

Waves — NEET Physics PYQ (2005-2020)

Class 11 Physics · 32 real NEET & AIPMT questions, year-tagged · answers checked by RankUp

NEET 2020 · Q147

1. In a guitar, two strings A and B made of same material are slightly out of tune and produce beats of frequency 6 Hz. When tension in B is slightly decreased, the beat frequency increases to 7 Hz. If the frequency of A is 530 Hz, the original frequency of B will be :

- (A) 523 Hz
- (B) 524 Hz
- (C) 536 Hz
- (D) 537 Hz

NEET 2018 · Q24

2. A tuning fork is used to produce resonance in a glass tube. The length of the air column in this tube can be adjusted by a variable piston. At room temperature of 27°C two successive resonances are produced at 20 cm and 73 cm of column length. If the frequency of the tuning fork is 320 Hz, the velocity of sound in air at 27°C is

- (A) 350 m/s
- (B) 339 m/s
- (C) 330 m/s
- (D) 300 m/s

NEET 2017 · Q146

3. Two cars moving in opposite directions approach each other with speed of 22 m/s and 16.5 m/s respectively. The driver of the first car blows a horn having a frequency 400 Hz. The frequency heard by the driver of the second car is [velocity of sound 340 m/s]:

- (A) 350 Hz
- (B) 361 Hz
- (C) 411 Hz
- (D) 448 Hz

NEET 2017 (Gujarati paper) · Q159

4. Two open organ pipes of fundamental frequencies n_1 and n_2 are joined in series. The fundamental frequency of the new pipe so obtained will be:

- (A) $(n_1 + n_2)/2$
- (B) $\sqrt{(n_1^2 + n_2^2)}$
- (C) $n_1 n_2 / (n_1 + n_2)$
- (D) $(n_1 + n_2)$

NEET 2016 Phase 2 · Q21

5. The second overtone of an open organ pipe has the same frequency as the first overtone of a closed pipe L metre long. The length of the open pipe will be

- (A) L
- (B) 2L
- (C) L/2
- (D) 4L

6. A uniform rope of length L and mass m_1 hangs vertically from a rigid support. A block of mass m_2 is attached to the free end of the rope. A transverse pulse of wavelength λ_1 is produced at the lower end of the rope. The wavelength of the pulse when it reaches the top of the rope is λ_2 . The ratio λ_2/λ_1 is:

- (A) $\sqrt{(m_1/m_2)}$
- (B) $\sqrt{((m_1 + m_2)/m_2)}$
- (C) $\sqrt{(m_2/m_1)}$
- (D) $\sqrt{((m_1 + m_2)/m_1)}$

7. An air column, closed at one end and open at the other, resonates with a tuning fork when the smallest length of the column is 50 cm. The next larger length of the column resonating with the same tuning fork is:

- (A) 66.7 cm
- (B) 100 cm
- (C) 150 cm
- (D) 200 cm

8. 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) 140 cm
- (B) 80 cm
- (C) 100 cm
- (D) 120 cm

9. 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) $1/\sqrt{n} = 1/\sqrt{n_1} + 1/\sqrt{n_2} + 1/\sqrt{n_3}$
- (B) $\sqrt{n} = \sqrt{n_1} + \sqrt{n_2} + \sqrt{n_3}$
- (C) $n = n_1 + n_2 + n_3$
- (D) $1/n = 1/n_1 + 1/n_2 + 1/n_3$

10. The number of possible natural oscillations of air column in a pipe closed at one end of length 85 cm whose frequencies lie below 1250 Hz are: (velocity of sound = 340 ms^{-1})

- (A) 5
- (B) 7
- (C) 6
- (D) 4

11. A speeding motorcyclist sees traffic jam ahead of him. He slows down to 36 km/hour. He finds that traffic has eased and a car moving ahead of him at 18 km/hour is honking at a frequency of 1392 Hz. If the speed of sound is 343 m/s, the frequency of the honk as heard by him will be:

- (A) 1372 Hz
- (B) 1412 Hz
- (C) 1454 Hz
- (D) 1332 Hz

NEET 2013

12. A wave travelling in the +ve x-direction having displacement along y-direction as 1 m, wavelength 2π m and frequency of $1/\pi$ 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) $y = \sin(2\pi x + 2\pi t)$

NEET 2013

13. A source of unknown frequency gives 4 beats/s when sounded with a source of known frequency 250 Hz. The second harmonic of the source of unknown frequency gives five beats per second when sounded with a source of frequency 513 Hz. The unknown frequency is

- (A) 254 Hz
- (B) 246 Hz
- (C) 240 Hz
- (D) 260 Hz

AIPMT 2012 Mains

14. The equation of a simple harmonic wave is given by $y = 3 \sin(\pi/2)(50t - x)$, where x and y are in metres and t is in seconds. The ratio of maximum particle velocity to the wave velocity is

- (A) 2π
- (B) $(3/2)\pi$
- (C) 3π
- (D) $(2/3)\pi$

AIPMT 2012 Mains

15. A train moving at a speed of 220 m s^{-1} towards a stationary object emits a sound of frequency 1000 Hz. Some of the sound reaching the object gets reflected back to the train as echo. The frequency of the echo as detected by the driver of the train is (speed of sound in air is 330 m s^{-1})

- (A) 3500 Hz
- (B) 4000 Hz
- (C) 5000 Hz
- (D) 3000 Hz

AIPMT 2012 Prelims

16. When a string is divided into three segments of length l_1 , l_2 and l_3 , the fundamental frequencies of these three segments are ν_1 , ν_2 and ν_3 respectively. The original fundamental frequency (ν) of the string is

- (A) $1/\nu = 1/\nu_1 + 1/\nu_2 + 1/\nu_3$
- (B) $\sqrt{\nu} = \sqrt{\nu_1} + \sqrt{\nu_2} + \sqrt{\nu_3}$
- (C) $\nu = \nu_1 + \nu_2 + \nu_3$
- (D) $1/\nu = 1/\nu_1 + 1/\nu_2 + 1/\nu_3$

AIPMT 2012 Prelims

17. Two sources of sound placed close to each other are emitting progressive waves given by $y_1 = 4 \sin 600\pi t$ and $y_2 = 5 \sin 608\pi t$. An observer located near these two sources of sound will hear

- (A) 4 beats per second with intensity ratio 81 : 1 between waxing and waning
- (B) 4 beats per second with intensity ratio 25 : 16 between waxing and waning
- (C) 8 beats per second with intensity ratio 25 : 16 between waxing and waning
- (D) 8 beats per second with intensity ratio 81 : 1 between waxing and waning

AIPMT 2011 Mains

18. 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) 0.04
- (B) 0.01
- (C) 0.02
- (D) 0.03

AIPMT 2011 Prelims

19. Two waves are represented by the equations $y_1 = a \sin(\omega t + kx + 0.57)$ m and $y_2 = a \cos(\omega t + kx)$ m, where x is in metre and t in s. The phase difference between them is

- (A) 0.57 radian
- (B) 1.0 radian
- (C) 1.25 radian
- (D) 1.57 radian

AIPMT 2011 Prelims

20. Sound waves travel at 350 m/s through warm air and at 3500 m/s through brass. The wavelength of a 700 Hz acoustic wave as it enters brass from warm air

- (A) Decreases by a factor 20
- (B) Decreases by a factor 10
- (C) Increases by a factor 20
- (D) Increases by a factor 10

AIPMT 2010 Prelims · Q20

21. 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) A
- (B) $\pi A/2$
- (C) πA
- (D) $2\pi A$

AIPMT 2010 Prelims · Q21

22. A tuning fork of frequency 512 Hz makes 4 beats per second with the vibrating string of a piano. The beat frequency decreases to 2 beats per sec when the tension in the piano string is slightly increased. The frequency of the piano string before increasing the tension was

- (A) 508 Hz
- (B) 510 Hz
- (C) 514 Hz
- (D) 516 Hz

AIPMT 2009 Prelims · Q16

23. Each of the two strings of length 51.6 cm and 49.1 cm are tensioned separately by 20 N force. Mass per unit length of both the strings is same and equal to 1 g/m. When both the strings vibrate simultaneously the number of beats is:

- (A) 7
- (B) 8
- (C) 3
- (D) 5

24. 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

25. A wave in a string has an amplitude of 2 cm. The wave travels in the + ve direction of x axis with a speed of 128 m/sec. and it is noted that 5 complete waves fit in 4 m length of the string. The equation describing the wave is:

- (A) $y = (0.02) \text{ m} \sin (15.7x - 2010t)$
- (B) $y = (0.02) \text{ m} \sin (15.7x + 2010t)$
- (C) $y = (0.02) \text{ m} \sin (7.85x - 1005t)$
- (D) $y = (0.02) \text{ m} \sin (7.85x + 1005t)$

26. The wave described by $y = 0.25 \sin(10\pi x - 2\pi t)$, where x and y are in metres and t in seconds, is a wave travelling along the

- (A) –ve x direction with amplitude 0.25 m and wavelength $\lambda = 0.2 \text{ m}$
- (B) –ve x direction with frequency 1 Hz
- (C) +ve x direction with frequency $\pi \text{ Hz}$ and wavelength $\lambda = 0.2 \text{ m}$
- (D) +ve x direction with frequency 1 Hz and wavelength $\lambda = 0.2 \text{ m}$

27. 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) $\pi/6$
- (B) $\pi/3$
- (C) $2\pi/3$
- (D) π

28. Two sound waves with wavelengths 5.0 m and 5.5 m respectively, each propagate in a gas with velocity 330 m/s. We expect the following number of beats per second :

- (A) 12
- (B) 0
- (C) 3
- (D) 6

29. A transverse wave propagating along x-axis is represented by : $y(x, t) = 8.0 \sin (0.5\pi x - 4\pi t - \pi/4)$

where x is in metres and t is in seconds. The speed of the wave is :

- (A) $8\pi \text{ m/s}$
- (B) $0.5\pi \text{ m/s}$
- (C) $\pi/4 \text{ m/s}$
- (D) 8 m/s

30. Which one of the following statements is true ?

- (A) Both light and sound waves in air are transverse
- (B) The sound waves in air are longitudinal while the light waves are transverse
- (C) Both light and sound waves in air are longitudinal
- (D) Both light and sound waves can travel in vacuum

31. A point source emits sound equally in all directions in a non-absorbing medium. Two points P and Q are at distance of 2m and 3m respectively from the source. The ratio of the intensities of the waves at P and Q is :

- (A) 9 : 4
- (B) 2 : 9
- (C) 9 : 2
- (D) 4 : 9

32. Two vibrating tuning forks produce progressive waves given by $y_1 = 4 \sin 500\pi t$ and $y_2 = 2 \sin 506\pi t$. Number of beats produced per minute is :

- (A) 360
- (B) 180
- (C) 120
- (D) 30

Answer key and explanations

1. Answer: (B) 524 Hz

With 6 Hz beats, B is 524 Hz or 536 Hz. Lowering tension lowers B's frequency ($f \propto \sqrt{T}$); the beat frequency rises only if B moves further from 530 Hz, so B must start below A at 524 Hz. Had B been 536 Hz, lowering it would bring it closer to 530 Hz and reduce the beats.

2. Answer: (B) 339 m/s

Successive resonance lengths differ by $\lambda/2$: $73 - 20 = 53$ cm, so $\lambda = 1.06$ m. $v = f\lambda = 320 \times 1.06 \approx 339$ m/s. Using 4×20 cm (ignoring end correction) would give a wrong value.

3. Answer: (D) 448 Hz

Source and observer approach each other, so $f' = f(v + v_o)/(v - v_s) = 400 \times (340 + 16.5)/(340 - 22) = 400 \times 356.5/318 \approx 448$ Hz. The heard frequency must be higher than 400 Hz, which rules out 350 Hz and 361 Hz.

4. Answer: (C) $n_1 n_2 / (n_1 + n_2)$

For an open pipe $n = v/2L$, so $L_1 = v/2n_1$ and $L_2 = v/2n_2$. The joined pipe has length $L_1 + L_2$, so $n = v/2(L_1 + L_2)$ and $1/n = 1/n_1 + 1/n_2$, giving $n = n_1 n_2 / (n_1 + n_2)$. A longer pipe must have a lower frequency, so $n_1 + n_2$ cannot be right.

5. Answer: (B) 2L

The first overtone of a closed pipe is $3v/(4L)$. The second overtone of an open pipe of length L' is the third harmonic $3v/(2L')$. Equating, $2L' = 4L$, so $L' = 2L$. Treating the second overtone as the second harmonic would give a different length.

6. Answer: (B) $\sqrt{((m_1 + m_2)/m_2)}$

Frequency stays the same, so $\lambda \propto v \propto \sqrt{T}$. Tension at the bottom is $m_2 g$ and at the top is $(m_1 + m_2)g$, so $\lambda_2/\lambda_1 = \sqrt{((m_1 + m_2)/m_2)}$. Putting m_1 in the denominator would wrongly use the rope's own weight as the bottom tension.

7. Answer: (C) 150 cm

For a closed pipe resonating with a fixed fork, resonant lengths are $\lambda/4, 3\lambda/4, 5\lambda/4, \dots$. The first is 50 cm, so the next is $3 \times 50 = 150$ cm. 100 cm would be the next length for a pipe open at both ends.

8. Answer: (D) 120 cm

Closed pipe fundamental = $v/(4 \times 20 \text{ cm}) = v/80$. Second overtone of an open pipe is the third harmonic, $3v/(2L)$. Equating, $3v/(2L) = v/80$ gives $L = 120$ cm. Taking second overtone as the second harmonic gives 80 cm.

9. Answer: (D) $1/n = 1/n_1 + 1/n_2 + 1/n_3$

At fixed tension and linear density the fundamental frequency is $n = (1/2l)\sqrt{T/\mu}$, so $l \propto 1/n$. Since the segment lengths add up to the whole length, $1/n = 1/n_1 + 1/n_2 + 1/n_3$; simply adding the frequencies would wrongly treat $n \propto l$.

10. Answer: (C) 6

For a closed pipe the fundamental is $v/4L = 340/(4 \times 0.85) = 100$ Hz and only odd harmonics exist: 100, 300, 500, 700, 900, 1100 Hz. That makes 6 below 1250 Hz; counting all harmonics would wrongly give more.

11. Answer: (B) 1412 Hz

Motorcyclist (10 m/s) moves towards the car, and the car (5 m/s, the source) moves away from him. $f' = 1392 \times (343 + 10)/(343 - 5) = 1392 \times 353/348 = 1412$ Hz.

12. Answer: (A) $y = \sin(x - 2t)$

$k = 2\pi/\lambda = 2\pi/2\pi = 1 \text{ m}^{-1}$ and $\omega = 2\pi f = 2\pi \times (1/\pi) = 2 \text{ rad s}^{-1}$, amplitude 1 m. A wave along $+x$ is $y = A \sin(kx - \omega t) = \sin(x - 2t)$. A plus sign between the terms would describe a wave moving along $-x$.

13. Answer: (A) 254 Hz

4 beats with 250 Hz means $f = 254$ Hz or 246 Hz. Second harmonics are 508 Hz or 492 Hz; only 508 Hz gives $513 - 508 = 5$ beats per second. So $f = 254$ Hz; 246 Hz would give 21 beats.

14. Answer: (B) $(3/2)\pi$

$y = 3 \sin(25\pi t - \pi x/2)$, so $A = 3$ m, $\omega = 25\pi \text{ rad/s}$, $k = \pi/2 \text{ m}^{-1}$. Wave speed $= \omega/k = 50$ m/s and maximum particle speed $= A\omega = 75\pi$ m/s, giving a ratio of $75\pi/50 = 3\pi/2$.

15. Answer: (C) 5000 Hz

The object receives $f_1 = f \cdot v/(v - u)$ and reflects it; the moving driver then hears $f_2 = f_1(v + u)/v = f(v + u)/(v - u) = 1000 \times 550/110 = 5000$ Hz. Treating only one Doppler shift gives 3000 Hz, which is wrong.

16. Answer: (D) $1/v = 1/v_1 + 1/v_2 + 1/v_3$

For the same string (same tension and linear density) the fundamental frequency $v = v/(2l)$ is inversely proportional to length. Since $l = l_1 + l_2 + l_3$, $1/v = 1/v_1 + 1/v_2 + 1/v_3$. Adding frequencies directly would wrongly treat v as proportional to length.

17. Answer: (A) 4 beats per second with intensity ratio 81 : 1 between waxing and waning

$\omega_1 = 600\pi$ gives $f_1 = 300$ Hz and $\omega_2 = 608\pi$ gives $f_2 = 304$ Hz, so beat frequency $= 4$ per second. Intensity ratio $I_{\text{max}}/I_{\text{min}} = (A_1 + A_2)^2/(A_1 - A_2)^2 = 9^2/1^2 = 81 : 1$. 25 : 16 is just the ratio of individual intensities, and 8 beats comes from using $\omega/2\pi$ wrongly.

18. Answer: (C) 0.02

$f \propto \sqrt{T}$, so $\Delta f/f = \frac{1}{2} \Delta T/T$. Six beats means $\Delta f = 6$ Hz, so $6/600 = \frac{1}{2} \Delta T/T$ and $\Delta T/T = 0.02$. Forgetting the square-root dependence gives 0.01.

19. Answer: (B) 1.0 radian

Write $y_2 = a \cos(\omega t + kx) = a \sin(\omega t + kx + \pi/2)$. The phase difference is $\pi/2 - 0.57 = 1.57 - 0.57 = 1.0$ radian. 1.57 rad would be the phase of the cosine wave alone, ignoring the 0.57 in the first wave.

20. Answer: (D) Increases by a factor 10

Frequency is unchanged when a wave enters a new medium, so $\lambda = v/f$ is proportional to speed. λ goes from $350/700 = 0.5$ m to $3500/700 = 5$ m, an increase by a factor of 10. It increases, not decreases, because sound is faster in brass.

21. Answer: (D) $2\pi A$

Wave speed ω/k equals the maximum particle speed $A\omega$ when $1/k = A$, i.e. $\lambda/(2\pi) = A$, so $\lambda = 2\pi A$. Choosing πA drops the factor 2 in $k = 2\pi/\lambda$.

22. Answer: (A) 508 Hz

The string frequency is 512 ± 4 , i.e. 508 or 516 Hz. Increasing tension raises the string's frequency; the beats fall to 2, so the frequency moved towards 512, meaning it was below: 508 Hz. If it were 516 Hz, raising it would increase the beats to more than 4.

23. Answer: (A) 7

Wave speed $v = \sqrt{T/\mu} = \sqrt{(20/10^{-3})} \approx 141.4$ m/s. Fundamentals: $f = v/2l$ gives $141.4/1.032 \approx 137.0$ Hz and $141.4/0.982 \approx 144.0$ Hz. Beat frequency $= 144 - 137 = 7$ per second.

24. Answer: (B) 720 Hz

The hill receives $f_1 = 600 \times 330/(330 - 30)$ from the approaching car and reflects it; the driver, moving towards the hill, hears $f = f_1 \times (330 + 30)/330 = 600 \times 360/300 = 720$ Hz. The reflected sound is heard at a higher, not lower, frequency.

25. Answer: (C) $y = (0.02) \sin(7.85x - 1005t)$

$\lambda = 4/5 = 0.8$ m, so $k = 2\pi/0.8 \approx 7.85 \text{ m}^{-1}$ and $\omega = kv = 7.85 \times 128 \approx 1005 \text{ s}^{-1}$. A wave moving towards $+x$ has the form $\sin(kx - \omega t)$, so $y = 0.02 \sin(7.85x - 1005t)$; the '+' form travels towards $-x$ and 15.7 uses $\lambda = 0.4$ m.

26. Answer: (D) +ve x direction with frequency 1 Hz and wavelength $\lambda = 0.2$ m

Compare with $y = A \sin(kx - \omega t)$: $k = 10\pi$ gives $\lambda = 2\pi/k = 0.2$ m, and $\omega = 2\pi$ gives $f = 1$ Hz. The minus sign between the kx and ωt terms means the wave moves along $+x$. Reading $\omega = 2\pi$ as 'frequency π Hz' confuses ω with $2\pi f$.

27. Answer: (C) $2\pi/3$

Wavelength $\lambda = vT = 300 \times 0.05 = 15$ m. Path difference $= 15 - 10 = 5$ m, so phase difference $= (2\pi/\lambda) \times 5 = 2\pi/3$. Using $\lambda = 5$ m by mistake would give 2π , not one of the options.

28. Answer: (D) 6

The frequencies are $330/5.0 = 66$ Hz and $330/5.5 = 60$ Hz. The beat frequency is the difference, $66 - 60 = 6$ per second. Adding or halving these does not give the beat count.

29. Answer: (D) 8 m/s

Comparing with $y = A \sin(kx - \omega t + \phi)$, $k = 0.5\pi \text{ rad/m}$ and $\omega = 4\pi \text{ rad/s}$. The wave speed is $v = \omega/k = 4\pi/0.5\pi = 8 \text{ m/s}$. The value $8\pi \text{ m/s}$ comes from mixing the amplitude with ω and is wrong.

30. Answer: (B) The sound waves in air are longitudinal while the light waves are transverse

Sound in air travels as compressions and rarefactions, so it is longitudinal; light is an electromagnetic wave with transverse fields. Light can travel through vacuum but sound needs a material medium, so the statement that both travel in vacuum is false.

31. Answer: (A) 9 : 4

A point source spreads energy over a sphere, so $I \propto 1/r^2$. $I_P/I_Q = (3/2)^2 = 9/4$, i.e. 9 : 4. Writing 4 : 9 inverts the ratio by taking $I \propto r^2$.

32. Answer: (B) 180

$\omega_1 = 500\pi$ gives $f_1 = 250$ Hz and $\omega_2 = 506\pi$ gives $f_2 = 253$ Hz. Beat frequency $= 3$ per second $= 180$ per minute. 360 per minute would double the true beat frequency of 3 Hz.

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