Oscillations And Waves JEE Main PYQ - 2

Total Time: 25 Minute **Total Marks:** 40

Instructions

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1. Test will auto submit when the Time is up.
2. The Test comprises of multiple choice questions (MCQ) with one or more correct answers.
3. The clock in the top right corner will display the remaining time available for you to complete the examination.

Navigating & Answering a Question

1. The answer will be saved automatically upon clicking on an option amongst the given choices of answer.
2. To deselect your chosen answer, click on the clear response button.
3. The marking scheme will be displayed for each question on the top right corner of the test window.

Oscillations And Waves

1. A train is moving on a straight track with speed $20\,ms^{-1}$. It is blowing its whistle at the frequency of $1000\,Hz$. The percentage change in the frequency heard by a person standing near the track as the train passes him is close to (speed of sound $= 320\,ms^{-1}$) **(+4, -1)**

[2015]

a. 12%

b. 6%

c. 18%

d. 24%

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2. A transverse wave is represented by : $y = \frac{10}{\pi}\sin\left(\frac{2\pi}{T}t - \frac{2\pi}{\lambda}x\right)$ For what value of the wavelength the wave velocity is twice the maximum particle velocity ? **(+4, -1)**

[26-Jul-2022-Shift-2]

a. 40 cm

b. 20 cm

c. 10 cm

d. 60 cm

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3. A travelling harmonic wave is represented by the equation $y(x,t) = 10^{-3}sin(50t + 2x)$, where x and y are in meter and t is in seconds. Which of the following is a correct statement about the wave? The wave is propagating along the **(+4, -1)**

[12 Jan. 2019 I]

a. negative x-axis with speed $25\,ms^{-1}$

b. The wave is propagating along the positive x-axis with speed $25\,ms^{-1}$

c. The wave is propagating along the positive x-axis with speed $100\,ms^{-1}$

d. The wave is propagating along the negative x-axis with speed $100\,ms^{-1}$

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4. A tuning fork of frequency $480\,Hz$ is used in an experiment for measuring speed of sound (n) in air by resonance tube method. Resonance is observed to occur at two successive lengths of the air column, l_1 = 30 cm and l_2 = $70\,cm$. Then, v is equal to : **(+4, -1)**

[12 April 2019 (II)]

a. $332\,ms^{-1}$

b. $379\,ms^{-1}$

c. $384\,ms^{-1}$

d. $338\,ms^{-1}$

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5. A tuning fork vibrates with frequency $256\,Hz$ and gives one beat per second with the third normal mode of vibration of an open pipe. What is the length of the pipe ? (Speed of sound in air is $340\,ms^{-1}$) **(+4, -1)**

[Online April 15, 2018]

a. 220 cm

b. 190 cm

c. 180 cm

d. 200 cm

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6. 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 : **(+4, -1)**

[Online April 9, 2013]

a. 32 m/s

b. 27.5 m/s

c. 60 m/s

d. 30 m/s

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7. Equation of travelling wave on a stretched string of linear density $5\,g/m$ is $y = 0.03\,sin(450\,t - 9x)$ where distance and time are measured is SI units. The **(+4, -1)**

[11 Jan 2019 (I)]

tension in the string is :

a. 10 N

b. 12.5 N

c. 7.5 N

d. 5 N

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8. A granite rod of $60\,cm$ length is clamped at its middle point and is set into longitudinal vibrations. The density of granite is $2.7 \times 10^3\,kg/m^3$ and its Young's modules is $9.27 \times 10^{10}\,Pa$. What will be the fundamental frequency of the longitudinal vibrations ? **(+4, -1)**

[2018]

a. 5 kHz

b. 2.5 kHz

c. 10 kHz

d. 7.5 kHz

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9. The distance between two consecutive points with phase difference of 60° in a wave of frequency $500\,Hz$ is $60\,m$ The velocity with which wave is traveling is ___ km/s **(+4, -1)**

[25-Jan-2023 Shift 1]

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10. A train blowing a whistle of frequency $320Hz$ approaches an observer standing on the platform at a speed of $66m/s$ .The frequency observed by the observer will be ____ Hz,
(Given speed of sound $= 330ms^-$ 1) **(+4, -1)**

[25-Jan-2023 Shift2]

Answers

1. **Answer: a**

Explanation:

$f_1 = 1000\left(\frac{320}{300-20}\right) = 1066\,Hz$
$f_2 = 1000\left(\frac{320}{300+20}\right) = 941\,Hz$
$\therefore$ Change is $\simeq 12\%$

Concepts:

1. Waves:

Waves are a disturbance through which the energy travels from one point to another. Most acquainted are surface waves that tour on the water, but sound, mild, and the movement of subatomic particles all exhibit wavelike properties. inside the most effective waves, the disturbance oscillates periodically (see periodic movement) with a set frequency and wavelength.

Types of Waves:

Transverse Waves -

Waves in which the medium moves at right angles to the direction of the wave.

Examples of transverse waves:

- Water waves (ripples of gravity waves, not sound through water)
- Light waves
- S-wave earthquake waves
- Stringed instruments
- Torsion wave

The high point of a transverse wave is a crest. The low part is a trough.

Longitudinal Wave -

A longitudinal wave has the movement of the particles in the medium in the same dimension as the direction of movement of the wave.

Examples of longitudinal waves:

- Sound waves
- P-type earthquake waves
- Compression wave

---

2. **Answer: a**

Explanation:

$$V = 2\,(V_p)_{max}$$
$$\because V = f\lambda$$
$$f\lambda = 2\omega A$$
$$\lambda = 4\pi A$$
$$= 4\pi \times \tfrac{10}{\pi}$$
$$= 40\,cm$$

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3. **Answer: a**

Explanation:

$y = a\ \sin(\omega t + kx)$
$\Rightarrow$ wave is moving along $-ve$ x-axis with speed
$v = \frac{\omega}{K} \Rightarrow v = \frac{50}{2} = 25m/\sec$

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4. Answer: c

Explanation:

$v = 2f(l_2 - l_1)$
$v = 2 \times 480 \times (70 - 30) \times 10^{-2}$
$v = 960 \times 40 \times 10^{-2}$
$v = 38400 \times 10^{-2} m/s$
$v = 384\, m/s$

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5. Answer: d

Explanation:

Given: Frequency of tuning fork $= 256Hz$.
It gives one beat per second with the third normal mode of vibration of an open pipe.
Therefore, frequency of open pipe $= (256 + 1)Hz$
Speed of sound in air is $340m/s$.
Now we know, frequency of third normal mode of vibration of an open pipe is given as
$f = \frac{3v_{\text{sound}}}{2l}$

$\Rightarrow \frac{3\times340}{2l} = 255$
$\Rightarrow l = \frac{3\times340}{2\times255} = 2\,m = 200\,cm$

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6. **Answer: d**

Explanation:

Let after 5 sec engine at point C

$t = \frac{AB}{330} + \frac{BC}{330}$

$5 = \frac{0.9 \times 1000}{330} + \frac{BC}{330}$

$\therefore BC = 750\,m$

Distance travelled by engine in 5\, sec

$= 900\,m - 750\,m = 150\,m$

Therefore velocity of engine

$= \frac{150m}{5sec} = 30\,m/s$

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7. **Answer: b**

Explanation:

$$y = 0.03 \sin(450t - 9x)$$
$$v = \frac{\omega}{k} = \frac{450}{9} = 50 m/s$$
$$v = \sqrt{\frac{T}{\mu}} \Rightarrow \frac{T}{\mu} = 2500$$
$$\Rightarrow T = 2500 \times 5 \times 10^{-3}$$
$$= 12.5\, N$$

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8. **Answer: a**

Explanation:

$$f_0 = \frac{V}{2L} = \frac{1}{2L}\sqrt{\frac{Y}{\rho}} = \frac{1}{2\times 0.6}\sqrt{\frac{9.27\times 10^{10}}{2.7\times 10^{3}}} = 4.88\,kHz \approx 5\,kHz$$

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9. Answer: 18 - 18

Explanation:

The correct answer is 18.

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

$\frac{\pi}{3} = \frac{2\pi}{\lambda}(6m)$

$\Rightarrow \lambda = 36\,m$

$V = f\lambda = (500\,Hz)(36\,m)$

$= 18000\,m/s = 18\,km/s$

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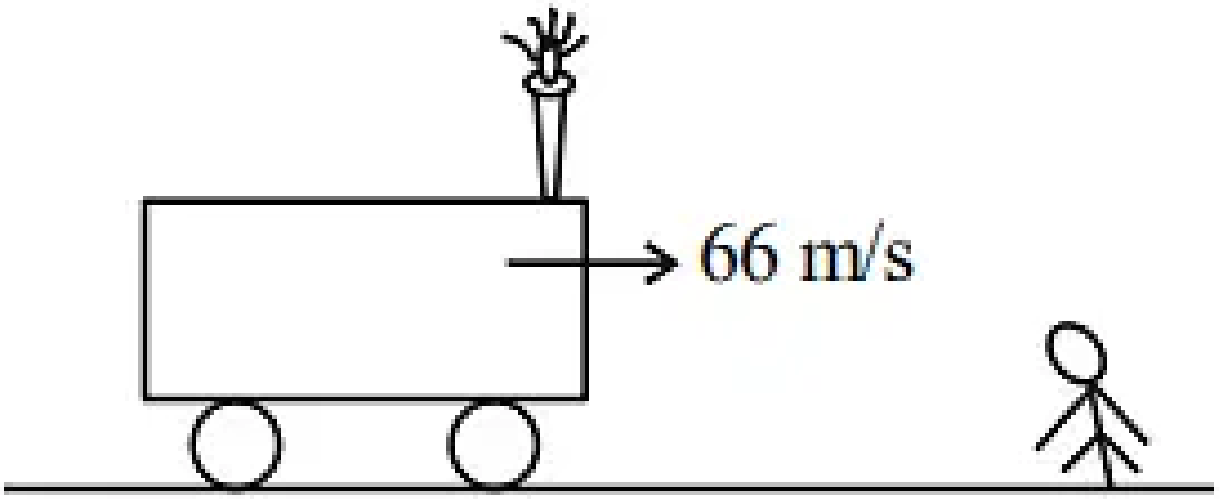
10. **Answer: 400 - 400**

Explanation:

The correct answer is 400



$f_{app} = f\left(\frac{v}{v-v_s}\right)$
$= 320(\frac{330}{330-66})$
$= 400Hz$

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