PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 32

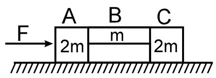
Total Marks : 25

Max. Time : 25 min.

Topics : Friction, Newton's Law of Motion

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.7	(3 marks, 3 min.)	[21, 21]
Multiple choice objective ('–1' negative marking) Q.8	(4 marks, 4 min.)	[4, 4]

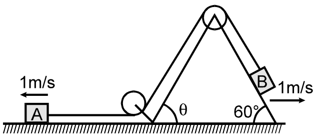
1. The system is pushed by a force F as shown in figure. All surfaces are smooth except between B and C. Friction coefficient between B and C is μ. Minimum value of F to prevent block B from downward slipping is



(A) $\left(\frac{3}{2\mu}\right)$mg (B) $\left(\frac{5}{2\mu}\right)$mg

(C) $\left(\frac{5}{2}\right)\mu$mg (D) $\left(\frac{3}{2}\right)\mu$mg

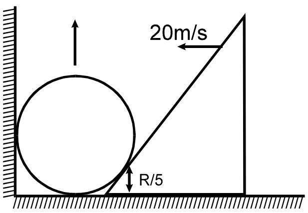
2. A system is shown in the figure. Block A is moving with 1 m/s towards left. Wedge is moving with 1 m/s towards right. Then speed of the block B will be:



(A) 1 m/s (B) 2 m/s

(C) $\sqrt{3}$ m/s (D) none of these

3. A sphere of radius R is in contact with a wedge. The point of contact is R/5 from the ground as shown in the figure. Wedge is moving with velocity 20 m/s, then the velocity of the sphere at this instant will be

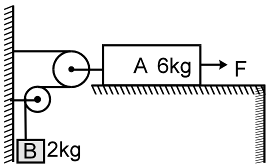


(A) 20 m/s (B) 15 m/s

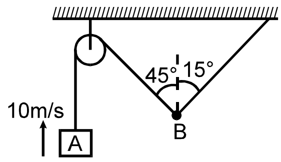
(C) 5 m/s (D) 10 m/s

4. The system starts from rest and A attains a velocity of 5 m/s after it has moved 5 m towards right. Assuming the arrangement to be frictionless every where and pulley & strings to be light, the value of the constant force F applied on A is :

(A) 50 N
(B) 75 N
(C) 100 N
(D) 96 N



5. A system is shown in the figure. Block A moves with velocity 10 m/s. The speed of the mass B will be:



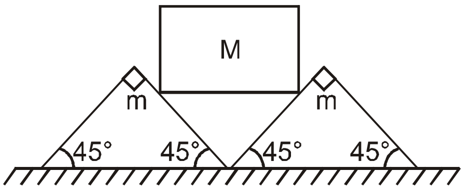
(A) $10\sqrt{2}$ m/s

(B) $5\sqrt{3}$ m/s

(C) $\frac{20}{\sqrt{3}}$ m/s

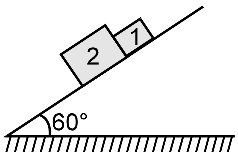
(D) 10 m/s

6. Two wedges, each of mass m, are placed next to each other on a flat horizontal floor. A cube of mass M is balanced on the wedges as shown in figure. Assume no friction between the cube and the wedges, but a coefficient of static friction $\mu < 1$ between the wedges and the floor. What is the largest M that can be balanced as shown without motion of the wedges ?



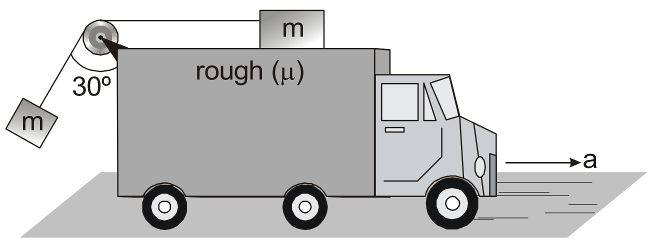
(A) $\frac{m}{\sqrt{2}}$ (B) $\frac{\mu m}{\sqrt{2}}$ (C) $\frac{\mu m}{1-\mu}$ (D) $\frac{2\mu m}{1-\mu}$

7. In the figure shown if friction co-efficient of block 1 and 2 with inclined plane is $\mu_1 = 0.5$ and $\mu_2 = 0.4$ respectively, then find out the correct statement.



(A) both block will move together
(B) both block will move separately
(C) there is a non-zero contact force between two blocks
(D) none of these

8. In the figure a truck is moving on a horizontal surface with acceleration a. Two blocks of equal masses m are supported on the truck as shown in figure. Given that when the block at the top surface is just about to slide, other block remains hanging at 30° from the vertical. In this system.



(A) $a = \frac{g}{\sqrt{3}}$ (B) $T = \frac{2}{\sqrt{3}}$ mg (C) $\mu = \frac{5-\sqrt{3}}{3\sqrt{3}}$ (D) $T = \frac{\sqrt{3}}{2}$ mg

Answers Key

DPP NO. - 32

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

Hint & Solutions

DPP NO. - 32

1. The acceleration of system is

$$a = \frac{F}{5m}$$

Hence the normal reaction B exerts on C is

$$N = 2ma = \frac{2}{5} F$$

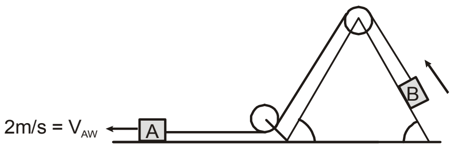
Thus frictional force on 'B' is

$$\mu N = \mu \frac{2}{5} F$$

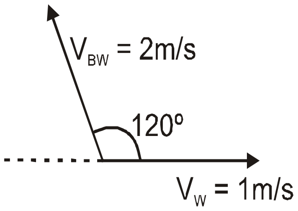
For B not of fall down.

$$\mu \frac{2}{5} F = mg \quad \text{or} \quad F = \frac{5mg}{2\mu}$$

2. Velocity of block A w.r.t. wedge is 2 m/s



So we have



$$\vec{V}_{BW} = \vec{V}_B - \vec{V}_W \Rightarrow \vec{V}_B = \vec{V}_{BW} + \vec{V}_W$$

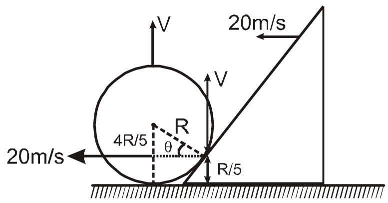
So

$$V_B = \sqrt{(V_W)^2 + (V_{BW})^2 + 2V_W \times V_{BW}(\cos 125°)}$$

$$= \sqrt{1^2 + 2^2 + 2 \times 1 \times 2 \times (-1/2)} = \sqrt{3} \text{ m/s}$$

3. Let v be velocity of sphere

$\sin\theta = \frac{4}{5}$, $\cos\theta = \frac{3}{5}$



From wedge constraint ;

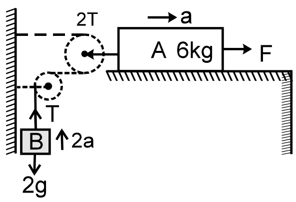
$V \sin\theta = 20 \cos\theta$

$V = 20 \cot\theta$

$V = 20 \times \frac{3}{4} = 15$ m/s.

4. (B)

$a = \frac{v^2}{2s} = \frac{25}{10} = 2.5$ m/s²

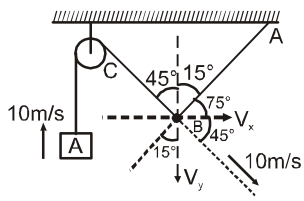


For 6 kg : – $F - 2T = 6a$

For 2 kg : – $T - 2g = 2(2a)$

From (1) & (2) F = 75 N

5. Let V_x & V_y be rectangular components of velocity of mass B



Net velocity along string BC is

$V_x \sin45^\circ + V_y \cos45^\circ = 10$

$V_x + V_y = 10\sqrt{2}$ ....(i)

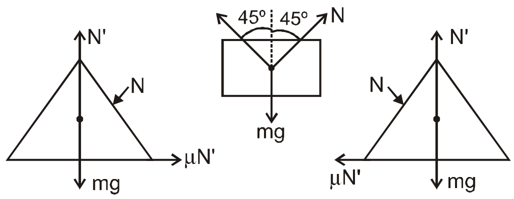
Net velocity along string BA is

$V_x \cos75^\circ - V_y \cos15^\circ = 0$ ....(ii)

Solving equations (ii) & (i)

$$V = \sqrt{V_x^2 + V_y^2} = \frac{20}{\sqrt{3}} \text{ m/s.}$$

6. The free body diagrams of all bodies are as shown.



From FBD of block

$2N \cos45^\circ = Mg$ .... (1)

For wedge to remain at rest

$N \sin 45^\circ < \mu N'$ .... (2)

and $N' = mg + N \cos 45^\circ$ .... (3)

From 1, 2 and 3 we get

$$M \le \frac{2\ \ m}{1-\mu}$$

7. If we consider blocks 2 & 1 independently then there accelerations would be

for block (1)

$$a_1 = g \sin\theta - \mu_1 g \cos\theta = g\left[\frac{\sqrt{3}}{2} - \frac{1}{2} \times \frac{1}{2}\right]$$

$$= \frac{g\ \ 2\sqrt{3} - 1}{4}$$

for block (2)

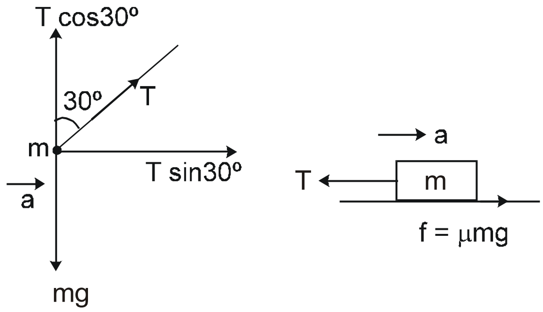
$$a_2 = g\sin\theta - \mu_2 g \cos\theta = g\left[\frac{\sqrt{3}}{2} - \frac{2}{5} \times \frac{1}{2}\right]$$

$$= \frac{g}{10}\ \ 5\sqrt{3} - 2$$

since $a_2 > a_1$ so both blocks will move separately.

8. $T \sin30^\circ = ma$ ....(1)

$T \cos30^\circ = mg$ ....(2)



dividing equation (1) by equation (2)

$\tan 30° = \dfrac{a}{g}$

$\Rightarrow \quad a = g \tan 30°$

$\Rightarrow \quad a = \dfrac{g}{\sqrt{3}}$ **Ans.**

From (2) $T = \dfrac{mg}{\cos 30^0} = \dfrac{2mg}{\sqrt{3}}$ **Ans.**

and $\mu mg - T = ma$

$\Rightarrow \quad \mu mg = T + ma = \dfrac{2mg}{\sqrt{3}} + ma$

$= \dfrac{2mg}{\sqrt{3}} + \dfrac{mg}{\sqrt{3}}$

$\Rightarrow \quad \mu mg = \dfrac{3mg}{\sqrt{3}} = \sqrt{3}\, mg$

$\Rightarrow \quad \mu = \sqrt{3}$ **Ans.**