PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 76

Total Marks : 28

Max. Time : 29 min.

Topics : Simple Harmonic Motion, Newton's Law of Motion, Work, Power and Energy

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1	(3 marks, 3 min.)	[3, 3]
Multiple choice objective ('–1' negative marking) Q.2 to Q.4	(4 marks, 4 min.)	[12, 12]
Subjective Questions ('–1' negative marking) Q.5	(4 marks, 5 min.)	[4, 5]
Comprehension ('–1' negative marking) Q.6 to Q.8	(3 marks, 3 min.)	[9, 9]

1. The resultant amplitude due to super position of $x_1 = \sin \omega t$, $x_2 = 5 \sin (\omega t + 37^\circ)$ and $x_3 = -15 \cos \omega t$ is:

(A) 17 (B) 21 (C) 13 (D) none of these

2. A 20 gm particle is subjected to two simple harmonic motions

$x_1 = 2 \sin 10 t$,

$x_2 = 4 \sin (10 t + \frac{\pi}{3})$. where x_1 & x_2 are in metre & t is in sec.

(A) The displacement of the particle at t = 0 will be $2\sqrt{3}$ m.

(B) Maximum speed of the particle will be $20\sqrt{7}$ m/s.

(C) Magnitude of maximum acceleration of the particle will be $200\sqrt{7}$ m/s^2.

(D) Energy of the resultant motion will be 28 J.

3. A particle moves in xy plane according to the law x = a sinwt and y = a(1-coswt) where a and w are constants. The particle traces

(A) a parabola (B) a straight line equally inclined to x and y axes

(C) a circle (D) a distance proportional to time.

4. Out of the statements given, which is/are correct ?

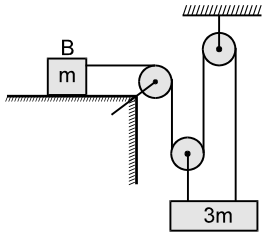
(A) The amplitude of a resultant simple harmonic motion obtained by superposition of two simple harmonic motions along the same direction can be less than lesser of the amplitudes of the participating SHMs.

(B) When two simple harmonic motions which are in phase and in perpendicular directions superpose then resulting motion will be SHM with same phase.

(C) When two simple harmonic motions (with amplitudes A_1 and A_2) which are out of phase (that means phase difference π) and in perpendicular directions, superpose then resulting motion will be SHM with amplitude $\sqrt{A_1^2 + A_2^2}$.

(D) The combination of two simple harmonic motions of equal amplitude in perpendicular directions differing in phase by $\pi/2$ rad is a circular motion.

5. If the acceleration of the block B in the following system is a (in m/s^2) then find out value of 2a/5 (g = 10 m/s^2) :



COMPREHENSION

The velocity of a block of mass 2 kg moving along x-axis at any time t is given by v = 20 – 10t (m/s) where t is in seconds and v is in m/s. At time t = 0, the block is moving in positive x-direction.

6. The work done by net force on the block starting from t = 0 till it covers a distance of 25 meter will be:

(A) +200 J (B) – 200J (C) + 300J (D) – 300J

7. The power due to net force on block at t = 3 sec. is :

(A) 100 watts (B) 200 watts (C) 300 watts (D) 400 watts

8. The Kinetic energy of block at t = 3 sec. is :

(A) 50 J (B) 100 J (C) 200 J (D) 300 J

Answers Key

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1. (C) **2.** (A) (B) (C) (D) **3.** (C) (D)
4. (A) (B) (C) (D) **5.** 3 **6.** (D)
7. (B) **8.** (B)

Hint & Solutions

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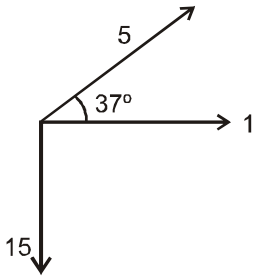
1. $x_1 = \sin \omega t$; $x_2 = 5 \sin (\omega t + 37^o)$
$x_3 = 15 \sin (\omega t - \pi/2)$
By the phasor diagram;



Get the resultant of these 3 vectors as 13.

2. At t = 0
Displacement $x = x_1 + x_2$

$= 4 \sin \frac{\pi}{3} = 2\sqrt{3}$ m.

Resulting Amplitude A =

$\sqrt{2^2 + 4^2 + 2(2)(4)\cos \pi/3} = \sqrt{4 + 16 + 8} = \sqrt{28}$ =

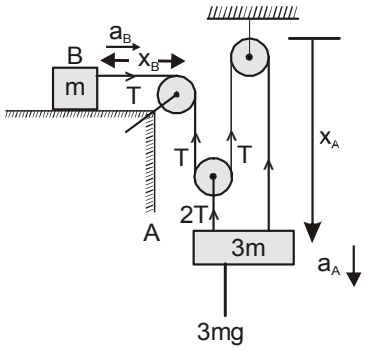
$2\sqrt{7}$ m

Maximum speed = $A\omega = 20\sqrt{7}$ m/s

Maximum acceleration = $A\omega^2 = 200\sqrt{7}$ m/s^2

Energy of the motion = $\frac{1}{2} m\omega^2 A^2$ = **28 J Ans.**

5.



$\ell = x_B + 3x_A$

$\Rightarrow 0 = \frac{d^2x_B}{dt^2} + 3\frac{d^2x_A}{dt^2}$

$\Rightarrow 0 = -a_B + 3a_A$

$\Rightarrow a_B = 3a_A$ ..... (1)

For B $T = ma_B$ ..... (2)

For A $3mg - 3T = 3ma_A$ ..... (3)

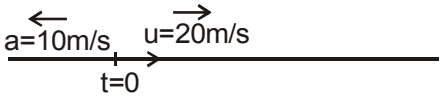
$mg - T = ma_A$

By (1) , (2) & (3)

$\therefore a_B = 15/2$ **Ans.**

6. The velocity of particle is zero when $v = (20 - 10t) = 0$.

That is at t = 2 sec. v = 0.



From t = 0 to t = 2 distance traveled is

$S_1 = \frac{(20)^2}{2\times 10} = 20$ m.

Next 5 meter wil be covered in $5 = \frac{1}{2} \times 10 \times t^2$ or t = 1 s.

$\therefore$ The particle covers 25 metres distance in 3 sec.

K.E. at t = 0 is $K_i = \frac{1}{2} mu^2 = \frac{1}{2} 2 \times (20)^2$

= 400 J

KE at t = 3 is

$K_f = \frac{1}{2} mv^2 = \frac{1}{2} 2 \times (10)^2 = 100$ J

Therefore work done by block from t = 0 to t = 3s is

$\Delta W = K_f - K_i = 100 - 400 = -300$ J

7. At t = 3 sec. force on particle is F = ma = 2 × 10 towards –ve x-direction

At t = 3 sec. the velocity of particles is v = 10 m/s towards – ve x-direction

P = FV = 200 watts **Ans.**

8. From solution of 37 $K_f = 100$ J **Ans.**