DPP
DAILY PRACTICE PROBLEMS

CLASS : XIth
DATE :

Solutions

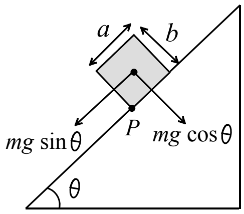
SUBJECT : PHYSICS
DPP No. : 6

Topic :- LAWS OF MOTION

1 **(b)**

For rotational equilibrium about point "P",

$mg\sin\theta\left(\frac{b}{2}\right) = mg\cos\theta\left(\frac{a}{2}\right)$



$\Rightarrow \tan\theta = \frac{a}{b} = \frac{10}{15} = \frac{2}{3}$

$\Rightarrow \theta = 33.69°$

i.e., toppling starts at $\theta = 33.69°$

and angle of repose $= \tan^{-1}(\mu) = \tan^{-1}(\sqrt{3}) = 60°$

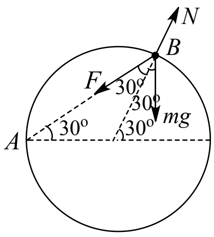
It mean the block will remain at rest on the plane up to certain angle θ and then it will topple

2 **(d)**

Extension in the string is

$x = AB - R = 2R\cos 30° - R = (\sqrt{3} - 1)R$

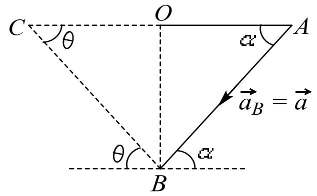
Spring force: $F = kx = \frac{(\sqrt{3}+1)mg}{R} \times (\sqrt{3} - 1)R = 2mg$



From the figure, we have $N = (F + mg)\cos 30° = \frac{3\sqrt{3}mg}{2}$

3 **(d)**

Direction of acceleration of B is along the fixed incline, and the of A is alonmg horizontal towards left

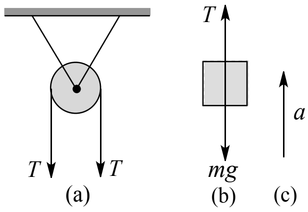


From diagram, acceleration of B is represented by $\overline{AB}$ while its horizontal and vertical components are shown by AO and OB, respectively. Acceleration of A is represented by $\overline{AC}$

$\vec{O}C = a(\sin\alpha\cot\theta + \cos\alpha)$

4 **(b)**

Equation of motion for M:



Since M is stationary

$T - Mg = 0 \Rightarrow T = mg$

Since the boy moves up with an acceleration a

$T - mg = ma \Rightarrow T = m(g + a)$

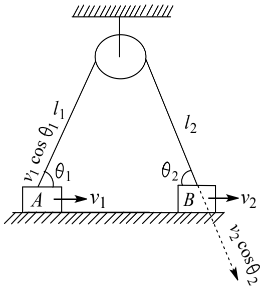
Equating Eqs. (i) and (ii), we obtain

$Mg = m(g + a)$

$\Rightarrow\ a = \left(\frac{M}{m} - 1\right)$ g, the block M can be lifted

5 **(c)**

From figure $\ell_1 + \ell_2 = C\ \ or\ \frac{d\ell_1}{dt} + \frac{d\ell_2}{dt} = 0$



$-v_1\cos\theta_1 + v_2\cos\theta_2 = 0$ or $\frac{v_1}{v_2} = \frac{\cos\theta_2}{\cos\theta_1}$

6 **(a)**

Velocity of object w.r.t. non-inertial frame is constant and hence w.r.t. some inertial frame of reference it is changing, hence it is acceleration. So net force acting on the object must be non-zero

7 **(a)**

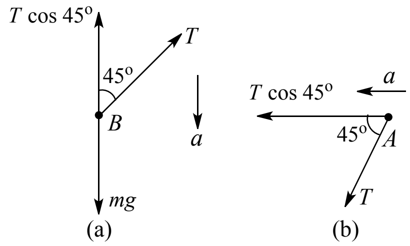
Let the total mass of the chain be M and mass of the hanging part be m_1. Then the mass of the part placed on table will be $m_2 = M - m_1$

Here weight of the hanging part will be balanced by the friction force acting on the upper part, i.e.

$m_1 g = \mu m_2 g$ solve to get $(m_1/M) \times 100 = 20\%$

8 **(d)**

As shown in figure (a) and (b) from FBD of A $T\cos 45° = ma$ (i)



From FBD of B:

$Mg - T\cos 45° = ma$ (2)

From (i) and(ii), we get $T = mg/\sqrt{2}$

9 **(b)**

For A:$T - 2g = 2a$ (i)

For B:$T_1 + 2g - T = 2a$ (ii)

For C:$2g - T_1 = 2a$ (iii)

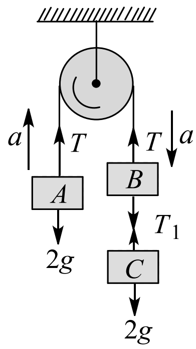
Adding (i) and (ii), we get

$T_1 = 4a$ (iv)

From Eq. (iii) and (iv), we get

$2g - 4a = 2a$

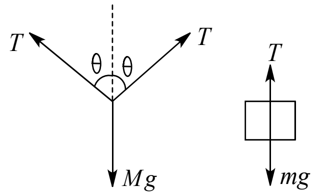
or $a = g/3$



From Eqs. (iv) and (v), $T_1 = 4 \times \frac{g}{3} = 13$ N

10 **(c)**

At equation $2T\cos\theta = Mg, T = mg$

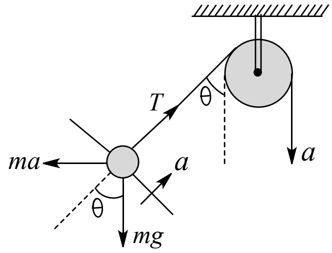


$\cos\theta = \frac{Mg}{2mg} = \frac{M}{2m} \Rightarrow \cos\theta < 1$

$\frac{M}{2m} < 1 \Rightarrow M < 2m$

11 **(c)**

(Check figure in the frame of the car)



Applying Newton's law perpendicular to string

$mg\sin\theta = ma\cos\theta \Rightarrow \tan\theta = \frac{a}{g}$

Applying Newton's law along string

$T - mg\cos\theta - ma\sin\theta = ma$

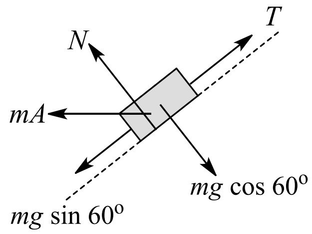
$\Rightarrow T = m\sqrt{g^2 + a^2} + ma$

12 **(b)**

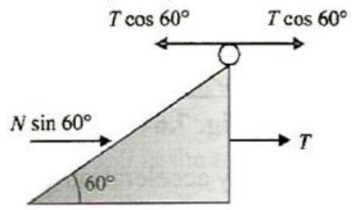
If initial acceleration of M towards right is A, thewn we can show that acceleration of m w.r.t. M down the incline is

$a = A(1 + \cos\theta) = \frac{3A}{2} \quad (\because \theta = 60°)$

FBD of block m (w.r.t. M) is shown below:



FBD of M (figure)



Equation of motion:

For m:$mg\frac{\sqrt{3}}{2} + mA \times \frac{1}{2} - T = m\frac{3}{2}A$ (i)

$N + mA\frac{\sqrt{3}}{2} = mg\frac{1}{2}$ (ii)

For M:$T + N\frac{\sqrt{3}}{2} = MA$ (iii)

From Eq. (i), (ii) and (iii) $A = \frac{3\sqrt{3}\,g}{23}$ ms^{-1}

13 **(c)**

From $s = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2}at^2, t = \sqrt{\frac{2s}{a}}$

From smooth plane $a = g\sin\theta$

For rough plane, $a' = g(\sin\theta - \mu\cos\theta)$

$\therefore\ t' = nt \Rightarrow \sqrt{\frac{2s}{g(\sin\theta - \mu\cos\theta)}} = n\sqrt{\frac{2s}{g\sin\theta}}$

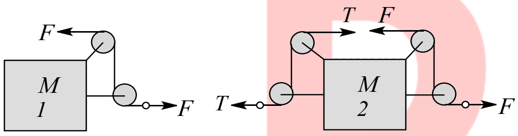
$\therefore\ n^2 g\,(\sin\theta - \mu\cos\theta) = g\sin\theta$

When $\theta = 45°, \sin\theta = \cos\theta = 1/\sqrt{2}$

Solving, we get $\mu = \left(1 - \frac{1}{n^2}\right)$

14 **(b)**

From FBD it is obvious that net force on each block is zero in horizontal direction. So $a_1 = a_2 = 0$



15 **(c)**

Frictional force:

$F = mR = 0.5 \times mg = 0.5 \times 60 = 30$ N

Now $F = T_1 = T_2\cos 45°$ or $30 = T_2\cos 45°$

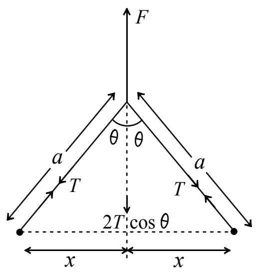
and $W = T_2\sin 45°$

Solving them, we get $W = 30$ N

16 **(b)**

$F = 2T\cos\theta$

$\Rightarrow T = \dfrac{F}{2\cos\theta}$



Magnitude of acceleration of the particle

$= \dfrac{T\sin\theta}{m}$

$$= \frac{F \tan\theta}{2m} = \frac{F}{2m} \frac{x}{\sqrt{a^2 - x^2}}$$

17 **(b)**

Change in momentum of one ball $= 2\,mu$, time taken = 1 s

$$F_{\text{av}} = \frac{\text{Total chnage in momentum}}{\text{Time taken}}$$

$$= \frac{n(2\,mu)}{1} = 2\,mnu$$

18 **(b)**

$$a = \frac{3T - mg \sin\theta}{m}$$

$$= \frac{3 \times 250 - 100 \times 10 \times \sin 30°}{100} = 2.5 \text{ ms}^{-2}$$

19 **(b)**

The pressure on the rear side would be more due to fictitious force (acting in the opposite direction of acceleration) on the rear face. Consequently the pressure in the front side would be lowered

20 **(b)**

$\vec{u} = 4\hat{i} + 2\hat{j}, \vec{a} = \frac{\vec{F}}{m} = \hat{i} - 4\hat{j}$

Let at any time, the coordinate be (x, y)

$x - 2 = u_x t + \frac{1}{2} a t^2$

$\Rightarrow x - 2 = 4t + \frac{1}{2} t^2$ *and* $y - 3 = 2t - \frac{1}{2} 4t^2$

$\Rightarrow y - 3 = 2t - 2t^2$

When $y = 3$m, $t = 0$, 1 s; when $t = 0$, $x = 2$ m When $t = 1$ s, $x = 6.5$ m

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	B	D	D	B	C	A	A	D	B	C
Q.	11	12	13	14	15	16	17	18	19	20
A.	C	B	C	B	C	B	B	B	B	B