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Knowledge is Discipline
BJNP
Learning with the Speed of Mumbai and the Tradition of Kota

Max Marks: 60 **Date: 06.08.2022**

ABHIMANYU BATCH
PHYSICS : DCT
Topic: Stationary Waves

1. Two organ pipes, each closed at one end, give 5 beats s^{-1} when emitting their fundamental notes. If their lengths are in the ratio 50 : 51, their fundamental frequencies are

   (a) 250, 255 (b) 255, 250 (c) 260, 265 (d) 265, 270

2. The frequency of the first overtone of a closed pipe of length l_1 is equal to that the first overtone of an open pipe of length l_2. The ratio of their lengths ($l_1 : l_2$) is

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

3. Air is blown at the mouth of an open tube of length 25 cm and diameter 2 cm. If the velocity of sound in air is 330 ms^{-1}, then the emitted frequencies (in Hz) are

   (a) 660, 1320, 2640 (b) 660, 1000, 3300 (c) 302, 664, 1320 (d) 330, 990, 1690

4. A pipe opened at both ends produces a note of frequency f_1. When the pipe is kept with $\frac{3}{4}$th of its length in water, it produces a note of frequency f_2. The ratio $\frac{f_1}{f_2}$ is

   (a) $\frac{3}{4}$ (b) $\frac{4}{3}$ (c) $\frac{1}{2}$ (d) 2

5. A closed organ pipe of length 1.2 m vibrates in first overtone mode. The pressure variation is maximum at

   (a) 0.4 m from the open end (b) 0.4 m from the closed end
   (c) Both (a) and (b) (d) 0.8 m from the open end

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6. An organ pipe P closed at one end vibrates in its first harmonic. Another organ pipe Q open at both ends vibrates in its third harmonic. When both are in resonance with a tuning fork, the ratio of the length of P to that of Q is

(a) $\frac{1}{2}$ (b) $\frac{1}{4}$ (c) $\frac{1}{6}$ (d) $\frac{1}{8}$

7. Two closed organ pipes A and B, have the same length. A is wider than B. they resonate in the fundamental mode at frequencies n_A and n_B respectively, then

(a) $n_A = n_B$

(b) $n_A > n_B$

(c) $n_A < n_B$

(d) Either (b) or (c) depending on the ratio of their diameters

8. If λ_1, λ_2 and λ_3 are the wavelengths of the waves giving resonance with the fundamental, first and second overtones respectively of a closed organ pipe. Then, the ratio of wavelengths $\lambda_1 : \lambda_2 : \lambda_3$ is

(a) 1 : 3 : 5 (b) 1 : 2 : 3 (c) 5 : 3 : 1 (d) $1 : \frac{1}{3} : \frac{1}{5}$

9. An organ pipe closed at one end has fundamental frequency of 1500 Hz. The maximum number of overtones generated by this pipe which a normal person can hear is

(a) 4 (b) 13 (c) 6 (d) 9

10. Two closed organ pipes 100 cm and 101 cm long gives 16 beats in 20 s, when each pipe is sounded in its fundamental mode. Calculate the velocity of sound

(a) 303 ms^{-1} (b) 332 ms^{-1} (c) 323.2 ms^{-1} (d) 300 ms^{-1}

11. An open pipe is suddenly closed at one end with the result that the frequency of third harmonic of the closed pipe is found to be higher at 100 Hz. The fundamental frequency of the open pipe is

(a) 200 Hz (b) 480 Hz (c) 240 Hz (d) 300 Hz

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12. An open organ pipe has fundamental frequency 100 Hz. What frequency will be produced if its one end is closed?

(a) 100, 200, 300, …
(b) 50, 150, 250, …
(c) 50, 100, 200, 300, …
(d) 50, 100, 150, 200, …

13. A pipe closed at one end and open at the other end, resonates with sound waves of frequency 135 Hz and also 165 Hz, but not with any wave of frequency intermediate between these two. Then. The frequency of the fundamental note is

(a) 30 Hz (b) 15 Hz (c) 60 Hz (d) 7.5 Hz

14. A glass tube is open at both the ends. A tuning fork of frequency f resonates with the air column inside the tube. Now, the tube is places vertically inside water so that half the length of the tube is filled with water. Now, the air column inside the tube is in unison with another fork of frequency f´. Then

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

15. A cylindrical tube, open at both ends emits a fundamental frequency f in air. The tube is dipped vertically in water, so that half of it is in water. The fundamental frequency of air column is now

(a) f/2 (b) 3f/4 (c) f (d) 2f

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ABHIMANYU BATCH
MATHEMATICS : DCT
Topic: Equation of Tangent Normal and Rate of Measurement

1. The abscissa of the points, where the tangent to curve $y = x^3 - 3x^2 - 9x + 5$ is parallel to X-axis, are

(a) $x = 0$ and 1 (b) $x = 1$ and -1 (c) $x = 1$ and -3 (d) $x = -1$

2. For the curve $x = t^2 - 1$, $y = t^2 - t$, the tangent line is perpendicular to X-axis when

(a) $t = 0$ (b) $t = \infty$ (c) $t = \frac{1}{\sqrt{3}}$ (d) $t = -\frac{1}{\sqrt{3}}$

3. The equation of tangent at $(-4, -4)$ on the curve $x^2 = -4y$ is

(a) $2x + y + 4 = 0$ (b) $2x - y - 12 = 0$ (c) $2x + y - 4 = 0$ (d) $2x - y + 4 = 0$

4. The equation of the tangent to the curve $\sqrt{x} + \sqrt{y} = a$ at $\left(\frac{a^2}{4}, \frac{a^2}{4}\right)$ is

(a) $xy = a^2$ (b) $x + y = \frac{a^2}{2}$ (c) $xy = \frac{a^2}{2}$ (d) $x - y = \frac{a^2}{2}$

5. The equation of the normal to the curve $y = \sin\frac{\pi x}{2}$ at $(1, 1)$ is

(a) $y = 1$ (b) $x = 1$ (c) $y = x$ (d) $y - 1 = \frac{-2}{\pi}(x - 1)$

6. The equation of tangent to the curve $y = 2\sin x$ at $x = \frac{\pi}{4}$ is

(a) $y - \sqrt{2} = 2\sqrt{2}\left(x - \frac{\pi}{4}\right)$ (b) $y + \sqrt{2} = \sqrt{2}\left(x + \frac{\pi}{4}\right)$

(c) $y - \sqrt{2} = -\sqrt{2}\left(x - \frac{\pi}{4}\right)$ (d) $y - \sqrt{2} = \sqrt{2}\left(x - \frac{\pi}{4}\right)$

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7. The equation of the tangent to the curve $y = 2\sin x + \sin 2x$ at $x = \frac{\pi}{3}$ is equal to

(a) $2y = 3\sqrt{3}$ (b) $y = 3\sqrt{3}$ (c) $2y + 3\sqrt{3} = 0$ (d) $y + 3\sqrt{3} = 0$

8. The displacement of a aprticle in time t is given by $s = 2t^2 - 3t + 1$. The acceleration is

(a) 1 (b) 3 (c) 4 (d) 5

9. If the distance 's' travelled by a particle in time t is $s = a\sin t + b\cos 2t$, then the acceleration at $t = 0$ is

(a) a (b) –a (c) 4b (d) –4b

10. The equation of motion of a particle moving along a straight line is $s = 2t^3 - 9t^2 + 12t$, where the units of s and t are cm and sec. The acceleration of the particle will be zero after

(a) 3/2 sec (b) 2/3 sec (c) 1/2sec (d) 2 sec

11. As tone is falling freely and describes a distance s in t seconds given by equation $s = \frac{1}{2}gt^2$. The acceleration of the stone is

(a) Uniform (b) Zero (c) Non-uniform (d) Indeterminate

12. A point moves in a straight line during the time $t = 0$ to $t = 3$ according to the law $s = 15t - 2t^{-2}$. The average velocity is

(a) 3 units (b) 9 units (c) 15 units (d) 27 units

13. Radius of a circle is increasing uniformly at the rate of 3 cm/sec. The rate of increase in area when radius is 10 cm, will be

(a) π cm^2/s (b) 2π cm^2/s (c) 10π cm^2/s (d) 60π cm^2/sec

14. Sides of a square are increasing at the rate 0.5 cm/sec. When the side is 10 cm long, its area is increasing at the rate of

(a) 100 cm^2/sec (b) 0.10 cm^2/sec (c) 10 cm^2/sec (d) 1 cm^{2}sec

15. The volume V and depth x of water in a vessel are connected by the relation $V = 5x - \frac{x^2}{6}$ and the volume of water is increasing at the rate of 5 cm^3/sec, when x = 2 cm. The rate at which the depth of water is increasing, is

(a) $\frac{5}{18}$ cm/sec (b) $\frac{1}{4}$ cm/sec (c) $\frac{5}{16}$ cm/sec (d) $\frac{15}{13}$ cm/sec

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PHYSICS : DCT ANSWER KEY
Topic: Stationary Waves

1.	(b)	2.	(d)	3.	(a)	4.	(c)	5.	(a)
6.	(c)	7.	(c)	8.	(d)	9.	(c)	10.	(c)
11.	(a)	12.	(b)	13.	(b)	14.	(a)	15.	(c)

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ABHIMANYU BATCH
MATHEMATICS : DCT ANSWER KEY
Topic: Equation of Tangent Normal and Rate of Measurement

1.	(d)	2.	(a)	3.	(d)	4.	(b)	5.	(b)
6.	(d)	7.	(a)	8.	(c)	9.	(d)	10.	(a)
11.	(a)	12.	(b)	13.	(d)	14.	(c)	15.	(d)