PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 33

Total Marks : 29

Max. Time : 31 min.

Topics : Projectile Motion, Friction,Newton's Law of 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 to Q.6	(4 marks, 4 min.)	[12, 12]
Subjective Questions ('–1' negative marking) Q.7 to Q.8	(4 marks, 5 min.)	[8, 10]

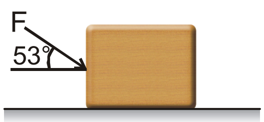
1. Two stones are projected simultaneously from a tower at different angles of projection with same speed 'u'. The distance between two stones is increasing at constant rate 'u'. Then the angle between the initial velocity vectors of the two stones is :

(A) 30° (B) 60° (C) 45° (D) 90°

2. A block is placed on an inclined plane and has to be pushed down. The angle of inclination of the plane is:

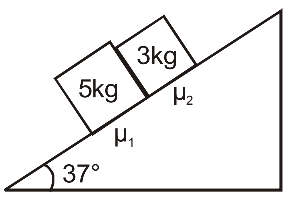
(A) equal to angle of repose (B) more than angle of repose
(C) less than the angle of repose (D) equal to angle of friction

3. A block of mass 20 kg is acted upon by a force F = 30 N at an angle 53° with the horizontal in downward direction as shown. The coefficient of friction between the block and the horizontal surface is 0.2. The friction force acting on the block by the ground is (g = 10 m/s^2)



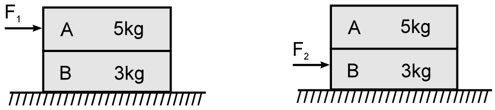
(A) 40.0 N (B) 30.0 N (C) 18.0 N (D) 44.8 N

4. Two blocks of masses 5 kg and 3kg are placed in contact over a fixed inclined surface of angle 37°, as shown. μ_1 is friction coefficient between 5kg block and the surface of the incline and similarly, μ_2 is friction coefficient between the 3kg block and the surface of the incline. After the release of the blocks from the inclined surface,



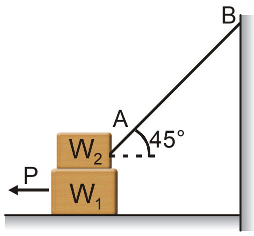
(A) if μ_1 = 0.5 and μ_2 = 0.3 then 5 kg block exerts 3N force on the 3 kg block
(B) if μ_1 = 0.5 and μ_2 = 0.3 then 5 kg block exters 8 N force on the 3 kg block
(C) if μ_1 = 0.3 and μ_2 = 0.5 then 5 kg block exerts 1 N force on the 3kg block.
(D) if μ_1 = 0.3 and μ_2 = 0.5 then 5 kg block exerts no force on the 3kg block.

5. A block A (5 kg) rests over another block B (3 kg) placed over a smooth horizontal surface. There is friction between A and B. A horizontal force F_1 gradually increasing from zero to a maximum is applied to A so that the blocks move together without relative motion. Instead of this another horizontal force F_2, gradually increasing from zero to a maximum is applied to B so that the blocks move together without relative motion. Then



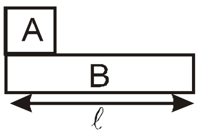
(A) F_1 (max) = F_2 (max)
(B) F_1 (max) > F_2 (max)
(C) F_1 (max) < F_2 (max)
(D) F_1 (max): F_2 (max) = 5: 3

6. In the arrangement shown, W_1 = 200 N, W_2 = 100 N, μ = 0.25 for allsurfaces in contact. The block W_1 just slides under the block W_2.



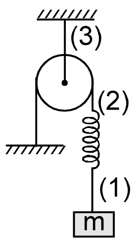
(A) A pull of 50 N is to be applied on W_1
(B) A pull of 90 N is to be applied on W_1
(C) Tension in the string AB is $10\sqrt{2}$ N
(D) Tension in the string AB is $20\sqrt{2}$N

7. Figure shows a small block A of mass m kept at the left end of a plank B of mass M = 2m and length ℓ. The system can slide on a horizontal road. The system is started towards right with the initial velocity v. The friction coefficients between the road and the plank is 1/2 and that between the plank and the block is 1/4. Find



(a) the time elapsed before the block separate from the plank.
(b) displacement of block and plank relative to ground till that moment.

8. Find the tensions in the strings (1), (2) and (3) and the acceleration of the mass 'm' just after (intially system is in equilibrium and at rest, pulley, string, spring are light):



(a) string (1) is cut
(b) string (2) is cut
(c) string (3) is cut

Answers Key

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

5. (B) (D) **6.** (B)(D) **7.** **(a)** $t = 4\sqrt{\frac{\ell}{3g}}$

(b) $S_A = 4V\sqrt{\frac{\ell}{3g}} - \frac{2}{3}\ell$, $S_B = 4V\sqrt{\frac{\ell}{3g}} - \frac{5}{3}\ell$,

8. (a) $T_1 = 0$; $T_2 = 0$; $T_3 = 0$; $a = g$
(b) $T_1 = 0$; $T_2 = 0$; $T_3 = 0$; $a = g$
(c) $T_1 = 0$; $T_2 = 0$; $T_3 = 0$; $a = g$

Hint & Solutions

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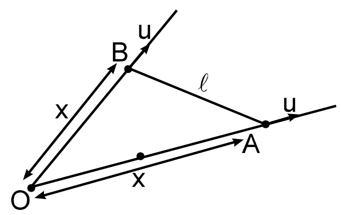
1. To an observer who starts falling freely under gravity from rest at the instant stones are projected, the motion of stone A and B is seen as



$$\frac{dx}{dt} = u \quad ....(1)$$

$$\frac{d\ell}{dt} = u \quad ....(2)$$

$\therefore$ $x = \ell$ and $\angle BOA = 60°$

2. Block slides down itself if inclination of plane is greater than angle of repose else it has to be pushed down.sw

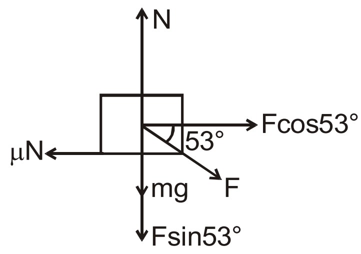
3. Max. frictional force

$f_{max} = \mu N$

$= \mu(mg + F \sin 53°)$

$= 0.2\ (20 \times 10 + 30 \times \frac{4}{5})$

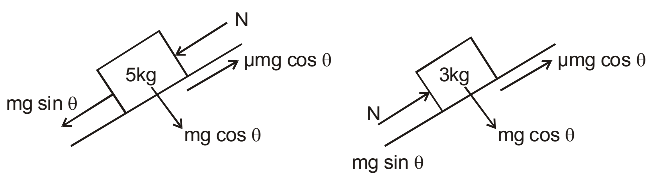
$= 44.8$ N



As applied horizontal force is Fcos53° $= 18\text{N} < f_{max}$, friction force will also be 18 N.

4. **Case-I :** $\mu_1 = 0.5$, $\mu_2 = 0.3$

Along the incline, acceleration of 5 kg block will be less than acceleration of 3 kg block provided they move alone on the incline. The reason is greater friction coefficient of 5 kg block, as acceleration along the incline is $g \sin\theta - \mu g \cos\theta$ One to the contain, both blocks will move together. In this case FBDs of both are shown.



For 5 kg block

$m_1 g \sin\theta + N - \mu_1 m_1 g \cos\theta = m_1 a$

For 3 kg block

$m_2 g \sin\theta - N - \mu_2 m_2 g \cos\theta = m_2 a$

5. **(B,D)** Case I :

Since, no relative motion :

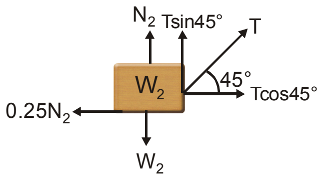
$$a = \frac{F_1 - F_f}{5} = \frac{F_f}{3} \quad \Rightarrow \quad F_{1\,(max)} = \frac{8}{3}F_f$$

Case II :

$$a = \frac{F_f}{5} = \frac{F_2 - F_f}{3} \quad \Rightarrow \quad F_{2\,(max)} = \frac{8}{5}F_f$$

Clearly ; $F_{1\,(max)} > F_{2\,(max)}$ and $\frac{F_{1(max)}}{F_{2(max)}} = \frac{5}{3}$

6. B, D

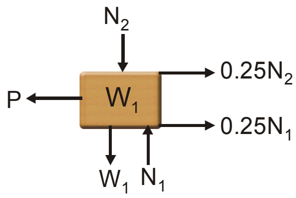


For W_2 :

$N_2 + T\sin45° = W_2 = 100$ .... (1)

$T\cos45° = 0.25\,N_2$ .... (2)

$\Rightarrow\ T = 20\sqrt{2}\,N\ ,\ N_2 = 80\ N$



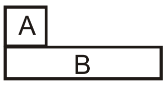
For W_1 :

$P = 0.25\,(N_1 + N_2)$ .... (3)

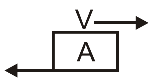
$N_2 + W_1 = N_1$ .... (4)

$\Rightarrow\ N_1 = 280\ N$

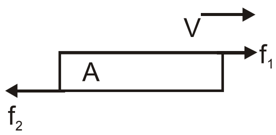
7.



System start moving towards right with velocity v.



$f_1 = 1/4\ mg$ $\qquad a_A = \dfrac{g}{4}$



$a_B = \dfrac{f_2 - f_1}{2m}$

$$= \frac{\frac{1}{2}(3m)g - \frac{1}{4}mg}{2m} = \frac{5g}{8}$$

$U_{rel} = 0$

$$a_{rel} = \frac{5g}{8} - \frac{g}{4} = \frac{3g}{8}$$

$$\therefore\ \ \ell = \frac{1}{2}\frac{3}{8}gt^2$$

$$t = 4\sqrt{\frac{\ell}{3g}}$$

$$S_1 = vt - \frac{1}{2}\frac{g}{4}\ t^2 = 4v\sqrt{\frac{\ell}{3g}} - \frac{2\ell}{3}\ s$$

$$S_2 = vt - \frac{1}{2}\frac{5}{8}\,gt^2 = 4v\sqrt{\frac{\ell}{3g}} - \frac{5}{3}\ell\ .$$

8. **Ans.** (a) $T_1 = 0$; $T_2 = 0$; $T_3 = 0$; $a = g$
(b) $T_1 = 0$; $T_2 = 0$; $T_3 = 0$; $a = g$
(c) $T_1 = 0$; $T_2 = 0$; $T_3 = 0$; $a = g$