PHYSICS

DPP
DAILY PRACTICE PROBLEMS

DPP No. 32

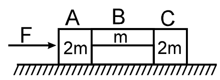
Total Marks : 25

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]**

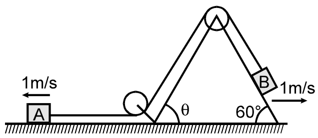
1. The system is pushed by a force F as shown in figure. All surfaces are smooth except between B and C. Friction coefficient between B and C is μ. Minimum value of F to prevent block B from downward slipping is



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

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

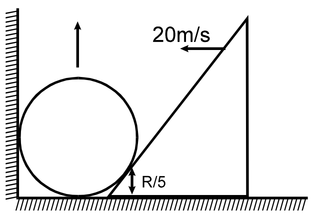
2. A system is shown in the figure. Block A is moving with 1 m/s towards left. Wedge is moving with 1 m/s towards right. Then speed of the block B will be:



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

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

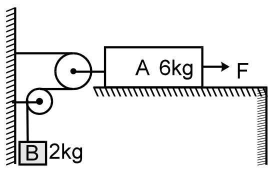
3. A sphere of radius R is in contact with a wedge. The point of contact is R/5 from the ground as shown in the figure. Wedge is moving with velocity 20 m/s, then the velocity of the sphere at this instant will be



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

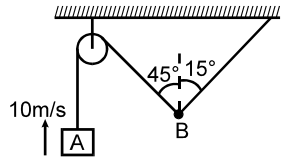
(C) 5 m/s (D) 10 m/s

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:



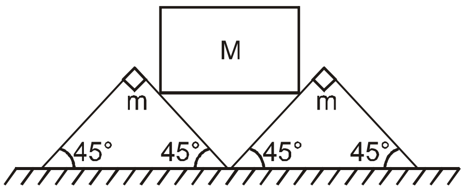
(A) $10\sqrt{2}$ m/s

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

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

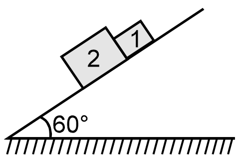
(D) 10 m/s

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 ?



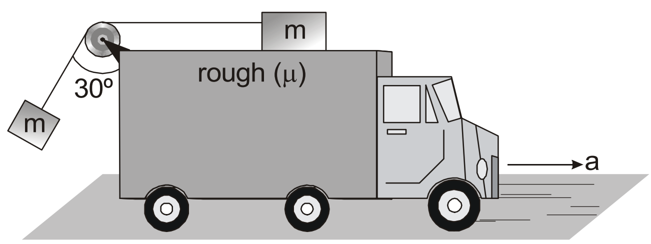
(A) $\frac{m}{\sqrt{2}}$ (B) $\frac{\mu m}{\sqrt{2}}$ (C) $\frac{\mu m}{1-\mu}$ (D) $\frac{2\mu m}{1-\mu}$

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 30º 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

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

Hint & Solutions

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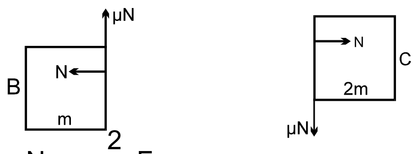
1. The acceleration of system is

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

Hence the normal reaction B exerts on C is

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

Thus frictional force on 'B' is

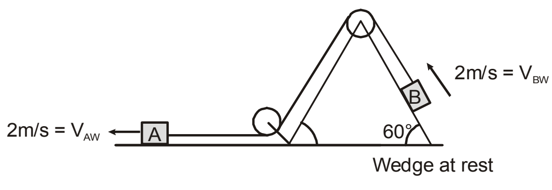


$$\mu N = \mu \frac{2}{5} F$$

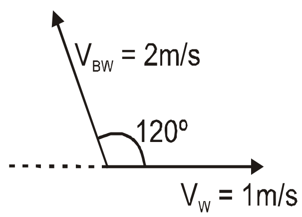
For B not of fall down.

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

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



So we have



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

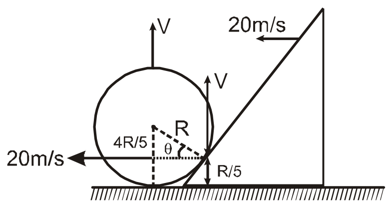
So

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

$$= \sqrt{1^2 + 2^2 + 2\times1\times2\times(-1/2)} = \sqrt{3} \text{ m/s}$$

3. Let v be velocity of sphere

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



From wedge constraint ;

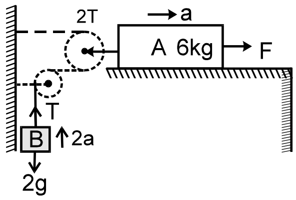
$V \sin\theta = 20 \cos\theta$

$V = 20 \cot\theta$

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

4. (B)

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

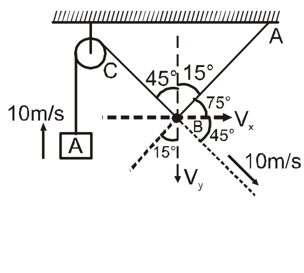


For 6 kg : – $F - 2T = 6a$

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

$V_x \sin45° + V_y \cos45° = 10$

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

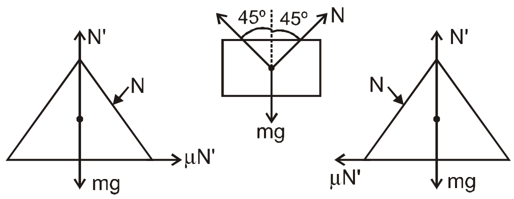
Net velocity along string BA is

$V_x \cos75° - V_y \cos15° = 0$ ....(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

$2N \cos45° = Mg$ .... (1)

For wedge to remain at rest

$N \sin 45° < \mu N'$ .... (2)

and $N' = mg + N \cos 45°$ .... (3)

From 1, 2 and 3 we get

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

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

for block (1)

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

$$= \frac{g\left[2\sqrt{3}-1\right]}{4}$$

for block (2)

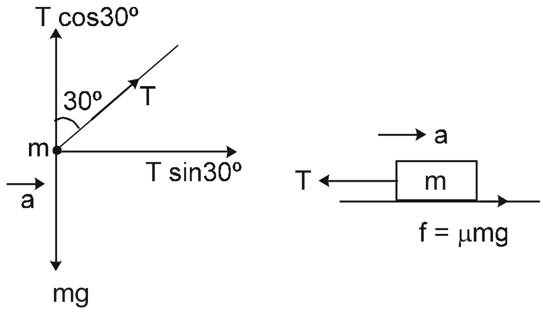
$$a_2 = g\sin\theta - \mu_2 g \cos\theta = g\left[\frac{\sqrt{3}}{2} - \frac{2}{5} \times \frac{1}{2}\right]$$

$$= \frac{g}{10}\left[5\sqrt{3}-2\right]$$

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

8. $T \sin30° = ma$ ....(1)

$T \cos30° = mg$ ....(2)



dividing equation (1) by equation (2)

$\tan 30^\circ = \dfrac{a}{g}$

$\Rightarrow \quad a = g \tan 30^\circ$

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