, $V_s = 87.5$ m/s

200 **(b)**

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Solving we get, $V_s = 87.5\ m/s$

201 **(a)**

We have, $v \propto \sqrt{T}$

$\therefore \quad v' = \sqrt{15} \cdot v = 122v$

202 **(a)**

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$\therefore \quad v' = \sqrt{15} \cdot v = 122v$

203 **(d)**

Doppler shift in frequency does not depend upon distance from the source to the listener.

204 **(d)**

Doppler shift in frequency does not depend upon distance from the source to the listener.

205 **(c)**

When source and observer are moving relative to each other, the frequency observed by the receiver is different from the actual source frequency. This effect is called the Doppler's effect.

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When source and observer are moving relative to each other, the frequency observed by the receiver is different from the actual source frequency. This effect is called the Doppler's effect.

207 **(a)**

A pulse of a wave train when travels along a stretched string and reaches the fixed end of the string, then it will be reflected back to the same medium and the reflected ray suffers a phase change of π(or 180°) with the incident wave and wave velocity after reflection gets reversed.

208 **(a)**

A pulse of a wave train when travels along a stretched string and reaches the fixed end of the string, then it will be reflected back to the same medium and the reflected ray suffers a phase change of π(or 180°) with the incident wave and wave velocity after reflection gets reversed.

209 **(b)**

At a given time (t = constant), the phase change with position x. Phase change at a given time for a distance Δx is

$$\Delta\phi = \frac{2\pi}{\lambda} \times \Delta x$$

As, the distance between two crests is λ.

For distance λ, the phase change is $\Delta\phi = \frac{2\pi}{\lambda} \cdot \lambda = 2\pi$

210 **(b)**

At a given time (t = constant), the phase change with position x. Phase change at a given time for a distance Δx is

$$\Delta\phi = \frac{2\pi}{\lambda} \times \Delta x$$

As, the distance between two crests is λ.

For distance λ, the phase change is $\Delta\phi = \frac{2\pi}{\lambda} \cdot \lambda = 2\pi$

211 **(c)**

For source, $v_S = r\omega = 0.70 \times 2\pi \times 5 = 22\ ms^{-1}$

Minimum frequency is heard when the source is receding the man. It is given by

$$n_{min} = n\left(\frac{v}{v + v_s}\right)$$

$$= 1000 \times \left(\frac{352}{352 + 22}\right) = 941\ Hz$$

212 **(c)**

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213 **(b)**

The velocity of a transverse wave,

and

$$v = \sqrt{\frac{T}{\rho A}}$$

and $\quad v \propto \frac{1}{\sqrt{A}}$

$\Rightarrow \quad v \propto \frac{1}{R}$

Because the velocity of wire depend on the radius. So, transverse wave travels faster in thinner wire.

214 **(b)**

The velocity of a transverse wave,

and

$$v = \sqrt{\frac{T}{\rho A}}$$

and $\quad v \propto \frac{1}{\sqrt{A}}$

$\Rightarrow \quad v \propto \frac{1}{R}$

Because the velocity of wire depend on the radius. So, transverse wave travels faster in thinner wire.

215 **(c)**

Velocity, $v = \sqrt{\frac{\gamma FT}{M}}$.

For diatomic gas, $\gamma = 1.4$

and $\quad T = 273\ K$

$\therefore \quad \gamma T = 382$

The velocity of sound through a diatomic gaseous medium.

$$v = \sqrt{\frac{382R}{M}}$$

216 **(c)**

Velocity, $v = \sqrt{\frac{\gamma FT}{M}}$.

For diatomic gas, $\gamma = 1.4$

and $T = 273$ K

$\therefore \quad \gamma T = 382$

The velocity of sound through a diatomic gaseous medium.

$$v = \sqrt{\frac{382R}{M}}$$

217 **(b)**

$$V = \sqrt{\frac{k}{\rho}}$$

218 **(b)**

$$V = \sqrt{\frac{k}{\rho}}$$

219 **(a)**

Frequency heard by observer,

$$f = 300\left(\frac{v}{v - v/3}\right) = 450 \text{ Hz}$$

220 **(a)**

Frequency heard by observer,

$$f = 300\left(\frac{v}{v - v/3}\right) = 450 \text{ Hz}$$

221 **(a)**

Height of the tower, $h = 300$ m

Initial velocity, $u = 0$

Acceleration due to gravity, $g = 9.8 \text{ m/s}^2$

Speed of sound in air, $v = 340$ m/s

Time taken by stone to reach the pond $= t_1$

Using second equation of motion.

$$h = ut + \frac{1}{2}gt_1^2$$

$$\Rightarrow \quad 300 = 0 + \frac{1}{2} \times 9.8t_1^2$$

$$\Rightarrow \quad t_1 = \sqrt{\frac{300 \times 2}{9.8}} = 7.82 \text{ s}$$

Time taken by the sound to reach the top of the tower,

$$t_2 = \frac{h}{v} = \frac{300}{340} = 0.88 \text{ s}$$

$\therefore$ Total time, $t = t_1 + t_2 = 7.82 + 0.88 = 8.7$ s

222 **(a)**

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Acceleration due to gravity, $g = 9.8 \text{ m/s}^2$

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Using second equation of motion.

$$h = ut + \frac{1}{2}gt_1^2$$

$$\Rightarrow \quad 300 = 0 + \frac{1}{2} \times 9.8t_1^2$$

$$\Rightarrow \quad t_1 = \sqrt{\frac{300 \times 2}{9.8}} = 7.82 \text{ s}$$

Time taken by the sound to reach the top of the tower,

$$t_2 = \frac{h}{v} = \frac{300}{340} = 0.88 \text{ s}$$

$\therefore$ Total time, $t = t_1 + t_2 = 7.82 + 0.88 = 8.7$ s

223 **(a)**

The speed of transverse wave along a wire is given by

$$v = \sqrt{\frac{T}{\mu}}$$

where, μ = mass per unit length

= volume of unit length $\times$ density

= area $\times$ density

$$\therefore \quad v = \sqrt{\frac{T}{A\rho}} \Rightarrow A = \frac{T}{v^2\rho}$$

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225 **(c)**

$$\text{Frequency, } f = f_0\left(\frac{V+V_0}{V}\right) = 10^3\left(1 + \frac{V_0}{V}\right)$$

$$= 10^3 + \frac{10^3}{V}(gt) = 10^3 + \left(\frac{10^4}{V}\right)t$$

Slope of f-t line should be equal to $\frac{10^4}{V}$

$$\therefore \quad \frac{1000}{30} = \frac{10^4}{V} \text{ or } V = 300 \text{ ms}^{-1}$$

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227 **(c)**

The particle velocity is maximum at *B* and is given by

$$\frac{dy}{dt} = (v_p)_{max} = \omega A$$

Also, wave velocity, $\frac{dx}{dt} = v = \frac{\omega}{k}$

So, slope, $\frac{dy}{dx} = \frac{(v_p)_{max}}{v} = kA$

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Also, wave velocity, $\frac{dx}{dt} = v = \frac{\omega}{k}$

So, slope, $\frac{dy}{dx} = \frac{(v_p)_{max}}{v} = kA$

229 **(b)**

Let b be the speed of the engine relative to observe at rest. Velocity of sound, v = 350 m/s

Let n′ = observed frequency, n = original frequency,

Then we have

$$\frac{n'}{n} = \frac{5}{6} \quad \text{or} \quad \frac{n'}{n} = \frac{v}{v+b}$$

$$\Rightarrow \quad \frac{5}{6} = \frac{v}{v+b}$$

$$5b = v = 350 \text{ m/s}$$

$$\Rightarrow \quad b = \frac{350}{5} = 70 \text{ m/s}$$

230 **(b)**

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231 **(b)**

Phase, $\Delta\phi = \frac{2\pi}{\lambda} \cdot \Delta x \Rightarrow \lambda = \left(\frac{2\pi}{0.5\,\pi}\right)(0.8) = 3.2$ m

∴ Velocity of wave, $v = f\lambda = 120 \times 3.2 = 384 \text{ ms}^{-1}$

232 **(b)**

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∴ Velocity of wave, $v = f\lambda = 120 \times 3.2 = 384 \text{ ms}^{-1}$

233 **(c)**

$$k = \frac{2\pi}{\lambda} = \frac{2\pi}{60}$$

$$\text{and } \omega = vk = (360)\left(\frac{2\pi}{60}\right) = 12\pi$$

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

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

235 **(a)**

When source is approaching the observer, the frequency heard,

$$n_a = \left(\frac{v}{v - v_s}\right) \times n = \left(\frac{340}{340 - 20}\right) \times 1000$$

$$= 1063 \text{ Hz}$$

When source is receding, the frequency heard,

$$n_r = \left(\frac{v}{v + v_s}\right) \times n = \left(\frac{340}{340 + 20}\right) \times 1000 = 94$$

$$\Rightarrow n_a : n_t = 9 : 8$$

Alternately, $\frac{n_a}{n_t} = \frac{v + v_s}{v - v_s} = \frac{340 + 20}{340 - 20} = \frac{9}{8}$

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237 **(c)**

As, $v \propto \sqrt{T}$

$$\Rightarrow \sqrt{\frac{T_2}{T_1}} = \frac{v_2}{v_1}$$

$$\Rightarrow T_2 = T_1\left(\frac{v_2}{v_1}\right)^2$$

$$\Rightarrow T_2 = 273 \times 4 = 1092 \text{ K}$$

238 **(c)**

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239 **(a)**

Frequency, $n' = n\left(\frac{v}{v - v_s}\right)$

$$\Rightarrow \lambda' = \lambda\left(\frac{v - v_5}{v}\right)$$

$$\Rightarrow \text{ Wavelength, } \lambda' = 120\left(\frac{330 - 60}{330}\right) = 98 \text{ cm}$$

240 **(a)**

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241 **(d)**

Apparent frequency, $f' = f\left(\frac{v}{v - v_s}\right)$

$= (1)\left(\frac{v}{v-0.9v}\right) = 10\text{kHz}$

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243 **(b)**

The number of waves present in a unit length of the medium is known as wave number. The SI unit of wave number is m^{-1}.

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245 **(c)**

$\text{Period} = \frac{1}{n}$

Time required for x vibrations,

$t = \frac{x}{n}$

Distance travelled by the wave,

$Vt = \frac{xV}{n}$

246 **(c)**

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247 **(d)**

Wavelength, $\lambda = \frac{v}{n} = \frac{350}{350} = 1\text{ m}$

Also, path difference (Δx) between the waves at the point of observation is $AP - BP = 25$ cm.

Hence, phase difference, $\Delta\phi = \frac{2\pi}{\lambda}(\Delta x) = \frac{2\pi}{1} \times \left(\frac{25}{100}\right) = \frac{\pi}{2}$

$\Rightarrow A = \sqrt{(a_1)^2 + (a_2)^2}$

$= \sqrt{(0.3)^2 + (0.4)^2} = 0.5\text{ mm}$

248 **(d)**

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249 **(c)**

Speed $= n\lambda = n(4ab) = 4n \times ab$

$\left(\therefore ab = \frac{\lambda}{4}\right)$

Path difference between b and e is $\frac{3\lambda}{4}$.

So, the phase difference $= \frac{2\pi}{\lambda} \times$ path difference

$= \frac{2\pi}{\lambda} \times \frac{3\lambda}{4} = \frac{3\pi}{2}$

250 **(c)**

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$= \frac{2\pi}{\lambda} \times \frac{3\lambda}{4} = \frac{3\pi}{2}$

251 **(a)**

$v' = v\left(\frac{v+v_0}{v}\right)$

$= v\left(1 + \frac{v_0}{v}\right)$

$v' = 2v$

$\therefore 2v = v\left(1 + \frac{v_0}{v}\right)$

$\therefore 2 = 1 + \frac{v_0}{v}$

$\therefore \frac{v_0}{v} = 1$

$\therefore v_0 = v$

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253 **(d)**

Comparing the given equation with the standard form

$y = A \sin\left(\frac{2\pi t}{T} + \frac{2\pi x}{\lambda}\right)$, we get

$\frac{2\pi}{T} = 10, \frac{2\pi}{\lambda} = 1$

And $v = \frac{\lambda}{T} = \frac{10}{1} = 10\ ms^{-1}$

254 **(d)**

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And $v = \frac{\lambda}{T} = \frac{10}{1} = 10\ ms^{-1}$

255 **(a)**

$f = 220\ Hz, v = 330\ m/s$

$v = f\lambda$

$\lambda = \frac{v}{f} = \frac{330}{220} = \frac{3}{2} m$

Distance travel by 80 vibrations is

$80 \times \frac{3}{2} = 120\ m$

256 **(a)**

$f = 220\ Hz, v = 330\ m/s$

$v = f\lambda$

$\lambda = \frac{v}{f} = \frac{330}{220} = \frac{3}{2} m$

Distance travel by 80 vibrations is

$80 \times \frac{3}{2} = 120\ m$

257 **(d)**

Path difference, $\Delta x = 50\ cm = \frac{1}{2}\ m$

$\therefore$ Phase difference, $\Delta\phi = \frac{2\pi}{\lambda} \times \Delta x$

$\Rightarrow\ \phi = \frac{2\pi}{1} \times \frac{1}{2} = \pi$

Total phase difference $= \pi - \frac{\pi}{3} = \frac{2\pi}{3}$

$\Rightarrow\ A = \sqrt{a^2 + a^2 + 2a^2 \cos\left(\frac{2\pi}{3}\right)} = a$

258 **(d)**

Path difference, $\Delta x = 50\ cm = \frac{1}{2}\ m$

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259 **(c)**

Velocity of sound, $v_{rms} = \sqrt{\frac{3RT}{M}} = c$ ...(i)

$\gamma = 1 + \frac{2}{f} = \frac{4}{3} \Rightarrow V_{sond} = \sqrt{\frac{\gamma RT}{M}} = \sqrt{\frac{4RT}{3M}}$ ...(ii)

From Eqs. (i) and (ii). we haves

$v_{sound} = \frac{2}{3} c$

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From Eqs. (i) and (ii). we haves

$v_{sound} = \frac{2}{3} c$

261 **(b)**

If t is the time taken by the stone to reach water surface; then we have

$s = \frac{1}{2} gt^2$

$\therefore t^2 = \frac{2s}{g} = \frac{2 \times 80}{9} = 16$

$\therefore t = 4\ s$

Total time = 4.25 s

$\therefore$ Time taken by the sound to travel from the surface of water to the top of the well is

$t' = 0.25\ s$

$\therefore$ speed of sound $v = \frac{80}{0.25} = 320\ m/s$

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263 **(c)**

Sound level, $L = 10\log_{10}\left(\frac{I}{I_0}\right)$, where $I_0 = 10^{-12} Wm^{-2}$

Since, $40 = 10\log_{10}\left(\frac{I_1}{I_0}\right) \Rightarrow \frac{I_1}{I_0} = 10^4$ (i)

Also, $20 = 10\log_{10}\left(\frac{I_1}{I_0}\right) \Rightarrow \frac{I_2}{I_0} = 10^2$ (ii)

∵ $\frac{I_2}{I_0} = 10^{-2} = \frac{r_1^2}{r_2^2}$

⇒ $r_2^2 = 100\, r_1^2 \Rightarrow r_2 = 10$ m (∵ $r_1 = 1$ m)

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⇒ $r_2^2 = 100\, r_1^2 \Rightarrow r_2 = 10$ m (∵ $r_1 = 1$ m)

265 **(a)**

$$n_{before} = \left(\frac{v}{v - v_C}\right) \cdot n \text{ and } n_{after} = \left(\frac{v}{v + v_C}\right) \cdot$$

$$\therefore \frac{n_{before}}{n_{after}} = \frac{11}{9} = \left(\frac{v + v_C}{v - v_C}\right)$$

$$\Rightarrow v_C = \frac{v}{10}$$

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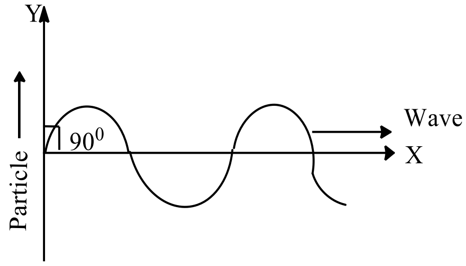
267 **(c)**

In a transverse wave, the particles of the medium vibrate about their mean positions in a direction perpendicular to the direction of wave propagation.



Here, the particle velocity is given by $\frac{dy}{dt}$ and wave velocity is given by $\frac{dx}{dt}$.

Hence, the angle between particle velocity and wave velocity in a transverse wave is $\frac{\pi}{2}$.

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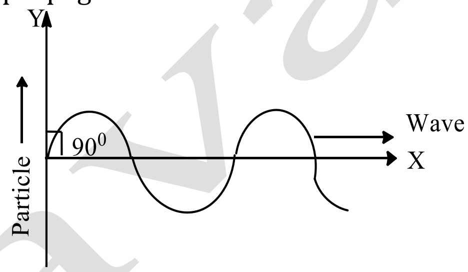

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Hence, the angle between particle velocity and wave velocity in a transverse wave is $\frac{\pi}{2}$.

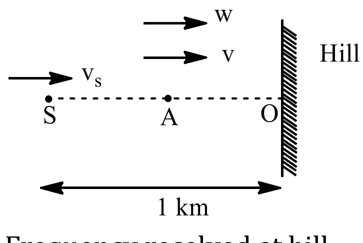
269 **(c)**

Speed of sound in air, V =40 km/h

Speed of source, V_s = 40 km/h ?

Speed of wind, w = 40 km/h

Frequencey emitted by source, f =580 Hz



Frequency recelved at hill,

$$f' = f\left(\frac{v + w - V_0}{v + w - V_u}\right) = 580\left(\frac{1200 + 40 - 0}{1200 + 40 - 40}\right)$$

= 599.33 Hz = 600Hz

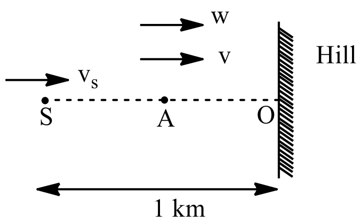
270 **(c)**

Speed of sound in air, V =40 km/h

Speed of source, V_s = 40 km/h ?

Speed of wind, w = 40 km/h

Frequencey emitted by source, f =580 Hz



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$f' = f\left(\frac{v + w - V_0}{v + w - V_u}\right) = 580\left(\frac{1200 + 40 - 0}{1200 + 40 - 40}\right)$

$= 599.33$ Hz $\quad = 600$Hz

271 **(c)**

Both the listeners, hears the same decreased frequencies.

272 **(c)**

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273 **(b)**

Speed of wave $= \frac{\text{Coefficient of t}}{\text{Coefficient of x}} = \frac{\frac{2\pi}{0.002}}{\frac{2\pi}{0.1}} = 50\ ms^{-1}$

274 **(b)**

Speed of wave $= \frac{\text{Coefficient of t}}{\text{Coefficient of x}} = \frac{\frac{2\pi}{0.002}}{\frac{2\pi}{0.1}} = 50\ ms^{-1}$

275 **(b)**

General equation of plane progressive wave is given by

$y = a \sin(kx + \omega t)$ ....(i)

Given equation,

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

Comparing Eqs. (i) and (ii), we get

$k = 62.4$

$\therefore \quad \frac{2\pi}{\lambda} = 62.4$

$\Rightarrow$ Wavelength, $\lambda = \frac{2\pi}{62.4} = 0.1$ unit

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$y = a \sin(kx + \omega t)$ ....(i)

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Comparing Eqs. (i) and (ii), we get

$k = 62.4$

$\therefore \quad \frac{2\pi}{\lambda} = 62.4$

$\Rightarrow$ Wavelength, $\lambda = \frac{2\pi}{62.4} = 0.1$ unit

277 **(b)**

The frequency of the reflected sound heard by man,

$f' = f\left(\frac{v}{v - v_s}\right) = 480\left(\frac{330}{330 - 20}\right)$

$= 5109$ Hz

$= 510$ Hz

278 **(b)**

The frequency of the reflected sound heard by man,

$f' = f\left(\frac{v}{v - v_s}\right) = 480\left(\frac{330}{330 - 20}\right)$

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$= 510$ Hz

279 **(b)**

$\therefore \frac{\Delta\lambda}{\lambda} = \frac{v}{c}$

$\Rightarrow \Delta\lambda = \frac{v}{c}\lambda = \frac{100 \times 10^3}{3 \times 10^8} \times 5700 = 1.90$ A

280 **(b)**

$\therefore \frac{\Delta\lambda}{\lambda} = \frac{v}{c}$

$\Rightarrow \Delta\lambda = \frac{v}{c}\lambda = \frac{100 \times 10^3}{3 \times 10^8} \times 5700 = 1.90$ A

281 **(a)**

From $v = \sqrt{\frac{\gamma RT}{M}}$

$\frac{\Delta v}{v} = \frac{1}{2}\left(\frac{\Delta T}{T}\right)$

$\Rightarrow \frac{\Delta v}{v} \times 100 = \frac{1}{2}\left(\frac{1}{T}\right) \times 100$

$= \frac{1}{2} \times \frac{1}{300} \times 100 = 0.167\%$

282 **(a)**

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$\frac{\Delta v}{v} = \frac{1}{2}\left(\frac{\Delta T}{T}\right)$

$\Rightarrow \frac{\Delta v}{v} \times 100 = \frac{1}{2}\left(\frac{1}{T}\right) \times 100$

$= \frac{1}{2} \times \frac{1}{300} \times 100 = 0.167\%$

283 **(a)**

The perceived frequency heard by the observer depends upon the relative motion between observer and source. If the source and observer are approaching each other, then velocity of the source v_s is positive and velocity of the observer v_0 is negative, the perceived frequency will be higher than the original.

Perceived frequency is given by

$n' = n\left(\frac{v + v_o}{v - v_s}\right) \quad \left[\because n' = n\frac{v - (-v_o)}{v - v_s}\right]$

Here, $v = 340\ ms^{-1}, v_0 = 20\ ms^{-1}, v_s = 20\ ms^{-1}, n = 240$ Hz

Hence,

$n' = 240\left(\frac{340 + 20}{340 - 20}\right)$

$= 240 \times \frac{360}{320} = 270$ Hz

284 **(a)**

The perceived frequency heard by the observer depends upon the relative motion between observer and source. If the source and observer are approaching each other, then velocity of the

source v_s is positive and velocity of the observer v_0 is negative, the perceived frequency will be higher than the original.
Perceived frequency is given by
$n' = n\left(\frac{v+v_0}{v-v_s}\right)\ \left[\because n' = n\frac{v-(-v_0)}{v-v_s}\right]$
Here, $v = 340\ ms^{-1}, v_0 = 20\ ms^{-1}, v_s = 20\ ms^{-1}, n = 240\ Hz$
Hence,
$n' = 240\left(\frac{340+20}{340-20}\right)$
$= 240 \times \frac{360}{320} = 270\ Hz$

285 **(c)**
Velocity of sound, $v = \sqrt{\frac{\gamma RT}{M}}$ or $v \propto T^{1/2}$ For small percentage change,
% decrease in $v = \frac{1}{2}$(% change in T) $= \frac{1}{2}(1\%) = 0.5\%$

286 **(c)**
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% decrease in $v = \frac{1}{2}$(% change in T) $= \frac{1}{2}(1\%) = 0.5\%$

287 **(c)**
Sound level (in dB) $= 10\log_{10}\left(\frac{l}{l_0}\right)$
Here, $l_0 = 10^{-12}Wm^{-2}$
$\therefore$ Sour level $= 10\log_{10}\frac{2\times10^{-8}}{10^{-12}} = 43\ dB$

288 **(c)**
Sound level (in dB) $= 10\log_{10}\left(\frac{l}{l_0}\right)$
Here, $l_0 = 10^{-12}Wm^{-2}$
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289 **(c)**
Speed of the wave, $v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{80}{5\times10^{-2}}} = 40\ ms^{-1}$
$\therefore$ Power, $P = \frac{1}{2}\rho\omega^2A^2Sv$
$= \frac{1}{2}\mu(2\pi f)^2vA^2 \qquad (\because \rho S = \mu)$
$= \frac{1}{2}\times 5\times10^{-2}\times(2\pi\times60)^2\times40\times(0.06)^2$
$= 511W$

290 **(c)**
Speed of the wave, $v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{80}{5\times10^{-2}}} = 40\ ms^{-1}$
$\therefore$ Power, $P = \frac{1}{2}\rho\omega^2A^2Sv$
$= \frac{1}{2}\mu(2\pi f)^2vA^2 \qquad (\because \rho S = \mu)$
$= \frac{1}{2}\times 5\times10^{-2}\times(2\pi\times60)^2\times40\times(0.06)^2$
$= 511W$

291 **(d)**
Given: $v_a = \frac{v}{5} \Rightarrow v_0 = \frac{320}{5} = 64\ m/s$
When observer moves towards the stationary source then
$n = \left(\frac{v+v_0}{n}\right)n = \left(\frac{320+64}{320}\right)n = \left(\frac{384}{320}\right)n$
$\therefore \frac{n'}{n} = \frac{384}{320}$
Hence, percentage increase
$\left(\frac{n-n}{n}\right) = \left(\frac{384-320}{320}\times100\right)\%$
$= \left(\frac{64}{320}\times100\right)\% = 20\%$

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293 **(b)**
Here, $\omega = 100\ \pi, k = 0.4\pi$
Wave velocity, $v = \frac{\omega}{k} = \frac{100\pi}{0.4\pi} = \frac{1000}{4} = 250\ ms^{-1}$

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Wave velocity, $v = \frac{\omega}{k} = \frac{100\pi}{0.4\pi} = \frac{1000}{4} = 250\ ms^{-1}$

295 **(c)**
Here, bat is a source of sound and the wall is observer at rest.
$\therefore$ Frequency of sound reaching the wall, $f' = \frac{vf}{v-v_s}$ ... (i)
where, v is the velocity of sound in the air and v_s is the velocity of source.
On reflection the wall is the source of sound of frequency f' at rest and bat is an observer approaching the wall.
$\therefore$ Frequency heard by the bat,
$f'' = \frac{f(v+v_0)}{v} = f\frac{(v+v_0)}{(v-v_s)}$ [using Eq. (i)]
$= 90\times10^3\left(\frac{330+4}{330-4}\right)$
$= \frac{90\times10^3\times334}{326} = 92.2\times10^3\ Hz$

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$$= 90 \times 10^3 \left(\frac{330 + 4}{330 - 4}\right)$$

$$= \frac{90 \times 10^3 \times 334}{326} = 92.2 \times 10^3\ Hz$$

297 **(a)**

$$V_0 = \frac{V}{5}$$

$$v_a = V_0\frac{v + v_0}{v} = v\frac{v + \frac{v}{5}}{v} = v_0\frac{6}{5}$$

$$\frac{v_a - v_0}{v_0} \times 100 = \frac{\left(\frac{6}{5} - 1\right)v_0}{v_0} \times 100 = \frac{1}{5} \times 100$$

$$= 20\%$$

298 **(a)**

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299 **(d)**
Speed of transverse waves is given by

$$V = \sqrt{\frac{T}{m}}$$

Where T is the tension and m is mass per unit length

For thinner wire m will be small, hence speed will be greater.

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301 **(a)**
The given equation is, $y = 8\sin\left[\pi\left(\frac{t}{10} - \frac{x}{4}\right) + \frac{\pi}{3}\right]$ m0

$$= 8\sin\left[2\pi\left(\frac{t}{20} - \frac{x}{8}\right) + \frac{\pi}{3}\right] \text{m} \quad \text{...(i)}$$

The standard equation is,

$$y = A\ \sin 2\pi\left(\frac{t}{T} - \frac{x}{\lambda} + \phi\right) \quad \text{...(ii)}$$

Now, comparing the given Eq. (i) with standard Eq. (ii), we get
Wavelength, $\lambda = 8$ m

302 **(a)**
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Wavelength, $\lambda = 8$ m

303 **(d)**
Phase difference,

$$\Delta\phi = \frac{2\pi}{\lambda}\cdot\Delta x = k(\Delta x) = k(vt)$$

Here, vt = distance travelled by insect in given time interval.
or $\Delta\phi = (20\pi)(5 \times 10^{-2} \times 5) = 5\pi$

304 **(d)**
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305 **(b)**
We have, $5.5 = 5\left(\frac{1 + v_A}{v}\right)$
(when sitting in moving train A)
or $\frac{v_A}{v} = \frac{1}{10}$ ...(i)

and $6 = 5\left(\frac{V + V_B}{1}\right)$
(when sitting in train B)
or $\frac{V_B}{V} = \frac{1}{5}$ ...(ii)
From Eqs. (i) and (ii), we have,

$$\frac{v_B}{v_A} = 2$$

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From Eqs. (i) and (ii), we have,

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307 **(d)**

Speed of sound $v \propto \sqrt{T}$

$$\frac{v_1}{v_2} = \sqrt{\frac{T_1}{T_2}} = \sqrt{\frac{300}{310}} = \sqrt{\frac{30}{31}}$$

Time taken is given by

$$t = \frac{d}{v}$$

$$\frac{t_2}{t_1} = \frac{v_1}{v_2} = \sqrt{\frac{30}{31}}$$

$$t_1 = 3\sqrt{\frac{30}{31}}\,\text{min}$$

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309 **(d)**

Frequency heard by observers, $f_1 = f\left(\frac{340}{340-34}\right)$

and $\quad f_2 = f\left(\frac{340}{340-17}\right)$

$\therefore \quad f_2 = \frac{323}{30} = \frac{19}{18}$

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311 **(d)**

$$\frac{V_2}{V_1} = \sqrt{\frac{T_2}{T_1}}$$

$$\therefore 1.5 = \sqrt{\frac{T_2}{273}}$$

$$\therefore 2.25 = \frac{T_2}{273}$$

$$\therefore T_2 = 2.25 \times 273 = 614.25\text{ K} = 341.25°C = 341°C$$

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313 **(a)**

When source of sound moving towards to stationary observer.

Apparent frequency, $n_a = n\left(\frac{v}{v - v_s}\right)$

Hence, the wavelength of sound received by him decreases while frequency increases.

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Phase difference, $\Delta\phi = \frac{2\pi}{\lambda} \cdot \Delta x$

$\Rightarrow \Delta\phi = k \times \Delta x = \pi \times 0.5 = \frac{\pi}{2}$

316 **(a)**

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$\Rightarrow \Delta\phi = k \times \Delta x = \pi \times 0.5 = \frac{\pi}{2}$

317 **(c)**

As, $\quad v = \frac{1}{2}\frac{\Delta v}{v}c$

$\therefore \quad 0.2c = \frac{1}{2}\frac{\Delta v}{(4\times10^7)}c$

$\Delta v = 1.6 \times 10^7$ Hz

As, the rocket is receding away.

$\therefore \quad v' = v - \Delta v = 4 \times 10^7 - 1.6 \times 10^7$
$= 2.4 \times 10^7$ Hz

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319 **(a)**

Speed of sound in a medium is independent of pressure.

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321 **(c)**

The given equation of SHM wave is

$y = 0.03 \sin \pi(2t - 0.01x)$ m
$= 0.03 \sin(2\pi t - 0.01\pi x)$ m

Comparing it with general equation, we get

$y = a \sin(\omega t - kx)$

where , $k = \frac{2\pi}{\lambda} \Rightarrow \lambda = 200$ m

The phase difference between two particles is given by

$\Delta\phi = kx = \frac{2\pi}{\lambda} \times x \qquad$ (i)

Here, $\quad x = 25$ m

Substituting the values of x and λ in Eq. (i), we get

$\Delta\phi = \frac{2\pi}{200} \times 25$
$= \frac{\pi}{4}$ rad

322 **(c)**

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323 **(d)**

$n = 1152 \text{ Hz}, V_s = 72 \frac{\text{km}}{\text{h}} = 20 \text{ m/s}$

$n' = n\left(\frac{V}{V + V_s}\right) = \frac{1152 \times 340}{340 + 20}$

$= \frac{1152 \times 340}{360} = 1088$

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325 **(c)**

Given, $y = 10^{-4} \sin\left(100t - \frac{x}{10}\right)$

Comparing it with the standard equation of wave motion

$Y = A \sin\left(\frac{2\pi}{T}t - \frac{2\pi}{\lambda}x\right)$, we get

$\frac{2\pi}{T} = 100$ or $T = \frac{2\pi}{100} = \frac{\pi}{50}$ s

$\frac{2\pi}{\lambda} = \frac{1}{10}$

or $\lambda = 20\pi$

and velocity, $v = \frac{\lambda}{T} = \frac{20\pi}{\pi/50} = 1000 \text{ ms}^{-1}$

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and velocity, $v = \frac{\lambda}{T} = \frac{20\pi}{\pi/50} = 1000 \text{ ms}^{-1}$

327 **(d)**

$n_1 = n\frac{V}{V - V_s}$

$n_2 = n\frac{V}{V + V_s}$

$\therefore n_1 - n_2 = n\left[\frac{V}{V - V_s} - \frac{V}{V + V_s}\right]$

$= nV\left[\frac{V + V_s - V + V_s}{V^2 - V_s^2}\right]$

$= \frac{2nVV_s}{V^2 - V_s^2}$

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329 **(c)**

Given, wave equation, $y = a \sin 2\pi(bt - cx)$
Comparing the above equation with the general equation of the progressive wave which is given as
$y = A_0 \sin 2\pi\left(ft - \frac{x}{\lambda}\right)$, we get
Frequency, $f = b$, wavelength, $\lambda = \frac{1}{c}$ and amplitude of the wave, $A_0 = a$
As we know that, the maximum velocity of the particle,
$V_{max} = A_0\omega = a \times 2\pi b$ ....(i)
Wave velocity, $v_{mave} = f\lambda$
$\Rightarrow \quad v_{want} = \frac{b}{c}$ ...(ii)
It is given that
$$v_{max} = 2v_{wave}$$
So, by substituting the values from Eqs. (i) and (ii) in the above relation, we get
$$a2\pi b = 2\frac{b}{c}$$
$$\therefore \quad c = \frac{1}{a\pi}$$

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331 **(c)**

At given temperature and pressure, $v \propto \frac{1}{\sqrt{\rho}}$
$$\Rightarrow \frac{v_1}{v_2} = \sqrt{\frac{\rho_2}{\rho_1}} = \sqrt{\frac{4}{1}} = 2 : 1$$

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333 **(c)**

Given, speed the wave, $v = 60\ ms^{-1}$,
Frequency of the wave, $v = 1200\ min^{-1}$
$$\frac{1200}{60} = 20\ s^{-1}$$
$\therefore$ Wavelength, $\lambda = \frac{v}{v} = \frac{60}{20} \Rightarrow \lambda = 3\ m$

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Frequency of the wave, $v = 1200\ min^{-1}$
$$\frac{1200}{60} = 20\ s^{-1}$$
$\therefore$ Wavelength, $\lambda = \frac{v}{v} = \frac{60}{20} \Rightarrow \lambda = 3\ m$

335 **(d)**

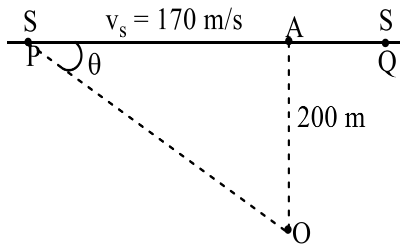
Compare the given equation with the standard equation of wave motion,
$$y = A \sin\left[2\pi\left(\frac{t}{T} - \frac{x}{\lambda}\right) + \frac{\pi}{4}\right]$$
where, A and λ are amplitude and wavelength, respectively.
Amplitude, $A = 3\ m$
Wavelength, $\lambda = 10\ m$

336 **(d)**

Compare the given equation with the standard equation of wave motion,
$$y = A \sin\left[2\pi\left(\frac{t}{T} - \frac{x}{\lambda}\right) + \frac{\pi}{4}\right]$$
where, A and λ are amplitude and wavelength, respectively.
Amplitude, $A = 3\ m$
Wavelength, $\lambda = 10\ m$

337 **(a)**

When source is nearest to 0, i.e. at A, detector will receive that frequency which was emitted by source sometime betore. Let source is now at P and sound takes time t to reach from P to O.



$PO = vt = 340\ t, PA = v_5 t = 170\ t$

$\because\ \cos\theta = \frac{PA}{PO} = \frac{170t}{340t} = \frac{1}{2}$

Frequency received at O.

$f' = f\left(\frac{v}{v - v_s\cos\theta}\right) \quad = 1200\left(\frac{340}{340 - \frac{170}{2}}\right)$

$= 1600\ Hz$

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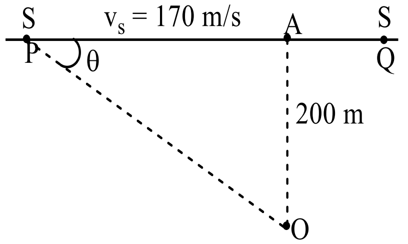

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$f' = f\left(\frac{v}{v - v_s\cos\theta}\right) \quad = 1200\left(\frac{340}{340 - \frac{170}{2}}\right)$

$= 1600\ Hz$

339 **(d)**

The current in an $L - C - R$ circuit is given by

$i = \frac{V}{\left[R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2\right]^{\frac{1}{2}}}$, where $\omega = 2\pi f$

Thus, i increases with an increase in ω upto a value given by,

$\omega = \omega_c$, i.e. at $\omega = \omega_c$, we have

$\omega L = \frac{1}{\omega C} \Rightarrow \omega_c = \frac{1}{\sqrt{LC}}$

Hence, $i_{max} = \frac{V}{R}$ at $\omega = \omega_c$

At $\omega > \omega_c$, i again starts decreasing with an increase in ω.

340 **(a)**

Reactance of the coil or inductive reactance is given as $X_L = \omega L = 2\pi fL$

where, f is frequency.

Given, $X_L = 50\Omega$ and $f = 50$cps

$\therefore L = \frac{X_L}{(1)} = \frac{X_L}{2\pi f} = \frac{50}{2\pi\times 50} = \frac{1}{2\times 314} = 0.16H$

341 **(c)**

Power factor of an AC circuit containing L, C and R connected in series is given by

$\cos\phi = \frac{R}{\sqrt{R^2 + \left[\omega L - \frac{1}{\omega C}\right]^2}}$

When an additional capacitance C is joined in parallel with capacitor C, then it makes power factor of circuit unity. i.e.

$\cos\phi = 1 \Rightarrow \frac{R}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega(C+C')}\right)^2}} = 1$

$\Rightarrow\ \omega L = \frac{1}{\omega(C + C')} \Rightarrow C + C' = \frac{1}{\omega^2 L}$

$\Rightarrow\ C' = \frac{1 - \omega^2 LC}{\omega^2 L}$

342 **(a)**

Given, $E = 4\cos 1000t$ ...(i)

$E = E_0\cos\omega t$ ...(ii)

From Eqs. (i) and (ii), we get

Peak value of emf, $E_0 = 4\ V$

Angular frequency, $\omega = 1000\ Hz$

Now, peak value of current is

$i_0 = \frac{E_0}{Z} = \frac{E_0}{\sqrt{R^2 + X_L^2}}$

$= \frac{E_0}{\sqrt{R^2 + \omega^2 L^2}}$

Putting $E_0 = 4\ V, R = 4\Omega, \omega = 1000\ Hz, L = 3mH$
$= 3\times 10^{-3}H$

we get, $i_0 = 0.8\ A$

343 **(d)**

Given, $V = 200\sqrt{2}\sin(100t)V$ ...(i)

Capacitance of capacitor, $C = 1\mu F = 1\times 10^{-6}\ F$

The standard equation of voltage of AC is given by

$V = V_0\sin\omega t$ ...(ii)

On comparing Eqs. (i) and (ii), we get

$V_0 = 200\sqrt{2}$

$\omega = 100$

We know that, $i_{rms} = \frac{V_{rms}}{X_C}$

But $V_{rms} = \frac{V_0}{\sqrt{2}}$

$i_{rms} = \frac{V_0}{\sqrt{2}X_C}$

$i_{rms} = \frac{V_0\omega C}{\sqrt{2}} \quad \left(\because X_C = \frac{1}{\omega C}\right)$

$i_{rms} = \frac{200\times\sqrt{2}\times 100\times 1\times 10^{-6}}{\sqrt{2}}$

$i_{rms} = 20\times 10^{-3}\ A = 20\ mA$

344 **(c)**

Here, phase difference in $R - L - C$ series circuit is given as,

$\tan\phi = \frac{X_L - X_C}{R}$

When L is removed, then $\phi = \frac{\pi}{3}$

$\therefore \tan\phi = \frac{X_C}{R} \Rightarrow X_C = R\tan\phi = R\tan\frac{\pi}{3} = \sqrt{3}R$

When C is removed, then ϕ again found to be $\frac{\pi}{3}$.

$\therefore \tan\phi = \frac{X_L}{R} \Rightarrow X_L = R\tan\phi = R\tan\frac{\pi}{3} = \sqrt{3}R$

Hence, power factor, $\cos\phi = \frac{R}{Z} = \frac{R}{\sqrt{(X_L-X_C)^2+R^2}}$

$= \frac{R}{\sqrt{(\sqrt{3}R-\sqrt{3}R)^2+R^2}} = \frac{R}{R} = 1$

345 **(c)**

The phase difference between instantaneous value of i and V is

$\frac{\pi}{4} - \left(-\frac{\pi}{4}\right) = \frac{\pi}{2}$

Hence, current leads the voltage by 90°.

346 **(c)**

The full cycle of alternating current consists of two half cycles. For one-half , current is positive and for second-half , current is negative .Therefore ,for an AC cycle, the net value of current average value, Hence, the alternating current cannot be measure by DC ammeter.

347 **(c)**

For series $L - C - R$ circuit,

$V = \sqrt{V_R^2 + (V_L - V_C)^2}$

$= \sqrt{(80)^2 + (40-100)^2} = 100$ V

348 **(d)**

As, $Z = \sqrt{R^2 + X_L^2} = \sqrt{R^2 + (2\pi fL)^2}$

Also, $i = \frac{V}{Z}$ and $P = i^2R$

When iron rod is inserted, then inductance L of the coil increases which increases impedance Z and consequently, current i and power P of the circuit ' decreases. So, brightness of bulb decreases.

349 **(c)**

Equation of alternating current is given as

$i = i_1\cos\omega t + i_2\sin\omega t$ ...(i)

Let, $i_1 = A\sin\phi$ ...(ii)

and $i_2 = A\cos\phi$ ...(iii)

From Eq. (i), we have

$i = A\sin\phi\cos\omega t + A\cos\phi\sin\omega t$

$= A[\cos\omega t\sin\phi + \sin\omega t\cos\phi]$

$i = A\sin(\omega t + \phi)$ ...(iv)

Squaring and adding Eqs. (ii) and (iii), we get

$i_1^2 + i_2^2 = A^2(\sin^2\phi + \cos^2\phi) = A^2 \Rightarrow A = [i_1^2 + i_2^2]^{\frac{1}{2}}$

From Eq. (iv), we get

$i = [i_1^2 + i_2^2]^{\frac{1}{2}}\sin(\omega t + \phi)$ ...(v)

Comparing Eq. (v) with equation, $i = i_m\sin(\omega t + \phi)$, we get

$i_m = (i_1^2 + i_2^2)^{\frac{1}{2}}$

$\therefore \quad i_{rms} = \frac{i_m}{\sqrt{2}} = \frac{(i_1^2+i_2^2)^{1/2}}{\sqrt{2}}$

350 **(a)**

Given, inductance, L = 0.01H, resistance, R = 1Ω, voltage, V = 200 Vand frequency, f = 50 Hz

Impedance of the circuit,

$Z = \sqrt{R^2 + X_L^2} = \sqrt{R^2 + (2\pi fL)^2}$

$= \sqrt{1^2 + (2\times3.14\times50\times0.01)^2}$

$Z = \sqrt{10.86} = 3.3\Omega$

$\tan\phi = \frac{\omega L}{R} = \frac{2\pi fL}{R} = \frac{2\times3.14\times50\times0.01}{1} = 9.14$

$\phi = \tan^{-1}(3.14) = 72°$

Phase difference, $\phi = \frac{72\times\pi}{180}$ rad

Time lag between alternating voltage and current,

$\Delta t = \frac{\phi}{\omega} = \frac{72\pi}{180\times2\pi\times50} = \frac{1}{250}$ s

351 **(a)**

Given, $i_0 = 5\sqrt{2}$ A

Root-mean-square-value of current,

$i_{rms} = \frac{i_0}{\sqrt{2}} = \frac{5\sqrt{2}}{\sqrt{2}} = 5$ A

352 **(c)**

Given, $C = 15\mu F = 15\times10^{-6}$ F, V = 220 V and v = 50 Hz

Capacitive reactance, $X_C = \frac{1}{2\pi vC} = \frac{1}{2\pi(50\text{ Hz})(15\times10^{-6}\text{ F})} = 212\Omega$

353 **(a)**

The reactance X_L of the inductance at 200 Hz is 120Ω.

As, $X_L = \omega L = 2\pi v\times L$

$\Rightarrow L = \frac{X_L}{2\pi v} = \frac{120\Omega}{2\pi\times200\text{ s}^{-1}} = \frac{3}{10\pi}$ H

If X_L' denotes the reactance of the same inductance at 60 Hz, then

$X_L' = \omega' L = 2\pi v' L$

$\Rightarrow X_L' = (2\pi\times60)\left(\frac{3}{10\pi}\right) = 36\Omega$

If i_{rms} is the current that flows through the inductance, when connected to 240 V and 60 Hz power line, then

$i_{rms} = \frac{V_{rms}}{X_L'} = \frac{240\text{ V}}{36\Omega} = 6.66$ A

354 **(b)**

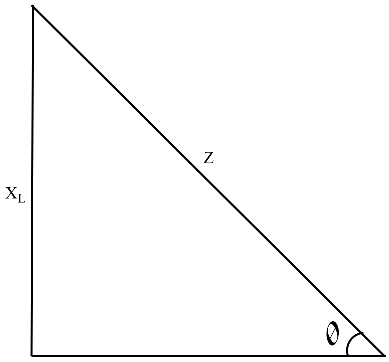
For high frequency, capacitor offers less resistance because, $X_C \propto \frac{1}{v}$.

355 **(d)**

Given, $R = 12\ \Omega$ and $X_L = 5\Omega$

$\therefore$ Impedance, $Z = \sqrt{(12)^2 + (5)^2} = 13\Omega$

The impedance triangle is as shown below



From this triangle, $\cos\theta = \frac{R}{Z}$

$\Rightarrow \theta = \cos^{-}\left(\frac{R}{Z}\right)$

$= \cos^{-1}\left(\frac{12}{13}\right)$

356 **(b)**

Reading of ammeter

$= I_{rms} = \frac{E_{rms}}{X_C} = \frac{E_0 \omega C}{\sqrt{2}}$

$= \frac{200\sqrt{2} \times 100 \times (1 \times 10^{-6})}{\sqrt{2}}$

$= 2 \times 10^{-2}\ \text{A} = 20\ \text{mA}$

357 **(c)**

Here, rms voltage, $V_{rms} = 220\ \text{V}$

Using the relation, $V_{rms} = \frac{\text{Peak voltage}}{\sqrt{2}} = \frac{V_p}{\sqrt{2}}$

Hence, peak value of AC voltage $V_P = 220\sqrt{2}\text{V}$

358 **(b)**

Given, $C = 50\ \mu\text{F} = 50 \times 10^{-6}\ \text{F}$

$V = 220 \sin\ (50t)$ ...(i)

But we know that,

$V = V_0 \sin \omega t$ ...(ii)

On comparing Eqs. (i) and (ii), we get

$V_0 = 220\ \text{V}, \omega = 50\ \text{rad/s}$

The capacitive reactance of the circuit is given by

$X_C = \frac{1}{\omega C} = \frac{1}{50 \times 50 \times 10^{-6}} = 400\Omega$

The peak and the rms values of current in the circuit are given as,

$i_0 = \frac{V_0}{X_C} = \frac{220}{400} = \frac{11}{20} = 0.55\ \text{A}$

359 **(a)**

The resonant frequency, $v_0 = \frac{1}{2\pi\sqrt{LC}}$

$\Rightarrow v_0 \propto \frac{1}{\sqrt{LC}}$

If inductance and capacitance both are doubled, then

$v_0 = \frac{1}{2}\left(\frac{1}{2\pi\sqrt{LC}}\right)$

So, the resonant frequency will decrease to one-half of the original value.

360 **(b)**

The value of current, $i_{ms} = \frac{i_0}{\sqrt{2}}$

361 **(a)**

The value of voltage and current at that instant are $V_m \sin \omega t$ and $i_m \sin \omega t$.

362 **(d)**

Power factor, $\cos\phi = \frac{R}{Z}$

If R is constant, then $\cos\phi \propto \frac{1}{Z}$

$\therefore \frac{Z_1}{Z_2} = \frac{\cos\phi_2}{\cos\phi_1} = \frac{\frac{1}{4}}{\frac{1}{2}} = \frac{1}{2}$

$\Rightarrow Z_2 = 2Z_1$

$\therefore$ Percentage change $= \frac{2Z_1 - Z_1}{Z_1} \times 100 = 100\%$

363 **(d)**

As power consumption, i.e. $P = VI \Rightarrow P = \frac{V^2}{R}$

So, brightness $\propto P_{consumed} \propto \frac{1}{R}$ for bulb, $R_{AC} = R_{DC}$.

So, brightness will be equal in both the cases.

364 **(b)**

Inductive reactance, $X_L = \omega L \Rightarrow X_L \propto \omega$

Hence, inductive reactance increases linearly with angular frequency as shown in graph (b).

365 **(b)**

AC measuring instrument (AC ammeter and voltmeter) always measures rms value.

366 **(c)**

Given, $C = 36\mu\text{F} = 36 \times 10^{-6}\ \text{F}, V_{rms} = 240\ \text{V}$ and $v = 50\ \text{Hz}$

Capacitive reactance,$x_C = \frac{1}{2\pi v C} = \frac{1}{2\pi \times 50 \times 36 \times 10^{-6}} = 88\Omega$

The rms current, $i_{rms} = \frac{V_{rms}}{X_C} = \frac{240\ \text{V}}{88\Omega} = 2.73\ \text{A}$

The peak current, $i_0 = \sqrt{2} i_{rms} = (1.414)(2.73\ \text{A}) = 3.85\ \text{A}$

367 **(d)**

Current corresponding to inductive circuit,

$i = \frac{V}{Z} = \frac{V}{\omega L} \Rightarrow i_{inductive} \propto \frac{1}{\omega}$

...(i)

Similarly, for capacitive circuit $i_{capacitive} \propto \omega$ ...(ii)
When frequency of AC is increased,
from Eq.(i), $i_{inductive}$ decreases
from Eq. (ii), $i_{capacitive}$ increases

368 **(a)**

Current in L − C − R series circuit,

$$i = \frac{V}{\sqrt{R^2 + (X_L - X_C)^2}}$$

where, V is rms value of current, R is resistance, X_L is inductive reactance and X_C is capacitive reactance.
For current to be maximum, denominator should be minimum which can be done, if
$X_L = X_C$
This happens in resonance state of the circuit, i.e.

$$\omega L = \frac{1}{\omega C}$$

or $L = \frac{1}{\omega^2 C}$ ...(i)
Given, $\omega = 1000\ s^{-1}, C = 10\mu F$
$= 10 \times 10^{-6}$ F
Putting the above values in Eq. (i), we get

$$L = \frac{1}{(1000)^2 \times 10 \times 10^{-6}}$$

$= 0.1H = 100mH$

369 **(b)**

Using Kirchhoff's rule in given figure,

$$V - L\frac{di}{dt} = 0$$

where, the second term is the self induced emf in the inductor and L is the self-inductance of coil.

370 **(d)**

The current takes $\frac{T}{4}$ seconds to reach the peak value, where T is the time period.
Comparing it with standard equation $i = i_0 \sin \omega t$, we get

$$\omega = \frac{2\pi}{T} = 200\pi \Rightarrow T = \frac{1}{100}\ s$$

∴ Time required to reach the peak value

$$= T/4 = \frac{1}{400}\ s.$$

371 **(d)**

Given, inductance of a coil, L = 2H
Reactance of coil, when it is connected to AC source,
$(X_L)_{AC} = \frac{1}{\omega L}$ (where, ω = angular frequency)
$(X_L)_\omega = \frac{1}{2\omega}$
For DC source, inductor coil behaves as pure conductor. hence $(X_L)_{DC} = 0$.

$$\therefore \frac{(X_L)_{AC}}{(X_i)_{DC}} = \frac{\frac{1}{2\omega}}{0} = \infty (\text{at infinity})$$

372 **(a)**

∵ Angular frequency at resonance, $\omega = \frac{1}{\sqrt{LC}}$ ⋯ (i)
According to question, when inductor's inductance is made 2 times and capacitance is 4 times, then

$$\omega' = \frac{1}{\sqrt{2L \times 4C}} = \left(\frac{1}{2\sqrt{2}}\right)\frac{1}{\sqrt{LC}}$$

$= \frac{\omega}{2\sqrt{2}}$ [from Eq. (i)]

373 **(a)**

Given, $L = 8mH = 8 \times 10^{-3}$H,
$C = 20\mu F = 20 \times 10^{-6}$ F, $R = 44\Omega$ and $V_{rms} = 220$ V
Angular resonant frequency of series L − C − R circuit,

$$\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{8 \times 10^{-3} \times 20 \times 10^{-6}}}$$

$= 2500\ rads^{-1}$
Resonant current $= V_m/R = \frac{V_{rms}\sqrt{2}}{R} = \frac{220\sqrt{2}}{44} = 5\sqrt{2}$ A

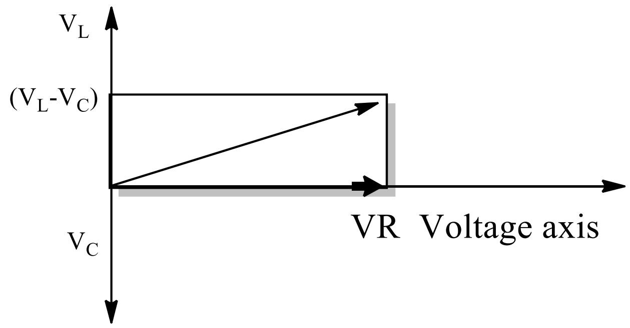
374 **(b)**

The instantaneous voltage through the given device,
$V = 80 \sin 100\pi t$
Comparing the given instantaneous voltage with standard instantaneous voltage
$V = V_0 \sin \omega t$, we get $V_0 = 80$ V
where, V_0 is the peak value of voltage.
Impedance, $Z = 20\Omega$
Peak value of current, $i_0 = \frac{V_0}{Z} = \frac{80}{20} = 4$ A
Effective value of current (root-mean-square value of current)

$$i_{rms} = \frac{i_0}{\sqrt{2}} = \frac{4}{\sqrt{2}} = 2\sqrt{2} = 2.828\ A$$

375 **(c)**

Phasor diagram of R-L-C series circuit is shown in figure



$$V^2 = V_R^2 + (V_L - V_C)^2$$

376 **(d)**

Since, alternating voltage, $V = 220\sin(100\pi t)$ is connected with 20Ω resistor only, hence equation of alternating current is

$i = i_m \sin(100\pi t)$

Peak value to rms value means current becomes $1/\sqrt{2}$ times.

If t be the time taken by current to change from its peak value to rms value, then from equation of current,

$i = i_m \sin(100\pi t)$

$\frac{i_m}{\sqrt{2}} = i_m \sin(100\pi t)$

$\Rightarrow \frac{1}{\sqrt{2}} = \sin(100\pi t)$

$\Rightarrow \sin\left(\frac{\pi}{4}\right) = \sin(100\pi t)$

$\Rightarrow \frac{\pi}{4} = 100\pi t \Rightarrow t = \frac{1}{400}\text{ s} = 2.5 \times 10^{-3}\text{ s}$

377 **(a)**

DC currents does not change direction with time. But voltages and currents that vary with time are very common.

378 **(d)**

Current in the series,

$L - C - R$ circuit is given by $i = \frac{V_m}{Z} \cdot \sin(\omega t + \phi)$

$i = \frac{V_m}{\sqrt{R^2 + (X_C - X_L)^2}} \sin(\omega t + \phi)$

and $i = i_m \sin(\omega t + \phi)$

379 **(d)**

When a circuit contains inductance only, then the current lags behind the voltage by the phase difference of $\frac{\pi}{2}$ or $90°$

While in a purely capacitive circuit, the current leads the voltage by a phase angle of $\frac{\pi}{2}$ or $90°$.

In a purely resistive circuit, current is in-phase with the applied voltage.

380 **(c)**

In L-R circuit,

Impedance, $Z = \sqrt{R^2 + X_L^2}$

Here, $X_L = \omega L = 2\pi f L$

$\therefore Z = \sqrt{R^2 + 4\pi^2 f^2 L^2}$

381 **(c)**

$V = V_0 \sin\omega t = V_{rms}\sqrt{2}\sin\omega t$

After $t = \frac{1}{720}$ s,

$V = 120\sqrt{2}\sin 2\pi v t$

$= 120\sqrt{2}\sin 2\pi \times 60 \times \frac{1}{720}$

$= 120\sqrt{2}\sin\frac{\pi}{6} = 120\sqrt{2} \times \frac{1}{2}$

$= 60\sqrt{2} = 84.8\text{ V}$

382 **(b)**

Given, alternating voltage, $V = 200\sqrt{2}\sin(100t)$ and $C = 1\mu F = 1 \times 10^{-6}$ F

Comparing the given voltage equation with standard equation $V = V_m \sin\omega t$, we get

$V_m = 200\sqrt{2}\text{ V}$ and $\omega = \frac{100\text{rad}}{\text{s}}$

Reading of ammeter

$= i_{rms} = \frac{V_{rms}}{X_C} = \frac{V_m \omega C}{\sqrt{2}} \quad \left(\because X_C = \frac{1}{\omega C}\right)$

$= \frac{200\sqrt{2 \times 100 \times (1 \times 10^{-6})}}{\sqrt{2}}$

$= 2 \times 10^{-2}\text{A} = 20\text{ mA}$

383 **(c)**

Power factor of AC circuit is given by $\cos\phi = \frac{R}{Z}$ ...(i)

where, R is the resistance employed and Z is the impedance of the circuit.

$Z = \sqrt{R^2 + (X_L - X_C)^2}$ ...(ii)

From Eqs. (i) and (ii), we get

$\cos\phi = \frac{R}{\sqrt{R^2 + (X_L - X_C)^2}}$

Given, $R = 8\Omega, X_L = 31\Omega, X_C = 25\Omega$

$\therefore \cos\phi = \frac{8}{\sqrt{(8)^2 + (31 - 25)^2}} = \frac{8}{\sqrt{64 + 36}} = \frac{8}{10}$

Hence, $\cos\phi = 0.80$

384 **(b)**

Average voltage,

$V_{av} = \frac{\int_0^{\pi/\omega} V dt}{\int_0^{\pi/\omega} dt} = \frac{\int_0^{\pi/\omega} V_m \sin\omega t\, dt}{[t]_0^{\pi/\omega}}$

$= \frac{V_m \left(\frac{-\cos\omega t}{\omega}\right)_0^{\frac{\pi}{\omega}}}{\frac{\pi}{\omega}}$

$= \frac{-V_m}{\pi}(\cos\pi - \cos 0°) = \frac{2V_m}{\pi}$

385 **(a)**

Capacitive reactance, $X_C = \frac{1}{\omega C} = \frac{1}{2\pi v C}$

$X_C \propto \frac{1}{v}$ ...(i)

Current, $i = \frac{V_{rms}}{X_C} = V_{rms} \cdot \omega C = V_{rms} \cdot 2\pi v C$

$\Rightarrow i \propto v$ ...(ii)

From Eqs. (i) and (ii), we conclude that, if the frequency is doubled, the capacitive reactance is halved and the current is doubled.

386 **(b)**

Alternating voltage source applied to capacitor,

$V = 200\sin\left(100\pi t - \frac{\pi}{3}\right)$

$\therefore$ Phase, $\phi_1 = \frac{\pi}{3}, V_m = 200$ V and $\omega = 100\pi$ rad/s

Since, alternating current leads by $\frac{\pi}{2}$ angle from alternating voltage in a purely capacitive circuit, hence phase angle of alternating current is

$\phi_2 = \frac{\pi}{2} - \phi_1 = \frac{\pi}{2} - \frac{\pi}{3} = \frac{\pi}{6}$

$\therefore$ Instantaneous value of alternating current through the capacitor is $i = i_m \sin(100\pi t + \phi_2)$

$= V_m\omega C\sin\left(100\pi t + \frac{\pi}{6}\right) \quad \left(\because i_m = \frac{V_m}{X_C}\right)$

$= 200 \times 100\pi \times 2 \times 10^{-6}\sin\left(100\pi t + \frac{\pi}{6}\right)$

$[\because C = 2\mu F = 2 \times 10^{-6}\ F]$

$= 0.04\pi\sin\left(100\pi t + \frac{\pi}{6}\right)$

387 **(b)**

When resistance R of the circuit is negligible,

$v = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{10^{-2} \times 25 \times 10^{-6}}}$

$= \frac{10^4}{10\pi} = \frac{10^3}{\pi}$

Thus, the time period, $T = \frac{1}{v} = \frac{\pi}{10^3}$ s $= \pi$ms

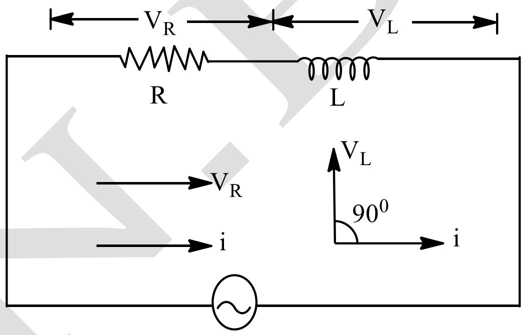
Thus, for the energy to be completely magnetic,

$t = \frac{T}{2}, T, \frac{3T}{2}, \ldots\ldots = \frac{\pi}{2}, \pi, \frac{3\pi}{2} \ldots\ldots$ ms

$= 1.57, 3.14, 4.71 \ldots$ ms

388 **(a)**

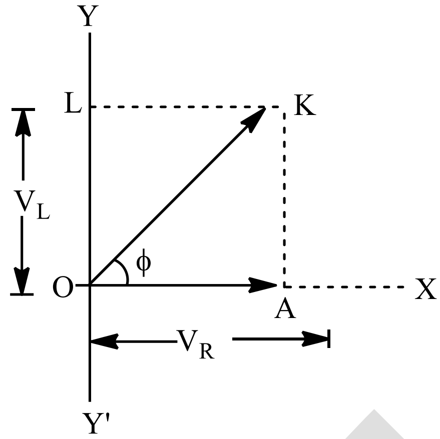
Since, current lags behind the voltage in phase by a constant angle, then circuit must contain R and L.



We find that in R − L circuit, voltage leads the current by a phase angle ϕ, where

$\tan\phi = \frac{AK}{OA} = \frac{OL}{OA} = \frac{V_L}{V_R} = \frac{i_0X_L}{I_0R}$

$\therefore \tan\phi = \frac{X_L}{R}$



389 **(b)**

The voltage equation for the circuit is

$L\frac{di}{dt} + Ri + \frac{q}{C} = V = v_m \sin\omega t$

We know that, $i = dq/dt$. Therefore, $di/dt = d^2q/dt^2$. Thus, in terms of q, the voltage equation becomes

$L\frac{d^2q}{dt^2} + R\frac{dq}{dt} + q/C = V_m\sin\omega t$

390 **(b)**

Angular frequency of free oscillations of the circuit, i.e.

$\omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{(27 \times 10^{-3})(30 \times 10^{-6})s^{-1}}}$

$= \frac{10^4}{9}\ s^{-1} = 1.1 \times 10^3\ s^{-1}$

391 **(b)**

Given, $C = 40\mu F = 40 \times 10^{-6}$ F, and $L = 16mH = 16 \times 10^{-3}H$

Angular frequency of oscillating circuit,

$\omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{(16 \times 10^{-3})(40 \times 10^{-6})}}$

$= \frac{10^4}{8} = 1.25 \times 10^3\ s^{-1}$

392 **(b)**

$\tan\phi = \frac{X_L}{R}$

$\therefore \tan 45° = L = \frac{R}{\omega} = \frac{100}{2\pi \times 1000} \quad (\because \tan 45° = 1)$

$L = \frac{1}{20\pi}$

393 **(c)**

As, $i = 2i_0\frac{t}{T_0}$, where $0 < t < \frac{T_0}{2}$

and $i = 2i_0\left(\frac{t}{T_0} - 1\right)$, where $\frac{T_0}{2} < t < T_0$

$\therefore i_{av} = \frac{2}{T}\int_0^{T/2} i\,dt = \frac{2}{T_0}\left[\int_0^{T_0/2}\frac{2i_0t}{T_0}dt\right]$

$= \frac{2}{T_0^2}\left[\frac{2i_0T_0^2}{2 \times 4}\right] = \frac{i_0}{2}$

394 **(d)**

In a parallel resonant circuit, at resonating frequency, the current would be minimum because impedance is maximum.
This is correctly depicted in the graph (d).

395 **(b)**

At resonance, $X_L = X_C$

$$\text{i.e. } \omega_r L = \frac{1}{\omega_r C}$$

$$\text{or } \omega_r = \frac{1}{\sqrt{LC}}$$

$$\text{or } 2\pi v_r = \frac{1}{\sqrt{LC}}$$

$$\text{or } v_r = \frac{1}{2\pi\sqrt{LC}}$$

or LC = constant (as V remain same)

$$\therefore \frac{L_2}{L_1} = \frac{C_1}{C_2} \text{ or } \frac{L_2}{L} = \frac{C}{2C} \text{ or } L_2 = \frac{L}{2}$$

396 **(c)**

In L-C-R series resonant circuit, $X_L = X_C$

Impedance, $Z = \sqrt{R^2 + (X_L - X_C)^2} = R$

$\therefore$ Power factor, $\cos\phi = \frac{R}{Z} = \frac{R}{R} = 1$

Hence, in L-C-R circuit, power factor at resonance is unity.

397 **(a)**

Impedance for series L − C − R circuit is given by

$$Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

Given, resistance, $R = 300\ \Omega$, inductance, $L = 0.9\text{H}$,
capacitance, $C = 2\mu F = 2 \times 10^{-6}$ F and angular frequency, $\omega = 1000$ rad/s.
Substituting the given values in the above equation, we get

$$\Rightarrow z = \sqrt{300^2 + \left(1000 \times 0.9 - \frac{1}{1000 \times 2 \times 10^{-6}}\right)^2}$$

$$\Rightarrow z = \sqrt{90000 + (900 - 500)^2}$$

$$\Rightarrow z = \sqrt{250000} = 500\Omega$$

Hence, the impedance of L − C − R circuit is 500Ω.

398 **(b)**

Amplitude of alternating voltage = Peak voltage $(V_m) = 120$ V, hence rms value of voltage, i.e.

$$V_{rms} = \frac{V_m}{\sqrt{2}} = \frac{120}{1.414} = 84.8 \text{ V}$$

399 **(a)**

The given value of voltage in rms value, is

$$E_{rms} = \frac{E_0}{\sqrt{2}}$$

$$E_0 = E_{rms} \times \sqrt{2} = 220 \times \sqrt{2} = 311 \text{ V}$$

The average emf during positive half cycle is given as

$$E_{av} = \frac{2E_0}{\pi} = \frac{2 \times 311}{3.14} = 198 \text{ V}$$

400 **(d)**

As for potential across capacitor in discharging RC circuit $V = V_0 e^{-t/\tau}$, when

$$t = \tau, V = V_0 e^{-1} = \frac{V_0}{e}$$

$$= \frac{25}{2.718} = 9.2 \text{ V} \quad (\because e = 2.718)$$

Corresponding to V = 9.2V, t lies between 100 s and 150 s.

401 **(c)**

The current in the circuit, $i = \frac{V_R}{R} = \frac{100}{1000} = 0.1$ A

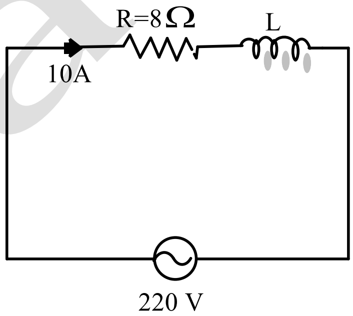
At resonance, $V_L = V_C = iX_C = \frac{i}{\omega C}$

$$= \frac{0.1}{200 \times 2 \times 10^{-6}} = 250 \text{ V}$$

402 **(d)**

Given, I = 10 A, V = 80 V,

$R = \frac{V}{I} = \frac{80}{10} = 8\Omega$ and $\omega = 50$ Hz



For AC circuit, we have

$$I = \frac{V}{\sqrt{8^2 + X_L^2}}$$

$$\Rightarrow 10 = \frac{220}{\sqrt{64 + X_L^2}}$$

$$\Rightarrow \sqrt{64 + X_L^2} = 22$$

Squaring on both sides, we get

$64 + X_L^2 = 484$

$\Rightarrow X_L^2 = 484 - 64 = 420$

$X_L = \sqrt{420}$

$\Rightarrow 2\pi \times \omega L = \sqrt{420}$

Series inductor on an arc lamp,

$$L = \frac{\sqrt{420}}{(2\pi \times 50)} = 0.065\text{H}$$

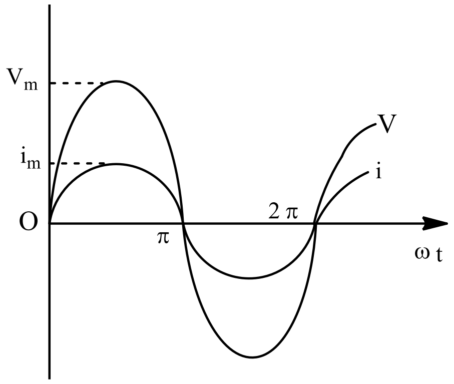
403 **(a)**

The effective voltage $= \frac{E_{max}}{\sqrt{2}} = \frac{282}{\sqrt{2}} = 199.4 \text{ V} \simeq 200 \text{ V}$

404 **(b)**

In a purely resistive circuit, the alternating current and voltage are in phase. This means that the maxima, zero and minima occur at the same time, for both quantities.

This can be graphically represented as



405 **(c)**

Given, $L = 25 \text{ mH} = 25 \times 10^{-3}\text{H}$ and $v = 50 \text{ Hz}$

The inductive reactance,

$X_L = 2\pi vL = 2 \times 3.14 \times 50 \times 25 \times 10^{-3} = 7.85\Omega$

406 **(c)**

Frequency of a generator, i.e.

$$v = \frac{\omega}{2\pi} = \frac{120 \times 7}{2 \times 22} = 19 \text{ Hz}$$

$$v_{rms} = \frac{240}{\sqrt{2}} = 120\sqrt{2} = 169.7 \approx 170 \text{ V}$$

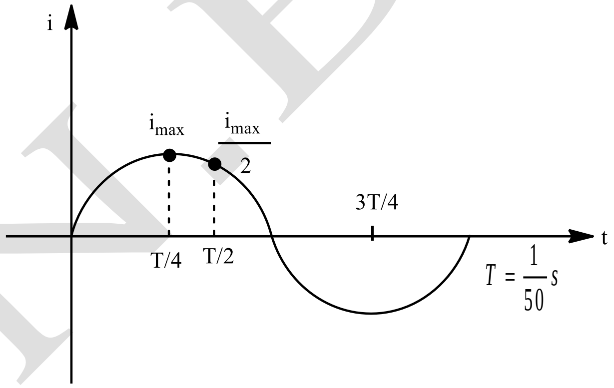
407 **(d)**

In an AC resistive circuit, current and voltage are in phase.

So, $i = \frac{V}{R} \Rightarrow i = \frac{220}{50}\sin(100\pi t)$ ...(i)

∴ Time period of one complete cycle of current is

$$T = \frac{2\pi}{\omega} = \frac{2\pi}{100\pi} = \frac{1}{50} \text{ s}$$



So, current reaches its maximum value at

$$t_1 = \frac{T}{4} = \frac{1}{200} \text{ s}$$

When current is half of its maximum value, then from Eq. (i), we have

$$i = \frac{i_{max}}{2} = i_{max}\sin(100\pi t_2)$$

$$\Rightarrow \sin(100\pi t_2) = \frac{1}{2} \Rightarrow 100\pi t_2 = \frac{5\pi}{6} \Rightarrow t_2 = \frac{1}{120} \text{ s}$$

So, instantaneous time at which current is half of m : ximum value is $t_2 = \frac{1}{120}$ s

Hence, time duration in which current reaches half of its if orimum value after reaching maximum value is

$$\Delta t = t_2 - t_1 = \frac{1}{120} - \frac{1}{200} = \frac{1}{300} \text{ s} = 3.3 \text{ ms}$$

408 **(a)**

Since, the current is the same throughout the circuit.

$$i = \frac{V}{Z} = \frac{220}{\sqrt{R^2 + X_C^2}}$$

$$= \frac{220}{\sqrt{200^2 + \left(\frac{1}{2\pi} \times 50 \times 15 \times 10^{-6}\right)^2}} = 0.755 \text{ A}$$

$V_R = iR = (0.755 \text{ A})(200\Omega) = 151 \text{ V}$

$V_C = iX_C = (0.755 \text{ A})(212.5\Omega) = 160.4 \text{ V}$

409 **(b)**

Given, $V_{rms} = 0.2 \text{ V}, R = 4\Omega$,

$C = 80 \text{ μF} = 80 \times 10^{-6} \text{ F}$

and $L = 200 \text{ mH} = 200 \times 10^{-3}\text{H}$

The impedance of the series L − C − R circuit.

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

At resonance, $X_L = X_C \Rightarrow Z = R = 4\Omega$

∴ Voltage drop across inductor,

$$(V_{rms})_L = i_{rms} \times X_L = \frac{V_{rms}}{Z} \times \omega L$$

$$= \frac{V_{rms}}{R} \times \frac{L}{\sqrt{LC}} \quad \left(\because \omega = \frac{1}{\sqrt{LC}}\right)$$

$$= \frac{V_{rms}}{R} \times \sqrt{\frac{L}{C}} = \frac{0.2}{4} \times \sqrt{\frac{200 \times 10^{-3}}{80 \times 10^{-6}}}$$

$$= 0.05 \times \sqrt{2500} = 0.05 \times 50 = 2.5 \text{ V}$$

410 **(b)**

Given, $L = 40 \text{ mH} = 40 \times 10^{-3}\text{H}, V = 200 \text{ V}$ and $v = 50 \text{ Hz}$

The rms current in the circuit is

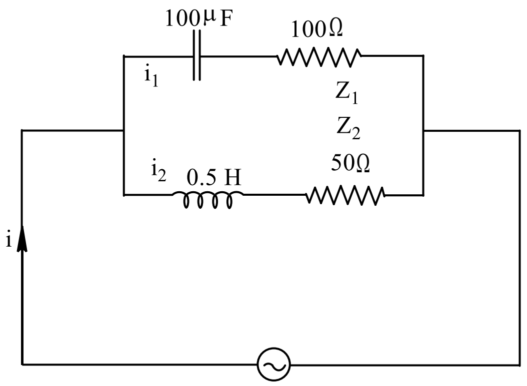
$$i_{rms} = \frac{V}{X_L} = \frac{V}{2\pi vL}$$

$$= \frac{200}{2 \times 3.14 \times 50 \times 40 \times 10^{-3}} \approx 16 \text{ A}$$

411 **(d)**

To express an AC power in the same form as DC power ($P = i^2R$), a special value of current is defined and used, it is called root-mean-square (rms) or effective current and is denoted by i_{rms} or i.

412 **(a)**



Circuit 1 $X_C = \frac{1}{\omega C} = \frac{1}{100 \times 100 \times 10^{-6}} = 100\Omega$

$\therefore\ Z_1 = \sqrt{(100)^2 + (100)^2} = 100\sqrt{2}\ \Omega$

$\phi_1 = \cos^{-1}\left(\frac{R_1}{Z_1}\right)$

$= \cos^{-1}\left(\frac{100}{100\sqrt{2}}\right) = \cos^{-1}\left(\frac{1}{\sqrt{2}}\right)$

$= 45°$

In this circuit, current leads the voltage,

$i_1 = \frac{V}{Z_1} = \frac{20}{100\sqrt{2}} = \frac{1}{5\sqrt{2}}$ A

$V_{100\Omega} = (100)i_1 = (100)\frac{1}{5\sqrt{2}} = 10\sqrt{2}$ V

Circuit 2 $X_L = \omega L = (100)(0.5) = 50\Omega$

$Z_2 = \sqrt{(50)^2 + (50)^2} = 50\sqrt{2}\Omega$

$\phi_2 = \cos^{-1}\left(\frac{R_2}{Z_2}\right) = \cos^{-1}\frac{50}{50\sqrt{2}} = \cos^{-1}\frac{1}{\sqrt{2}} = 45°$

In this circuit, voltage leads the current,

$i_2 = \frac{V}{Z_2} = \frac{20}{50\sqrt{2}} = \frac{\sqrt{2}}{5}$ A

$V_{50\Omega} = (50)i_2 = 50\left(\frac{\sqrt{2}}{5}\right) = 10\sqrt{2}$ V

Further, I_1 and I_2 have a mutual phase difference of 90°.

$\therefore I = \sqrt{I_1^2 + I_2^2} = \sqrt{\frac{1}{50} + \frac{4}{50}}$

$I = \frac{1}{\sqrt{10}}$ A ≈ 0.3 A

413 **(a)**

For L − C oscillations,

Energy stored in inductor = Energy stored in capacitor

$\frac{1}{2}Li_m^2 = \frac{1}{2}CV_m^2$

Given, $V_m = 25$ V, $C = 10\mu F = 10^{-5}$ F

and $L = 100mH = 10^{-1}H$

or $i_m = V_m\sqrt{\frac{C}{L}} = 25\sqrt{\frac{10^{-5}}{10^{-1}}}$

$= 25 \times 10^{-2}$ A $= 0.25$ A

414 **(b)**

Given, $L = 25mH = 25 \times 10^{-3}H$

$C = 10\mu F = 10^{-5}$ F

If T be the time period in L − C oscillation, then

$T = 2\pi\sqrt{LC} = 2\pi\sqrt{25 \times 10^{-3} \times 10^{-5}}$

$= \pi \times 10^{-3}$ s $= \pi$ m − s

Current in the circuit will be maximum, when

$t = \frac{T}{4} = \frac{\pi}{4}$ m − s

415 **(c)**

At resonant frequency, $X_L = X_C$ $\left(\because \omega L = \frac{1}{\omega C}\right)$

The frequencies are higher than resonance frequencies.

$X_L > X_C$

i.e., behavior is inductive.

416 **(d)**

Given, $L = 1.5mH = 1.5 \times 10^{-3}H$

$E = 30\mu J = 3 \times 10^{-5}$ J

Maximum energy stored in the inductor, $E = \frac{1}{2}Li_m^2$

where, i_m is peak current.

$\Rightarrow\ i_m = \sqrt{\frac{2E}{L}} = \sqrt{\frac{2 \times 3 \times 10^{-5}}{1.5 \times 10^{-3}}} = 0.2$ A

$\therefore\ i_{rms} = \frac{i_m}{\sqrt{2}} = \frac{0.2}{\sqrt{2}} = \sqrt{2} \times 10^{-1}$ A

417 **(c)**

As natural frequency, i.e. $f = \frac{1}{2\pi\sqrt{LC}}$ or $f \propto \frac{1}{\sqrt{C}}$

When capacitor C is replaced by another capacitor C′ of dielectric constant K, then

$C' = KC$

$\therefore \frac{f'}{f} = \sqrt{\frac{C}{C'}}$

$\Rightarrow \frac{125000 - 25000}{125000} = \sqrt{\frac{C}{KC}}$

$\Rightarrow \frac{100}{125} = \frac{1}{\sqrt{K}}$

$\Rightarrow K = \left(\frac{125}{100}\right)^2 = 1.56$

418 **(c)**

The root-mean-square value (V_{rms}) of alternating voltage is given by

$V_{rms} = \frac{V_0}{\sqrt{2}}$, where V_0 is peak value

Given, $V_0 = 707$ V

$\therefore\ V_{rms} = \frac{707}{\sqrt{2}} = \frac{707}{1.414} \approx 500\text{ V}$

419 **(a)**

In the given question, there are identical positive and negative half cycles , so the mean value of current is zero for one cycle, but the rms value is not zero . It is calculated as

$$(i^2)_{mean} = \frac{\int_O^T i^2 dt}{\int_O^T dt}$$

$$= \frac{1}{T}\left[\int_O^{T/2}(2)^2 dt + \int_{T/2}^{T}(-2)^2 dt\right]$$

$$= \frac{4}{T}\left(\int_O^{T/2} dt + \int_{T/2}^{T} dt\right) = \frac{4}{T}\left([f]_O^{T/2} + [t]_{T/2}^{T}\right)$$

$$= \frac{4}{T}\left(\frac{T}{2} + T - \frac{T}{2}\right)$$

$$= \frac{4T}{T} = 4$$

$$\therefore i_{rms} = \sqrt{(i^2)_{mean}} = \sqrt{4} = 2\text{ A}$$

420 **(b)**

Given, $V = 200\sqrt{2}\sin(100t)$. Comparing this equation with $V = V_0 \sin\omega t$, we have

$V_0 = 200\sqrt{2}$ V and $\omega = 100\text{rad s}^{-1}$

The current in the capacitor,

$$i = \frac{V_{rms}}{Z_C} = V_{rms} \times \omega C \qquad \left(\because Z_C = \frac{1}{\omega C}\right)$$

$$= \frac{V_0}{\sqrt{2}} \times \omega C = \frac{200\sqrt{2}}{\sqrt{2}} \times 100 \times 1 \times 10^{-6}$$

$$= 20 \times 10^{-3}\text{ A} = 20\text{ mA}$$

421 **(d)**

Ammeter reads the root-mean-square value of current (i_{rms}) which is related to the peak value of current (i_0) by the relation,

$$i_{rms} = \frac{i_0}{\sqrt{2}}$$

$$\Rightarrow i_0 = \sqrt{2} \times i_{rms}$$

$$= \sqrt{2} \times 10\text{ A} = 10\sqrt{2}\text{ A}$$

422 **(a)**

$$i_{rms} = \sqrt{\frac{i_1^2 + i_2^2 + i_3^2}{3}} = \sqrt{\frac{1^2 + 2^2 + 1^2}{3}}$$

$$= \sqrt{\frac{6}{3}} = \sqrt{2} = 1.41\text{ A}$$

$$\simeq 1.4\text{ A}$$

423 **(b)**

According to question, peak value of current,

$$i_0 = \sqrt{2} \times i_{rms} = \frac{2}{\pi}\text{A}$$

Coefficient of mutual inductance = 1H

As we know, induced emf in secondary coil is given by

$$\varepsilon_s = M \cdot \frac{di}{dt} \qquad [\text{where, } i = i_0 \sin\omega t]$$

$$\varepsilon_s = M\,\omega i_0 \cos(\omega t)$$

$$= 1 \times 2\pi \times 50 \times \frac{2}{\pi}\cos(2\pi \times 50 \times t)\ (\because \omega = 2\pi n)$$

For $t = 0$, we have

$$\varepsilon_s = 4 \times 50 = 200\text{ V}$$

424 **(c)**

Given, $V_{rms} = 220\text{ V}, v = 50\text{ Hz}$

As, $V_{rms} = \frac{V_m}{\sqrt{2}}$

$$\Rightarrow V_m = V_{rms}\sqrt{2}$$

$$= (220\text{ V})(1.414) = 311.1\text{ V}$$

Further, $\omega = 2\pi v = 2\pi \times 50 = 100\,\pi\text{ rads}^{-1}$

Thus, the equation for the instantaneous voltage is given as

$$V = V_m \sin\omega t = 311.1\sin(100\pi)t.$$