DPP
DAILY PRACTICE PROBLEMS

CLASS : XIth **Solutions** **SUBJECT : PHYSICS**
DATE : **DPP No. : 5**

Topic :- LAWS OF MOTION

1 **(b)**

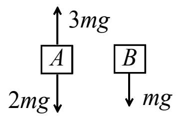
To move up with acceleration a, themonkey will, push the rope downwards with a force of

$T_{\text{min}} = mg + 40\ a_{\text{max}}; 600 = 400 + 40\ a_{\text{max}}$

$a_{\text{max}} = \frac{200}{40} 5$ ms^{-2}

So rope will break if the monkey climbs up with acceleration 6 ms^{-2}

2 **(b)**



$a_A = g/2$

$a_B = g$

3 **(b)**

The force of 100 N acts on both the boats

$250\ a_1 = 100$ and $500 a_2 = 100$

or $a_1 = 0.4$ ms^{-2} and $a_2 = 0.2$ ms^{-2}

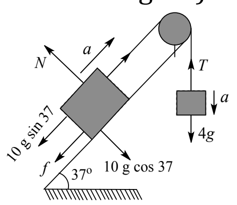
the relative acceleration: $a_2 = 0.2$ ms^2

Using $S = ut + \frac{1}{2}at^2$ we get

$100 = (1/2) \times 0.6 \times t^2$ or $t = 18.3$ s

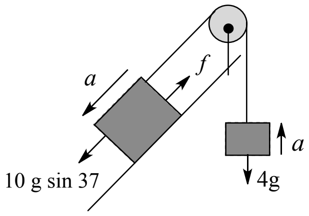
4 **(a)**

Let us first assume that the 4 kg block is moving down, then different forces acting on two blocks would be like as shown in the figure. (Normal to inclines forces are not shown in figure)



To have the motion, he friction force f should be equal to limiting value i.e., $f_L = \mu_s mg\cos 37 = 0.27 \times 10g \times \frac{4}{5} = 2.16$ g

here, the 4 kg block is not able to pull the 10 kg block up the incline as $4g < 10g\sin 37 + f_L$, so system won't move in the direction that we assumed. So if there is a chance of motion of system, it can only move down the incline and system will move only if the net pulling force down the incline is greater than zero. For down the incline motion, the FBD is as shown in the figure



For a to be non-zero, i.e., positive

$10g\sin 37 > f_L + 4g$

Which is not, so the system is moving neither down the incline, nor up the incline and so the system remains at rest

5 **(b)**

For equilibrium

$$\int \mu dmg\cos\theta \geq \int dmg\sin\theta$$

or $\int \mu\lambda\, d\ell g\cos\theta \geq \int \lambda\, d\ell g\sin\theta$

$$\mu \int d\ell \cos\theta \geq \int d\ell \sin\theta$$

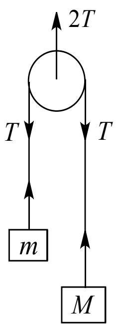
$$\left(\therefore \sin\theta = \frac{dy}{d\ell}, \cos\theta = \frac{dx}{d\ell}\right)$$

or $\mu\int dx \geq \int dy$ or $\mu\ell \geq h$

6 **(b)**

$$T = \frac{2m\,Mg}{m+M} = \frac{2mg}{1+\frac{m}{M}} \simeq 2\,mg$$

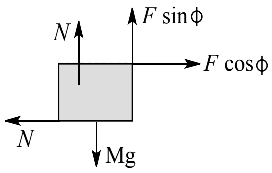
Hence, total downward force is $2T = 4\,mg$



7 **(c)**

$N = Mg - F\sin\phi$

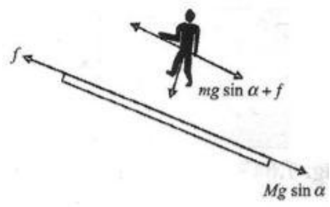
From figure



$$a = \frac{F\cos\phi - \mu(Mg - F\sin\phi)}{M}$$

8 **(b)**

Free-body diagram of man and plank is given below figure



For plank to be at rest, applying Newton's second law to plank along the incline

$M\text{g}\sin\alpha = f$ (i)

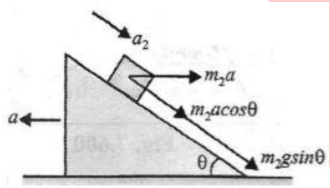
And applying Newton's second law to man along the incline

$m\text{g}\sin\alpha + f = ma$ (ii)

$\Rightarrow a = \text{g}\sin\alpha\left(1 + \frac{M}{m}\right)$ down the incline

9 **(a)**

In first case, acceleration of m_1 will be $a_1 = \text{g}\sin\theta$ down the inclined plane. In second case,



Acceleration of m_2 w.r.t. incline is

$$a_2 = \frac{m_2\text{g}\sin\theta + m_2 a\cos\theta}{m_2} \Rightarrow a_2 = \text{g}\sin\theta + a\cos\theta$$

Since $a_2 > a_1$, so $T_2 < T_1$

10 **(c)**

Maximum frictional force on block B is

$\mu m_B \text{g} = 0.4 \times 3 \times 10 = 12$ N

Hence, maximum acceleration $= \frac{12}{3} = 4$ ms^{-1}

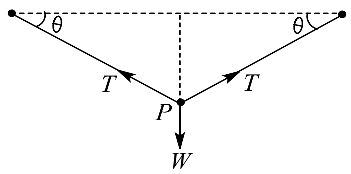
Hence, maximum force

$F = (m_A + m_B)a = (6 + 3) \times 4 = 36$ N

Aliter: We can also apply the formula discussed in previous problem by putting $\mu_2 = 0$ and $\mu_1 = 0.4$

11 **(d)**

When a string is fixed horizontally (by champing its free ends) and loaded at the middle, then for the equilibrium of point P



$2T\sin\theta = W$

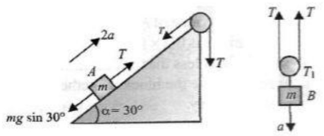
i.e., $T = \frac{W}{2\sin\theta}$

Tension in the string will be maximum when $\sin\theta$ is minimum, i.e., $\theta = 0°$ or $\sin\theta = 0$ and then$T = \infty$. However, as every string can bear a maximum finite tension (lesser than breaking strength), this situation cannot be realized practically. We conclude that a string can never remain horizontal when loaded at the middle howsoever great may be the tension applied

12 **(d)**

For b (figure)

$mg - 2T = ma$



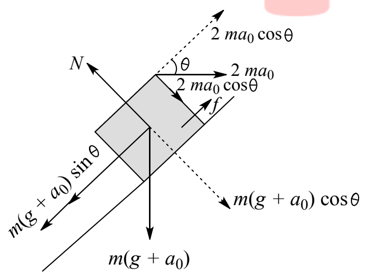
For A,

$T - \frac{mg}{2} = m(2a)$

Solving $a = 0$

13 **(d)**

The FBD of block from lift frame is as shown in figure. From given data, as $m(g + a_0)$ $\sin\theta > 2\,ma_0\cos\theta$



So friction force acts upwards

$f = m(g + a_0)\sin\theta - 2ma_0\cos\theta$

$= \frac{9g}{10} - \frac{4mg}{5} = \frac{mg}{10}$

$N = m(g + a_0)\cos\theta + 2ma_0\sin\theta = \frac{9mg}{5}$

As $f_L = \mu_s N = \frac{18mg}{50} = \frac{9mg}{25} > f$ so static friction

Reaction force,

$R = \sqrt{f^2 + N^2} = \frac{mg}{5}\sqrt{\frac{1}{4} + 9^2} = \frac{mg\sqrt{13}}{2}$

Alternative solution:

Net force $\vec{F} - mg\hat{i} = m(a_0\hat{j} - 2a_0\hat{i})$

$$\Rightarrow \vec{F} = m\left(-2a_0\hat{i} + (a_0 + g)\hat{j}\right) \Rightarrow \vec{F} = m\left(-g\hat{i} + \frac{3g}{2}\hat{j}\right)$$

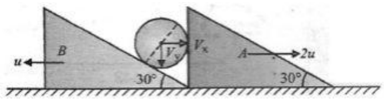
$$\Rightarrow F = m\sqrt{g^2 + \left(\frac{3g}{2}\right)^2} = \frac{\sqrt{13}mg}{2}$$

14 **(d)**

Method-1:Velocity components perpendicular to the comtact surface remain same

As cylinder will remain in contact with wedge A, (figure)

$V_x = 2u$



As it also remain in contact with wedge B

$u \sin 30° = V, \cos 30° - V, \sin 30°$

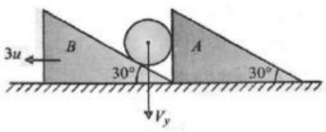
$$V_y = V_x\frac{\sin 30°}{\cos 30°} + \frac{u \sin 30°}{\cos 30°}$$

$V_y = 3u \tan 30° = \sqrt{3}\,u$

$\Rightarrow V = \sqrt{V_x^2 + V_y^2} = \sqrt{7}u$

Method-2

In the frame of A



$3u \sin 30° = V_y \cos 30°$

$V_y = 3u\tan 30° = \sqrt{3}\,u$ and $V_x = 2u$

$\Rightarrow\ V = \sqrt{V_x^2 + V_y^2} = \sqrt{7}\,u$

15 **(a)**

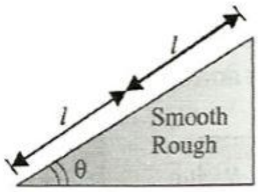
Since there in no resultant external force, linear momentum of the system remains constant

16 **(a)**

For first half acceleration $= g\sin\phi$

Therefore, velocity after travelling half distance

$v^2 = 2(g\sin\phi)l$ (i)



For second half, acceleration $= g(\sin\phi - \mu_k\cos\phi)$

So $0^2 = v^2 + 2g(\sin\phi - \mu_k\cos\phi)\ell$ (ii)

Solving (i) and (ii), we get $\mu_k = 2\tan\phi$

17 **(c)**

Given horizontal force $F = 25$ N and coefficient of friction between block and wall (μ) $= 0.4$

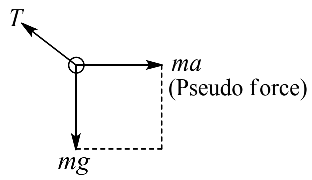
We know that at equilibrium horizontal force provides the normal reaction to the block against the wall. Therefore, normal reaction to the block $(R) = F = 25$ N

We also know that weight of the block $(W) =$ Frictional force $= \mu R = 0.4 \times 25 = 10$ N

18 **(b)**

Acceleration of box $= 10\ \mathrm{ms^{-2}}$

Inside the box forces acting on bob (see figure)



$T = \sqrt{(mg^2) + (ma)^2} = 10\sqrt{2}$ N

19 **(c)**

$a_{B,g} = \sqrt{b^2 + c^2 + 2bc\cos(180 - \theta)}$

$= \sqrt{b^2 + \left(\frac{b\cos\theta}{2}\right)^2 + bb\cos\theta\,(-\cos\theta)}$

$= b\sqrt{1 + \frac{\cos^2\theta}{4} - \cos^2\theta} = \frac{b}{2}\sqrt{1 + 3\sin^2\theta}$

$= \frac{2g\sin\theta}{\sqrt{1 + 3\sin\theta}}$

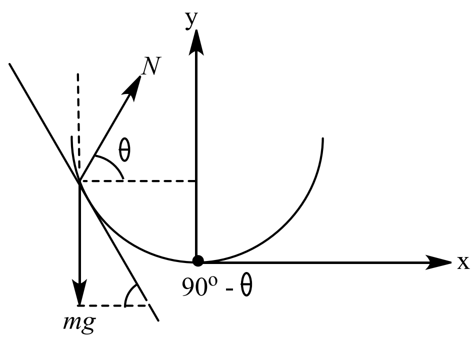
20 **(d)**

$N\sin\theta = mg$

$N\cos\theta = ma$

$\tan\theta = \frac{g}{a}$

$\cos\theta = \frac{a}{8} = \tan(90° - \theta) - \frac{dy}{dx} = 2k\,x$



$\therefore x = \frac{a}{2k\,g}$

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