PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 87

Total Marks : 28

Max. Time : 31 min.

Topics : String, Simple Harmonic Motion, Wave on a String, Rigid Body Dynamics, Sound Waves

Type of Questions		**M.M., Min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.5	**(3 marks, 3 min.)**	**[12,12]**
Multiple choice objective ('–1' negative marking) Q.5	**(4 marks, 4 min.)**	**[4, 4]**
Subjective Questions ('–1' negative marking) Q.6	**(4 marks, 5 min.)**	**[4, 5]**
Match the Following (no negative marking) (2 × 4)	**(8 marks, 10 min.)**	**[8, 10]**

1. When a particle oscillates in simple harmonic motion, both in potential energy and kinetic energy vary sinusoidally with time. If ν be the frequency of the motion of the particle, the frequency associated with the kinetic energy is :

(A) 4ν (B) 2ν (C) ν (D) $\frac{\nu}{2}$

2. Two elastic waves move along the same direction in the same medium. The pressure amplitudes of both the waves are equal, but the wavelength of the first wave is three times that of the second. If the average power transmitted through unit area by the first wave is W_1 and that by the second is W_2, then.

(A) $W_1 = W_2$ (B) $W_1 = 3W_2$ (C) $W_2 = 3W_1$ (D) $W_1 = 9W_2$

3. A spring of certain length and having spring constant k is cut into two pieces of lengths in a ratio 1 : 2. The spring constants of the two pieces are in a ratio :

(A) 1 : 1 (B) 1 : 4 (C) 1 : 2 (D) 2 : 1

4. Which of the following options is not correct :

(A) Intensity of the wave produced by a point source at any point is inversely proportional to square of the distance from point source

(B) Power of the wave, produced by a point source, varies as inverse square of the distance from point source

(C) Intensity of the wave produced by line source at any point varies as inverse of the distance from line source

(D) Amplitude of the wave produced by a point source at any point varies as inverse of the distance from point source

5. The rate of change of angular momentum of a system of particles about the centre of mass is equal to the sum of external torques about the centre of mass when the centre of mass is :

(A) Fixed with respect to an inertial frame.

(B) in linear acceleration

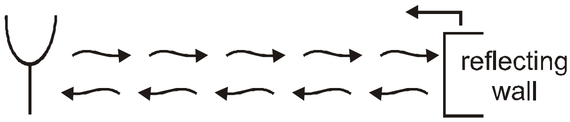
(C) in rotational motion.

(D) is in a translational motion.

6. A man standing in front of a mountain beats a drum at regular intervals. The druming rate is gradually increased and he finds that the echo is not heard distinctly when the rate becomes 40 per minute.He then moves towards mountain by 90 m and finds that echo is again not heard when drumming rate becomes 60 per minute. Find the ratio of distance between the mountain and the initial position of the man and the distance by which he moved.

7. Match the column:

Column–I

(A) 

Sinusoidal sound waves are continuously sent from one end by a tuning fork and they are reflected from a moving wall. Due to the superposition of the incident waves and the reflected waves.

(B) Equation of vibrating particles is
$y = A\sin^2(\omega t - kx) + B\cos^2(kx - \omega t)$
$+ C\cos(kx + \omega t)\sin(\omega t + kx)$
(where A,B,C are constants and can have any value) it is possible that

(C) 

A metal rod is fixed at one end and free at the other end. The free end is hit once by a hammer as shown. Then :

(D) Equation of vibrating particles is

$$y = (1\text{mm})\ \sin 100\left(t - \frac{x}{330}\right)\cos\left(\frac{x}{330} - t\right)$$

Column–II

(p) Travelling wave is formed

(q) Standing wave is formed

(r) Beats are formed

(s) Particles perform simple harmonic motion

Answers Key

DPP NO. - 87

1. (B) **2.** (A) **3.** (D) **4.** (B)
5. (A) (B) (C) (D) **6.** 3
7. (A) – r ; (B) – p,q,s ; (C) – p ; (D) – r, p

Hint & Solutions

DPP NO. - 87

1. $x = A \sin wt$

K.E. = $\frac{1}{2}$ $KA^2w^2 \cos^2 wt$

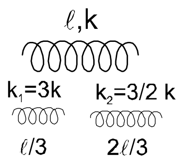
PE = $\frac{1}{2}$ $mA^2w^2 \sin^2 wt$

frequancy of kinetic energy is 2V **Ans. (B)**

2. $I = \frac{\text{Power}}{\text{Area}} = \frac{P_0^2}{2\rho v}$

$I = I_1 = I_2$

$w_1 = w_2$ **Ans. (A)**

3. 

$\frac{k_1}{k_2} = \frac{3k}{3k/2} = \frac{2}{1}$ **Ans. (D)**

5. $\frac{d\vec{L}_C}{dt} = \vec{\tau}_C$ **Ans. (A,B,C,D)**

6. $\frac{2S}{v} = \frac{60}{40}$ ....(1)

$\frac{2(S-90)}{v} = 1$ ....(2)

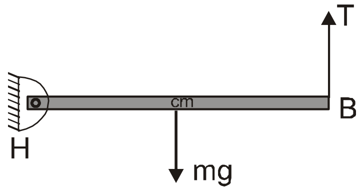
on solving S = 270 m

$\therefore \frac{270}{90} = 3$

7. Ans.
(A) – r ; (B) – q,s ; (C) – p,q,s ; (D) – p ; (E) – r

Ans.
(A) – r ; (B) – q,s ; (C) – p,q,s ; (D) – p ; (E) – r

Sol. (A) Due to reflection from a moving wall, frequency of the sound wave will change. So, the superposition of the incident waves and the reflected waves will produce beats.

(B) 

Applying torque balance about the hinge point 'H'

$$(mg)\left(\frac{\ell}{2}\right) = (T)(\ell)$$

$$T = \frac{mg}{2} = \frac{20 \times 10}{2} = 100 \text{ m}$$

Natural frequencies of the fixed–free wire are

$$f = \frac{1}{4\ell}\sqrt{\frac{T}{\mu}}, \frac{3}{4\ell}\sqrt{\frac{T}{\mu}}, \frac{5}{4\ell}\sqrt{\frac{T}{\mu}}, \ldots\ldots\ldots\ldots\ldots$$

$$f = \frac{1}{4 \times 1}\sqrt{\frac{100}{0.01}}, \ldots\ldots\ldots\ldots\ldots$$

$\Rightarrow$ f = 25, ***75***, 125,.............

f = 75 Hz matches with the frequency of the source, so resonance will occur and standing waves are generated.

(C) $y = A\sin^2(\omega t - kx) + B\cos^2(kx - \omega t) + C\cos(kx + \omega t)\sin(kx + \omega t)$

Solving we can get,

$y = (\text{some constant})\cos 2(\omega t - kx) + (\text{some constant})\sin 2(kx + \omega t)$

which is superposition of waves moving in opposite direction. So, standing waves can be produced.

But if A = B

or C = 0, then only travelling waves will be formed.

(D) If the hammer is hit once,a pulse will generated and a moving pulse is a travelling wave. The pulse will more rightward, will be reflected from the wall and then move in opposite direction.

As there is no other wave, so standing waves will not form. As this is just a pulse, so particle will not perform SHM.

(E) This is equation of beats, and in the beats, particle doesn't perform SHM.