PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 71

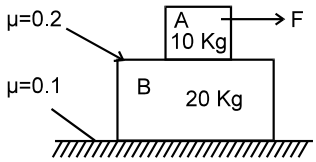
Total Marks : 27

Max. Time : 29 min.

Topics : Friction, Rigid Body Dynamics, Work, Power and Energy, Simple Harmonic Motion

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks, 3 min.)	[15, 15]
Multiple choice objective ('–1' negative marking) Q.6	(4 marks, 4 min.)	[4, 4]
Subjective Questions ('–1' negative marking) Q.7 to Q.8	(4 marks, 5 min.)	[8, 10]

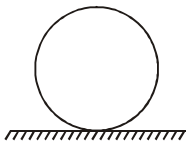
1. In given diagram what is the minimum value of a horizontal external force F on Block 'A' so that block 'B' will slide on ground is:



(A) 30 N (B) 20 N

(C) 10 N (D) Not possible

2. A ring of radius R rolls without slipping on a rough horizontal surface with a constant velocity. The radius of curvature of the path followed by any particle of the ring at the highest point of its path will be :



(A) (B) 2 R (C) 4 R (D) none of these

3. A particle is moving along x – axis has potential energy U = $(2 - 20x + 5x^2)$ Joules.
The particle is released at x = – 3. The maximum value of 'x' will be:
[x is in meters and U is in joules]

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

4. The potential energy of a particle executing SHM changes from maximum to minimum in 5 s. Then the time period of SHM is :

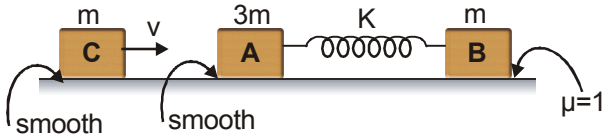
(A) 5 s (B) 10 s (C) 15 s (D) 20 s

5. A particle performs S.H.M. of amplitude A along a straight line. When it is at a distance $\frac{\sqrt{3}}{2}$ A from mean position, its kinetic energy gets increased by an amount 1/2 m $\omega^2 A^2$ due to an impulsive force. Then its new amplitude becomes:

(A) $\frac{\sqrt{5}}{2}$ A (B) $\frac{\sqrt{3}}{2}$ A (C) $\sqrt{2}$ A (D) $\sqrt{5}$ A

6. The amplitude of a particle executing SHM about O is 10 cm. Then:
(A) when the K.E. is 0.64 of its maximum K.E. its displacement is 6 cm from O.
(B) when the displacement is 5 cm from O its K.E. is 0.75 times its maximum K.E.
(C) Its total energy of SHM at any point is equal to its maximum K.E.
(D) Its speed is half the maximum speed when its displacement is half the maximum displacement.

7. A block of mass m collides with another block of mass 3m completely inelastically as shown in figure. What is the maximum value of v (in m/s) for which the block B does not move. Assume that initially spring is in natural length and blocks A and B are at rest. (K/m = 100 S.I. unit)



8. A particle performs SHM of time period T, along a straight line. Find the minimum time interval to go from position A to position B. At A both potential energy and kinetic energy are same and at B the speed is half of the maximum speed.

Answers Key

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1. (D) **2.** (C) **3.** (C) **4.** (D) **5.** (C)

6. (A)(B) (C) **7.** 2 **8.** $\frac{T}{24}$

Hint & Solutions

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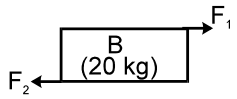
1.



$F_{1(max)} = 0.2 \times 10 \times 10 = 20$ N

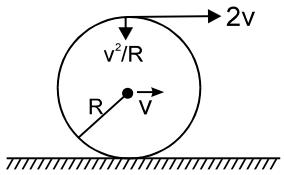
$F_{2(max)} = 0.1 \times 30 \times 10 = 30$ N

$F_{1(max)} < F_{2(max)}$

$\Rightarrow$ 'B' can never move.

2. Radius of Curvature $= \frac{(\text{velocity})^2}{\text{Normal Acceleration}}$

$= \frac{(2v)^2}{v^2/R} = 4R$



3. $U = 2 - 20x + 5x^2$

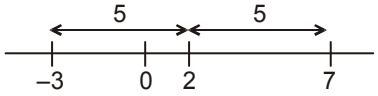
$F = -\frac{dU}{dx} = 20 - 10x$

At equilibrium position ; $F = 0$

$20 - 10x = 0$

$\Rightarrow$ $x = 2$

Since particle is released at $x = -3$, therefore amplitude of particle is 5.



It will oscillate about $x = 2$ with an amplitude of 5.

$\therefore$ maximum value of x will be 7.

4. P.E. is maximum at extreme position and minimum at mean position.

Time to go from extreme position to mean position is, $t = \frac{T}{4}$; where T is time period of SHM 5 s = $\frac{T}{4}$

$\Rightarrow$ T = 20 s.

5. Due to impulse, the total energy of the particle becomes :

$$\frac{1}{2}m\omega^2A^2 + \frac{1}{2}m\omega^2A^2 = m\omega^2A^2$$

Let ; A' be the new amplitude.

$$\therefore \quad \frac{1}{2}m\omega^2(A')^2 = m\omega^2A^2$$

$\Rightarrow$ $A' = \sqrt{2}\,A$. **Ans.** उत्तर

7. Velocity of (A + C),

$$V_1 = \frac{V}{1+3} = \frac{V}{4}$$

If B does not move, maximum compression X in the spring is

$$\frac{1}{2}KX^2 = \frac{1}{2} \times 4m\left(\frac{v}{4}\right)^2$$

$$\therefore \quad X = \left(\frac{4m}{K}\right) \cdot \frac{v}{4}$$

$\therefore$ $KX = \mu mg$

$$\Rightarrow \quad 100 \cdot \sqrt{\frac{4}{100}} \cdot \frac{v}{4} = 1 \times 10$$

$\Rightarrow$ v = 2 m/s

Ans. 2

8. $x_A = \frac{A}{\sqrt{2}}$

and for x_B ; $\frac{\omega A}{2} = \omega\sqrt{A^2 - x_B^2}$

or $x_B = \frac{\sqrt{3}}{2}A$

or $\omega t_A = \frac{\pi}{4}$ and $\omega t_B = \frac{\pi}{3}$

or $\omega\,(t_B - t_A) = \frac{\pi}{3} - \frac{\pi}{4}$

or $\frac{\pi}{3} - \frac{\pi}{4} = \frac{2\pi}{T}t$

or $t = \frac{T}{2\pi} \times \frac{\pi}{12} = \frac{T}{24}$

Ans. $\frac{T}{24}$