PHYSICS

DPP
DAILY PRACTICE PROBLEMS

DPP No. 40

Total Marks : 26

Max. Time : 27 min.

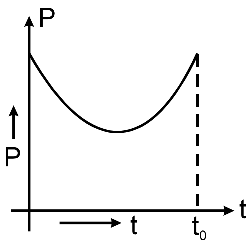
Topics : Relative Motion, Work, Power and Energy, Projectile Motion

Type of Questions		**M.M., Min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.3	**(3 marks, 3 min.)**	**[9, 9]**
Multiple choice objective ('–1' negative marking) Q.4	**(4 marks, 4 min.)**	**[4, 4]**
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. For a particle undergoing rectilinear motion with uniform acceleration, the magnitude of displacement is one third the distance covered in some time interval. The magnitude of final velocity is less than magnitude of initial velocity for this time interval. Then the ratio of initial speed velocity to the final speed for this time interval is :

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

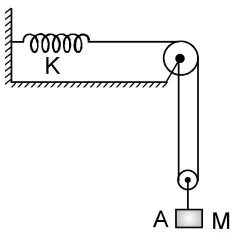
2. Power versus time graph for a given force is given below. Work done



by the force upto time $t(\leq t_0)$.

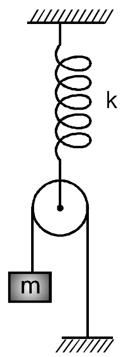
(A) First decreases then increases
(B) First increases then decreases
(C) Always increases
(D) Always decreases

3. Block A in the figure is released from the rest when the extension in the spring is x_0 . The maximum downward displacement of the block will be :



(A) $Mg/2k - x_0$ (B) $Mg/2k + x_0$ (C) $2\,Mg/k - x_0$ (D) $2\,Mg/k + x_0$

4. Block m is released from rest when spring is in its natural length (assume pulley is ideal and block does not strike on ground during it's motion in vertical plane)
than :

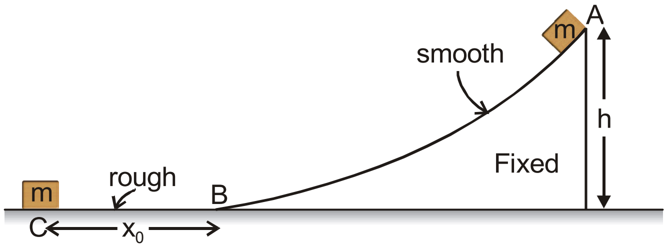


(A) maximum elongation in spring is 4 mg/k
(B) maximum elongation in spring is 2 mg/k
(C) maximum speed of block is $2g\sqrt{\frac{m}{k}}$
(D) maximum speed of block is $g\sqrt{\frac{m}{k}}$

5. A particle is projected at an angle of 30^0 w.r.t. horizontal with speed 20 m/s : (use g = 10 m/s^2)
(i) Find the position vector of the particle after 1s.
(ii) Find the angle between velocity vector and position vector at t = 1s.

COMPREHENSION

A small block of mass m is released from a fixed smooth wedge as shown in figure. Initial point is marked as A. Bottom of wedge is marked as B and at a point C the block stops moving because the straight part of floor is rough.



6. Work done by normal reaction is zero during the motion of the block
(A) from point A to B only
(B) from point B to C only
(C) from A to C
(D) None of these

7. The friction coefficient of the block with the floor is :
(A) $\frac{h}{x_0}$
(B) $\frac{x_0}{h}$
(C) zero
(D) 1

8. The velocity of the block at the midpoint between B to C will be :
(A) $\frac{\sqrt{2gh}}{2}$
(B) $\sqrt{2gh}$
(C) $\sqrt{gh}$
(D) $\frac{\sqrt{gh}}{2}$

Answers Key

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1. (A) **2.** (C) **3.** (A)

4. (A)(C) **5.** **(i)** $10\sqrt{3}\,\hat{i} + 5\,\hat{j}$,

(ii) $\cos^{-1}\left(2\sqrt{\frac{3}{13}}\right)$

6. (C) **7.** (A) **8.** (C)

Hint & Solutions

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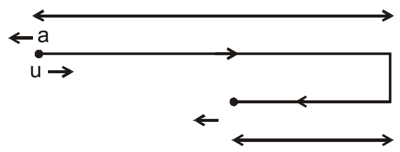
1. Let u and v denote initial and find velocity, then then nature of motion is indicated in diagram



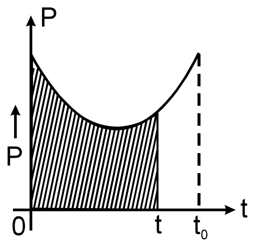
Hence initial and final speed are given by equation

$0^2 = u^2 - 2a \times 2S$ and $v^2 = 0^2 + 2as$

$\therefore \quad v = \frac{u}{\sqrt{2}}$ or $\frac{u}{v} = \sqrt{2}$ **Ans.**

2. The work done by force from time t = 0 to t = t sec. is given by shaded area in graph below.

Hence as t increases, this area increases.



$\therefore$ Work done by force keeps on increasing.

3. From work, energy theorem :

$W_g + U_i - U_f = \Delta K$

$Mgh + \frac{1}{2}Kx_0^2 - \frac{1}{2}K(x_0 + 2h)^2 = 0$

$\Rightarrow \frac{1}{2}K(x_0^2 - (x_0 + 2h)^2) = -Mgh$

$\Rightarrow \frac{1}{2}K(x_0 + x_0 + 2h)(x_0 - x_0 - 2h) = -Mgh$

$\Rightarrow \frac{1}{2}K\,2(x_0 + h)(-2h) = -Mgh$

$h = \frac{Mg}{2K} - x_0$.

4. By energy conservation $\frac{1}{2}kx^2 = mg(2x)$

$\Rightarrow \quad x = \frac{4mg}{k}$ (maximum elongation) at equilibrium $kx = 2mg$

$\Rightarrow \quad x = \frac{2mg}{k}$

So $(K.E.)_{max} = mg(2x) - \frac{1}{2}kx^2$

$= 2mg\left(\frac{2mg}{k}\right) - \frac{1}{2}k\left(\frac{2mg}{k}\right)^2$

$\frac{1}{2}mv^2_{max} = \frac{2m^2g^2}{k}$

$\Rightarrow \quad v_{max} = 2g\sqrt{\frac{m}{k}}$.

5. (i) $x = u \cos \theta\, t$

$= 20 \times \frac{\sqrt{3}}{2} \times t \quad = 10\sqrt{3}$ m

$y = u \sin \theta t - \frac{1}{2} \times 10 \times t^2$

$= 20 \times \frac{1}{2} \times (1) - 5\,(1)^2 \quad = 5m$

Position vector, $= 10\sqrt{3}\,\hat{i} + 5\,\hat{j}$,

$|\vec{r}| = \sqrt{10\sqrt{3}^{\;2} + 5^2}$

(ii) $v_x = 10\sqrt{3}\;\hat{}$

$v_y = u_y + a_y t = 10 - g\,t = 0$

$\therefore \quad = 10\,\sqrt{3}\;\hat{}\,, \quad |\quad| = 10\sqrt{3}$

$v \cdot r = (10\sqrt{3}\,\hat{i}) \cdot (10\sqrt{3}\,\hat{i} + 5\hat{j}) \;=\; 300$

$. \quad = |\quad||\quad| \cos \theta$

$\Rightarrow \cos \theta = \frac{v \cdot r}{|\vec{v}||\vec{r}|} = \frac{300}{10\sqrt{3}\sqrt{325}}$

$\Rightarrow \quad \theta = \cos^{-1}\left(2\sqrt{\frac{3}{13}}\right)$

6. The normal reaction is always $\perp$ to surface and the displacement is always along the surface.

$\therefore$ force and displacement are $\perp$ to each other. From A to C it is zero.

7. Total work done by gravity = work done against friction

$mgh = \mu\, mg.\, x_0$

$\Rightarrow \mu = \frac{}{x}$

8. (work done by gravity – work done by friction) = change in K.E.

$$\therefore mgh - \mu\, mg\, \frac{x_0}{2} = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$= mgh - \frac{h}{x_0}mg\frac{x_0}{2} = \frac{1}{2}mv_f^2 - 0 \qquad \because \mu = \frac{h}{x_0}$$

$$\therefore \frac{mgh}{2} = \frac{1}{2}mv_f^2 \qquad \Rightarrow v_f = \sqrt{gh}$$