3. In the above question, thension in string is

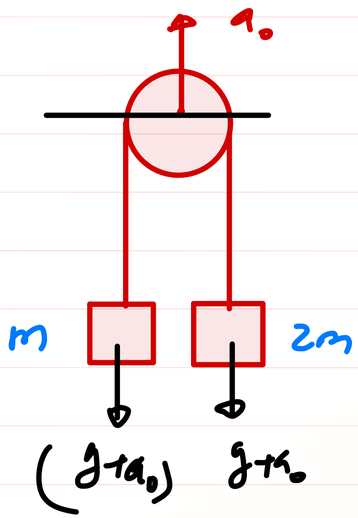
(A) $\frac{4}{3}m(g+a_0)$ (B) $\frac{4}{3}m(g-a_0)$ (C) $\frac{4}{3}mg$ (D) $\frac{2mg}{3}$

From Eq. ①

$$T - mg - ma_0 = m\frac{1}{3}(g+a_0)$$

$$T = m(g+a_0) + \frac{m}{3}(g+a_0)$$

$$T = \frac{4m}{3}(g+a_0)$$

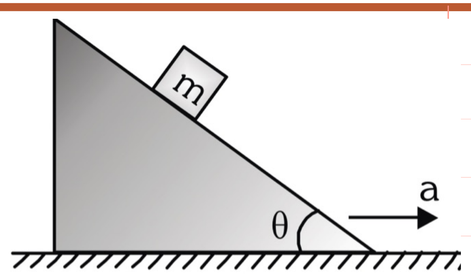


$$a_r = \frac{2m(g+a_0) - m(g+a_0)}{m+2m}$$

$$a_r = \frac{m(g+a_0)}{3m}$$

$$a_r = \frac{1}{3}(g+a_0)$$

5. In the given figure if acceleration of block with respect to wedge is zero. Then find the value of 'a'

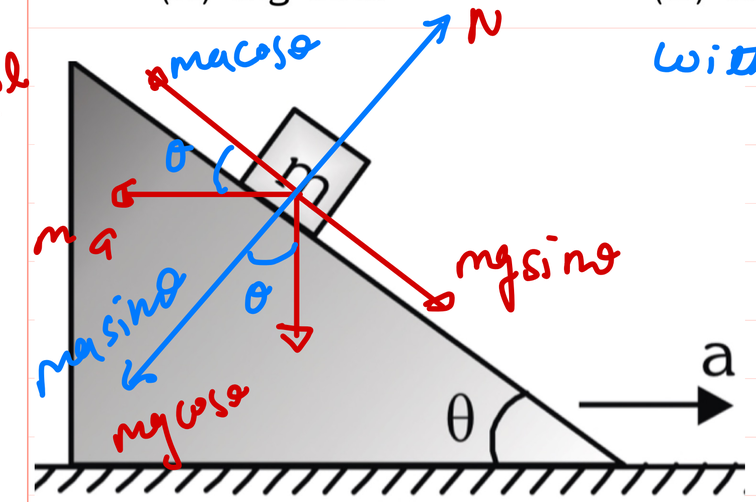


(A) g cotθ
(B) g sinθ
(C) g tanθ
(D) g cosθ

6. In above question find normal force between block and wedge.

(A) mg cosθ
(B) mg sec θ
(C) mg tan θ
(D) mg cosec θ

Sol



With respect to wedge

$a_x = 0$

$mg\sin\theta - ma\cos\theta = m(a_x)$

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

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

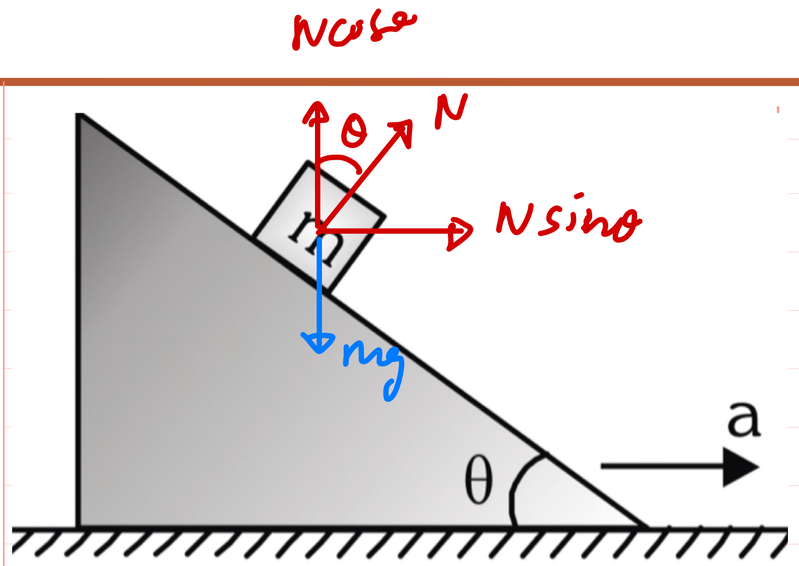
$N = ma\sin\theta + mg\cos\theta$

$= mg\tan\theta \cdot \sin\theta + mg\cos\theta$

$= mg\left(\frac{\sin^2\theta}{\cos\theta} + \cos\theta\right)$

$= \frac{mg}{\cos\theta}$

$\boxed{N = mg\sec\theta}$



In Ground frame

$$\frac{N\sin\theta}{N\cos\theta} = \frac{ma}{mg}$$

$$N\cos\theta = mg$$

$$N = \frac{mg}{\cos\theta}$$

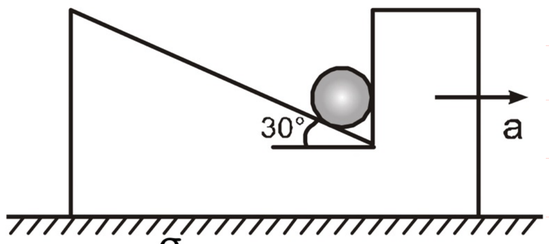
$$\boxed{N = mg\sec\theta}$$

Ans

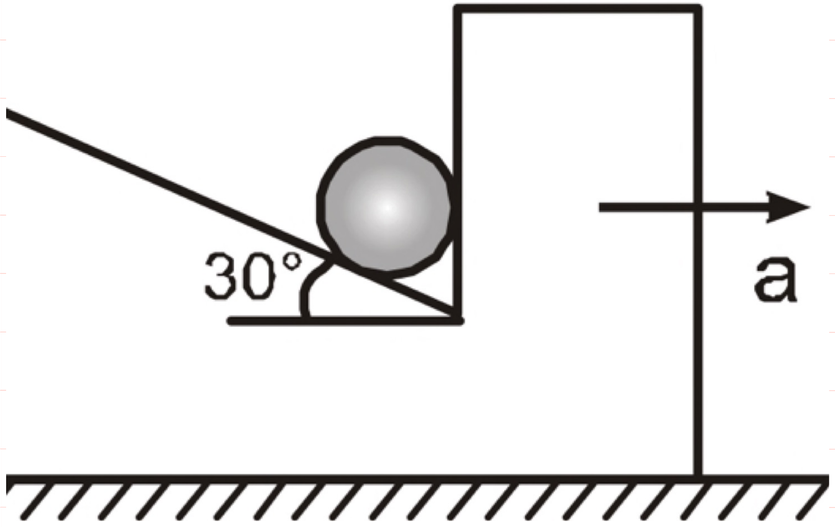
$$\tan\theta = \frac{a}{g} \Rightarrow \boxed{a = g\tan\theta}$$

Ans

7. A heavy spherical ball is constrained in a frame as in figure. The inclined surface is smooth. The maximum acceleration with which the frame can move without causing the ball to leave the frame:



(A) $\frac{g}{2}$ (B) $g\sqrt{3}$ (C) $\frac{g}{\sqrt{3}}$ (D) $\frac{g}{\sqrt{2}}$

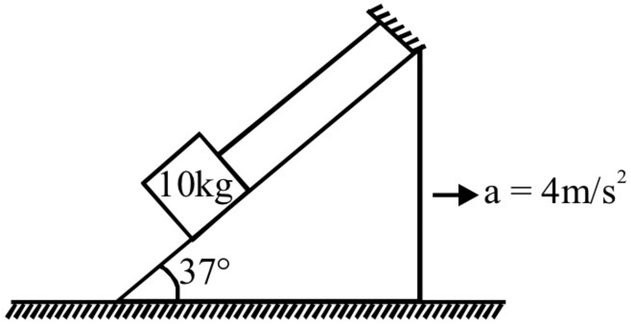


$a = g \tan\theta$

$a = g \times \tan 30$

$a = \frac{g}{\sqrt{3}}$

A body of mass 10 kg is placed on a smooth inclined plane as shown in figure. The inclined plane is moved with a horizontal acceleration a.



13. The normal reaction between block and inclined plane is :-

(A) 92 N (B) 44 N (C) 56 N (D) Can't be determined

14. The tension in thread is :-

(A) 92 N (B) 44 N (C) 56 N (D) Can't be determined

15. At what acceleration 'a' will the body lose contact with the inclined plane ?

(A) 10 m/s^2 (B) 13.33 m/s^2 (C) 3.33 m/s^2 (D) 6.66 m/s^2

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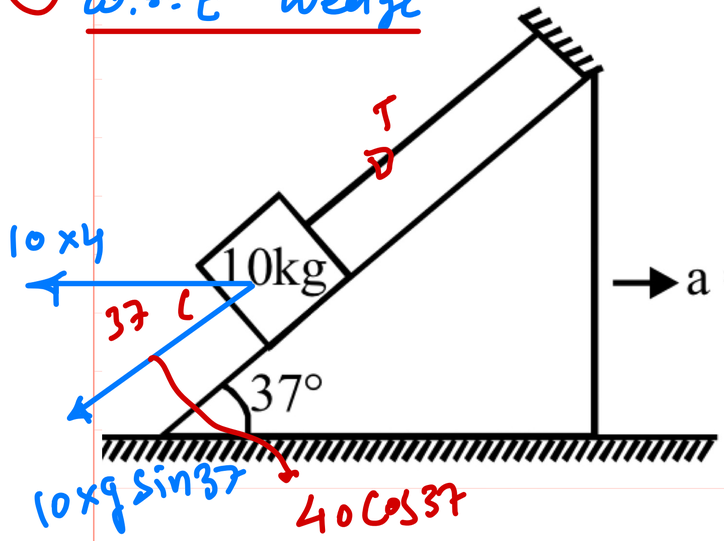
(14) w.r.t wedge



$= 100 \times \frac{3}{5}$

$= 60N$

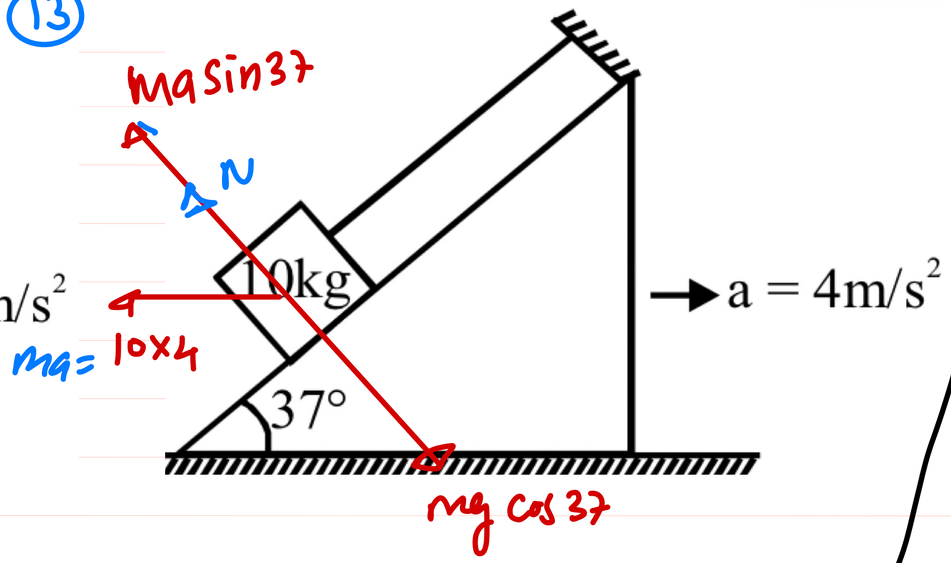
$40 \times \frac{4}{5}$

$32 N$

Tension $T = 60 + 32$

$\boxed{T = 92 N}$

(13)



$ma \sin 37 + N = mg \cos 37$

$40 \times \frac{3}{5} + N = 100 \times \frac{4}{5}$

$24 + N = 80$

$\boxed{N = 56 \text{ Newton}}$

(15) When loose the contact

$\boxed{N = 0}$

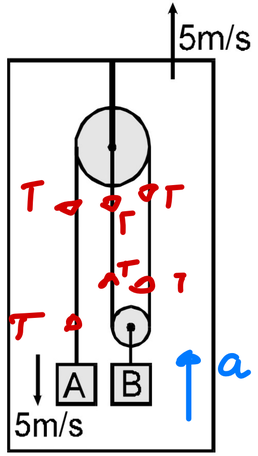
$ma \sin 37 = mg \cos 37$

$a = g \cot 37$

$= \frac{4g}{3}$

$\boxed{a = \frac{40}{3} \text{ m/s}^2}$

2. A system is as shown in the figure. All speeds shown are with respect to ground. Then the speed of Block B with respect to ground is :



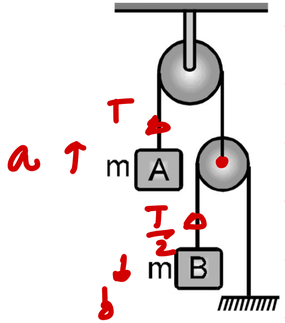
(A) 5 m/s

(B) 10 m/s

(C) 15 m/s

(D) 7.5 m/s

1. In the figure shown neglecting friction and mass of pulleys, what is the acceleration of mass B?



(A) $\frac{g}{3}$

(B) $\frac{5g}{2}$

(C) $\frac{2g}{2}$

(D) $\frac{2g}{5}$

$-T\times 5 - 5\times 3T + 2T\,\cancel{a} = 0$

$5 + 15 = 2\cancel{a} \Rightarrow \boxed{\cancel{a} = 10\,m/s^2 \uparrow}$

$Ta - \frac{T}{2}b = 0$

$\boxed{b = 2a}$

$T - mg = ma$ — (1)

$mg - \frac{T}{2} = mb$

$2mg - T = 2mb$ — (2)

(1) + (2)

$mg = ma + 2mb$

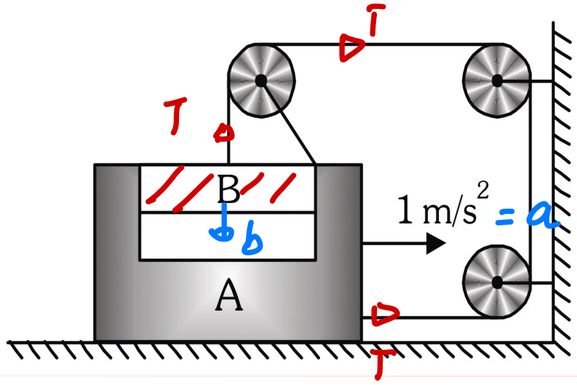
$g = \frac{b}{2} + 2b$

$\boxed{\frac{2g}{5} = b}$

6. If block A is moving with an acceleration of 1 m/s^2, the acceleration of B w.r.t. ground is:

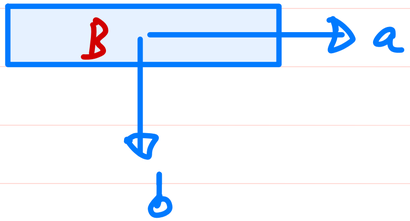
(A) 1 m/s^2 (B) $\sqrt{2}$ m/s^2

(C) $\sqrt{5}$ m/s^2 (D) 2 m/s^2



$2Ta - Tb = 0$

$b = 2a$

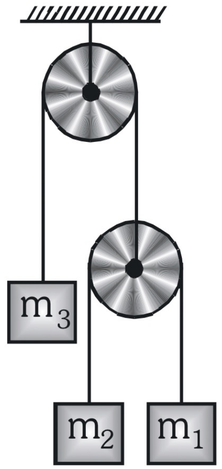


$a_B = \sqrt{a^2 + b^2}$

$= \sqrt{5}\,a$

$a_B = \sqrt{5}$ m/s^2 Ans

7. Three masses m_1, m_2 and m_3 are attached to a string as shown in the figure. All three masses are held at rest and then released. To keep m_3 at rest, the condition is:

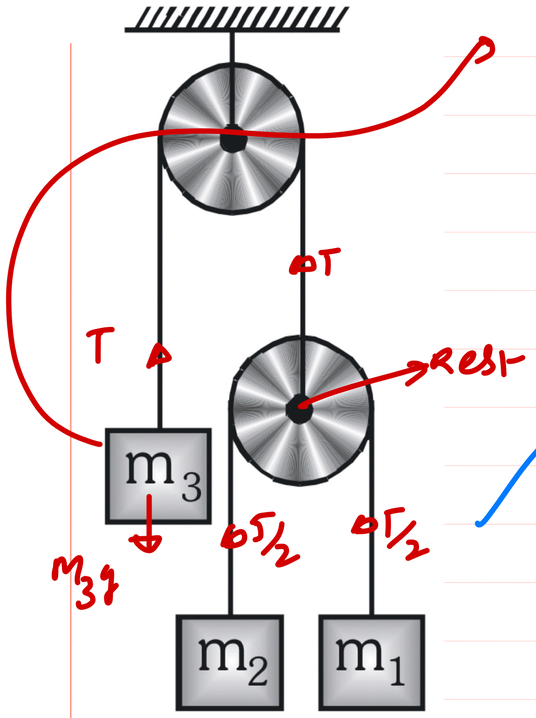


(A) $\frac{1}{m_3} = \frac{1}{m_1} + \frac{1}{m_2}$

(B) $m_1 + m_2 = m_3$

(C) $\frac{4}{m_3} = \frac{1}{m_1} + \frac{1}{m_2}$

(D) $\frac{1}{m_1} + \frac{2}{m_2} = \frac{3}{m_3}$



$T = m_3 g$

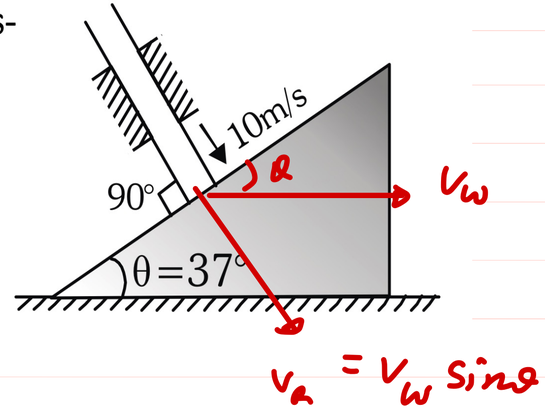
$$\frac{T}{2} = \frac{2 m_1 m_2}{m_1 + m_2} g$$

$$\frac{m_3 \cancel{g}}{2} = \frac{2 m_1 m_2 \cancel{g}}{m_1 + m_2}$$

$$\frac{m_1 + m_2}{m_1 m_2} = \frac{4}{m_3}$$

$$\boxed{\frac{1}{m_1} + \frac{1}{m_2} = \frac{4}{m_3}}$$

3. In the given situation when rod is moving with speed 10 m/s, speed of wedge is-



(A) $\frac{50}{3}$ m/s

(B) $\frac{40}{3}$ m/s

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

(D) None of these

$V_R = V_w \sin 37$

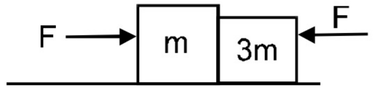
$10 = V_w \times \frac{3}{5}$

$V_w = \frac{50}{3}$ m/s

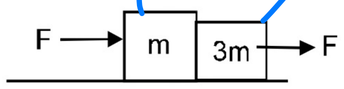
5. In all the given cases blocks are at rest, are in contact and the forces are applied as shown. All the surfaces are smooth. Then in which of the following cases, normal reaction between the two blocks is zero choose the most approprite options.

$N \neq 0$

(i)



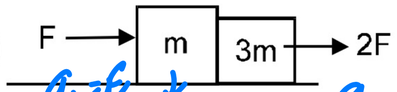
(ii)



$a_1 = F/m$ $a_2 = F/3m$

$N \neq 0$

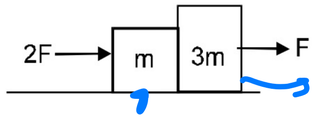
(iii)



$a_1 = F/m$ $a_2 = 2F/3m$

$N \neq 0$

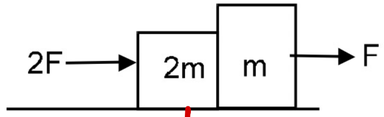
(iv)



$a_1 = 2F/m$ $a_2 = F/3m$

$N \neq 0$

(v)



$a_2 = F/m$

$a_1 = 2F/2m = F/m$

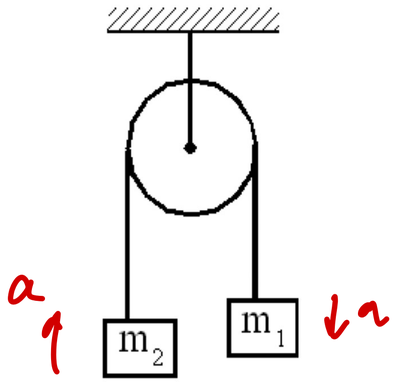
(A) (i) , (iv)

(B) (ii) , (iii)

(C) (iii)

(D) (v)

3. Two blocks of masses $m_1 = 5$ kg and $m_2 = 2$ kg hang on either side of a frictionless cylinder as shown in the figure . If the system starts at rest , what is the speed of m_1 after it has fallen 40 cm ?



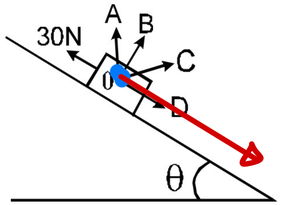
$$a = \frac{5-2}{7} \times g = \frac{30}{7}\ m/s^2$$

$$v^2 = 0^2 + 2a \cdot s$$

$$v = \sqrt{2 \times \frac{30}{7} \times 40 \times 10^{-2}}$$

$$\boxed{v = \sqrt{\frac{24}{7}}\ m/s}$$

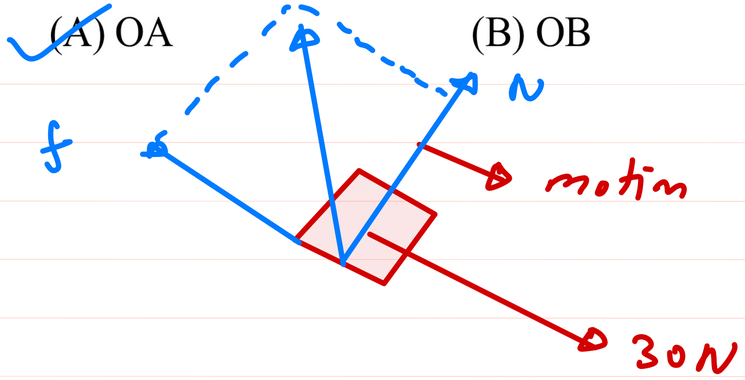
7. A body of mass 10 kg is on a rough inclined plane of inclination $\theta = \sin^{-1}(3/5)$ with the horizontal. When a force of 30 N is applied on the block parallel to and upward the plane, the total reaction by the plane on the block is nearly along :



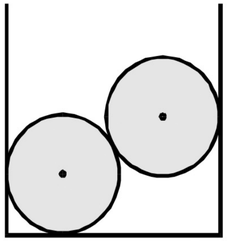
$mg\sin\theta = 100 \times \frac{3}{5} = 60\,N$

F_{net} = Net contact force

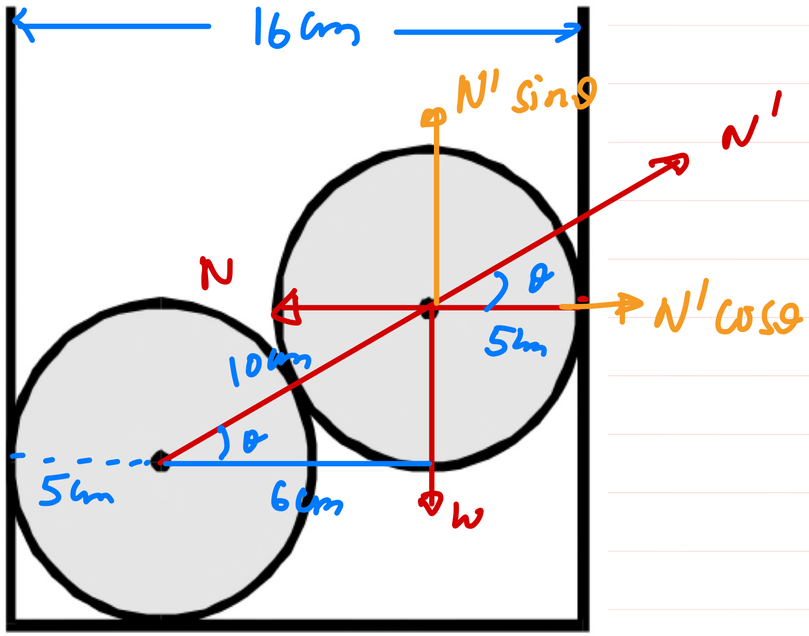
(A) OA (B) OB (C) OC (D) OD



9. Two smooth spheres each of radius 5 cm and weight W rest one on the other inside a fixed smooth cylinder of radius 8 cm. The reactions between the spheres and the vertical side of the cylinder are :



(A) W/4 & 3W/4 (B) W/4 & W/4 (C) 3W/4 & 3W/4 (D) W & W



$\cos\theta = \frac{6}{10} = \frac{3}{5}$

$\sin\theta = 4/5$

$\frac{N'\cos\theta}{N'\sin\theta} = \frac{N}{W}$

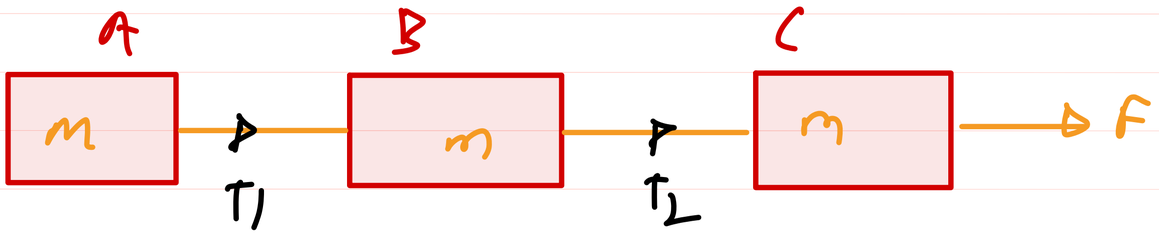
$\frac{N}{W} = \cot\theta$

$N = W\cot\theta$

$\boxed{N = W \times \frac{3}{4}}$ Ans

1. A toy train consists of three identical compartment A, B and C. It is being pulled by a constant force F along C. The ratio of the tensions in the string connecting AB and BC is

(A) 2 : 1 (B) 1 : 3 (C) 1 : 1 (D) 1 : 2



$a = \frac{F}{3m}$

$T_1 = ma$

$T_2 = 2ma$

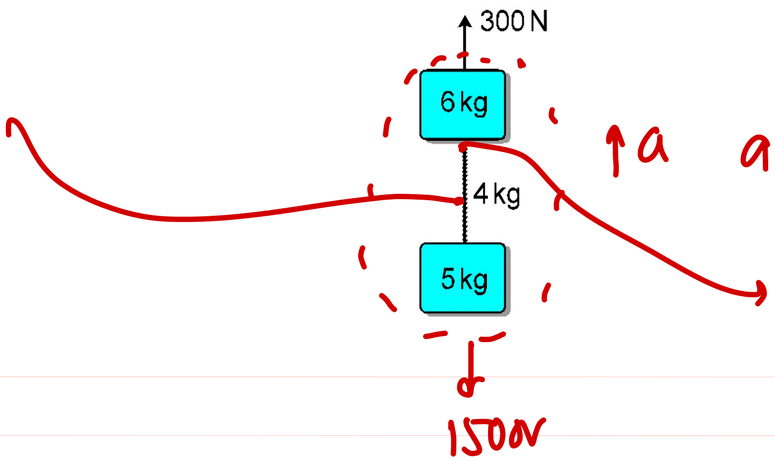
$T_1 : T_2 = \cancel{ma} : 2\cancel{ma}$

$= 1 : 2$

Two blocks (as shown in figure) are connected by a heavy uniform rope of mass 4 kg. An upward force of 300 N is applied on upper block. ($g = 10$ m/sec^2)

$T - 7g = 7a$

$T = 140$ N



$\uparrow a$ $\quad a = \frac{300 - 150}{15} = 10$ m/s^2

$T - 9g = 9 \times 10$

$T = 180$ N

2. The acceleration of the system is equal to ;

(A) 20 m/sec^2 upward (B) 10 m/sec^2 upward

(C) 10 m/sec^2, downward (D) 30 m/sec^2, downward

3. The tension at the top of the heavy rope is equal to

(A) 90 N (B) 60 N (C) 180 N (D) 240 N

4. The tension at the mid-point of the rope is equal to

(A) 240 N (B) 180 N (C) 70 N (D) 140 N

CH- FRICTION

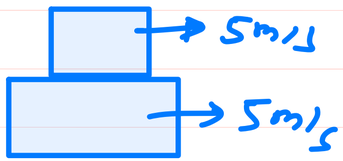
FRICTION
- → contact force (Electro magnetic force)
- → which opposes the relative motion b/w 2 contact objects

FRICTION

Static Friction (f_s)

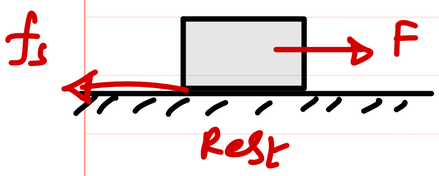
No Relative motion b/w 2-contact objects

$v_r = 0$



$v_r = 0$

No friction



$f_s = F$

Kinetic friction (f_k)

→ there is Relative motion b/w contact surfaces

→ this is a constant friction

→ $f_k = \mu_k N$

μ_k = coefficient of Kinetic friction → depend on Nature of surfaces

N = Normal b/w contact surface