PHYSICS

Waves

Speed TEST 14

Chapter-wise

No. of Questions	Maximum Marks	Time
45	180	1 Hour

GENERAL INSTRUCTIONS

- This test contains 45 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.
- You have to evaluate your Response Grids yourself with the help of solutions provided at the end of this book.
- Each correct answer will get you 4 marks and 1 mark shall be deduced for each incorrect answer. No mark will be given/ deducted if no bubble is filled. Keep a timer in front of you and stop immediately at the end of 60 min.
- The sheet follows a particular syllabus. Do not attempt the sheet before you have completed your preparation for that syllabus.
- After completing the sheet check your answers with the solution booklet and complete the Result Grid. Finally spend time to analyse your performance and revise the areas which emerge out as weak in your evaluation.

1. Where should the two bridges be set in a 110cm long wire so that it is divided into three parts and the ratio of the frequencies are 3 : 2 : 1 ?
(a) 20cm from one end and 60cm from other end
(b) 30cm from one end and 70cm from other end
(c) 10cm from one end and 50cm from other end
(d) 50cm from one end and 40cm from other end

2. When a wave travel in a medium, the particle displacement is given by the equation $y = a \sin 2\pi (bt - cx)$ where a, b and c are constants. The maximum particle velocity will be twice the wave velocity if

(a) $c = \frac{1}{\pi a}$ (b) $c = \pi a$ (c) $b = ac$ (d) $b = \frac{1}{ac}$

3. The wave described by $y = 0.25 \sin (10\pi x - 2\pi t)$, where x and y are in meters and t in seconds, is a wave travelling along the:
(a) –ve x direction with frequency 1 Hz.
(b) +ve x direction with frequency π Hz and wavelength $\lambda = 0.2$ m.
(c) +ve x direction with frequency 1 Hz and wavelength $\lambda = 0.2$ m
(d) –ve x direction with amplitude 0.25 m and wavelength $\lambda = 0.2$ m

4. The equation of a plane progressive wave is $y = 0.9 \sin 4\pi\left[t - \frac{x}{2}\right]$. When it is reflected at a rigid support, its amplitude becomes $\frac{2}{3}$ of its previous value. The equation of the reflected wave is

(a) $y = 0.6 \sin 4\pi\left[t + \frac{x}{2}\right]$

(b) $y = -0.6 \sin 4\pi\left[t + \frac{x}{2}\right]$

(c) $y = -0.9 \sin 8\pi\left[t - \frac{x}{2}\right]$

(d) $y = -0.6 \sin 4\pi\left[t + \frac{x}{2}\right]$

5. A person carrying a whistle emitting continuously a note of 272 Hz is running towards a reflecting surface with a speed of 18 km h^{-1}. The speed of sound in air is 345 m s^{-1}. The number of beats heard by him is
(a) 4 (b) 6 (c) 8 (d) zero

RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ

Space for Rough Work

6. A closed organ pipe (closed at one end) is excited to support the third overtone. It is found that air in the pipe has
(a) three nodes and three antinodes
(b) three nodes and four antinodes
(c) four nodes and three antinodes
(d) four nodes and four antinodes

7. A wave disturbance in a medium is described by $y(x,t) = 0.02\cos\left(50\pi t + \frac{\pi}{2}\right)\cos(10\pi x)$ where x and y are in metre and t is in second. Which of the following is correct?
(a) A node occurs at x = 0.15 m
(b) An antinode occurs at x = 0.3 m
(c) The speed wave is 5 ms^{-1}
(d) The wavelength is 0.3 m

8. In a resonance column, first and second resonance are obtained at depths 22.7 cm and 70.2 cm. The third resonance will be obtained at a depth
(a) 117.7 cm (b) 92.9 cm
(c) 115.5 cm (d) 113.5 cm

9. 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 seconds. If the speed of sound in air is 330 m/s, then the speed of the engine is :
(a) 32 m/s (b) 27.5 m/s (c) 60 m/s (d) 30 m/s

10. Two identical piano wires kept under the same tension T have a fundamental frequency of 600 Hz. The fractional increase in the tension of one of the wires which will lead to occurrence of 6 beats/s when both the wires oscillate together would be
(a) 0.02 (b) 0.03 (c) 0.04 (d) 0.01

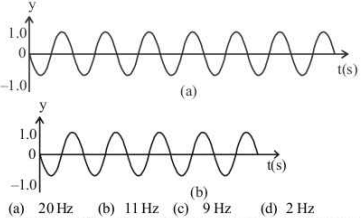
11. Two sound sources emitting sound each of wavelength λ are fixed at a given distance apart. A listener moves with a velocity u along the line joining the two sources. The number of beats heard by him per second is
(a) $\frac{u}{2\lambda}$ (b) $\frac{2u}{\lambda}$ (c) $\frac{u}{\lambda}$ (d) $\frac{u}{3\lambda}$

12. An observer moves towards a stationary source of sound, with a velocity one-fifth of the velocity of sound. What is the percentage increase in the apparent frequency ?
(a) 0.5% (b) zero (c) 20 % (d) 5 %

13. Velocity of sound in air is 320 m s^{-1}. A pipe closed at one end has a length of 1 m. Neglecting end correction, the air column in the pipe cannot resonate with sound of frequency
(a) 80 Hz (b) 240 Hz (c) 320 Hz (d) 400 Hz

14. The driver of a car travelling with speed 30 m/sec towards a hill sounds a horn of frequency 600 Hz. If the velocity of sound in air is 330 m/s, the frequency of reflected sound as heard by driver is
(a) 555.5 Hz (b) 720 Hz (c) 500 Hz (d) 550 Hz

15. What will be the frequency of beats formed from the superposition of two harmonic waves shown below?



(a) 20 Hz (b) 11 Hz (c) 9 Hz (d) 2 Hz

16. What is the effect of increase in temperature on the frequency of sound produced by an organ pipe?
(a) increases (b) decreases
(c) no effect (d) erratic change

17. A cylinderical tube open at both ends, has 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) f (c) 3f / 4 (d) 2 f

18. The transverse displacement y (x, t) of a wave on a string is given by $y(x,t) = e^{-\left(ax^2+bt^2+2\sqrt{ab}xt\right)}$.
This represents a:
(a) wave moving in –x direction with speed $\sqrt{\frac{b}{a}}$
(b) standing wave of frequency $\sqrt{b}$
(c) standing wave of frequency $\frac{1}{\sqrt{b}}$
(d) wave moving in + x direction with speed $\sqrt{\frac{a}{b}}$

19. A longitudinal wave is represented by
$x = x_0 \sin 2\pi\left(nt - \frac{x}{\lambda}\right)$
The maximum particle velocity will be four times the wave velocity if
(a) $\lambda = \frac{\pi x_0}{4}$ (b) $\lambda = 2\pi x_0$
(c) $\lambda = \frac{\pi x_0}{2}$ (d) $\lambda = 4\pi x_0$

20. Two tones of frequencies n_1 and n_2 are sounded together. The beats can be heard distinctly when
(a) $10 < (n_1 - n_2) < 20$ (b) $5 < (n_1 - n_2) > 20$
(c) $5 < (n_1 - n_2) < 20$ (d) $0 < (n_1 - n_2) < 10$

RESPONSE GRID					
	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ
	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ
	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ

Space for Rough Work

21. A pipe of length 85 cm is closed from one end. Find the number of possible natural oscillations of air column in the pipe whose frequencies lie below 1250 Hz. The velocity of sound in air is 340 m/s.
(a) 12 (b) 8 (c) 6 (d) 4

22. A vehicle, with a horn of frequency n is moving with a velocity of 30 m/s in a direction perpendicular to the straight line joining the observer and the vehicle. The observer perceives the sound to have a frequency $n + n_1$. Then (if the sound velocity in air is 300 m/s)
(a) $n_1 = 10n$ (b) $n_1 = 0$
(c) $n_1 = 0.1n$ (d) $n_1 = -0.1n$

23. A source of sound gives 5 beats per second, when sounded with another source of frequency 100/sec. The second harmonic of the source, together with a source of frequency 205/sec gives 5 beats per second. What is the frequency of the source?
(a) 95 sec^{-1} (b) 100 sec^{-1}
(c) 105 sec^{-1} (d) 205 sec^{-1}

24. If we study the vibration of a pipe open at both ends, then which of the following statements is not true ?
(a) Odd harmonics of the fundamental frequency will be generated
(b) All harmonics of the fundamental frequency will be generated
(c) Pressure change will be maximum at both ends
(d) Antinode will be at open end

25. 41 forks are so arranged that each produces 5 beats per sec when sounded with its near fork. If the frequency of last fork is double the frequency of first fork, then the frequencies (in Hz) of the first and the last fork are respectively.
(a) 200, 400 (b) 205, 410
(c) 195, 390 (d) 100, 200

26. Two points are located at a distance of 10 m and 15 m from the source of oscillation. The period of oscillation is 0.05 sec and the velocity of the wave is 300 m/sec. What is the phase difference between the oscillations of two points?
(a) $\frac{\pi}{3}$ (b) $\frac{2\pi}{3}$ (c) π (d) $\frac{\pi}{6}$

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

28. A wave travelling along the x-axis is described by the equation $y(x, t) = 0.005 \cos(\alpha x - \beta t)$. If the wavelength and the time period of the wave are 0.08 m and 2.0s, respectively, then α and β in appropriate units are
(a) $\alpha = 25.00\pi, \beta = \pi$ (b) $\alpha = \frac{0.08}{\pi}, \beta = \frac{2.0}{\pi}$
(c) $\alpha = \frac{0.04}{\pi}, \beta = \frac{1.0}{\pi}$ (d) $\alpha = 12.50\pi, \beta = \frac{\pi}{2.0}$

29. The equation $Y = 0.02 \sin(500\pi t) \cos(4.5 x)$ represents
(a) progressive wave of frequency 250 Hz along x-axis
(b) a stationary wave of wavelength 1.4 m
(c) a transverse progressive wave of amplitude 0.02 m
(d) progressive wave of speed of about 350 m s^{-1}

30. Which of the following statements is/are incorrect about waves ?
(a) Waves are patterns of disturbance which move without the actual physical transfer of flow of matter as a whole.
(b) Waves cannot transport energy.
(c) The pattern of disturbance in the form of waves carry information that propagate from one point to another.
(d) All our communications essentially depend on transmission of signals through waves.

31. An organ pipe P_1, closed at one end vibrating in its first harmonic and another pipe P_2, open at both ends vibrating in its third harmonic, are in resonance with a given tuning fork. The ratio of the lengths of P_1 and P_2 is :
(a) $\frac{8}{3}$ (b) $\frac{1}{6}$ (c) $\frac{1}{2}$ (d) $\frac{1}{3}$

32. Two vibrating tuning forks producing waves given by $y_1 = 27 \sin 600\pi t$ and $y_2 = 27 \sin 604\pi t$ are held near the ear of a person, how many beats will be heard in three seconds by him ?
(a) 4 (b) 2 (c) 6 (d) 12

33. A source of sound A emitting waves of frequency 1800 Hz is falling towards ground with a terminal speed v. The observer B on the ground directly beneath the source receives waves of frequency 2150 Hz. The source A receives waves, reflected from ground of frequency nearly: (Speed of sound = 343 m/s)
(a) 2150 Hz (b) 2500 Hz (c) 1800 Hz (d) 2400 Hz

34. Consider the three waves z_1, z_2 and z_3 as
$z_1 = A \sin(kx - \omega t)$
$z_2 = A \sin(kx + \omega t)$
$z_3 = A \sin(ky - \omega t)$
Which of the following represents a standing wave?
(a) $z_1 + z_2$ (b) $z_2 + z_3$
(c) $z_3 + z_1$ (d) $z_1 + z_2 + z_3$

35. A sonometer wire supports a 4 kg load and vibrates in fundamental mode with a tuning fork of frequency 416 Hz. The length of the wire between the bridges is now doubled. In order to maintain fundamental mode, the load should be changed to
(a) 1 kg (b) 2 kg (c) 4 kg (d) 16 kg

RESPONSE GRID					
	21. (a)(b)(c)(d)	**22.** (a)(b)(c)(d)	**23.** (a)(b)(c)(d)	**24.** (a)(b)(c)(d)	**25.** (a)(b)(c)(d)
	26. (a)(b)(c)(d)	**27.** (a)(b)(c)(d)	**28.** (a)(b)(c)(d)	**29.** (a)(b)(c)(d)	**30.** (a)(b)(c)(d)
	31. (a)(b)(c)(d)	**32.** (a)(b)(c)(d)	**33.** (a)(b)(c)(d)	**34.** (a)(b)(c)(d)	**35.** (a)(b)(c)(d)

Space for Rough Work

36. The vibrations of a string of length 60 cm fixed at both the ends are represented by the equation $y = 2\sin\left(\frac{4\pi x}{15}\right)\cos(96\pi t)$ where x and y are in cm. The maximum number of loops that can be formed in it is
(a) 4 (b) 16 (c) 5 (d) 15

37. If n_1, n_2 and n_3 are the fundamental frequencies of three segments into which a string is divided, then the original fundamental frequency n of the string is given by
(a) $n = n_1 + n_2 + n_3$
(b) $\frac{1}{n} = \frac{1}{n_1} + \frac{1}{n_2} + \frac{1}{n_3}$
(c) $\frac{1}{\sqrt{n}} = \frac{1}{\sqrt{n_1}} + \frac{1}{\sqrt{n_2}} + \frac{1}{\sqrt{n_3}}$
(d) $\sqrt{n} = \sqrt{n_1} + \sqrt{n_2} + \sqrt{n_3}$

38. An echo repeats two syllables. If the velocity of sound is 330 m/s, then the distance of the reflecting surface is
(a) 66.0m (b) 33.0m (c) 99.0m (d) 16.5m

39. What is the effect of humidity on sound waves when humidity increases?
(a) Speed of sound waves is more
(b) Speed of sound waves is less
(c) Speed of sound waves remains same
(d) Speed of sound waves becomes zero

40. If the ratio of maximum to minimum intensity in beats is 49, then the ratio of amplitudes of two progressive wave trains is
(a) 7 : 1 (b) 4 : 3 (c) 49 : 1 (d) 16 : 9

41. A whistle of frequency 1000 Hz is sounded on a car travelling towards a cliff with velocity of 18 m s^{-1} normal to the cliff. If velocity of sound (v) = 330 m s^{-1}, then the apparent frequency of the echo as heard by the car driver is nearly
(a) 1115 Hz (b) 115 Hz (c) 67 Hz (d) 47.2 Hz

42. The transverse wave represented by the equation $y = 4\sin\left(\frac{\pi}{6}\right)\sin(3x - 15t)$ has
(a) amplitude = 4
(b) wavelength $= 4\frac{\pi}{3}$
(c) speed of propagation = 5
(d) period $= \frac{\pi}{15}$

43. If the intensities of two interfering waves be I_1 and I_2, the contrast between maximum and minimum intensity is maximum, when
(a) $I_1 >> I_2$ (b) $I_1 << I_2$
(c) $I_1 = I_2$ (d) either I_1 or I_2 is zero

44. The fundamental frequency of a closed organ pipe of length 20 cm is equal to the second overtone of an organ pipe open at both the ends. The length of organ pipe open at both the ends is
(a) 100 cm (b) 120 cm (c) 140 cm (d) 80 cm

45. The equation of a travelling wave is $y = 60\cos(180\,t - 6x)$ where y is in μm, *t* in second and x in metres. The ratio of maximum particle velocity to velocity of wave propagation is
(a) 3.6×10^{-2} (b) 3.6×10^{-4}
(c) 3.6×10^{-6} (d) 3.6×10^{-11}

RESPONSE GRID					
	36. (a)(b)(c)(d)	**37.** (a)(b)(c)(d)	**38.** (a)(b)(c)(d)	**39.** (a)(b)(c)(d)	**40.** (a)(b)(c)(d)
	41. (a)(b)(c)(d)	**42.** (a)(b)(c)(d)	**43.** (a)(b)(c)(d)	**44.** (a)(b)(c)(d)	**45.** (a)(b)(c)(d)

PHYSICS CHAPTERWISE SPEED TEST-14			
Total Questions	45	Total Marks	180
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	50	Qualifying Score	70
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work