

PHYSICS · JEE MAIN

Mechanical Waves

Chapter-wise previous year questions, with answer key

43

PYQS

2020–2025

PAPERS

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TOPICS

Superposition and Interference

Wave Equation and Speed

Standing Waves in Strings

Standing Waves in Organ Pipes

- 1 Attempt each question on paper first — they're grouped by topic, newest papers first.
- 2 Check yourself against the answer key at the end.
- 3 Got one wrong? Tap “Step-by-step solution” under it for the full working.

Stuck on a question?

Every question has a free step-by-step solution on PrepWiser — tap “Step-by-step solution” under it.

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Superposition and Interference · 3 PYQs

Q1 JEE Main 2023 · 31 Jan · Shift 2

The displacement equations of two interfering waves are given by

$$y_1 = 10 \sin \left(\omega t + \frac{\pi}{3} \right) \text{ cm}, y_2 = 5 [\sin \omega t + \sqrt{3} \cos \omega t] \text{ cm} \text{ respectively.}$$

The amplitude of the resultant wave is _____ cm.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/XzvHJTA4mz](https://www.prepwiser.in/questions/XzvHJTA4mz)

Q2 JEE Main 2022 · 24 Jun · Shift 1

The equations of two waves are given by :

$$y_1 = 5 \sin 2\pi(x - vt) \text{ cm}$$

$$y_2 = 3 \sin 2\pi(x - vt + 1.5) \text{ cm}$$

These waves are simultaneously passing through a string. The amplitude of the resulting wave is :

(A) 2 cm

(B) 4 cm

(C) 5.8 cm

(D) 8 cm

[Step-by-step solution ► prepwiser.in/questions/t5eZMNOG7x](https://www.prepwiser.in/questions/t5eZMNOG7x)

Q3 JEE Main 2021 · 26 Aug · Shift 2

Two waves are simultaneously passing through a string and their equations are :

$y_1 = A_1 \sin k(x - vt)$, $y_2 = A_2 \sin k(x - vt + x_0)$. Given amplitudes $A_1 = 12 \text{ mm}$ and $A_2 = 5 \text{ mm}$, $x_0 = 3.5 \text{ cm}$ and wave number $k = 6.28 \text{ cm}^{-1}$. The amplitude of resulting wave will be mm.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/KIc-Xqt6F4](https://www.prepwiser.in/questions/KIc-Xqt6F4)

Wave Equation and Speed · 20 PYQs

Q4 JEE Main 2025 · 8 Apr · Shift 2

Two strings with circular cross section and made of same material, are stretched to have same amount of tension. A transverse wave is then made to pass through both the strings. The velocity of the wave in the first string having the radius of cross section R is v_1 , and that in the other string having radius of cross section $R/2$ is v_2 . Then $\frac{v_2}{v_1} =$

(A) 8

(B) 4

(C) 2

(D) $\sqrt{2}$

[Step-by-step solution ► prepwiser.in/questions/TJuvFwEm-K](https://www.prepwiser.in/questions/TJuvFwEm-K)

Q5 JEE Main 2025 · 7 Apr · Shift 2

The equation of a wave travelling on a string is $y = \sin[20\pi x + 10\pi t]$, where x and t are distance and time in SI units. The minimum distance between two points having the same oscillating speed is :

- (A) 10 cm
- (B) 2.5 cm
- (C) 20 cm
- (D) 5.0 cm

Step-by-step solution ► [prepwiser.in/questions/vsYdryskBH](https://www.prepwiser.in/questions/vsYdryskBH)

Q6 JEE Main 2025 · 4 Apr · Shift 2

Displacement of a wave is expressed as $x(t) = 5 \cos(628t + \frac{\pi}{2})$ m. The wavelength of the wave when its velocity is 300m/s is :

($\pi = 3.14$)

- | | |
|------------|-----------|
| (A) 0.33 m | (B) 0.5 m |
| (C) 3 m | (D) 5 m |

Step-by-step solution ► [prepwiser.in/questions/2KGpygI7-X](https://www.prepwiser.in/questions/2KGpygI7-X)

Q7 JEE Main 2025 · 2 Apr · Shift 2

A sinusoidal wave of wavelength 7.5 cm travels a distance of 1.2 cm along the x -direction in 0.3 sec . The crest P is at $x = 0$ at $t = 0$ sec and maximum displacement of the wave is 2 cm . Which equation correctly represents this wave?

- (A) $y = 2 \cos(0.83x - 3.35t)$ cm
- (B) $y = 2 \sin(0.83x - 3.5t)$ cm
- (C) $y = 2 \cos(0.13x - 0.5t)$ cm
- (D) $y = 2 \cos(3.35x - 0.83t)$ cm

Step-by-step solution ► [prepwiser.in/questions/J7T9--YwPZ](https://www.prepwiser.in/questions/J7T9--YwPZ)

Q8 JEE Main 2025 · 23 Jan · Shift 2

The equation of a transverse wave travelling along a string is $y(x, t) = 4.0 \sin [20 \times 10^{-3}x + 600t]$ mm, where x is in mm and t is in second. The velocity of the wave is :

- | | |
|---------------------|---------------------|
| (A) -60m/s | (B) $+60\text{m/s}$ |
| (C) $+30\text{m/s}$ | (D) -30m/s |

Step-by-step solution ► [prepwiser.in/questions/hR_xrBI7Iv](https://www.prepwiser.in/questions/hR_xrBI7Iv)

Q9 JEE Main 2023 · 11 Apr · Shift 1

The equation of wave is given by

$$Y = 10^{-2} \sin 2\pi(160t - 0.5x + \pi/4)$$

where x and Y are in m and t in s. The speed of the wave is _____ kmh^{-1} .

Numerical answer — enter the value.

Step-by-step solution ► [prepwiser.in/questions/UuHgRjyM9G](https://www.prepwiser.in/questions/UuHgRjyM9G)

Q10 JEE Main 2023 · 10 Apr · Shift 1

A transverse harmonic wave on a string is given by

$$y(x, t) = 5 \sin(6t + 0.003x)$$

where x and y are in cm and t in sec. The wave velocity is _____ ms^{-1} .

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/sYDiAqwwP7](https://www.prepwiser.in/questions/sYDiAqwwP7)

Q11 JEE Main 2023 · 1 Feb · Shift 1

A steel wire with mass per unit length $7.0 \times 10^{-3} \text{kgm}^{-1}$ is under tension of 70N. The speed of transverse waves in the wire will be:

(A) 10m/s

(B) 50m/s

(C) 100m/s

(D) $200\pi \text{m/s}$

[Step-by-step solution ► prepwiser.in/questions/a7L9fBP30e](https://www.prepwiser.in/questions/a7L9fBP30e)

Q12 JEE Main 2023 · 24 Jan · Shift 1

A travelling wave is described by the equation

$$y(x, t) = [0.05 \sin(8x - 4t)] \text{ m}$$

The velocity of the wave is : [all the quantities are in SI unit]

(A) 4ms^{-1}

(B) 2ms^{-1}

(C) 8ms^{-1}

(D) 0.5ms^{-1}

[Step-by-step solution ► prepwiser.in/questions/axUwxVSJkh](https://www.prepwiser.in/questions/axUwxVSJkh)

Q13 JEE Main 2022 · 28 Jul · Shift 1

In the wave equation

$$y = 0.5 \sin \frac{2\pi}{\lambda} (400t - x) \text{ m}$$

the velocity of the wave will be:

(A) 200 m/s

(B) $200\sqrt{2} \text{ m/s}$

(C) 400 m/s

(D) $400\sqrt{2} \text{ m/s}$

[Step-by-step solution ► prepwiser.in/questions/JkWfbPS8aG](https://www.prepwiser.in/questions/JkWfbPS8aG)

Q14 JEE Main 2022 · 26 Jul · Shift 2

A transverse wave is represented by $y = 2 \sin(\omega t - kx) \text{ cm}$. The value of wavelength (in cm) for which the wave velocity becomes equal to the maximum particle velocity, will be :

(A) 4π

(B) 2π

(C) π

(D) 2

[Step-by-step solution ► prepwiser.in/questions/muFzmEt6yo](https://www.prepwiser.in/questions/muFzmEt6yo)

Q15 JEE Main 2022 · 30 Jun · Shift 1

Which of the following equations correctly represents a travelling wave having wavelength $\lambda = 4.0$ cm, frequency $\nu = 100$ Hz and travelling in positive x-axis direction?

(A) $y = A \sin[(0.50 \pi \text{ cm}^{-1})x - (100 \pi \text{ s}^{-1})t]$

(B) $y = A \sin 2\pi[(0.25 \text{ cm}^{-1})x - (50 \text{ s}^{-1})t]$

(C) $y = A \sin \left[\left(\frac{2\pi}{4} \text{ cm}^{-1} \right) x - \left(\frac{2\pi}{100} \text{ s}^{-1} \right) t \right]$

(D) $y = A \sin \pi[(0.5 \text{ cm}^{-1})x - (200 \text{ s}^{-1})t]$

Step-by-step solution ► [prepwisar.in/questions/QeZuCHEWIy](https://www.prepwisar.in/questions/QeZuCHEWIy)

Q16 JEE Main 2022 · 29 Jun · Shift 1

A longitudinal wave is represented by $x = 10 \sin 2\pi \left(nt - \frac{x}{\lambda} \right)$ cm. The maximum particle velocity will be four times the wave velocity if the determined value of wavelength is equal to :

(A) 2π

(B) 5π

(C) π

(D) $\frac{5\pi}{2}$

Step-by-step solution ► [prepwisar.in/questions/Uh_EIK2Bqz](https://www.prepwisar.in/questions/Uh_EIK2Bqz)

Q17 JEE Main 2021 · 20 Jul · Shift 1

The amplitude of wave disturbance propagating in the positive x-direction is given by $y = \frac{1}{(1+x)^2}$ at time $t = 0$ and $y = \frac{1}{1+(x-2)^2}$ at $t = 1$ s, where x and y are in metres. The shape of wave does not change during the propagation. The velocity of the wave will be _____ m/s.

Numerical answer — enter the value.

Step-by-step solution ► [prepwisar.in/questions/M3sTvnsxDs](https://www.prepwisar.in/questions/M3sTvnsxDs)

Q18 JEE Main 2021 · 26 Feb · Shift 1

The mass per unit length of a uniform wire is 0.135 g/cm. A transverse wave of the form $y = -0.21 \sin(x + 30t)$ is produced in it, where x is in meter and t is in second. Then, the expected value of tension in the wire is $x \times 10^{-2}$ N. Value of x is _____. (Round off to the nearest integer)

Numerical answer — enter the value.

Step-by-step solution ► [prepwisar.in/questions/vOIL9ubDUy](https://www.prepwisar.in/questions/vOIL9ubDUy)

Q19 JEE Main 2021 · 25 Feb · Shift 2

The percentage increase in the speed of transverse waves produced in a stretched string if the tension is increased by 4%, will be _____%.

Numerical answer — enter the value.

Step-by-step solution ► [prepwisar.in/questions/rBWBf9sqj](https://www.prepwisar.in/questions/rBWBf9sqj)

Q20 JEE Main 2021 · 24 Feb · Shift 2

Which of the following equations represents a travelling wave?

(A) $y = Ae^x \cos(\omega t - \theta)$

(B) $y = Ae^{-x^2}(vt + \theta)$

(C) $y = A \sin(15x - 2t)$

(D) $y = A \sin x \cos \omega t$

[Step-by-step solution ► prepwiser.in/questions/fSQm2PzCjQ](https://www.prepwiser.in/questions/fSQm2PzCjQ)

Q21 JEE Main 2020 · 4 Sep · Shift 1

For a transverse wave travelling along a straight line, the distance between two peaks (crests) is 5 m, while the distance between one crest and one trough is 1.5 m. The possible wavelengths (in m) of the are :

(A) 1, 3, 5,

(B) $\frac{1}{1}, \frac{1}{3}, \frac{1}{5}, \dots$

(C) 1, 2, 3,

(D) $\frac{1}{2}, \frac{1}{4}, \frac{1}{6}, \dots$

[Step-by-step solution ► prepwiser.in/questions/6aPWOSIY-g](https://www.prepwiser.in/questions/6aPWOSIY-g)

Q22 JEE Main 2020 · 2 Sep · Shift 1

Two identical strings X and Z made of same material have tension T_X and T_Z in them. If their fundamental frequencies are 450 Hz and 300 Hz, respectively, then the ratio T_X/T_Z is

(A) 2.25

(B) 0.44

(C) 1.25

(D) 1.5

[Step-by-step solution ► prepwiser.in/questions/B2BVn-nZvQ](https://www.prepwiser.in/questions/B2BVn-nZvQ)

Q23 JEE Main 2020 · 8 Jan · Shift 2

A transverse wave travels on a taut steel wire with a velocity of v when tension in it is 2.06×10^4 N. When the tension is changed to T , the velocity changed to $v/2$. The value of T is close to :

(A) 30.5×10^4 N

(B) 2.50×10^4 N

(C) 10.2×10^2 N

(D) 5.15×10^3 N

[Step-by-step solution ► prepwiser.in/questions/HTZnFa2j-6](https://www.prepwiser.in/questions/HTZnFa2j-6)

Standing Waves in Strings · 11 PYQs

Q24 JEE Main 2024 · 5 Apr · Shift 2

A sonometer wire of resonating length 90cm has a fundamental frequency of 400Hz when kept under some tension. The resonating length of the wire with fundamental frequency of 600Hz under same tension _____ cm.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/8fYgqzNfD2](https://www.prepwiser.in/questions/8fYgqzNfD2)

Q25 JEE Main 2023 · 15 Apr · Shift 1

The fundamental frequency of vibration of a string stretched between two rigid support is 50Hz. The mass of the string is 18g and its linear mass density is 20g/m. The speed of the transverse waves so produced in the string is _____ ms^{-1}

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/UvrV8tl7tj](https://www.prepwiser.in/questions/UvrV8tl7tj)

Q26 JEE Main 2023 · 13 Apr · Shift 2

In an experiment with sonometer when a mass of 180g is attached to the string, it vibrates with fundamental frequency of 30Hz. When a mass m is attached, the string vibrates with fundamental frequency of 50Hz. The value of m is _____ g.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/VtXE2TiTzS](https://www.prepwiser.in/questions/VtXE2TiTzS)

Q27 JEE Main 2023 · 11 Apr · Shift 2

A wire of density $8 \times 10^3 \text{kg/m}^3$ is stretched between two clamps 0.5m apart. The extension developed in the wire is $3.2 \times 10^{-4} \text{m}$. If $Y = 8 \times 10^{10} \text{N/m}^2$, the fundamental frequency of vibration in the wire will be _____ Hz.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/Ji6D15W8vG](https://www.prepwiser.in/questions/Ji6D15W8vG)

Q28 JEE Main 2023 · 8 Apr · Shift 2

A guitar string of length 90 cm vibrates with a fundamental frequency of 120 Hz. The length of the string producing a fundamental frequency of 180 Hz will be _____ cm.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/DsxOrOAKg8](https://www.prepwiser.in/questions/DsxOrOAKg8)

Q29 JEE Main 2022 · 27 Jul · Shift 2

A wire of length 30 cm, stretched between rigid supports, has its n^{th} and $(n + 1)^{\text{th}}$ harmonics at 400 Hz and 450 Hz, respectively. If tension in the string is 2700 N, its linear mass density is _____ kg/m.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/UI8MH_nRs2](https://www.prepwiser.in/questions/UI8MH_nRs2)

Q30 JEE Main 2022 · 24 Jun · Shift 2

Two travelling waves of equal amplitudes and equal frequencies move in opposite directions along a string. They interfere to produce a stationary wave whose equation is given by $y = (10 \cos \pi x \sin \frac{2\pi t}{T})$ cm. The amplitude of the particle at $x = \frac{4}{3}$ cm will be _____ cm.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/QXLRWEBNu2](https://www.prepwiser.in/questions/QXLRWEBNu2)

Q31 JEE Main 2021 · 31 Aug · Shift 1

A wire having a linear mass density $9.0 \times 10^{-4} \text{kg/m}$ is stretched between two rigid supports with a tension of 900 N. The wire resonates at a frequency of 500 Hz. The next higher frequency at which the same wire resonates is 550 Hz. The length of the wire is _____ m.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/3iyOjt1hxW](https://www.prepwiser.in/questions/3iyOjt1hxW)

Q32 JEE Main 2021 · 26 Aug · Shift 1

Two travelling waves produces a standing wave represented by equation,

$$y = 1.0 \text{ mm} \cos(1.57 \text{ cm}^{-1})x \sin(78.5 \text{ s}^{-1})t.$$

The node closest to the origin in the region $x > 0$ will be at $x = \dots\dots\dots$ cm.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/ZXZU85zPBm](https://www.prepwiser.in/questions/ZXZU85zPBm)

Q33 JEE Main 2020 · 2 Sep · Shift 2

A wire of density $9 \times 10^{-3} \text{ kg cm}^{-3}$ is stretched between two clamps 1 m apart. The resulting strain in the wire is 4.9×10^{-4} . The lowest frequency of the transverse vibrations in the wire is : (Young's modulus of wire $Y = 9 \times 10^{10} \text{ Nm}^{-2}$), (to the nearest integer), _____

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/pkkMt3jfdj](https://www.prepwiser.in/questions/pkkMt3jfdj)

Q34 JEE Main 2020 · 9 Jan · Shift 2

A wire of length L and mass per unit length $6.0 \times 10^{-3} \text{ kgm}^{-1}$ is put under tension of 540 N. Two consecutive frequencies that it resonates at are : 420 Hz and 490 Hz. Then L in meters is :

- | | |
|-----------|-----------|
| (A) 5.1 m | (B) 2.1 m |
| (C) 1.1 m | (D) 8.1 m |

[Step-by-step solution ► prepwiser.in/questions/17cG-Gs42E](https://www.prepwiser.in/questions/17cG-Gs42E)

Standing Waves in Organ Pipes · 9 PYQs

Q35 JEE Main 2025 · 22 Jan · Shift 1

A closed organ and an open organ tube are filled by two different gases having same bulk modulus but different densities ρ_1 and ρ_2 , respectively. The frequency of 9th harmonic of closed tube is identical with 4th harmonic of open tube. If the length of the closed tube is 10 cm and the density ratio of the gases is $\rho_1 : \rho_2 = 1 : 16$, then the length of the open tube is :

- | | |
|-------------------------------|-------------------------------|
| (A) $\frac{15}{7} \text{ cm}$ | (B) $\frac{20}{9} \text{ cm}$ |
| (C) $\frac{20}{7} \text{ cm}$ | (D) $\frac{15}{9} \text{ cm}$ |

[Step-by-step solution ► prepwiser.in/questions/UTIM7WUXfA](https://www.prepwiser.in/questions/UTIM7WUXfA)

Q36 JEE Main 2024 · 8 Apr · Shift 1

A closed and an open organ pipe have same lengths. If the ratio of frequencies of their seventh overtones is $\left(\frac{a-1}{a}\right)$ then the value of a is _____.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/XNAon6tfEI](https://www.prepwiser.in/questions/XNAon6tfEI)

Q37 JEE Main 2024 · 6 Apr · Shift 2

Two open organ pipes of lengths 60cm and 90cm resonate at 6th and 5th harmonics respectively. The difference of frequencies for the given modes is _____ Hz. (Velocity of sound in air = 333m/s)

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/onuBL8eHdN](https://www.prepwiser.in/questions/onuBL8eHdN)

Q38 JEE Main 2024 · 30 Jan · Shift 1

In a closed organ pipe, the frequency of fundamental note is 30Hz. A certain amount of water is now poured in the organ pipe so that the fundamental frequency is increased to 110Hz. If the organ pipe has a cross-sectional area of 2cm², the amount of water poured in the organ tube is _____ g. (Take speed of sound in air is 330m/s)

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/cXaMqH86Ad](https://www.prepwiser.in/questions/cXaMqH86Ad)

Q39 JEE Main 2023 · 12 Apr · Shift 1

For a certain organ pipe, the first three resonance frequencies are in the ratio of 1 : 3 : 5 respectively. If the frequency of fifth harmonic is 405Hz and the speed of sound in air is 324ms⁻¹ the length of the organ pipe is _____ m.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/KW3J8UI0kC](https://www.prepwiser.in/questions/KW3J8UI0kC)

Q40 JEE Main 2023 · 8 Apr · Shift 1

An organ pipe 40cm long is open at both ends. The speed of sound in air is 360ms⁻¹. The frequency of the second harmonic is _____ Hz.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/K4pMCjuxjR](https://www.prepwiser.in/questions/K4pMCjuxjR)

Q41 JEE Main 2022 · 25 Jun · Shift 1

The first overtone frequency of an open organ pipe is equal to the fundamental frequency of a closed organ pipe. If the length of the closed organ pipe is 20 cm. The length of the open organ pipe is _____ cm.

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/8S6h79Qlfd](https://www.prepwiser.in/questions/8S6h79Qlfd)

Q42 JEE Main 2021 · 16 Mar · Shift 2

A closed organ pipe of length L and an open organ pipe contain gases of densities ρ_1 and ρ_2 respectively. The compressibility of gases are equal in both the pipes. Both the pipes are vibrating in their first overtone with same frequency. The length of the open pipe is $\frac{x}{3}L\sqrt{\frac{\rho_1}{\rho_2}}$ where x is _____. (Round off to the Nearest Integer)

Numerical answer — enter the value.

[Step-by-step solution ► prepwiser.in/questions/bReKlyQcY1](https://www.prepwiser.in/questions/bReKlyQcY1)

Q43 JEE Main 2020 · 8 Jan · Shift 1

A one metre long (both ends open) organ pipe is kept in a gas that has double the density of air at STP. Assuming the speed of sound in air at STP is 300 m/s, the frequency difference between the fundamental and second harmonic of this pipe is _____ Hz.

Numerical answer — enter the value.

Step-by-step solution ► prepwiser.in/questions/7_aqTd2KtN

Answer key — Mechanical Waves

Numbers match the question numbers above. For full working, open the solution link under each question.

1	20	2	A	3	7	4	C	5	D	6	C	7	A	8	D
9	1152	10	20	11	C	12	D	13	C	14	A	15	D	16	B
17	2	18	1215	19	2	20	C	21	B	22	A	23	D	24	60
25	90	26	500	27	80	28	60	29	3	30	5	31	10	32	1
33	35	34	B	35	B	36	16	37	740	38	400	39	1	40	900
41	80	42	4	43	105										

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