PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 31

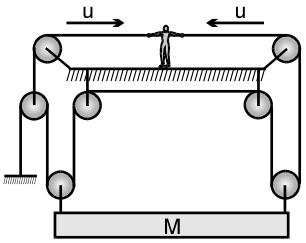
Total Marks : 22

Max. Time : 22 min.

Topics : Newtons's Law of Motion, Projectile Motion, Friction

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.6	(3 marks, 3 min.)	[18, 18]
Multiple choice objective ('–1' negative marking) Q.7	(4 marks, 4 min.)	[4, 4]

1. System is shown in the figure and man is pulling the rope from both sides with constant speed ' u'. Then the speed of the block will be:



(A) $\frac{3u}{4}$

(B) $\frac{3u}{2}$

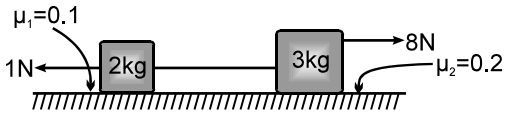
(C) $\frac{u}{4}$

(D) none of thes

2. Hailstones falling vertically with a speed of 10 m/s, hit the wind screen (wind screen makes an angle 30° with the horizontal) of a moving car and rebound elastically. The velocity of the car if the driver finds the hailstones rebound vertically after striking is :

(A) $10\sqrt{3}$ m/s (B) $20\sqrt{3}$ m/s (C) 10 m/sec (D) $\frac{10}{\sqrt{3}}$ m/sec

3. In the shown arrangement if f_1, f_2 and T be the frictional forces on 2 kg block, 3kg block & tension in the string respectively, then their values are:



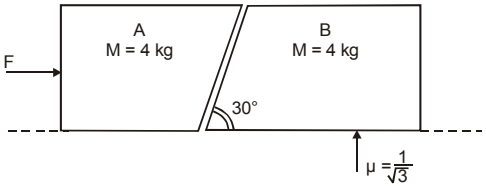
(A) 2 N, 6 N, 3.2 N

(B) 2 N, 6 N, 0 N

(C) 1 N, 6 N, 2 N

(D) data insufficient to calculate the required values.

4. Two blocks A and B are placed in contact on a horizontal surface. Faces of blocks A and B, which are in contact, are inclined at 30° with the horizontal, as shown. There is no friction between block A and any surface which is in contact with this whereas friction coefficient between block B and the surface is $\frac{1}{\sqrt{3}}$. A force F is applied in horizontal direction on block A. What is the minimum value of F at which the block B just start moving rightwards?



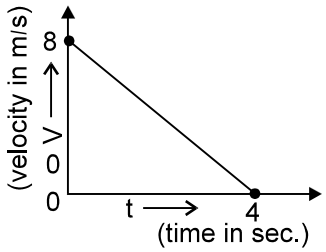
(A) $\frac{40}{\sqrt{3}}$N

(B) $\frac{80}{\sqrt{3}}$N

(C) 100 N

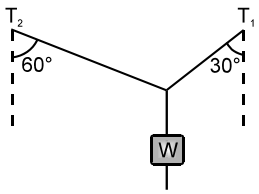
(D) For any value of F, motion will not start

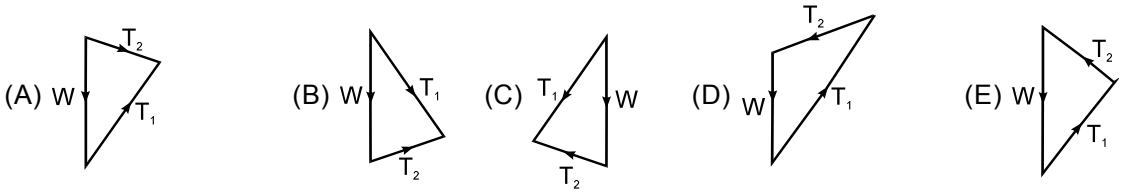
5. A block of mass 2 kg is given a push for a moment horizontally and then the block starts sliding over a horizontal plane. The graph shows the velocity-time graph of the motion. The co-efficient of sliding friction between the plane and the block is:



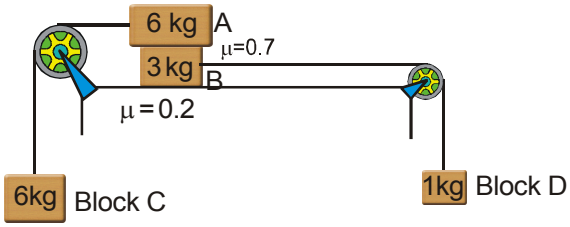
(A) 0.02 (B) 0.20
(C) 0.04 (D) 0.40

6. A weight W is supported by two strings inclined at 60º and 30º to the vertical. The tensions in the strings are T_1 & T_2 as shown. If these tensions are to be determined in terms of W using a triangle of forces, which of these triangles should you draw? (block is in equilibrium)





7. An arrangement of the masses and pulleys is shown in the figure. Strings connecting masses A and B with pulleys are horizontal and all pulleys and strings are light. Friction coefficient between the surface and the block B is 0.2 and between blocks A and B is 0.7. The system is released from rest. (use g = 10 m/s^2)



(A) The magnitude of acceleration of the system is 2 m/s^2 and there is no slipping between block A and block B.
(B) The magnitude of friction force between block A and block B is 42 N.
(C) Acceleration of block C is 1 m/s^2 downwards.
(D) Tension in the string connecting block B and block D is 12 N.

Answers Key

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

Hint & Solutions

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1. $u = \frac{0+v_1}{2}$, $\frac{v_1+v_2}{2} = v$, $\frac{-v_2+u}{2} = v$

Hence v = velocity of M = $\frac{3u}{4}$.

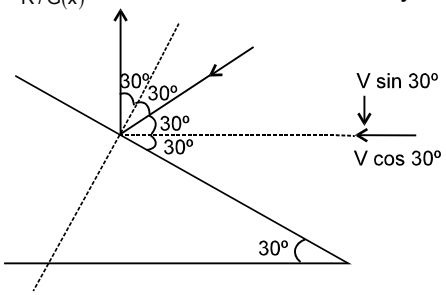
2. For the driver to observe the rain move vertically upward after the elastic collision, rain shoud come at an angle 30° with the horizontal (as clear from figure).

Let , velocity of rain w.r.t. car be $V_{m/c}$

$\vec{V}_{R/G} = \vec{V}_{R/C} + \vec{V}_{C/G}$

$\vec{V}_{R/G(x)} = \vec{V}_{R/C(x)} + \vec{V}_{C/G(x)}$

But $\vec{V}_{R/G(x)} = 0$, since rain fall vertically down.



$\Rightarrow \vec{V}_{C/G(x)} = -\vec{V}_{R/C(x)} = -(V \cos 30°)$

$\Rightarrow |\vec{V}_{C/G(x)}| = V \cos 30°$ .....(i)

Now, $\vec{V}_{R/G(y)} = \vec{V}_{R/C(y)}$

$\Rightarrow -10 = -V \sin 30° + 0$

[Since ; $V_{R/G(y)} = -10$ m/s ; $V_{C/G(y)} = 0$]

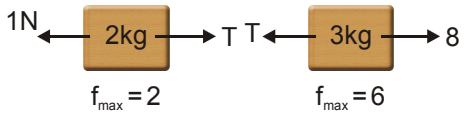
$\Rightarrow$ V sin 30° = 10 $\Rightarrow$ V = 20 m/s.

Substituting V = 20 m/s in equation (i)

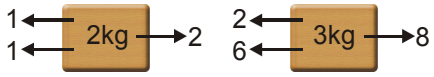
$\vec{V}_{C/G(x)} = V \cos 30° = 20 \times \frac{\sqrt{3}}{2} = 10\sqrt{3}$ m/s.

$\therefore \vec{V}_{C/G} = 10\sqrt{3}\,\hat{i}$ m/s.

3. **(C)** FBD



Net force without friction on system is '7N' in right side so first maximum friction will come on 3 kg block.



So f_1 = 1 N, f_2 = 6 N, T = 2N

f_1 = 1 N, f_2 = 6 N, T = 2N

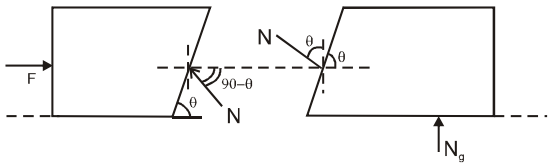
4. $F = N \sin\theta \qquad N = \dfrac{F}{\sin\theta}$

$N \sin\theta = \mu (N \cos\theta + mg)$

$F = \mu(F \cot\theta + mg)$

$F(1 - \mu \cot\theta) = \mu mg$

$F = \dfrac{\mu mg}{1 - \mu \cot\theta}$



On putting $\mu = \dfrac{1}{\sqrt{3}}$ and $\theta = 30°$

$\mu = \dfrac{1}{\sqrt{3}} \quad \theta = 30°$

$F = \infty$

Therefore motion will not start for any value of F.

5. The magnitude of deceleration from graph is

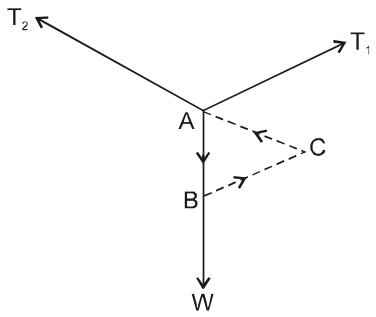
$a = \dfrac{8-0}{4-0} = 2 m/s^2$

The deceleration of block is

$a = \mu g \qquad \therefore \ \mu = \dfrac{a}{g} = 0.2$

6. $\overrightarrow{AB} = \overrightarrow{W}$, $\overrightarrow{BC} = \overrightarrow{T_1}$, $\overrightarrow{CA} = \overrightarrow{T_2}$

$\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{CA} = 0$



Ans. (E)

7. Suppose blocks A and B move together. Applying NLM on C, A + B, and D

60 – T = 6a

T – 18 – T' = 9a

T' – 10 = 1a

Solving a = 2 m/s^2

To check slipping between A and B, we have to find friction force in this case. If it is less than limiting static friction, then there will be no slipping between A and B.

Applying NLM on A.

T – f = 6(2)

as T = 48 N

f = 36 N

and f_s = 42 N hence A and B move together.

and तथा T' = 12 N.