

Ultimate KCET Crash Course 2026

PHYSICS

DPP: 1

Waves

- Q1** The equation of a stationary wave is $y = 2 \sin\left(\frac{\pi x}{15}\right) \cos(48\pi t)$. The distance between a node and its next antinode is
 (A) 1.5 units (B) 30 units
 (C) 7.5 units (D) 22.5 units
- Q2** The equation of a stationary wave is $y = 2 \sin\left(\frac{\pi x}{15}\right) \cos(48\pi t)$. The distance between a node and its next antinode is
 (A) 1.5 units
 (B) 30 units
 (C) 7.5 units
 (D) 22.5 units
- Q3** In a Resonance-Coulmn lab experiment to measure the velocity of sound, the first resonance is obtained at a length ℓ_1 } second resonance at a length ℓ_2 Then
 (A) $\ell_2 > 3\ell_1$
 (B) $\ell_2 = 3\ell_1$
 (C) $\ell_2 < 3\ell_1$
 (D) May be any of the above, depending on the frequency of the tuning fork used.
- Q4** Two pipes are each 50 cm in length. One of them is closed at one end while the other is open at both ends. The speed of sound in air is 340 ms^{-1} . The frequency at which both the pipes can resonate is
 (A) 510 Hz
 (B) 680 Hz
 (C) None of these
 (D) 85 Hz
- Q5** The phase difference between two vibrating particles separated by a distance of 11m into medium through which a progressive wave is travelling is 1320° . If the frequency of the disturbance is 105 Hz, the phase velocity of the progressive wave is
 (A) 315 m s^{-1}
 (B) 330 m s^{-1}
 (C) 350 m s^{-1}
 (D) 300 m s^{-1}
- Q6** The displacement y of a particle in a medium can be expressed as $y = 10^{-6} \sin\left(100t + 20x + \frac{\pi}{4}\right)$, where t is in second and x is in metre. The speed of the wave is:
 (A) 2000 ms^{-1}
 (B) 5 ms^{-1}
 (C) 20 ms^{-1}
 (D) $5\pi \text{ ms}^{-1}$
- Q7** If speed of sound in air in 330 ms^{-1} , then find the number of tones present in an open organ pipe of length 1 m whose frequency $f \leq 1000$.
 (A) 2 (B) 4
 (C) 8 (D) 6
- Q8** The velocity of sound in glass in which two waves of wavelength 50cm and 50.4cm produces 6 beats per second is
 (A) 340m/s (B) 380m/s
 (C) 378m/s (D) 348m/s



Q9 For a standing wave, $y=10\sin(\pi/18x)\cos(84\pi t)$ m, the distance (in metre) between a node and the next antinode is

- (A) 8.5 (B) 9.0
(C) 18 (D) 19

Q10 Three sound waves of equal amplitudes have frequencies $v-1, v, v+1$, They superpose to produce beats. The number of beats produced per sec will be

- (A) v (B) $v/2$
(C) 2 (D) 1

Q11 A wave travelling in positive x-direction with $a = 0.2$ m/s. Velocity = 360 m/s. and $\lambda = 60$ m, then correct expression for the wave is

- (A) $y = 0.2 \sin\left[2\pi\left(6t + \frac{x}{60}\right)\right]$
(B) $y = 0.2 \sin\left[\pi\left(6t + \frac{x}{60}\right)\right]$
(C) $y = 0.2 \sin\left[2\pi\left(6t - \frac{x}{60}\right)\right]$
(D) $y = 0.2 \sin\left[\pi\left(6t + \frac{x}{60}\right)\right]$

Q12 A stretched wire is vibrating in the second overtone. In the wire there are

- (A) Two nodes and two antinodes
(B) One node and two antinodes
(C) Four nodes and three antinodes
(D) Three nodes and three antinodes

Q13 In a transverse wave, the particles of the medium

- (A) vibrate in a direction perpendicular to the direction of the propagation
(B) vibrate in a direction parallel to the direction of the propagation
(C) move in circle
(D) move in ellipse.

Q14 The temperature at which the speed of sound in air becomes double of its value at 27°C is

- (A) 327°C
(B) 127°C
(C) 927°C
(D) -123°C

Q15 Three sound waves of equal amplitudes have frequencies

$(n-1), n, (n+1)$ They superimpose to give beats The number of beats produced per second will be

- (A) 3 (B) 2
(C) 1 (D) 4

Q16 The equation of a progressive wave can be given by $y = 15 \sin (660\pi t - 0.02\pi x)$ cm. The frequency of the wave is

- (A) 330 Hz
(B) 342 Hz
(C) 365 Hz
(D) 660 Hz

Q17 Two waves of wave length 2 m and 2.02 m respectively moving with the same velocity and superimpose to produce 2 beats per sec. The velocity of the waves is:

- (A) 400.0 m/s
(B) 402 m/s
(C) 404 m/s
(D) 406 m/s

Q18 The speed of sound in air is directly proportional to

- (A) square of adiabatic elasticity
(B) square root of adiabatic elasticity
(C) adiabatic elasticity
(D) square of isothermal elasticity

Q19 A transverse wave is represented by $y = A \sin (\omega t - kx)$. For what value of the wavelength is the wave velocity equal to the maximum particle velocity?

- (A) $\frac{\pi A}{2}$ (B) πA
(C) $2\pi A$ (D) A



Q20 The lengths of two organ pipes open at both ends are L and $L + d$. If they are sounded together, then the beat frequency will be

- (A) $\frac{2Vd}{L(L+d)}$ (B) $\frac{2L(L+d)}{Vd}$
 (C) $\frac{Vd}{L(L+d)}$ (D) $\frac{Vd}{2L(L+d)}$

Q21 An open pipe of length 33 cm resonates to a frequency of 1000 Hz. The mode of vibration is: (velocity of sound)

- (A) Fundamental
 (B) The 2nd harmonic
 (C) The 3rd Harmonic
 (D) The 4th harmonic

Q22 The path difference between two waves

$y_1 = a_1 \sin(\omega t - \frac{2\pi x}{\lambda})$
 and $y_2 = a_2 \cos(\omega t - \frac{2\pi x}{\lambda} + \phi)$ is:

- (A) $\frac{\lambda}{2\pi}(\phi)$
 (B) $\frac{\lambda}{2\pi}(\phi + \frac{\pi}{2})$
 (C) $\frac{2\pi}{\lambda}(\phi - \pi)$
 (D) $\frac{2\pi}{\lambda}(\phi)$

Q23 Two waves are represented by the equations $y_1 = a \sin \omega t$ and $y_2 = a \cos \omega t$. The first wave:-

- (A) Leads the second by π
 (B) Lags the second by π
 (C) Leads the second by $\pi/2$
 (D) Lags the second by $\pi/2$

Q24 Two tuning forks of frequencies n_1 and n_2 produce n beats per second. If n_2 and n are known, n_1 may be given by

- (A) $\frac{n_2}{2} + n$ (B) $n_2 n$
 (C) $n_2 \pm n$ (D) $\frac{n_2}{n} + n$

Q25 Two tuning forks A and B give 6 beats/s. The frequency of B is 432 Hz. When B is fixed 4 beats/s are produced. The frequency of fork A is

- (A) 438 Hz (B) 426 Hz
 (C) 483 Hz (D) 462 Hz

Q26 Velocity of sound in vacuum is

- (A) 300 ms^{-1} (B) 165 ms^{-1}
 (C) Zero (D) 660 ms^{-1}

Q27 Longitudinal wave can travel in

- (A) solids only
 (B) liquids only
 (C) liquids and gases only
 (D) all mediums

Q28 A wave travelling in a stretched string is given by $y = A \sin(kx - \omega t)$. The ratio of maximum velocity of particle with wave velocity is

- (A) $A\omega$ (B) $A\omega/k$
 (C) ωk (D) Ak

Q29 If the amplitude of sound is doubled and the frequency is reduced to one-fourth, the intensity of sound at the same point will be:

- (A) Increasing to a factor 2
 (B) Decreasing to a factor 1/2
 (C) Decreasing to a factor 1/4
 (D) Unchanged

Q30 An open pipe resonates with a tuning fork of frequency 500 Hz. It is observed that two successive nodes are formed at distances 16 and 46 cm from the open end. The speed of sound in air in the pipe is

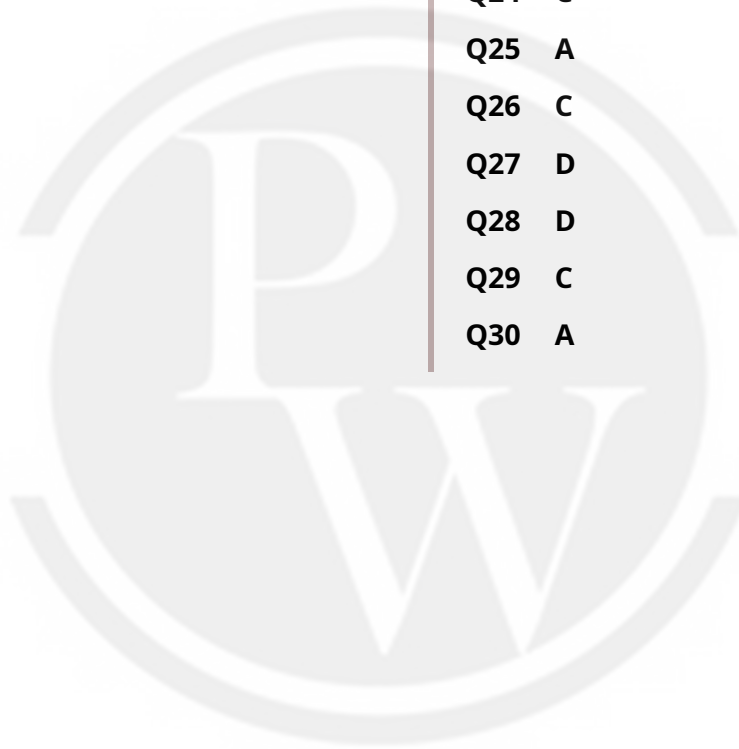
- (A) 300 m/s (B) 360 m/s
 (C) 320 m/s (D) 230 m/s



Answer Key

Q1 C
Q2 C
Q3 C
Q4 C
Q5 A
Q6 B
Q7 D
Q8 C
Q9 B
Q10 C
Q11 C
Q12 C
Q13 A
Q14 C
Q15 B

Q16 A
Q17 C
Q18 B
Q19 C
Q20 C
Q21 B
Q22 B
Q23 D
Q24 C
Q25 A
Q26 C
Q27 D
Q28 D
Q29 C
Q30 A



Hints & Solutions

Note: scan the QR code to watch video solution

Q1 Text Solution:

$$Y = 2 \sin\left(\frac{\pi x}{15}\right) \cos(48\pi t)$$

$$\frac{2\pi}{\lambda} = \frac{\pi}{15}$$

$$\Rightarrow \lambda = 30 \text{ units}$$

$$\frac{\lambda}{4} = \frac{30}{4} = 7.5 \text{ units}$$

Video Solution:



Q2 Text Solution:

$$\text{WKT distance b/w node and antinode} = \frac{\lambda}{4}$$

$$K = \frac{\pi}{15} = \frac{2\pi}{\lambda}$$

$$\therefore X_{avn} = \frac{30}{4} : 7.5$$

Video Solution:



Q3 Text Solution:

λ = Wavelength of sound δ = end correction

$$l_1 = \lambda/4 + \delta$$

$$l_2 = 3\lambda/4 + \delta$$

$$\text{or } l_2 = (l_1 - \delta) + \delta = 3l_1 - 2\delta$$

$$\therefore l_2 < 3l_1$$

Video Solution:



Q4 Text Solution:

A pipe open only at one end and another one of equal length but open at both the ends have their fundamental frequencies and 2ν respectively. Again only odd harmonics are possible for a pipe open at one end whereas all harmonics are possible for a pipe open at both ends. Thus, it is impossible to have a common frequency at which they can resonate.

Video Solution:



Q5 Text Solution:

Here, Phase difference

$$\Delta\phi = 1320^\circ = \frac{\pi}{180^\circ} \times 1320^\circ = \frac{22}{3}\pi \text{ rad}$$

Path difference, $\Delta x = 11 \text{ m}$, Frequency, $\nu = 105 \text{ Hz}$

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

$$\lambda = \frac{2\pi}{\Delta\phi} \times \Delta x \therefore = \frac{2\pi}{\frac{22\pi}{3}} \times 11 = 3 \text{ m}$$

Phase velocity, $v = \nu\lambda = (105)(3) = 315 \text{ m s}^{-1}$

Video Solution:



Q6 Text Solution:

Comparing with standard equation

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

$$\omega = 100, k = 20$$

where, ω is angular frequency and k is angular wave number.

$$\text{Now, } k = \frac{2\pi}{\lambda} = \frac{2\pi v}{\lambda v} = \frac{\omega}{v} = 20$$

$$v = \frac{\omega}{20} = \frac{100}{20} = 5 \text{ ms}^{-1}$$

So, the speed of the wave is 5 ms^{-1} .

Video Solution:



Q7 Text Solution:

Fundamental frequency

$$= f = \frac{v}{2l} = \frac{330}{2 \times 1} = 165 \text{ Hz}$$

$$\text{Number of overtones allowed} = \frac{1000}{165} = 6$$

Video Solution:



Q8 Text Solution:

$$v = f\lambda$$

$$f_1 = v/\lambda_1 = v/0.50, \text{ and } f_2 = v/0.504$$

$$f_b = f_1 - f_2, \quad 6 = (v/0.50) - (v/0.504)$$

therefore, $v = 378 \text{ m/s}$.

Video Solution:



Q9 Text Solution:

$$y = 10 \sin\left(\frac{\pi x}{18}\right) \cdot \cos(84\pi t)$$

$$y = 2a \sin\left(\frac{2\pi x}{\lambda}\right) \cdot \cos\left(\frac{2\pi t}{T}\right)$$

$$\lambda = 36 \text{ m}$$

$$\text{Distance between node to antinode } \frac{\lambda}{4} = 9 \text{ m}$$

Video Solution:



Q10 Text Solution:

$$2$$

Video Solution:



Q11 Text Solution:

The equation of progressive wave travelling in positive x -direction is given by

$$y = a \sin \frac{2\pi}{\lambda} (vt - x)$$

$$\text{Here } a = 0.2 \text{ m, } v = 360 \text{ m/s, } \lambda = 60 \text{ m}$$

$$\therefore y = 0.2 \sin \frac{2\pi}{60} (360t - x) = 0$$

$$.2 \sin \left[2\pi \left(6t - \frac{x}{60} \right) \right]$$

Video Solution:



Q12 Video Solution:



Q13 Text Solution:

vibrate in a direction perpendicular to the direction of the propagation

Video Solution:



Q14 Text Solution:

Speed of Sound, $v \propto \sqrt{T}$
 $\therefore \frac{v}{2v} = \frac{\sqrt{273+27}}{\sqrt{T}}$ or $T = 1200K = 927^{\circ}C$

Video Solution:



Q15 Text Solution:

The Formula for the beat frequency is $f_b = f_2 - f_1$
 Where f_1 and f_2 are the frequency of two waves

Now

$$f_b = f_2 - f_1$$

$$f_b = (n + 1) - (n - 1)$$

$$f_b = (n + 1 - n + 1)$$

$$f_b = 2$$

Thus the number of beats produced per second will be 2.

Video Solution:



Q16 Text Solution:

Given, equation of progressive wave,
 $y = 16 \sin (660 \pi t - 0.02 \pi x)$
 Comparing this equation with standard equation of progressive wave as $y = A \sin \left(\frac{2\pi}{T} \cdot t - \frac{2\pi}{\lambda} \cdot x \right)$
 We get, $\frac{2\pi}{T} = 660\pi$
 $\Rightarrow T = \frac{2\pi}{660\pi}$
 Frequency of the wave,
 $f = \frac{1}{T} = \frac{1}{1/330} = 330 Hz$

Video Solution:



Q17 Text Solution:

The number of beats per second is given by the absolute difference in frequencies:

$$|n_1 - n_2| = 2$$

Substituting the expressions for n_1 and n_2 :

$$\left| \frac{v}{2} - \frac{v}{2.02} \right| = 2$$

Step 5: Simplify the equation

To eliminate the absolute value, we can consider:

$$\left| \frac{v}{2} - \frac{v}{2.02} \right| = 2$$

Now, find a common denominator:

$$\frac{v \cdot 2.02 - v \cdot 2}{2 \cdot 2.02} = 2$$

This simplifies to:

$$\frac{v(2.02 - 2)}{4.04} = 2$$

$$\frac{v(0.02)}{4.04} = 2$$

Step 6: Solve for v

Now, multiply both sides by 4.04 :

$$v(0.02) = 8.08$$

Now divide by 0.02 :

$$v = \frac{8.08}{0.02} = 404 \text{ m/s}$$

Video Solution:



Q18 Text Solution:

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

Video Solution:



Q19 Text Solution:

Wave velocity, $v = \frac{\omega}{k}$

Particle velocity, $u_{\text{max}} = A\omega$

Since $A\omega = \frac{\omega}{k} = \frac{\lambda}{2\pi}$

$$\lambda = 2\pi A$$

Video Solution:



Q20 Text Solution:

beat frequency

$$nA - nB = \frac{V}{lA} - \frac{V}{l\theta}$$

$$= \frac{v}{\theta} \left[\frac{1}{l} - \frac{1}{l+d} \right]$$

$$= \frac{v}{\theta} \left(\frac{l+d-l}{l(l+d)} \right)$$

$$= \frac{Vd}{l(l+d)}$$

Video Solution:



Q21 Text Solution:

$$f = \frac{nV}{2L}$$

$$1000 = \frac{n \times 330}{2 \times \frac{33}{100}}$$

$$1000 = \frac{n \times 330 \times 100}{2 \times 33}$$

$$n = 2$$

Video Solution:



Q22 Text Solution:

$$\begin{aligned}
 \text{As } y_2 &= a_2 \cos\left(\omega t - \frac{2\pi x}{\lambda} + \phi\right) \\
 &= a_2 \sin\left[\frac{\pi}{2} + \left(\omega t - \frac{2\pi x}{\lambda} + \phi\right)\right] \\
 \text{Compare it with } y_1 &= a_1 \sin\left(\omega t - \frac{2\pi x}{\lambda}\right) \\
 \text{We get, Phase difference} &= \left(\frac{\pi}{2} + \phi\right) \\
 \text{Path difference} &= \frac{\lambda}{2\pi} \left(\frac{\pi}{2} + \phi\right)
 \end{aligned}$$

Video Solution:



Q23 Text Solution:

Lags the second by $\pi/2$

Video Solution:



Q24 Text Solution:

Beat frequency = Number of beat /sec.
 $n = n_2 - n_1$ or $n_1 - n_2 \therefore n_1 = n_2 \pm n$

Video Solution:



Q25 Text Solution:

No. of beats heard per second = $f_A - f_B = 6$
 Frequency of the fork B = 432 Hz
 Frequency of the fork A = $432 \pm 6 = 426$ or 438
 When the fork B is filed its frequency slightly increases. Since the number of beats heard per second becomes 4, the frequency of the tuning fork A must be greater than that of B.
 Frequency of the fork A = 438 Hz

Video Solution:



Q26 Text Solution:

Sound requires a material medium for propagation Hence, velocity of sound in vacuum is Zero

Video Solution:



Q27 Text Solution:

Longitudinal waves need bulk modulus of elasticity. Therefore, they can travel in all media, i.e., solids, liquids and gases.

Video Solution:



Q28 Text Solution:

$$\frac{v_{\max}}{v} = \frac{A\omega}{(\omega/k)} = Ak$$

Video Solution:



Q29 Text Solution:

I is proportional to A^2 and f^2

$$\text{hence, } \frac{I_1}{I_2} = \left(\frac{A_1}{A_2}\right)^2 \left(\frac{f_1}{f_2}\right)^2$$

$$A_1 = A,$$

$$A_2 = 2A$$

$$f_1 = f$$

$$f_2 = f/4$$

$$\text{hence, } I_2 = I_1/4$$

Video Solution:



Q30 Text Solution:

$$V = 2v(I_2 - I_1)$$

$$= 2 \times 500(46 - 16) \text{ cm/s}$$

$$= 3000 \text{ cm/s} = 300 \text{ m/s}$$

Video Solution:



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