PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 28

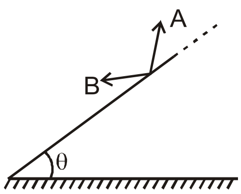
Total Marks : 24

Max. Time : 25 min.

Topics : Relative Motion, Newtons's Law of Motion

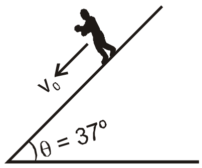
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.4	(3 marks, 3 min.)	[12, 12]
Multiple choice objective ('–1' negative marking) Q.5 to Q.6	(4 marks, 4 min.)	[8, 8]
Subjective Questions ('–1' negative marking) Q.7	(4 marks, 5 min.)	[4, 5]

1. Two stones A and B are projected from an inclined plane such that A has range up the incline and B has range down the incline. For range of both stones on the incline to be equal in magnitude, pick up the correct condition. (Neglect air friction)



(A) Component of initial velocity of both stones along the incline should be equal and also component of initial velocity of both stones perpendicular to the incline should be equal.
(B) Horizontal component of initial velocity of both stones should be equal and also vertical component of initial velocity of both stones should be equal.
(C) Component of initial velocity of both stones perpendicular to the incline should be equal and also horizontal component of initial velocity of both stones should be equal in magnitude.
(D) None of these.

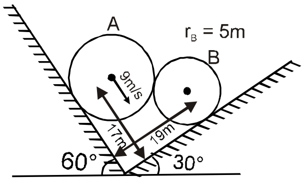
2. A man is moving downward on an inclined plane ($\theta = 37°$) with velocity v_0 and rain drops appear to him moving in horizontal direction with velocity $2v_0$ towards him. If man increases his velocity to $2v_0$ him velocity of rain drops as observed by man is :



(A) $\sqrt{\frac{41}{5}}\ v_0$ (B) $\sqrt{39}\ v_0$

(C) $7\ v_0$ (D) $6\ v_0$

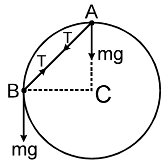
3. System is shown in the figure. Velocity of sphere A is 9 m/s. Then speed of sphere B will be:



(A) 9 m/s (B) 12 m/s

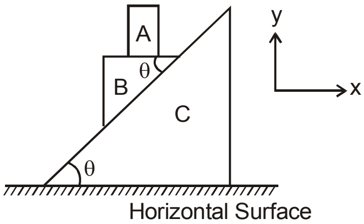
(C) $9 \times \frac{5}{4}$ m/s (D) none of these

4. Objects A and B each of mass m are connected by light inextensible cord. They are constrained to move on a frictionless ring in a vertical plane as shown in figure. The objects are released from rest at the positions shown. The tension in the cord just after release will be



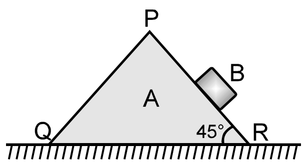
(A) $mg\sqrt{2}$ (B) $\frac{mg}{\sqrt{2}}$ (C) $\frac{mg}{2}$ (D) $\frac{mg}{4}$

5. In the figure shown all the surface are smooth. All the blocks A, B and C are movable X-axis is horizontal and y-axis vertical as shown. Just after the system is relased from the position as shown.

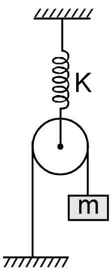


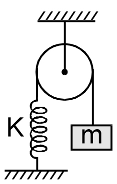
(A) Acceleration of 'A' relative to ground is in negative y-direction
(B) Acceleration of 'A' relative to B is in positive x-direction
(C) The horizontal acceleration of 'B' relative to ground is in negative x-direction.
(D) The acceleration of 'B' relative to ground directed along the inclined surface of 'C' is greater than $g \sin\theta$.

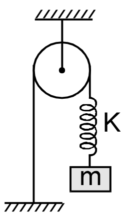
6. A block B of mass 0.6 kg slides down the smooth face PR of a wedge A of mass 1.7 kg which can move freely on a smooth horizontal surface. The inclination of the face PR to the horizontal is 45°. Then :
(A) the acceleration of A is 3 g/20
(B) the vertical component of the acceleration of B is 23 g/40
(C) the horizontal component of the acceleration of B is 17 g/40
(D) none of these

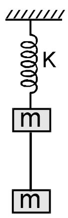


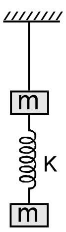
7. Find the tension in the string and the extension in the spring at equilibrium. Where pulley, strings and springs are ideal.

(a) 

(b) 

(c) 

(d) 

(e) 

Answers Key

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

7. (a) $T = mg$, $x = \frac{2mg}{K}$;

(b) $T_1 = mg$, $T_2 = 2mg$, $x = \frac{mg}{K}$;

(c) $T_1 = mg$, $T_2 = 2mg$, $x = \frac{mg}{K}$;

(d) $T = mg$, $x = \frac{2mg}{K}$; (e) $T = 2mg$, $x = \frac{mg}{K}$

Hint & Solutions

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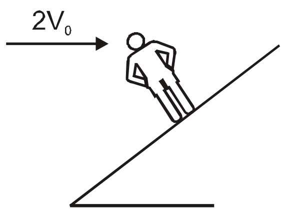
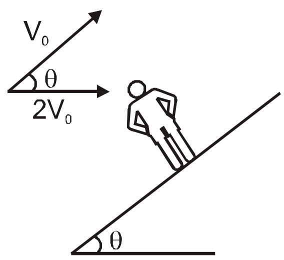
1. If component of velocity normal to incline are equal, time of flight is same. Also if horizontal components are equal, range on inclined plane will be equal for both.

2._ Velocity of rain with respect to man initially as shown



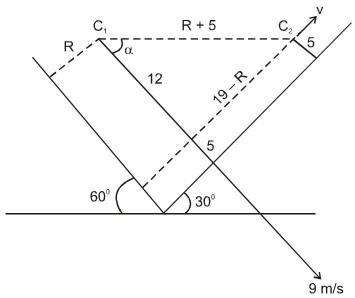
Velocity relative to man when it increase its speed to $2V_0$



So resultant velocity of rain with respect to man

$= \sqrt{(2V_0)^2 + (V_0)^2 + 4V_0^2 \cos 37^\circ} = \sqrt{\frac{41}{5}}\ V_0$

3.



$9\cos\alpha = v\sin\alpha \quad \rightarrow \quad$ (i)

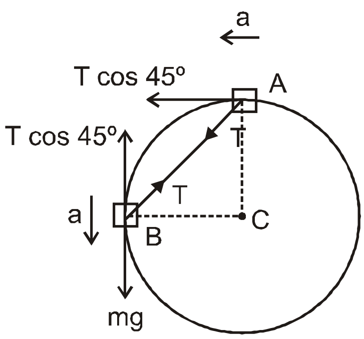
$\frac{19-R}{12} = \tan\alpha \quad \rightarrow \quad$ (ii)

$(R + 5)^2 = (12)^2 + (19 - R)^2$ [Pythagorean]

$\Rightarrow R = 10$

Hence from (i) and (ii) $v = 12$ m/s

4.



On block B :

$mg - T\cos 45^\circ = ma$ ...(i)

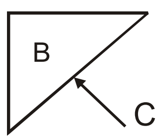
on block A :

$T\cos 45^\circ = ma$ ...(ii)

by equation (i) and (ii)

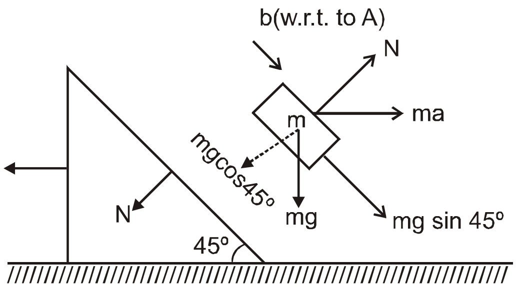
$T = \frac{mg}{\sqrt{2}}$

5. There is no horizontal force on block A, therefore it does not move in x-directing, whereas there is net downward force (mg – N) is acting on it, making its acceleration along negative y-direction. Block B moves downward as well as in negative x-direction. Downward acceleration of A and B will be equal due to constrain, thus w.r.t. B, A moves in positive x-direction.



Due to the component of normal exerted by C on B, it moves in negative x-direction.

6. F.B.D. of block B w.r.t. wedge



for block A

N cos 45º = 1.7 a .....(i)

for block B

0.6g sin 45º + 0.6a cos 45º = 0.6b .....(ii)

N + 0.6 a cos 45º = 0.6 g cos 45º .....(iii)

by solving (i), (ii) & (iii)

$a = \frac{3g}{20}$ and $b = \frac{23g}{20\sqrt{2}}$

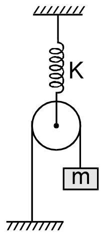
Now vertical componentof acceleration of

$B = b \cos 45^\circ = \frac{23g}{40}$

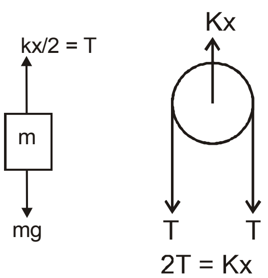
and horizontal component of acceleration of

$B = b \sin 45^\circ - a = \frac{17g}{40}$

7. (a)

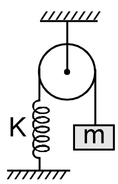


F.B.D. of m FBD



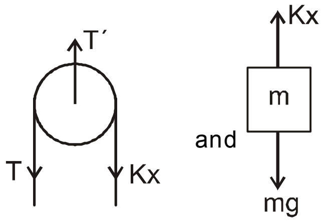
$\frac{kx}{2} = mg$ $x = \frac{2mg}{k}$ $T = mg$

(b)



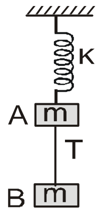
$kx - mg = 0$

F.B.D of pulley



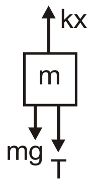
$x = \frac{mg}{k}$ T = mg

(d)



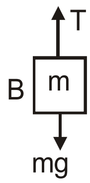
F.B.D. Block A

kx = mg + T .... (1)



A

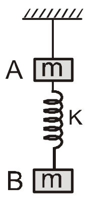
F.B.D. Block B



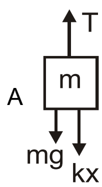
T = mg .... (2)

$\therefore$ kx = 2mg $x = \frac{2mg}{k}$

(e)

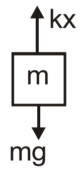


F.B.D. of Upper Block A



T = mg + kx .... (1)

F.B.D. of Lower Block (B)



$$kx = mg \text{ ..... (2)} \therefore x = \frac{mg}{k}$$

By (1) & (2) T = 2mg