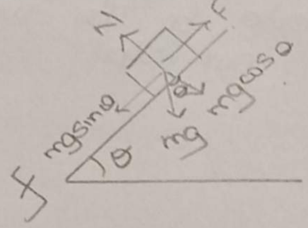
AAQIL AHMED

JEE QUESTION: LAW OF MOTION

1. A block placed on a rough inclined plane of inclination [$\theta = 30$] can just be pushed upwards by applying a force 'F'. If the angle of inclination of the inclined plane is increased to [$\theta = 60$], the same block can just be prevented from sliding down by application of a force of same magnitude. The coefficient of friction between the ~~se~~ block and inclined plane is



ANSWER

$\theta = 30$

$N = mg\cos\theta$

$F = f + mg\sin\theta$

$F = mg$

$\mu\cos\theta + \sin\theta \Rightarrow F = mg\left[\mu \times \frac{\sqrt{3}}{2} + \frac{1}{2}\right]$

$F = \frac{mg}{2}\left[\sqrt{3}\mu + 1\right] - (1)$

$\theta = 60^\circ$

$F = mg(\sin\theta - \mu\cos\theta)$

$F = \frac{mg}{2}\left[\sqrt{3} - \mu\right] - (2)$

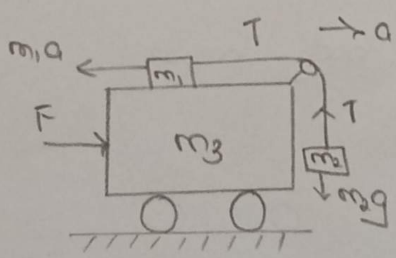
(1) & (2)

$\frac{mg}{2}\left[\sqrt{3} - \mu\right] = \frac{mg}{2}\left[\sqrt{3}\mu + 1\right]$

$(\sqrt{3} + 1)\mu = \sqrt{3} - 1$

$\mu = \frac{\sqrt{3} - 1}{\sqrt{3} + 1}$

2. Three block m_1, m_2, m_3 are ~~represented~~ arranged. Find the force (F) that must be applied on M_3, so that the blocks are relatively at Rest w.R.T m_3



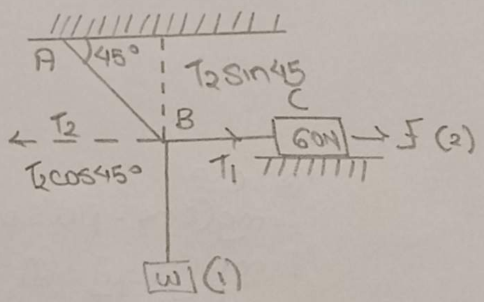
$T = m_2 g$ $\Rightarrow m_1 a = m_2 g$

$T = m_1 a$

$$a = \frac{m_2 g}{m_1} \quad -(1)$$

$$\Rightarrow F = (m_1 + m_2 + m_3)\frac{m_2 g}{m_1}$$

3. In the figure, a block of weight 60N is placed on rough surface. The coefficient of friction between the block is 0.5. What should be the weight W such that the block does not slip?



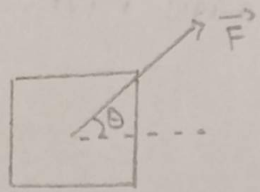
For block (2)

$T_1 = F$	$T_2 \cos 45° = 30N$	$T_2 \sin 45° = W$
$T_1 = \mu N$	$T_2 = \frac{30}{\cos 45}$	$30\sqrt{2} \times \frac{1}{\sqrt{2}} = W$
$= 0.5 \times 60$	$= 30\sqrt{2} N$	$W = 30N$
$= 30N$		

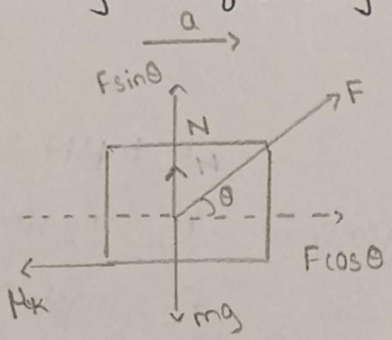
Ans). The weight of the body must be 30N

Hazique Rizvi
2025 - 2026

Q A block of mass 'm' slides along a floor while force of magnitude 'F' is applied to it at an angle θ as shown in figure. The coefficient of kinetic friction is μ_k. Then, the block's acceleration 'a' is given by: (g is acceleration due to gravity)



Sol: On drawing the free body diagram of the block



$$N = mg - F\sin\theta \quad - 1$$

also $F\cos\theta - \mu_k = ma \quad - 2$

On substituting the value of N from equation 1 in equation 2

$$F\cos\theta - \mu_k(mg - F\sin\theta) = ma$$

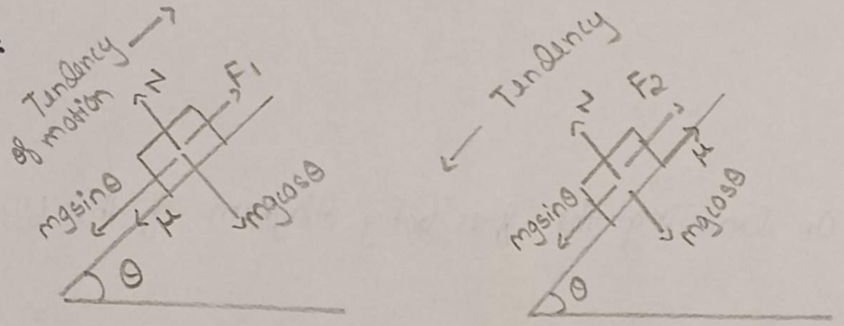
$$a = \frac{F\cos\theta}{m} - \frac{\mu_k mg}{m} + \frac{\mu_k F\sin\theta}{m}$$

$$a = \frac{F\cos\theta}{m} - \mu_k g + \frac{\mu_k F\sin\theta}{m}$$

$$a = \frac{F\cos\theta}{m} - \mu_k\left(g - \frac{F\sin\theta}{m}\right)$$

Q The minimum force required to start pushing a body up a rough (frictional coefficient μ) inclined plane is F_1 while the minimum force needed to prevent it from sliding down is F_2. If the inclined plane makes an angle θ from the horizontal such that $\tan\theta = 2\mu$, then the ratio F_1/F_2 is

Sol:



$F_1 = mg\sin\theta + \mu N$

$F_1 = mg\sin\theta + \mu mg\cos\theta$

$F_2 + \mu N = mg\sin\theta$

$F_2 = mg\sin\theta - \mu N$

$F_2 = mg\sin\theta - \mu mg\cos\theta$

$$\frac{F_1}{F_2} = \frac{\cancel{m}g\sin\theta + \mu \cancel{m}g\cos\theta}{\cancel{m}g\sin\theta - \mu\cancel{m}g\cos\theta} = \frac{\sin\theta + \mu\cos\theta}{\sin\theta - \mu\cos\theta}$$

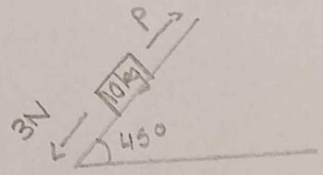
↳ On dividing by $\cos\theta$

$$\frac{\frac{\sin\theta}{\cos\theta} + \frac{\mu\cos\theta}{\cos\theta}}{\frac{\sin\theta}{\cos\theta} - \frac{\mu\cos\theta}{\cos\theta}} = \frac{\tan\theta + \mu}{\tan\theta - \mu}$$

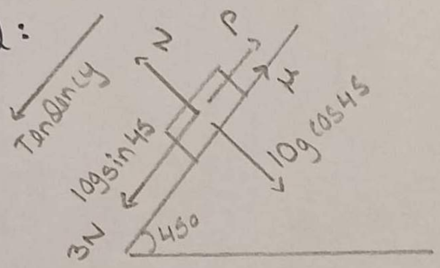
We know that $\tan\theta = 2\mu$

$$\frac{F_1}{F_2} = \frac{2\mu + \mu}{2\mu - \mu} = \frac{3\mu}{\mu} \Rightarrow \frac{F_1}{F_2} = 3$$

Q A block of mass 10kg is kept on a rough inclined plane as shown in the figure. A force of 3N is applied on the block. The coefficient of static friction between the plane and the block is 0.6. What should the minimum value of force P, such that the block does not move downward?



Sol:



$$10g\sin 45 + 3 = P + F_{s\,max}$$

$$\frac{100}{\sqrt{2}} + 3 = P + \mu 10g \cos 45$$

$$\frac{100}{\sqrt{2}} + 3 = P + \frac{3}{5} \times \frac{100}{\sqrt{2}}$$

$$\frac{\cancel{100}^{20}}{\sqrt{\cancel{2}}} \times \frac{\cancel{2}^{\sqrt{2}}}{\cancel{5}} + 3 = P$$

$$20\sqrt{2} + 3 = P$$

$$20 \times 1.414 + 3 = P$$

$$P = 31.38 \text{ (approx)}$$

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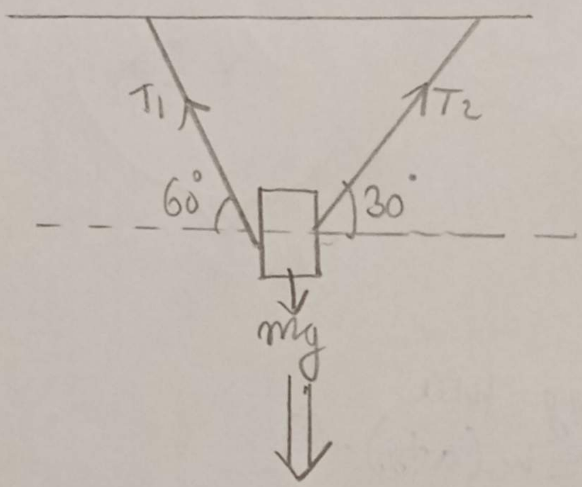
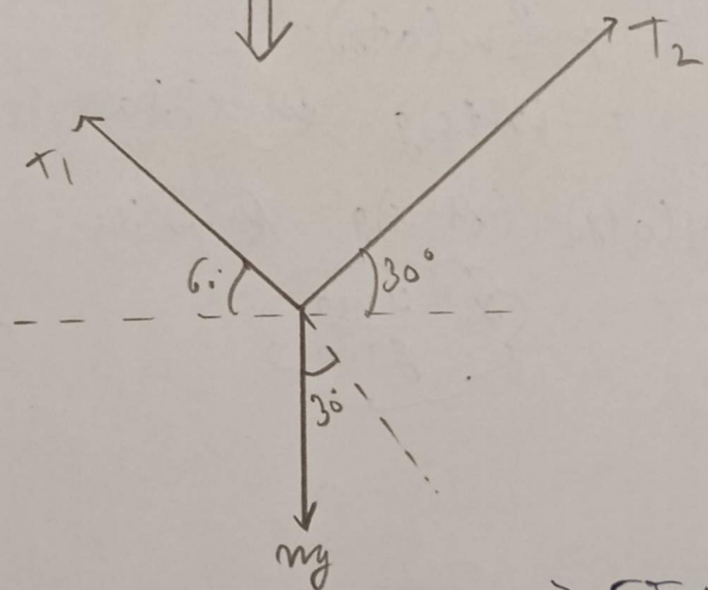
JEE Questions

Newton's Law's of Motion

Q.1) A body of mass 1 kg is suspended with the help of two strings making angles 60° and 30°. Magnitudes of tensions T_1 and T_2 respectively, are (in N): $(g = 10\ m/s^2)$

Ans:- ④ [JEE Main 2025]



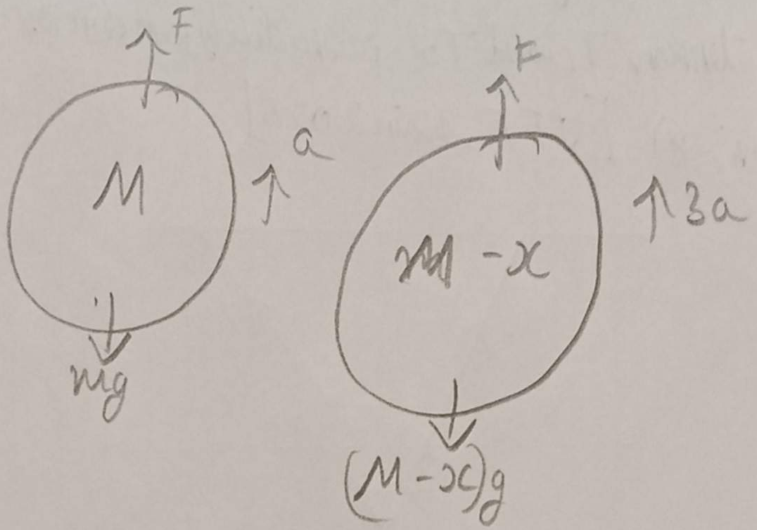


$\therefore T_1 = mg\cos 30° \Rightarrow \underline{\underline{5\sqrt{3}N}}$

$\therefore T_2 = mg\sin 30° \Rightarrow \underline{\underline{5N}}$

Q.2) A ballon and its content having mass M is moving up with acceleration 'a'. The mass that must be released from the content so that the ballon starts moving up with an acceleration '3a' will be. [JEE Main 2025] (2)

Ans: (*)



$$F - Mg = Ma$$

$$F = M(a+g) \quad -(1)$$

$$F - (M - x)g = (M - x)3a$$

$$M(a+g) - (M - x)g = (M - x)3a$$

$$\boxed{x = \frac{2Ma}{g+3a}}$$

Q.3) A light unstretchable string passing over a smooth light pulley connects two blocks of masses m_1 and m_2. If the acceleration of the system is $g/8$, then the ratio of the masses m_2/m_1 is :- ③

(A) 5 : 3 (B) 8 : 1 (C) 9 : 7 (D) 4 : 3

[JEE Main 2025]

Ans :- $\cancel{g}(m_2 - m_1) = (m_1 + m_2)\frac{\cancel{g}}{8}$

$$8m_2 - 8m_1 = m_1 + m_2$$

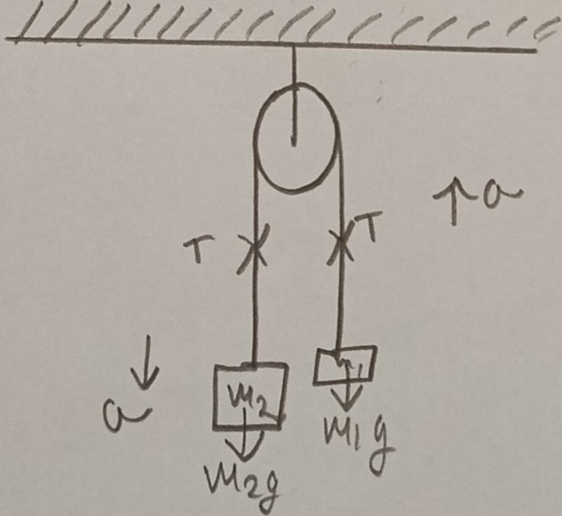
$$8m_2 - 8m_1 - m_1 - m_2 = 0$$

$$7m_2 - 9m_1 = 0$$

$$7m_2 = 9m_1$$

Since, they asked m_2/m_1, Therefore :-

$$\frac{m_2}{m_1} = \frac{9}{7} \Rightarrow \underline{\underline{9:7\ (C)}}$$



Newton's Laws of Motion [JEE Questions]

Q1: A block of mass 2kg is placed on a horizontal surface. A force of 10N is applied horizontally on the block. If the coefficient of friction is 0.3, find the acceleration of the block.

Ans: The frictional force 'f' is given by 'μN', where N is the normal force.

$f = 0.3 \times 2 \times 10$
$= 6N$

Net force F_{net} is given by '$F-f$'

$\therefore F_{net} = F - f$

$\Rightarrow F_{net} = 10-6$
$= \underline{4N}$

Acceleration 'a' is given by $a = \frac{F_{net}}{m}$

$\therefore a = \frac{4}{2}$
$= \underline{2 m/s^2}$

$\therefore$ Acceleration $= \underline{2 m/s^2}$

Q2. A body of mass 5 kg is suspended from a string. Find the tension in the string when the body is moving upward with an acceleration of $2 m/s^2$.

Ans: Tension is given by $T = m(g+a)$, where 'g' is the acceleration due to gravity and a is acceleration.

$\therefore T = 5(10+2)$
$= 5(12)$
$= \underline{60N}$

Q3. Two block of masses 3Kg and 5Kg are connected by a string passing over a pulley. Find the acceleration of the blocks and the tension in the string.

Ans. Acceleration is given by $a = \frac{(m_2 - m_1)g}{m_1 + m_2}$.

$\therefore a = \frac{(5-3)\,10}{3+5}$

$= \frac{\cancel{20}^{5}}{\cancel{8}_{2}} = \frac{5}{2}$

$\therefore a = 2.5\ m/s^2$

Tension is given by $T = m_1(g+a)$ or $T = m_2(g-a)$

$\therefore T = m_1(g+a)$

$= 3\,(10+2.5)$

$= 3 \times 12.5$

$= 37.5 N$

or

$T = m_2(g-a)$

$= 5\,(10-2.5)$

$= 5 \times 7.5$

$= 37.5 N$

$\therefore$ Acceleration $= 2.5\ m/s^2$ and Tension $= 37.5\ N$

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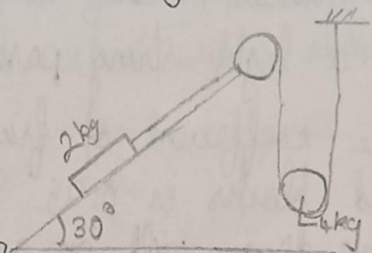
LAWS OF MOTION

Q1 All surfaces shown in figure are assumed to be frictionless and the pulleys and the string are light. The acceleration of the mass 2kg is:—



ANS

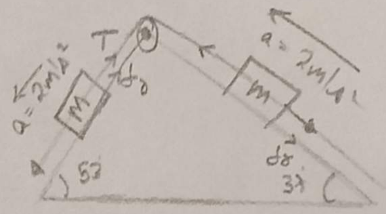
$40 - 2T = 4a$

$\therefore 20 - T = 2a$

$a = \frac{5}{3} \Rightarrow 2a = \frac{10}{3} = \frac{9}{3}$ [Taking $g = 10 m/s^2$]

Q.2. In the given arrangement of a doubly inclined plane 2 blocks of masses M and m are placed. The blocks are connected by a light string passing over an ideal pulley as shown. The coefficient of friction between the surface of the plane and blocks is 0.25. The value of m, for which M = 10kg will move down with an acceleration of $2 m/s^2$ is :—

[Take $g = 10 m/s^2$, $\tan 37° = 3/4$]



Ans For Block M

$10g \sin 53° - \mu (10g) \cos 53° - T = 20$

$\Rightarrow 80 - 15 - 20 = T \Rightarrow \underline{\underline{T = 45 N}}$

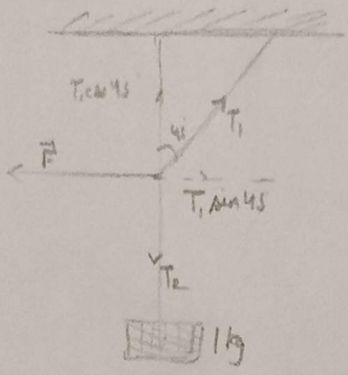
For Block m

$T - mg \sin 37° - \mu mg \cos 37° = 2m$

$\therefore 45 = 10m$

$\Longrightarrow \underline{\underline{m = 4.5 kg}}$

Q3. A 1kg mass is suspended from the ceiling by a rope of length 4m. A horizontal force 'F' is applied at the midpoint of the rope so that the rope makes an angle of 45° wrt the vertical axis as shown in figure. Magnitude of F:—



ANS

$T_1 \cos 45° = T_2$

$\therefore T_1 \cos 45° = 10N$

$\therefore T_1 = 10\sqrt{2}\ N$

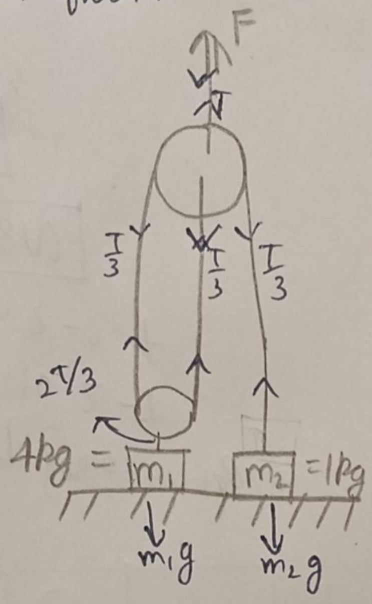
$F = \sin 45° \times T_1$

$\Rightarrow F = 10N$

Sarthak Shinde
2025-2026

Newton's Law Of Motion

Q1) Force F is applied on upper pulley. If $F = 30t$ N where t is time in seconds. Find time when m_1 looses contact with floor.



Sol.

$F = 30t$

$F = T = \text{tension}$ {as only one force acts}

Since upper pulley of tension T is connected to 3 string, so T (tension) will also be equally divided into 3 different parts. ($\frac{T}{3}, \frac{T}{3} \& \frac{T}{3}$)

The m_1 block is connect to ~~block~~ pulley by a string of Tension $\left(\frac{2T}{3}\right)$ as pulley contains 2 string of tension $\frac{T}{3}$

$\therefore \frac{2T}{3} = m_1 g$ {as object m_1 almost going up so we can say $a = 0$}

$\frac{2T}{3} = 4 \times 10 = 40$

$T = 60$

$T = F = 60$

$30t = 60$

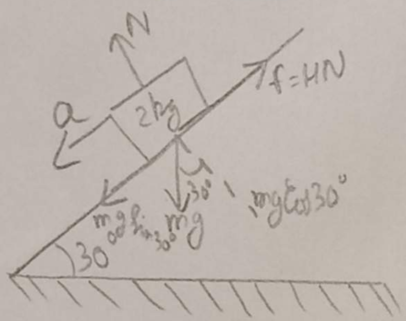
$\underline{\underline{t = 2s}}$

$\therefore$ 2 seconds are required

Q2) A body of mass 2 kg slides down with an acceleration of $3 m/s^2$ on a rough inclined plane having slope of 30°. The external force required to take same body up plane with same acceleration will be: $(g = 10 m/s^2)$ - JEE MAINS 2018

sol.

When object slides down with $3 m/s^2$



$N = mg\cos 30^\circ = 2\times10\times\frac{\sqrt{3}}{2} = \underline{10\sqrt{3}N}$

$f = \mu N = \underline{\mu 10\sqrt{3}}$

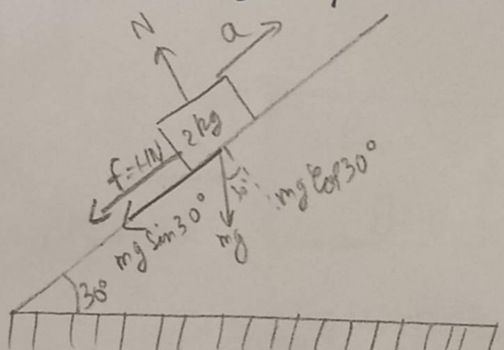
$ma = mg\sin 30^\circ - f$ (object goes down)

$2\times3 = 2\times10\times\frac{1}{2} - 10\sqrt{3}\mu$

$6 = 10 - 10\sqrt{3}\mu$

$\mu = \frac{10-6}{10\sqrt{3}} = \frac{4}{10\sqrt{3}} = \boxed{\frac{2}{5\sqrt{3}} = \mu}$

When object goes up with same acceleration of $3 m/s^2$



$N = 10\sqrt{3}N$ (calculated)

$\cancel{f = \mu N}$ $\mu = \frac{2}{5\sqrt{3}}$

$f = \mu N = \frac{2}{5\sqrt{3}}\times 10\sqrt{3} = 4N$

As object goes up the friction act down along plane.

let external force required = F

$F - f - mg\sin 30^\circ = ma$ ($a = 3 m/s^2$ same a)

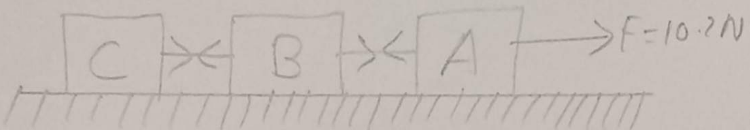
$F - 4 - 2\times10\times\frac{1}{2} = 2\times3$

$F - 4 - 10 = 6$

$\boxed{F = 20N}$

$\boxed{\therefore \text{Force Required} = 20N}$

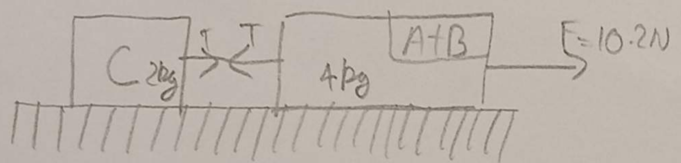
Q3> 3 identical masses blocks of 2 kg are drawn by Force $F = 10.2N$ with an acceleration of $0.6\ m/s^2$ on frictionless surface then what is tension (in N) in string between blocks B & C?



(A) 9.2N (B) 3.4N (C) 4N (D) 7.8N

Sol.

We can consider A and B block as a single system as all 3 blocks are moving with same acceleration $a = 0.6\ m/s^2$



For system (A+B):

$$F - T = ma \quad \left\{ \begin{array}{l} m = 2+2 = 4kg \text{ (total mass)} \\ a = 0.6\ m/s^2 \text{ (same acceleration)} \end{array} \right\}$$

$$10.2 - T = 4 \times 0.6$$

$$T = 10.2 - 2.4$$

$$\boxed{T = 7.8N}$$

$\boxed{\text{Answer : } 7.8N \text{ (D)}}$

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Laws of Motion

(Q1) A body of mass 2kg moving with velocity of $\vec{v}_{in} = 3\hat{i} + 4\hat{j}\, ms^{-1}$ enters into a constant force field of 6N directed along +ve z-axis. If the body remains in the field for a period of $\frac{5}{3}$ seconds, then velocity of the body when it emerges from force field is:

(A) $3\hat{i} + 4\hat{j} + \sqrt{5}\hat{k}$ (B) $4\hat{i} + 3\hat{j} + 5\hat{k}$ (C) $3\hat{i} + 4\hat{j} - 5\hat{k}$ (D) $3\hat{i} + 4\hat{j} + 5\hat{k}$

Ans:-

$\vec{F} = m\vec{a}$

$\Rightarrow \vec{a} = \frac{\vec{F}}{m} = \frac{6\hat{k}}{2} = 3\hat{k}\ ms^{-2}$

$\therefore \vec{u} = 3\hat{i} + 4\hat{j}\ ms^{-1}$; $t = 5/3$ sec.

$\vec{v} = 3\hat{i} + 4\hat{j} + \cancel{3}\hat{k}\left(\frac{5}{\cancel{3}}\right)$

$\Rightarrow \boxed{\vec{v} = 3\hat{i} + 4\hat{j} + 5\hat{k}\ [D]}$

(Q2) An object with mass 500 g moves along X-axis with speed $v = 4\sqrt{x}\ ms^{-1}$. The force acting on the object is:

Ans:-

$F = ma$; $v = 4\sqrt{x}$

$\Rightarrow F = 0.5 \times 8$

$\Rightarrow \boxed{F = 4N}$

$\Rightarrow v^2 = 16x$

$\Rightarrow 2v \cdot \frac{dv}{dx} = 16 \Rightarrow v\frac{dv}{dx} = 8$

$\Rightarrow \frac{dx}{dt} \cdot \frac{dv}{dx} = 8 \Rightarrow \frac{dv}{dt} = 8 \Rightarrow \boxed{a = 8}$

$\left[\because v = \frac{dx}{dt} ; a = \frac{dv}{dt}\right]$

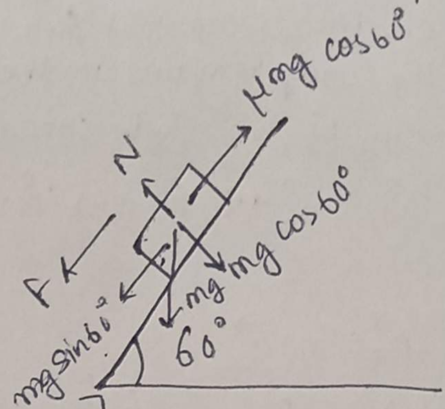
Ans:- Force acting is 4N.

(Q3) A cubic block of mass m is sliding down on an inclined plane at 60° with an acceleration of $g/2$, the value of coefficient of kinetic friction is:

Ans:-

$\boxed{F = ma}$

~~$\therefore mg \sin 60° \times \mu mg \cos$~~



$\therefore mg \sin 60° - \mu mg \cos 60° = ma$

$\Rightarrow g \cdot \frac{\sqrt{3}}{2} - \mu g \frac{1}{2} = \frac{g}{2}$

$\Rightarrow \frac{g\sqrt{3}}{2} - \frac{\mu g}{2} = \frac{g}{2}$

$\left[\begin{array}{l} \sin 60° \rightarrow \frac{\sqrt{3}}{2} \\ \cos 60° \rightarrow \frac{1}{2} \end{array} \right]$

$\Rightarrow \frac{\sqrt{3}}{2} - \frac{\mu}{2} = \frac{1}{2}$

$\Rightarrow \sqrt{3} - \mu = 1$

$\Rightarrow \boxed{\mu = \sqrt{3} - 1}$

KoushikoB

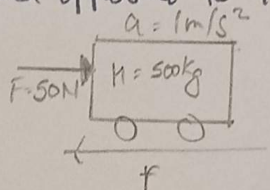
NEWTON'S LAWS OF MOTION

(1) A force of 50N is required to push a car on a level road with constant speed of 10m/s. The mass of the car is 500 kg. What force should be applied to make the car accelerate at $1 m/s^2$?

(a) 550N (b) 450N (c) 500N (d) 2500N

Ans:- Resistive force on car are equal and opposite to F=50N

velocity = acceleration = 0



$F' - 50 = 500 \times 1$

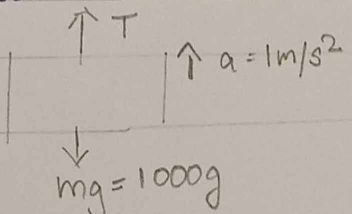
$F = 500 + 50$

$\boxed{F = 550N \quad \text{option(a)}}$

(2) A lift weighing 1000kg is moving upward with an acceleration of $1 m/s^2$. The tension in the supporting cable is

(a) 980N (b) 10800N (c) 9800N (d) 8800N

Ans:



From F.B.D of block $T - 1000g = 1000 \times a$

if $g = 9.8 m/s^2$ then

$T = 1000 \times 9.8 + 1000$

$= 9800 + 1000$

$= 10,800 N$

(3) A force vector applied on a mass is represented by $\vec{F} = 6\hat{i} - 8\hat{j} + 10\hat{k}$ and accelerates with $1 m/s^2$. What is the mass of the body

(a) 10kg (b) $10\sqrt{2}$kg (c) $2\sqrt{10}$kg (d) 20kg

Ans: By newtons 2nd Law F=ma

$F = 6\hat{i} - 8\hat{j} + 10\hat{k} = |\vec{F}| = \sqrt{6^2+8^2+10^2}$

$|\vec{F}| = \sqrt{200} = 10\sqrt{2}kg$

mass $= 10\sqrt{2}$ kg

$a = 1m/s^2 = m = \frac{F}{a} = \frac{10\sqrt{2}}{1}$ option (b)

Arun Sam Isac
2025-26

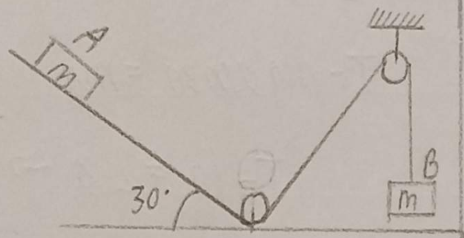
Two blocks A and B of same mass are connected through a string and arranged as shown in figure. When the system is released from rest and there is no friction, then

(A) Acceleration of A is g

(B) Acceleration of A is $\frac{g}{2}$

(C) Tension in the string is zero

(D) Tension in the string is $\frac{mg}{4}$



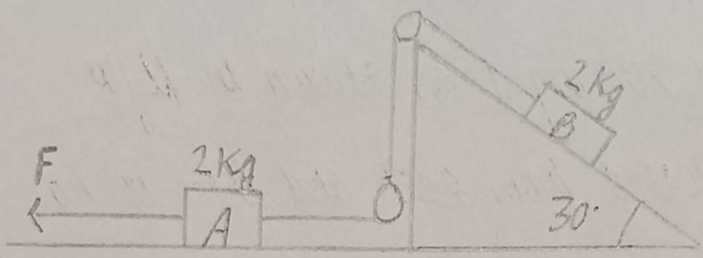
$Mg - T = ma$

$T + mg\sin\theta = ma$

which gives $a = \frac{g(1+\sin\theta)}{2} = \frac{3}{4}g$

Tension in the string, $T = mg - ma = \frac{mg}{2}(1-\sin\theta) = \frac{mg}{4}$

In the figure shown, coefficient of friction between block A and ground is 0.4 and that between wedge and block B is zero. The wedge is fixed. Find the tension in the string and acceleration of block A if F = 28N.



$f_{max} = \mu mg = 8N$

For Block A:

$F - f_{max} - T = ma$

$28 - 8 - T = 2a \rightarrow (1)$

For Block B:

$T - mg\sin 30 = ma$

$T - 10 = 2a \rightarrow (2)$

From 1 and 2

$a = 2.5\ m/s^2$ and $T = 15N$

A block of metal weighing 2 kg is resting 2kg is resting on a frictionless plane. It is struck by a jet releasing water at a rate of 1 kg/sec and at a speed of 5m/sec. The initial acceleration of the block will be

$$a = \frac{F_{impact}}{m}$$

$$= \frac{v(dm/dt)}{m}$$

$$= \frac{5 \times 1}{2}$$

$$= \frac{5}{2}$$

$$= 2.5\ m/s^2$$

Zaid Shamsheeri
XI-A.

Newtons law of motion

Q1. A block mass "m" is placed on a rough inclined plane making an angle θ with horizontanl. The coefficient of static friction between the block and plane μs. find range of values of θ for which it remains at rest.

Sol:.

$$mg\sin\theta \leq \mu s\, mg\cos\theta$$

$$\boxed{\tan\theta \leq \mu s}$$

Q2. Two blocks A (4kg) and C (6 kg) connected by a smooth horizontal surface. A force of "30N" is applied on "A". find tension (g=10m/s).

Sol:.

total = 4+6 = 10kg.

$$a = \frac{f}{total} = \frac{30}{10} = 3m/s^2$$

$$T = 4Ba = 6 \times 3 = 18N.$$

$$\boxed{18N}$$

Q3. A light pulley is fixed at the edge of a smooth table. A mass "$m_1 = 3kg$" lies on the table and is connected by a light inextensible string over the pulley to a hanging mass $m_2 = 2k$. find accelaration

Sol:

$$T = m_1 a$$

$$m_2 g - T = m_2 a$$

$$m_2 g - m_1 a = m_2 a$$

$$m_2 g = a(m_1 + m_2)$$

$$a = \frac{m_2 g}{m_1 + m_2} = \frac{2 \times 10}{3+2} = \frac{20}{5} = \boxed{4 m/s}$$

D.S. HARINI, XI-A
2025-2026

NLM

Q. 2 Masses M_1 & M_2 are tied together at the 2 ends of a ~~f~~ light inextensible string that passes over a frictionless pulley. When the mass M_2 is twice that of M_1, the acceleration of the system is a_2. The ratio a_1/a_2 will be:

Sol: Let $M_1 = m$ & $M_2 = km$

Applying Newton's 2nd law to each mass, taking the direction of motion of M_2 as +ve:

- For M_2: $M_2g - T = M_2a$
- For M_1: $T - M_1g = M_1a$

Add 2 eq to eliminate T:

$$M_2g - M_1g = (M_1 + M_2)a$$

$$a = \frac{M_2 - M_1}{M_1 + M_2} g$$

Case 1: $M_2 = 2M_1$

$$a_1 = \frac{2m - m}{m + 2m} g = 1/3\, g$$

Case 2: $M_2 = 3M_1$

$$a = 2 = \frac{3m - m}{m + 3m} g = \frac{1}{2} g$$

$$\therefore \frac{a_1}{a_2} = \frac{\frac{1}{3}g}{\frac{1}{2}g} = \frac{1/3}{1/2} = 2/3 \quad \boxed{\frac{a_1}{a_2} = \frac{2}{3}}$$

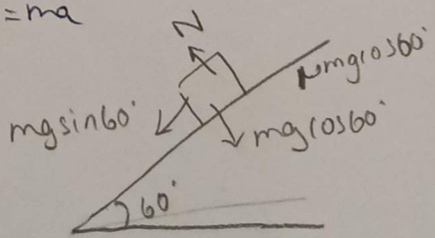
Q. A cubic block of mass m is sliding down on an inclined plane at 60° with an acceleration of $\frac{g}{2}$. The value of coeff of Kinetic friction is;

Sol: $mg\sin 60° - \mu mg\cos 60° = ma$

$g\sin 60 - \mu g\cos 60 = g/2$

$\sqrt{3}/2 - \mu/2 = 1/2$

$\mu = \sqrt{3} - 1$

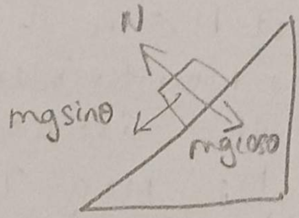


Q. A block 'A' takes 2s to slide down a frictionless incline of 30° & length 'l', kept inside a lift going up with uniform velocity 'v'. If the incline is changed to 45°, the time taken by block to slide down the incline, will be approx:

Sol: $t_1 = 2s$, $t_2 = ?$

$a = g\sin\theta$

$l = \frac{1}{2}at^2 = \frac{1}{2}g\sin\theta\, t^2$



For 1st incline (30°)

$l = \frac{1}{2}g\sin 30° (t^2)$,

$\Rightarrow l = \frac{1}{2}g \times \frac{1}{2} \times (2)^2 = g \therefore l = g$

For 2nd incline (45°):

$l = \frac{1}{2}g\sin 45°\, t_2^2$

$\frac{l}{l} = \frac{\frac{1}{2}g\sin 30°\, t_1^2}{\frac{1}{2}g\sin 45°\, t_2^2}$ $\qquad 1 = \frac{\sin 30°\, t_1^2}{\sin 45\, t_2^2}$

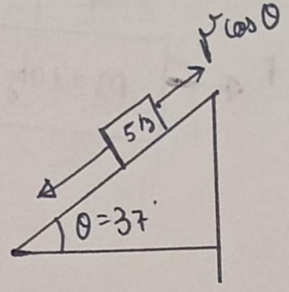
$t_2 = t_1\sqrt{\frac{\sin 30°}{\sin 45}}$

Subs value of $\sin 30°$ & $\sin 45°$

$t_2 = 2\sqrt{\frac{1/2}{1/\sqrt{2}}} = 2\sqrt{\frac{\sqrt{2}}{2}} = 2 \times (2^{-1/4})$

$= \boxed{1.68s}$

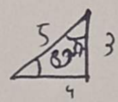
Q. A block of mass 5kg is kept on a inclined plane with $\mu = 0.25$ find acceleration. [Jee main]



Ans →

Acceleration is given by

$$a = g(\sin\theta - \mu\cos\theta)$$



$$a = 10\left(\frac{4}{5} - \frac{1}{4}\times\frac{3}{5}\right)$$

$$a = 10\left(\frac{4}{5} - \frac{3}{20}\right)$$

$$a = 10\left(\frac{16-3}{20}\right)$$

$$a = 1\cancel{0}\left(\frac{13}{2\cancel{0}}\right)$$

$$a = 13/2 \ ms^{-2}$$

SAANVI PATEL (2025-26)

Q. Two inclined planes are placed as shown in fig. A block is projected from Point A of inclined plane AB along its surface with a velocity just sufficient to carry it to the top Point B at height 10 m. After reaching point B the block slides down an inclined plane BC. Time it takes to reach ~~down~~ to the point C from Point A is $t(\sqrt{2}+1)$ s. The value of t is ____. $[g = 10 \, m/s^2]$

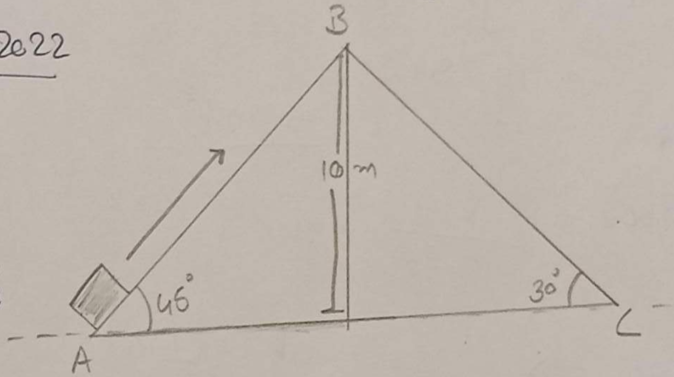
JEE Main 2022

From A → B.

$V_B = 0$

$\theta_1 = 45^\circ$

$acc_1 = -g \sin\theta_1$



$\hookrightarrow a_1 = -10 \sin 45^\circ$

$= -10\left(\frac{1}{\sqrt{2}}\right) = \underline{-5\sqrt{2} \, m/s^2}$

(dist) $S_{AB} = \frac{h}{\sin\theta_1} = \frac{10}{1/\sqrt{2}} = \underline{10\sqrt{2} \, m}$

$V_A \Rightarrow v^2 = u^2 + 2as$

$V_B^2 = V_A^2 + 2a_1 S_{AB}$

$0^2 = V_A^2 + 2(-5\sqrt{2}) \times 10\sqrt{2}$

$V_A^2 = 200 \qquad V_A = \sqrt{200} = \underline{\underline{10\sqrt{2} \, m/s}}$

$\hookrightarrow$ VA.

$t_{AB} \Rightarrow \quad v_B = v_A + a_1 t_{AB}$

$$0 = 10\sqrt{2} + (-5\sqrt{2})\, t_{AB}$$

$$t_{AB} = \frac{\cancel{10}^{\,2}\cancel{\sqrt{2}}}{\cancel{5}_{\,1}\cancel{\sqrt{2}}}$$

$$\underline{t_{AB} = 2 \text{ sec}}$$

From $B \rightarrow C$

$v_B = 0 \; ; \; \theta_2 = 30^\circ$

$$acc = +g \sin\theta_2$$

$$= 10 \sin 30$$

$$= 10 \cdot \frac{1}{2} = \underline{5 \text{ m/s}^2}$$

$$S_{BC} = \frac{h}{\sin\theta_2} = 10 \times 2 = \underline{20 \text{m}}$$

$t_{BC} \Rightarrow \quad S = ut + \frac{1}{2}at^2$

$$20 = 0 + \frac{1}{2} \times 5 \times (t_{BC})^2$$

$$\frac{\cancel{20}^{\,4} \times 2}{\cancel{5}_{\,1}} = (t_{BC})^2$$

$$t_{BC} = \sqrt{8} = \underline{2\sqrt{2} \text{ sec}}$$

t = total time

$\Rightarrow t_{AB} + t_{BC} = 2 + 2\sqrt{2} = 2(1+\sqrt{2})\,s.$

Compare

$$t(\sqrt{2}+1) = 2(\sqrt{2}+1)$$

$$t = \frac{2\cancel{(\sqrt{2}+1)}}{\cancel{(\sqrt{2}+1)}}$$

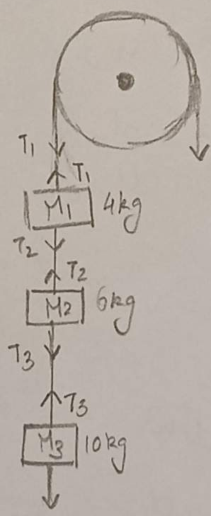
$t = 2$ sec

→ Ans

Q. Three block M_1, M_2, M_3 having masses 4kg, 6kg and 10 kg respectively are hanging from a smooth pully using rope 1, 2 and 3 as shown in the figure. The tension in the rope 1, T_1 when moving upwards with acceleration of $2\ m/s^2$ is ____ N. [$g = 10\ m/s^2$] [JEE Main 2024]

$M_1 = 4kg$; $M_2 = 6kg$; $M_3 = 10kg$.

$a = 2\ m/s^2$; $g = 10\ m/s$.



Tension of T_1

$M_{total} = M_1 + M_2 + M_3 = 20\ kg$

$W_{total} = M_{total} \cdot g$

$F = ma$

$F = T_1 - W_{total}$

$M \cdot a = T_1 - M_{total} \cdot g$

$T_1 = M_{total}(a+g)$

$T_1 = 20\,(2\,m/s^2 + 10\,m/s^2)$

$= 20\,(12)$

$\boxed{T_1 = 240N}$ → Ans.

Q. A object of mass 500g moves along x-axis with speed $v = 4\sqrt{x}$ m/s. The force acting on object is ?

a) 8N b) 4N

c) 5N d) 6N

[JEE Main 2025].

⟹ $m = 500g = 0.5\,kg$

$v = 4\sqrt{x}$ m/s

$a = \frac{d}{dt}v = \frac{dv}{dx} \times \frac{dx}{dt}$

$\frac{dx}{dt} = v$ $\therefore$ $a = \frac{dv}{dx}$

$v = 4\sqrt{x}$

$\frac{dv}{dx} = \frac{d}{dx}(4\sqrt{x}) = 4 \times \frac{1}{2} x^{1/2 - 1}$

$= 2x^{-1/2} = 2/\sqrt{x}$

$$a = v\frac{dv}{dx} = (4\sqrt{x})\left(\frac{2}{\sqrt{x}}\right)$$

$$a = 4 \cdot 2$$

$$a = 8\,m/s^2$$

Now $F = m \cdot a$

$$= 0.5 \times 8$$

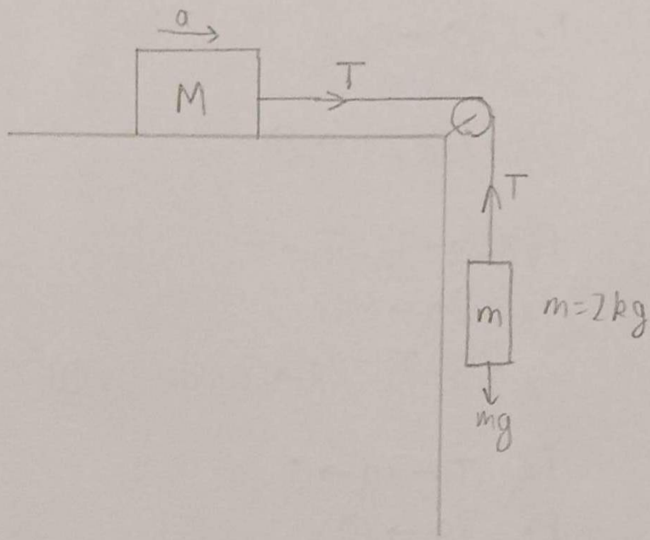
$$= \frac{\cancel{5}^{1}}{\cancel{10}\,\cancel{2}_{1}} \times \cancel{8}^{4}$$

$$= \underline{\underline{4\,N}} \Longrightarrow \underline{\underline{(b)}}$$

Deepinder Maheshwari
2025 - 2026

Q1) A block of mass 2 kg hangs freely at end of string, which passes over a smooth pulley fixed at the edge of a smooth table. The other end of string is attached to a mass M on the table. If the mass M is doubled tension in increases by one-half. Find M.

A) $T = \frac{mM}{m+M} g \rightarrow ①$



$\frac{3}{2} T = T'$

$2M = M'$

$T = \frac{mM}{m+M} g$

$\frac{3}{2} T = \frac{2mM}{m+2M} g \rightarrow ②$

Dividing ① by ②,

$\frac{2}{3} = \frac{m+2M}{m+M} \times \frac{1}{2}$

Substitute $m = 2$ kg

$\frac{2}{3} = \frac{2+2M}{2+M} \times \frac{1}{2}$

$3(2+2M) = 2(4+2M)$

$6+6M = 8+4M$

$2M = 2$

$M = 1$ kg //

Q2) A body of mass 2kg moving with velocity $\vec{V}_{in} = 3\hat{i} + 4\hat{j}\ ms^{-1}$ enters into a constant force feild of 6 N directed along positive z-axis. If the body remains in the feild for $\frac{5}{3}$ seconds, find velocity of body after exiting feild.

A) $\vec{F} = 6\hat{k}$, $m = 2$kg, $\vec{V}_{in} = 3\hat{i} + 4\hat{j}\ ms^{-1}$, $t = \frac{5}{3}$ s

$F = ma$

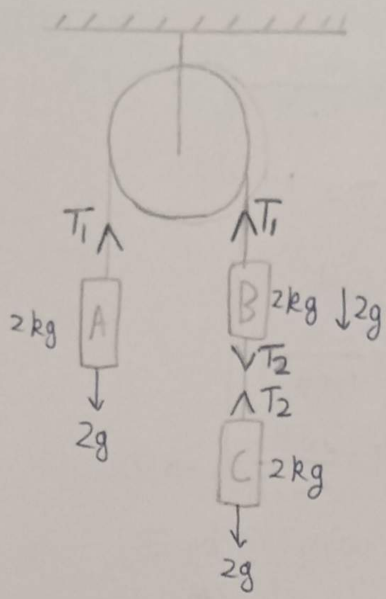
$a = \frac{\vec{F}}{m} = \frac{6\hat{k}}{2} = 3\hat{k}$

$\vec{V}_{fi} = \vec{V}_{in} + \vec{a}t$

$= 3\hat{i} + 4\hat{j} + 3\hat{k}\frac{5}{3}$

$= 3\hat{i} + 4\hat{j} + 5\hat{k}$ //

Q3) 3 equal weights A, B & C each of mass 2 kg are hanging on a string passing over a fixed frictionless pulley as shown in figure. The tension in string connecting B and C is:



A) $F = ma$

$F_C = 2g - T_2 \rightarrow (1)$

$F_C = 2a \rightarrow (2)$

From (1) & (2),

$2g - T_2 = 2a \rightarrow (a)$

$F_B = 2g + T_2 - T_1 \rightarrow (3)$

$F_B = 2a \rightarrow (4)$

$2g + T_2 - T_1 = 2a \rightarrow (b)$ (from (3) & (4))

$F_A = T_1 - 2g \rightarrow (5)$

$F_A = 2a \rightarrow (6)$

$T_1 - 2g = 2a \rightarrow (c)$ (from (5) & (6))

Adding (a), (b) & (c),

$$\begin{aligned} 2g - T_2 &= 2a \\ 2g + T_2 - T_1 &= 2a \\ (+)\ -2g + 0 + T_1 &= 2a \\ \hline 2g &= 6a \end{aligned}$$

$a = \frac{2g}{6} = \frac{g}{3}$

$T_2 = 2g - 2a = 2g - \frac{2g}{3} = \frac{4g}{3} = \frac{4 \times 9.8}{3} = \frac{39.2}{3} = 13\,N$

Tension in string connecting B and C is 13 N.