PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 78

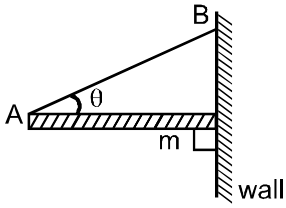
Total Marks : 27

Max. Time : 30 min.

Topics : Rigid Body Dynamics, Circular Motion, Friction, Projectile Motion, Work, Power and Energy

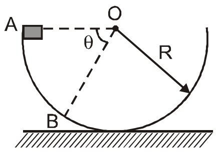
Type of Questions			**M.M., Min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.2		(3 marks, 3 min.)	[6, 6]
Subjective Questions ('–1' negative marking) Q.3		(4 marks, 5 min.)	[4, 5]
Comprehension ('–1' negative marking) Q.4 to Q.6		(3 marks, 3 min.)	[9, 9]
Match the Following	(no negative marking) (2 × 4)Q.7	(8 marks, 10 min.)	[8, 10]

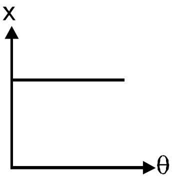
1. A rod of mass m is supported by string AB and friction due to wall. Then friction force on rod due to wall is : (g = acceleration due to gravity).

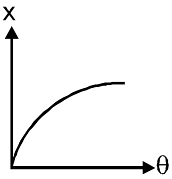


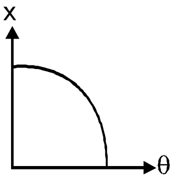
(A) mg upward (B) mg downward (C) $\frac{mg}{2}$ upward (D) Data insufficient

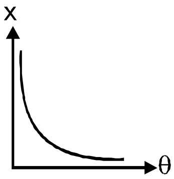
2. A small block of mass m is released from rest from point A inside a smooth hemisphere bowl of radius R, which is fixed on ground such that OA is horizontal. The ratio (x) of magnitude of centripetal force and normal reaction on the block at any point B varies with θ as :



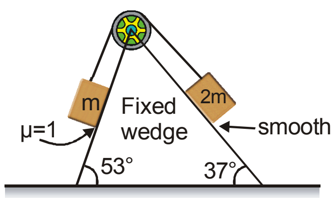
(A)


(B)


(C)


(D)


3. Two blocks of mass m and 2m are arranged on a wedge that is fixed on a horizontal surface. Friction coefficient between the block and wedge are shown in figure. Find the magnitude of acceleration of two blocks.



COMPREHENSION

A projectile is fired with speed v_0 at t = 0 on a planet named 'Increasing Gravity'. This planet is strange one, in the sense that the acceleration due to gravity increases linearly with time t as g(t) = bt, where b is a positive constant. 'Increasing Gravity'

4. If angle of projection with horizontal is θ then the time of flight is :

(A) $\sqrt{\frac{6v_0 \sin\theta}{b}}$ (B) $\sqrt{\frac{2v_0 \sin\theta}{b}}$ (C) $\sqrt{\frac{3v_0 \sin\theta}{b}}$ (D) $\sqrt{\frac{2v_0}{b}}$

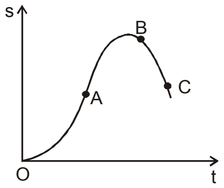
5. If angle of projection with horizontal is θ, then the maximum height attained is

(A) $\frac{1}{3}\frac{(v_0 \sin\theta)^{3/2}}{\sqrt{b}}$ (B) $\frac{4}{3}\frac{(v_0 \sin\theta)^{3/2}}{\sqrt{b}}$ (C) $\frac{(2v_0 \sin\theta)^{3/2}}{3\sqrt{b}}$ (D) None of these

6. At what angle with horizontal should the projectile be fired so that it travels the maximum horizontal distance:

(A) $\theta = \tan^{-1}\frac{1}{2}$ (B) $\theta = \tan^{-1}\frac{1}{\sqrt{2}}$ (C) $\theta = \tan^{-1}\sqrt{2}$ (D) $\theta = \tan^{-1}2$

7. The displacement-time graph of a body acted upon by some forces is shown in the figure. For this situation match the entries of column I with the entries of column II.



Column I	Column II
(A) For OA, the total work done by all forces together	(p) always positive
(B) For OA, the work done by few of the acting forces	(q) always negative
(C) For AB, the work done by few of the acting forces	(r) can be positive
(D) For BC, the work done by few of the acting forces.	(s) can be zero
	(t) can be negative

Answers Key

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1. (C) **2.** (A) **3.** Acceleration = 0

4. (A) **5.** (C) **6.** (B)

7. (A) – p ; (B) – r, s, t ; (C) – r, s, t ; (D) – r, s, t

Hint & Solutions

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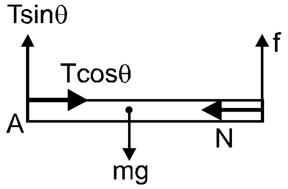
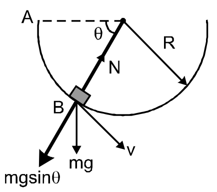
1. 

Torque about A

$mg\frac{\ell}{2} - f\ell = 0$

$F = \frac{mg}{2}$.

2. $\frac{mv^2}{R} = N - mg\sin\theta$



$N = \frac{mv^2}{R} + mg\sin\theta$

By energy conservation,

$mgR\sin\theta = \frac{1}{2}mv^2$

$\frac{mv^2}{R} = 2mg\sin\theta$

$N = 3mg\sin\theta$

Ratio $= \frac{mv^2}{RN} = \frac{2}{3}$ (constant)

$x = \frac{2}{3}$.

3. **Ans.** Acceleration = 0

4. $\frac{dV_y}{dt} = -bt$

or $v_y = -\frac{bt^2}{2} + v_0\sin\theta$ .... (1)

$\frac{dy}{dt} = -\frac{bt^2}{2} + v_0\sin\theta$

or $y = -\frac{bt^3}{6} + v_0\sin\theta\, t$ .... (2)

Putting y = 0 in equation (2)

$T = \sqrt{\frac{6v_0\sin\theta}{b}}$ = Time of flight.

5. For maximum height $\frac{dy}{dt} = 0 = -\frac{bt^2}{2} + v_0\sin\theta$

$\therefore$ y is maximum at $t = \sqrt{\frac{2v_0\sin\theta}{b}}$

or $y_{max} = (-\frac{bt^2}{6} + v_0\sin\theta)\,t$

$= \left(-\frac{b}{6}\times\frac{2v_0\sin\theta}{b} + v_0\sin\theta\right)\sqrt{\frac{2v_0\sin\theta}{b}}$

$= \frac{2}{3}\frac{v_0\sin\theta}{\sqrt{b}}\sqrt{2v_0\sin\theta} = \frac{(2v_0\sin\theta)^{3/2}}{3\sqrt{b}}$

6. $R = v_0\cos\theta \times \sqrt{\frac{6v_0\sin\theta}{b}}$

$\therefore \frac{dR}{d\theta} = 0$ at $\tan\theta = \frac{1}{\sqrt{2}}$

or $\theta = \tan^{-1}\frac{1}{\sqrt{2}}$

7. **(A) – p ;**
(B) – r, s, t ;
(C) – r, s, t ;
(D) – r, s, t