



Mahendra Singh ✓

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B.tech Gold Medalist, Awarded with Teaching Excellence by Unacademy. Produced AIR 49 in JEE Advanced, Got AIR 368 in GATE 2016 & AIR 192 in

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MSLIVE

10AM

HINDI PHYSICS

Practice Session on NLM & Friction

Starts on Apr 12, 2022 • 10:00 AM

In this session, Mahendra Singh will discuss Units and Measurements. It will be helpful for the aspirants preparing for NEET. This session will be conducted in Hindi and the notes will be provided in English.

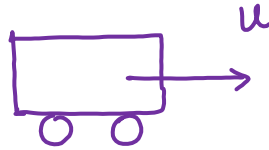




ग्राव्य/किश्मत
↓
सिफमत X

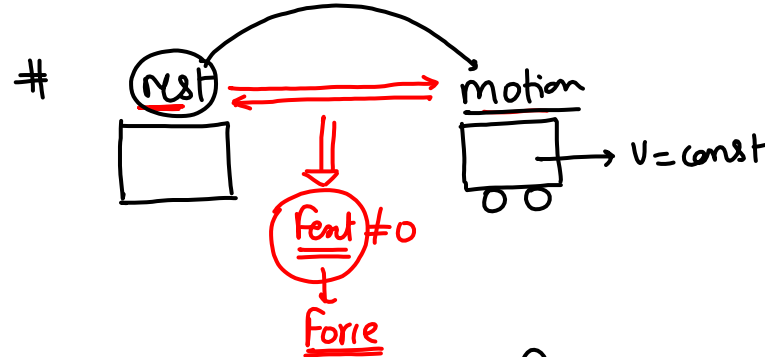
मेहनत
↓
सिफमत

Laws of Motion & Friction → 2 to 3 Q, 08-12 M



speed
velocity
acceleration
dist
displacement

Cause of motion



Body/object opposes change in
· State, Inertia

Laws of Motion & Friction



Inertia :-

rest

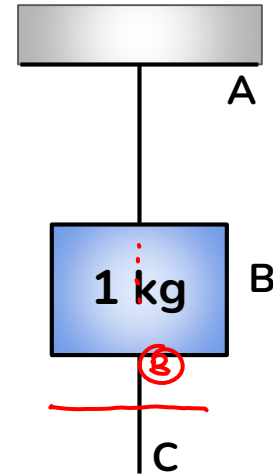
motion

Direction

Example

A mass of 1 kg is suspended by a string A. Another string C is connected to its lower end. If a sudden jerk is given to C, then

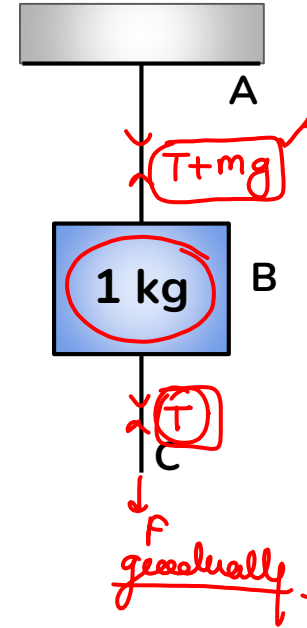
- A. The portion AB of the string will break.
- ☒ B. The portion BC of the string will break.
- C. None of the strings will break.
- ☒ D. The mass will start rotating



Example

A mass of 1 kg is suspended by a string A. Another string C is connected to its lower end. If the string C is stretched slowly, then

- ☒ A. The portion AB of the string will break.
- ☐ B. The portion BC of the string will break.
- ☐ C. None of the strings will break.
- ☐ D. The mass will start rotating





Hw

A boy sitting on the top most berth in the compartment of a train which is just going to stop on a railway station, drops an apple aiming at the open hand of his brother situated vertically below his hands at a distance of about 2m. The apple will fall :-

- (1) In the hand of his brother
- (2) Slightly away from the hands of his brother in the direction of motion of the train
- (3) Slightly away from the hands of his brother in the direction opposite to the direction of motion of the train
- (4) None of the above

Laws of Motion & Friction

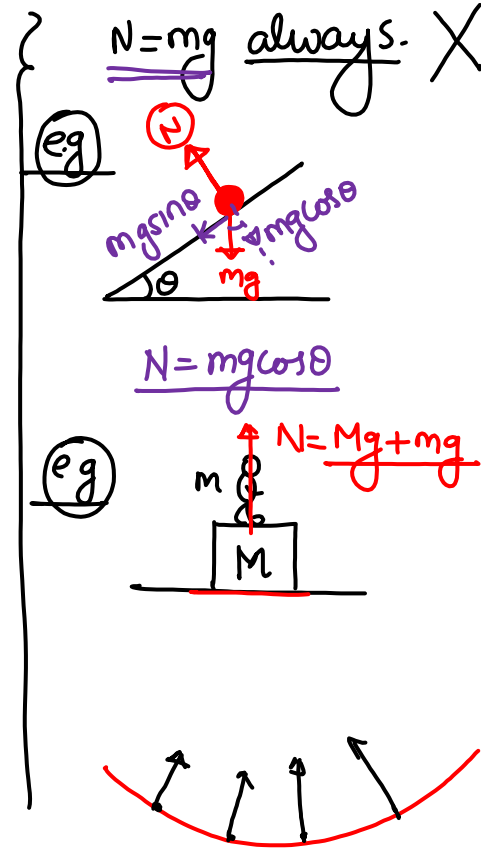
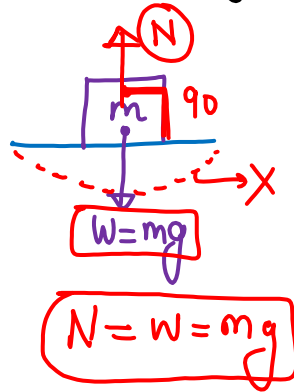


Force :-

↓
anything → push or pull
↓
vector quantity

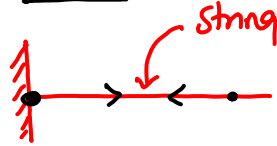
⊗ Self weight, $W = mg \downarrow$

⊗ Normal,
acts at 90
to surface
always



Laws of Motion & Friction

⊗ Tension:-

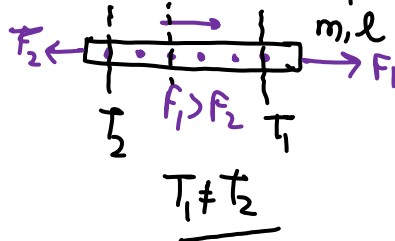


• always act away from PoA

• For ideal string → $T = \text{const}$
throughout length
 • massless
 • Inextensible
 ↓
 $l = \text{const}$

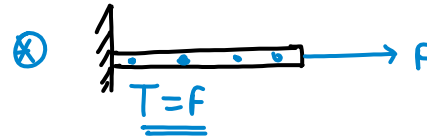
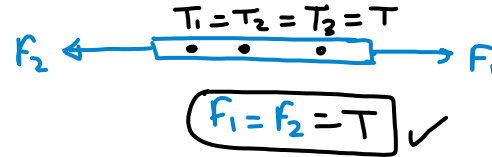


• For massive string



$T = \text{const}$; for massive string

→ string must be at rest ⊗ or move with $v = \text{const}$

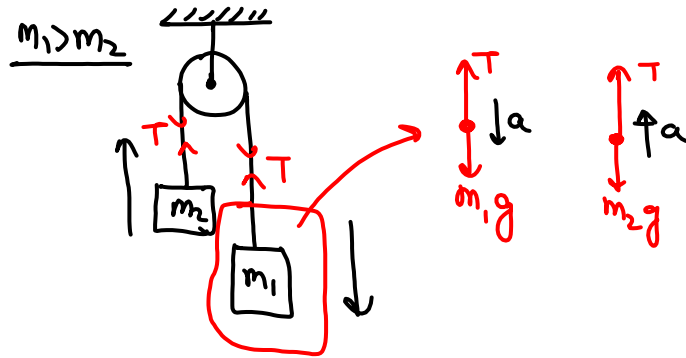
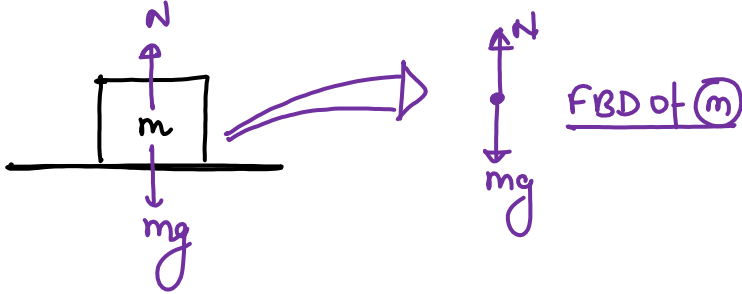


Laws of Motion & Friction



(FBD)

Free Body Diagram:-



Laws of Motion & Friction



Example

MCQ type Question [+4 , -1]

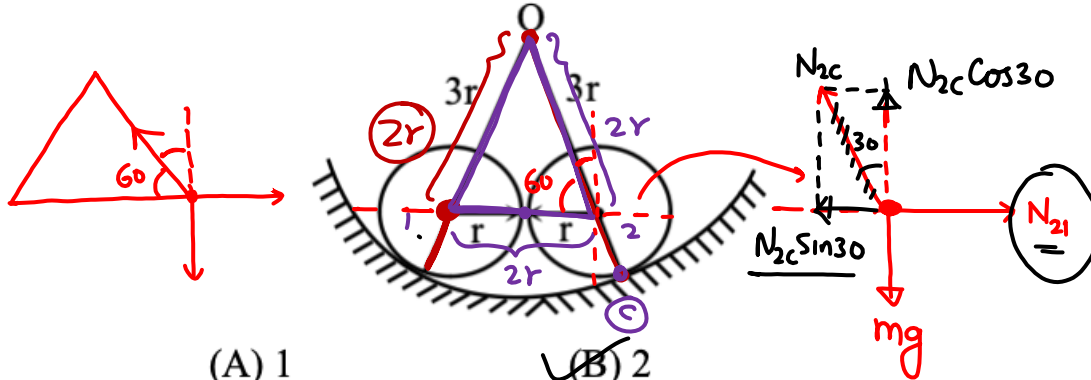
Quality
सवाल

Two identical heavy spheres of equal mass are placed on a smooth cup of radius $3r$ where r is radius of each sphere. Then the ratio of reaction force between cup and any sphere to reaction force between two sphere is –

$$\frac{N_{2c}}{N_{21}} = \frac{N_{1c}}{N_{12}}$$

$$N_{2c} \sin 30^\circ = N_{21}$$

$$\frac{N_{2c}}{N_{21}} = \frac{1}{\sin 30^\circ} = \frac{2}{1}$$



- (A) 1
(C) 3

- (B) 2
(D) None

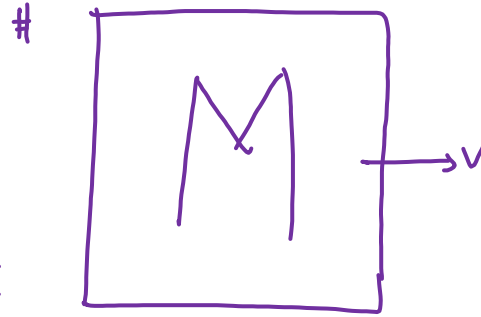
Momentum



$$\bar{p} = m\bar{v}$$

↓
rate of measure of inertia.

Easy to stop.



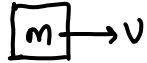
$$\bar{p} = M\bar{v}$$

difficult to stop.

Newton's 2nd Law of Motion



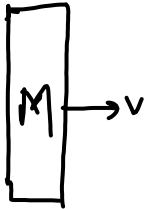
#



p_1

can be brought to rest with (F) .

$$\therefore \boxed{\vec{F}_{\text{ext}} = \frac{d\vec{p}}{dt}}$$



p_2

can't be stop by (F)

(or)

$$\int d\vec{p} = \int \vec{F}_{\text{ext}} \cdot dt$$

$$\Delta \vec{p} = \vec{p}_f - \vec{p}_i = \underline{\text{Impulse}} (\vec{J})$$

$$\vec{p} = m \cdot \vec{v}$$

$$\vec{F}_{\text{ext}} = \frac{d}{dt} (m\vec{v})$$

$$\underline{m = \text{const}}$$

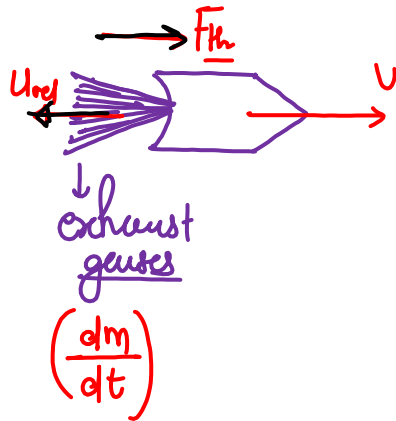
$$\boxed{\vec{F}_{\text{ext}} = m \frac{d\vec{v}}{dt} = m \cdot \vec{a}}$$

$$\boxed{p_2 \gg p_1}$$

Newton's 2nd Law of Motion

⊗ $m \neq \text{const}$

⇒ Rocket propulsion



$$F_{ext} = \frac{dP}{dt} = \frac{d}{dt} (m \underset{\substack{\downarrow \\ r}}{u})$$

$$\boxed{F_{ext} = m \frac{d\bar{v}}{dt} + \bar{v} \frac{dm}{dt}}^{\#}$$

$$\underline{v = \text{const}}$$

$$\frac{dv}{dt} = 0$$

$$\boxed{\bar{F}_{th} = -\bar{v}_{ex} \frac{dm}{dt}}$$

A stone is dropped from a height h . It hits the ground with a certain momentum P . If the same stone is dropped from a height 100% more than the previous height, the momentum when it hits the ground will change by

(a) 68%

~~(b) 41%~~

(c) 200%

(d) 100%

(Mains 2012)

$u=0$

h $2h$

$v = \sqrt{2gh}$ $v' = \sqrt{2g(2h)}$

$p = m \cdot v$ $p' = m \cdot \sqrt{2g(2h)}$

$\textcircled{p} = m\sqrt{2gh}$ $\underline{p' = \sqrt{2} [p]}$

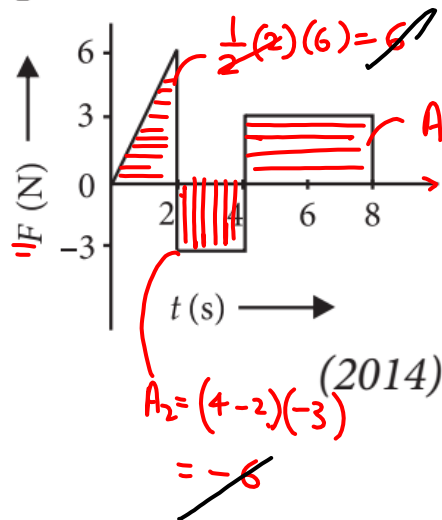
$= 1.414 P$

$\frac{p' - p}{p} \times 100 = (1.414 - 1) \times 100$

$= 41\%$

The force F acting on a particle of mass m is indicated by the force-time graph as shown. The change in momentum of the particle over the time interval from zero to 8 s is

- (a) 24 N s
- (b) 20 N s
- (c) 12 N s
- (d) 6 N s



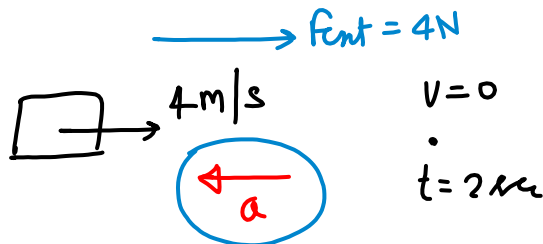
$$F = \frac{dP}{dt}$$

$$\int dP = \Delta P = \int F dt$$

(area under curve)

A body of mass 2 kg moving on a horizontal surface with an initial velocity of 4 m/s comes to rest after 2 sec. If one wants to keep this body moving on the same surface with a velocity of 4 m/s, the force required is :

- A. 8 N
- ☒ B. 4 N
- C. Zero
- D. 2 N



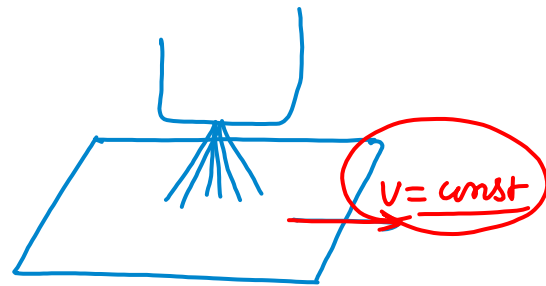
$$v = u + at$$
$$0 = (4) - a(2)$$

$$a = 2 \text{ m/s}^2$$

retardation

$$F_{\text{net}} = m a = (2)(2) = \underline{4 \text{ N}}$$

Sand is being dropped on a conveyor belt at the rate of $M \text{ kg/s}$. The force necessary to keep the belt moving with a constant velocity of $v \text{ m/s}$ will be



(a) $\frac{Mv}{2}$ newton

(b) zero

(c) Mv newton

(d) $2 Mv$ newton (2008)

$$F_{th} = v \frac{dm}{dt} + m \frac{dv}{dt}$$

$\cancel{\frac{dv}{dt}}$
 $\underline{v = \text{constant}}$

$$\underline{= v(M)}$$

$$\frac{dm}{dt} \neq 0$$

$$\frac{dm}{dt} = M \frac{kg}{sec}$$

Example

MCQ type Question [+4 , -1]

If the force on a rocket, moving with a velocity of 300 m/s is 210 N, then the rate of combustion of the fuel is

(a) 0.07 kg/s

(b) 1.4 kg/s

☒ (c) 0.7 kg/s

(d) 10.7 kg/s

(1999)

$$F_{th} = v \cdot \frac{dm}{dt}$$

$$210 = 300 \left(\frac{dm}{dt} \right)$$

$$\frac{210}{300} = \frac{dm}{dt}$$

A 5000 kg rocket is set for vertical firing. The exhaust speed is 800 m s^{-1} . To give an initial upward acceleration of 20 m s^{-2} , the amount of gas ejected per second to supply the needed thrust will be ($g = 10 \text{ m s}^{-2}$)

(a) 185.5 kg s^{-1}

(c) 127.5 kg s^{-1}

✓ (b) 187.5 kg s^{-1}

(d) 137.5 kg s^{-1}

$$F_{th} - mg = ma$$

$$v \frac{dm}{dt} = m(g+a)$$

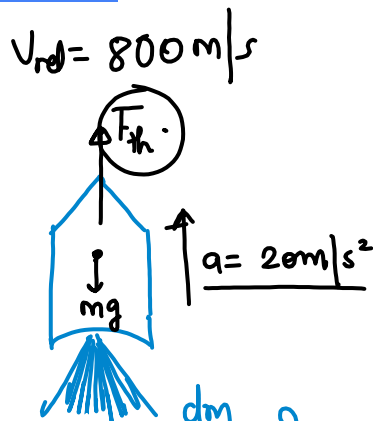
$$\frac{dm}{dt} = \frac{m}{v}(g+a)$$

(1998)

$$= \frac{5000}{800} (10 + 20)$$

$$= \frac{50}{8} \times 30$$

$$\frac{dm}{dt} = ?$$



Newton's 3rd Law of Motion



To every action there is equal and opposite reaction

→ action $\rightleftharpoons$ Reactⁿ

- Instantaneous.
- act on different body
- $F_{net} = 0$

$$\vec{F}_{12} = -\vec{F}_{21}$$

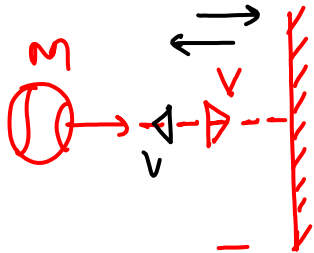
$$\underline{|\vec{F}_{12}| = |\vec{F}_{21}|}$$

Example

MCQ type Question [+4 , -1]

A body of mass M hits normally a rigid wall with velocity V and bounces back with the same velocity. The impulse experienced by the body is

- (a) MV (b) $1.5MV$
 (c) $2MV$ (d) zero (2011)



$$\vec{p}_i = MV(\hat{i})$$

$$\vec{p}_f = MV(-\hat{i})$$

$$\begin{aligned} \vec{J} &= \vec{p}_f - \vec{p}_i \\ &= -MV\hat{i} - MV\hat{i} \\ &= -2MV\hat{i} \end{aligned}$$

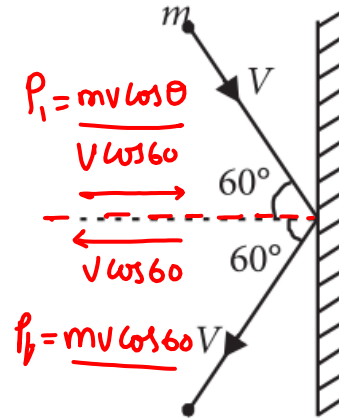
Impulsion on ball by wall

$$J_{w \text{ by ball}} = 2MV(\hat{i})$$

Example

MCQ type Question [+4 , -1]

A rigid ball of mass m strikes a rigid wall at 60° and gets reflected without loss of speed as shown in the figure. The value of impulse imparted by the wall on the ball will be



along the wall no impulse

(a) mV

(b) $2mV$

(c) $\frac{mV}{2}$

(d) $\frac{mV}{3}$

(NEET-II 2016)

$$J = \Delta p = 2mV \cos 60$$

$$= 2mV \cdot \cos 60$$

Example

MCQ type Question [+4 , -1]

A 0.5 kg ball moving with a speed of 12 m/s strikes a hard wall at an angle of 30° with the wall. It is reflected with the same speed at the same angle. If the ball is in contact with the wall for 0.25 seconds, the average force acting on the wall is

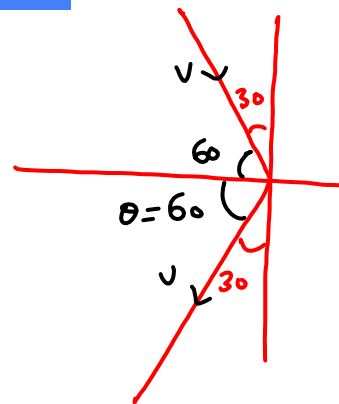
(a) 96 N

(b) 48 N

~~(c) 24 N~~

(d) 12 N

(2006)



$$\Delta p = 2mv \cos \theta = mv$$

$$F = \frac{\Delta p}{\Delta t} = \frac{mv}{0.25}$$

$$= \frac{0.5 \times 12}{0.25}$$

Conservation of Momentum



$$\begin{aligned} F &= \frac{d\bar{p}}{dt} \\ \text{net} \\ 0 &= \frac{d\bar{p}}{dt} \end{aligned}$$

$$d\bar{p} = 0$$

$$\Delta\bar{p} = 0$$

$$\boxed{\bar{p}_i = \bar{p}_f}$$

An object flying in air with velocity $(20\hat{i} + 25\hat{j} - 12\hat{k})$ suddenly breaks in two pieces whose masses are in the ratio 1 : 5. The smaller mass flies off with a velocity $(100\hat{i} + 35\hat{j} + 8\hat{k})$.

The velocity of the larger piece will be

- (a) $4\hat{i} + 23\hat{j} - 16\hat{k}$ (b) ~~$-100\hat{i} - 35\hat{j} - 8\hat{k}$~~
 (c) $20\hat{i} + 15\hat{j} - 80\hat{k}$ (d) ~~$-20\hat{i} - 15\hat{j} - 80\hat{k}$~~

$$\frac{m_1}{m_2} = \frac{1}{5}$$

$$m_T = 6m$$

$$m_1 = m$$

$$m_2 = 5m$$

(Odisha NEET 2019)

$$P_i = 6m(20\hat{i} + 25\hat{j} - 12\hat{k})$$

$$\bar{P}_i = \underline{120m\hat{i} + 150m\hat{j} - 72m\hat{k}}$$

$$\bar{P}_f = \bar{P}_1 + \bar{P}_2$$

$$= m(100\hat{i} + 35\hat{j} + 8\hat{k}) + 5m(\bar{v}_2)$$

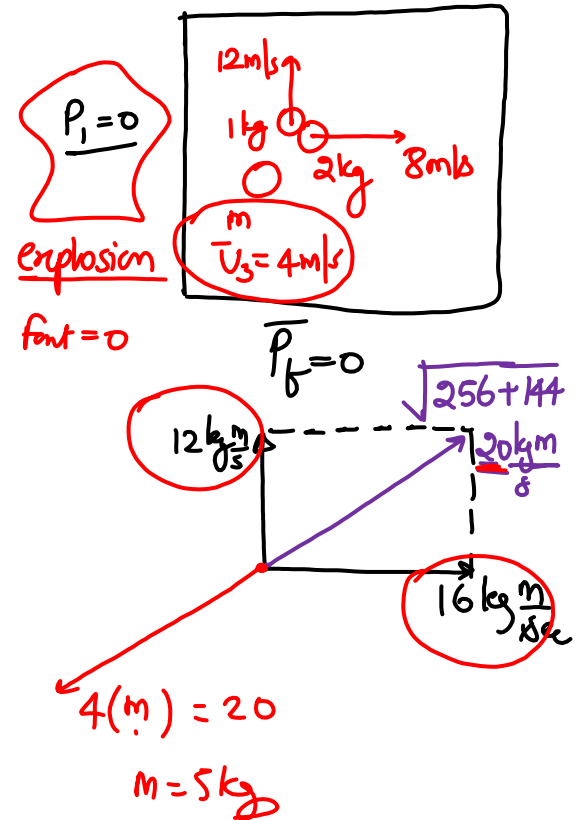
$$\underline{\bar{P}_1 = \bar{P}_f}$$

An explosion breaks a rock into three parts in a horizontal plane. Two of them go off at right angles to each other. The first part of mass 1 kg moves with a speed of 12 m s^{-1} and the second part of mass 2 kg moves with 8 m s^{-1} speed. If the third part flies off with 4 m s^{-1} speed, then its mass is

- (a) 7 kg
(c) 3 kg

- (b) 17 kg
(d) 5 kg

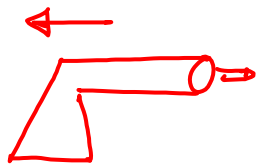
(NEET 2013)



A person holding a rifle (mass of person and rifle together is 100 kg) stands on a smooth surface and fires 10 shots horizontally, in 5 s. Each bullet has a mass of 10 g with a muzzle velocity of 800 m s⁻¹. The final velocity acquired by the person and the average force exerted on the person are

- (a) - 0.08 m s⁻¹, 16 N (b) - 0.8 m s⁻¹, 8 N
 (c) - 1.6 m s⁻¹, 16 N (d) - 1.6 m s⁻¹, 8 N

(Karnataka NEET 2013)



$$F_{th} = v \frac{dm}{dt} = 800 \times \frac{10}{1000}$$

(gm = 1kg)

$$\left(\frac{dm}{dt}\right)_T = N \frac{5g}{5sec} = 10 \frac{g}{s} = 10 \frac{gm}{sec}$$

$$P_i = P_f$$

$$0 = MV - mV \textcircled{N}$$

$$V = \frac{\textcircled{N}mv}{M} = \frac{(10 \times 800)10}{1000 \times 100} = \frac{80}{100}$$

Example

MCQ type Question [+4 , -1]

A 1 kg stationary bomb is exploded in three parts having mass 1 : 1 : 3 respectively. Parts having same mass move in perpendicular direction with velocity 30 m/s, then the velocity of bigger part will be

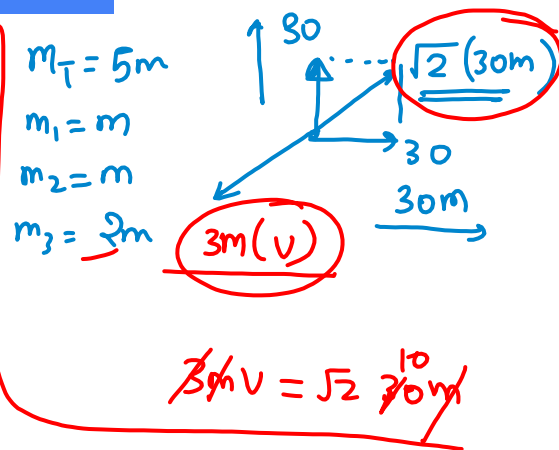
(a) $10\sqrt{2}$ m/s

(b) $\frac{10}{\sqrt{2}}$ m/s

(c) $15\sqrt{2}$ m/s

(d) $\frac{15}{\sqrt{2}}$ m/s

(2001)



Equilibrium of Particle



$$\underline{F_{net} = 0.}$$

$$\checkmark \sum F_x = 0$$

$$\checkmark \sum F_y = 0$$

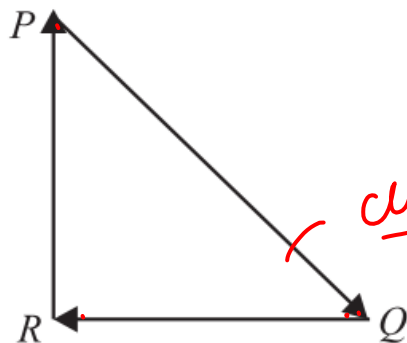
$$\checkmark \sum F_z = 0$$

Example

MCQ type Question [+4 , -1]

A particle moving with velocity $\vec{v}$ is acted by three forces shown by the vector triangle PQR . The velocity of the particle will

- (a) change according to the smallest force $\overline{QR}$
(b) increase (c) decrease
(d) ☒ remain constant



$F_{net} = 0$
closed polygon

(NEET 2019)

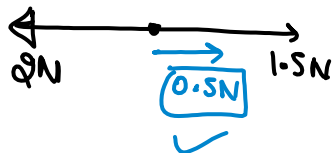
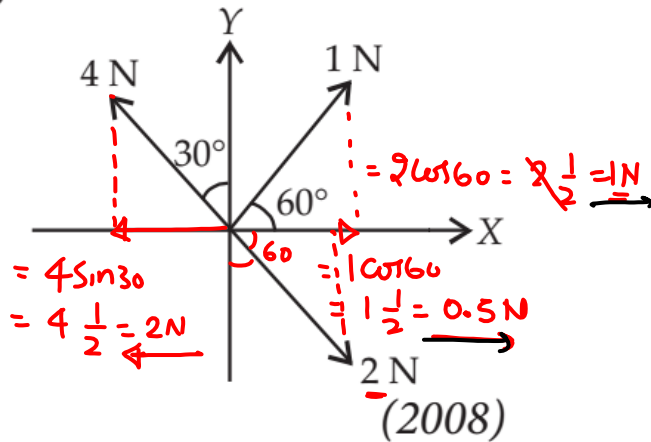
Three forces acting on a body are shown in the figure. To have the resultant force only along the y-direction, the magnitude of the minimum additional force needed is

(a) $\frac{\sqrt{3}}{4}$ N

(b) $\sqrt{3}$ N

(c) 0.5 N

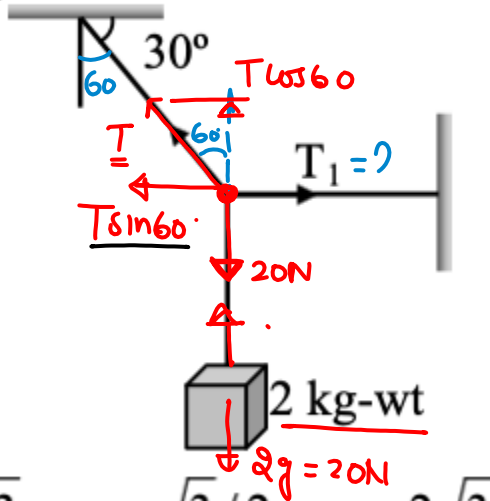
(d) 1.5 N



Example

MCQ type Question [+4 , -1]

A body of weight 2 kg is suspended as shown in the figure. The tension T_1 in the horizontal string (in kg wt) is :



- (A) ~~$2/\sqrt{3}$~~ (B) $\sqrt{3}/2$ (C) $2\sqrt{3}$ (D) 2

$$T \sin 60 = T_1$$

$$\frac{\sqrt{3}}{2} T = T_1$$

$$T \cos 60 = mg = 20N$$

$$T \frac{1}{2} = 20$$

$$T = 40N$$

$$T_1 = \frac{\sqrt{3}}{2} (40) = 20\sqrt{3}$$

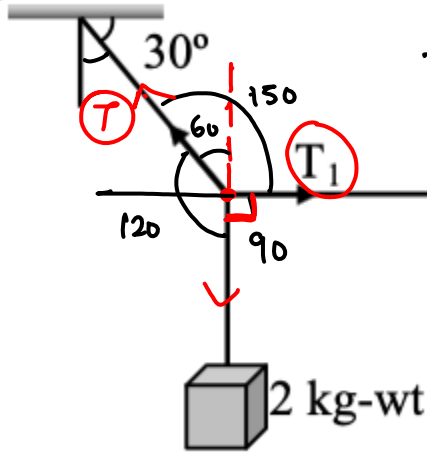
$$T_1 = 20\sqrt{3} N$$

$$\frac{T_1}{g} = \frac{20\sqrt{3}}{10} = 2\sqrt{3} \text{ kg-wt}$$

Example

MCQ type Question [+4 , -1]

A body of weight 2 kg is suspended as shown in the figure. The tension T_1 in the horizontal string (in kg wt) is :



Lami's theorem:-

→ Applicable for 3 Force system only.

→ One force must be known

$$\frac{T_1}{\sin(120)} = \frac{T}{\sin(90)} = \frac{W}{\sin(150)}$$

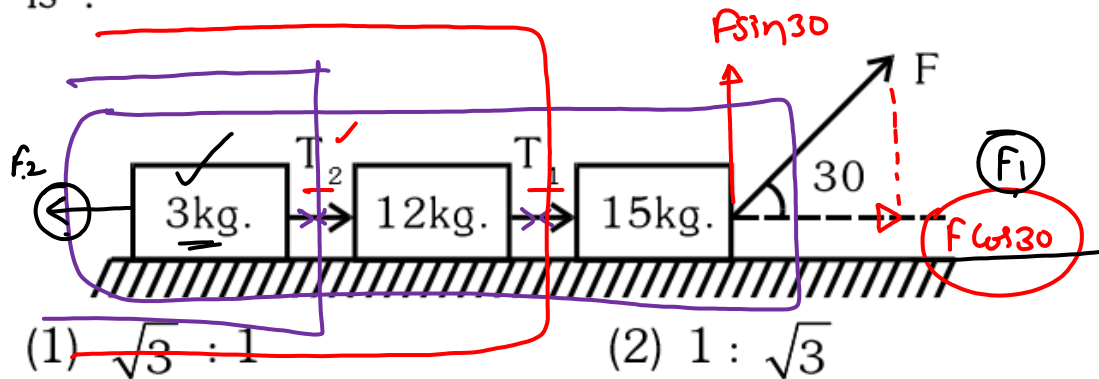
$$\frac{T_1}{\cos 30} = \frac{2}{\cos 60}$$

$$\frac{T_1(2)}{\sqrt{3}} = \frac{2}{1/2}$$

$$\underline{T_1 = 2\sqrt{3}}$$

- (A) $2/\sqrt{3}$ (B) $\sqrt{3}/2$ (C) $2\sqrt{3}$ (D) 2

The surface are frictionless, the ratio of T_1 and T_2 is :-



(1) $\sqrt{3} : 1$

(2) $1 : \sqrt{3}$

(3) $1 : 5$

(4) $5 : 1$

$$\frac{T_1}{T_2} = \frac{10}{2} = \frac{5}{1}$$

$$T_1 = \frac{(3+12)}{30} (F_1 - f_2) + f_2$$

$$= \frac{1}{2} F_1$$

$$T_2 = \frac{3}{30} (F_1 - f_2) + f_2$$

$$= \frac{F_1}{10}$$

$$a_c = \frac{F \cos 30}{30}$$

$$a_c \rightarrow$$

$$\boxed{3} \rightarrow T_2$$

$$T_2 = m \cdot a$$

$$= 3 \frac{F \cos 30}{30} = \frac{F \cos 30}{10}$$

①

$$a_c \rightarrow$$

$$\boxed{15} \rightarrow T_1$$

$$T_1 = \frac{F \cos 30}{30} \cdot 15 = \frac{F \cos 30}{2}$$

Example

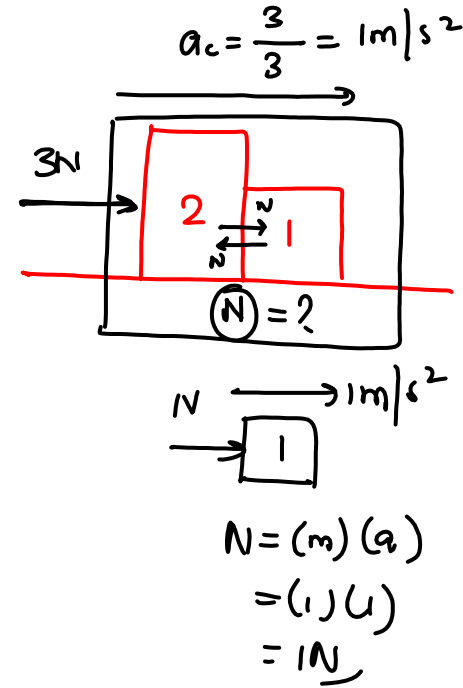
MCQ type Question [+4 , -1]

Two blocks of masses 2 kg and 1 kg are in contact with each other on a frictionless table. When a horizontal force of 3.0 N is applied to the block of mass 2 kg the value of the force of contact between the two blocks is -

(1) 4 N

(2) 3N

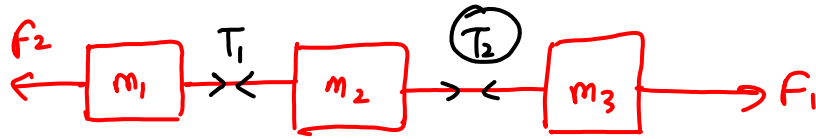
(3) 5N

✓ (4) 1N

MS Technique

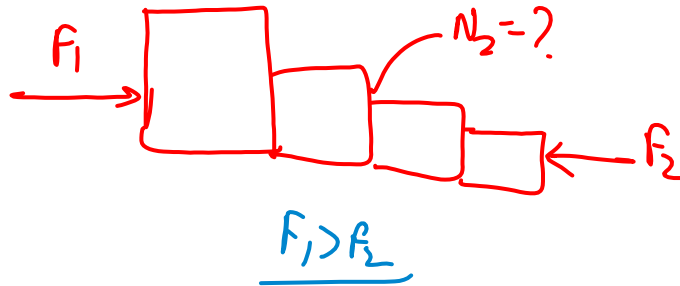


$$F_1 > F_2$$



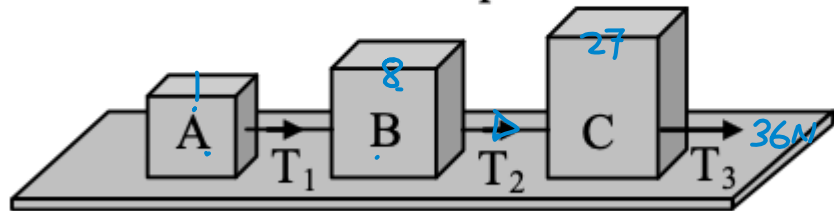
$$T_1 = \frac{(\text{mass b/w } F_2 \text{ and } T_1)}{m_T} \times (F_1 - F_2) + F_2$$

$$T_2 = \frac{(\text{mass b/w } F_2 \text{ and } T_2)}{m_T} \times (F_1 - F_2) + F_2$$



$$N_2 = \frac{\text{mass b/w } F_2 \text{ and } N_2}{m_T} \times (F_1 - F_2) + F_2$$

Three blocks A, B and C weighing 1, 8 and 27 kg respectively are connected as shown in the figure with an inextensible string and are moving on a smooth surface. T_3 is equal to 36 N. Then T_2 is :



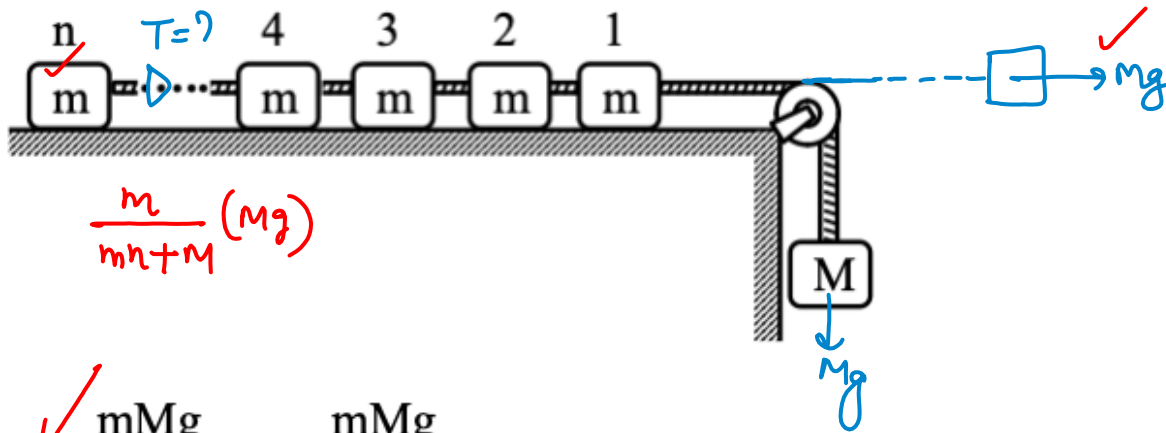
- (A) 18 N (B) 9 N (C) 3.375 N (D) 1.25 N

$$= \frac{9}{36} \times 36$$

Example

MCQ type Question [+4 , -1]

In the given arrangement, n number of equal masses are connected by strings of negligible masses. The tension in the string connected to n^{th} mass is—



(A) $\frac{mMg}{nm+M}$ (B) $\frac{mMg}{nmM}$

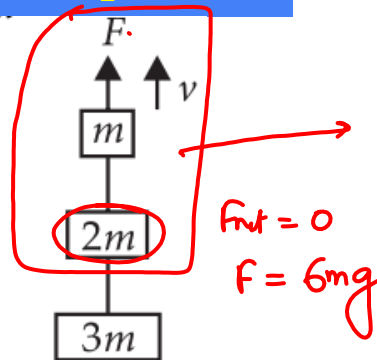
(C) mg

(D) nmg

Example

MCQ type Question [+4 , -1]

Three blocks with masses m , $2m$ and $3m$ are connected by strings, as shown in the figure. After an upward force F is applied on block m , the masses move upward at constant speed v .



What is the net force on the block of mass $2m$? (g is the acceleration due to gravity)

- (a) $3mg$ (b) $6mg$
 (c) zero (d) $2mg$

(NEET 2013)

$$\begin{aligned}
 &F = 6mg \\
 &\uparrow v = \text{const} \\
 &\downarrow 3mg \quad \downarrow 6mg - 3mg \\
 &= \underline{3mg}
 \end{aligned}$$

Example

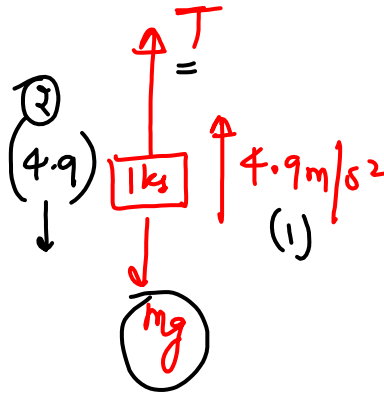
MCQ type Question [+4 , -1]

A mass of 1 kg is suspended by a thread. It is

- (i) lifted up with an acceleration 4.9 m/s^2 ,
 (ii) lowered with an acceleration 4.9 m/s^2 .

The ratio of the tensions is

- (a) 1 : 3 (b) 1 : 2 ☒ (c) 3 : 1 (d) 2 : 1 (1998)



$$\textcircled{1} T_1 > mg$$

$$T_1 - mg = ma$$

$$T_1 = m(a + g) = \textcircled{15}$$

$$\text{ii) } T_2 < mg$$

$$mg - T_2 = ma$$

$$T_2 = mg - ma$$

$$T_2 = m(g - a) \\ \approx \underline{5}$$

Example

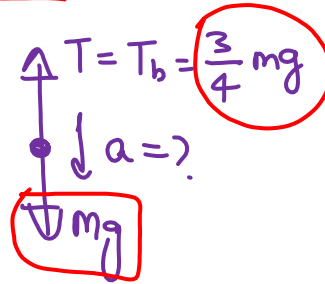
MCQ type Question [+4 , -1]

A monkey is decending from the branch of a tree with constant acceleration. If the breaking strength of branch is 75% of the weight of the monkey, the minimum acceleration with which monkey can slide down without breaking the branch is

- (a) g (b) $3g/4$ (c) $g/4$ (d) $g/2$ (1993)

Breaking strength
↓

maximum tension
that can be be

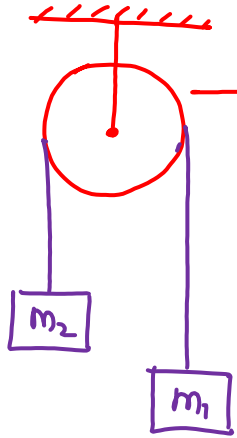


$$mg - \frac{3mg}{4} = m(a)$$

$$\frac{1}{4}mg = m a$$

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

Pulley Block System



$$\underline{m_1 = m_2}$$

→ ideal pulley

→ massless
frictionless

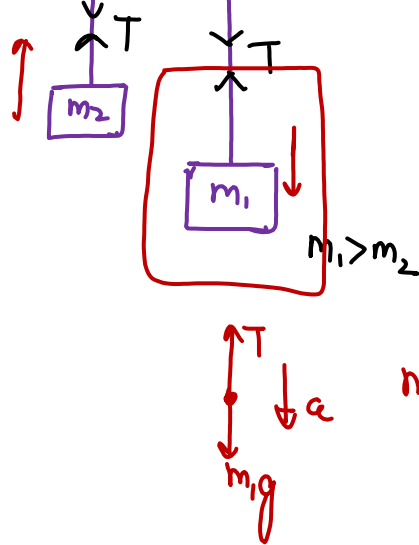
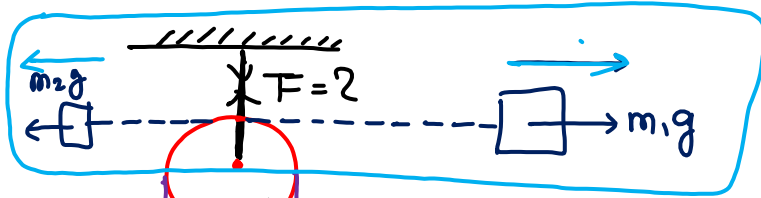
string will not slip over pulley

pulley → change direction of force

→ Reduces effort

→ mechanical advantage ↑

Pulley Block System



$$a = \frac{F_{net}}{m_T}$$

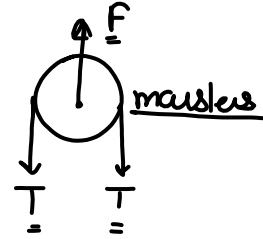
$$a = \frac{(m_1 - m_2)g}{(m_1 + m_2)}$$

$$m_1g - T = m_1a$$

$$T = \left(\frac{2m_1m_2}{m_1 + m_2} \right) g$$

Force on support by pulley.

$$F = 2T, \quad F = \left(\frac{4m_1m_2}{m_1 + m_2} \right) g$$



special case

$$m_1 = M$$

$$m_2 = m$$

$$m_1 \gg m_2$$

$$\frac{m}{M} \approx 0$$

$$a = \frac{(M - m)}{M + m} g \approx g$$

$$T = \frac{2Mm}{M + m} g$$

$$= \frac{2Mm}{M(1 + \frac{m}{M})} g$$

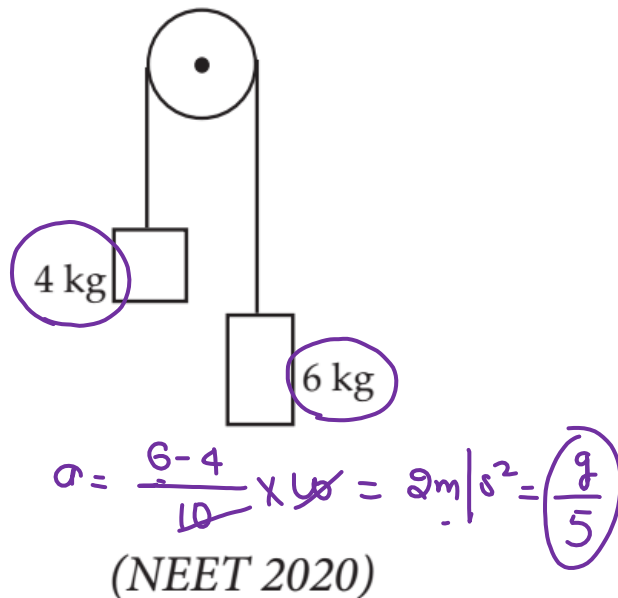
$$T = 2mg; \quad F = 2T = 4mg$$

Example

MCQ type Question [+4 , -1]

Two bodies of mass 4 kg and 6 kg are tied to the ends of a massless string. The string passes over a pulley which is frictionless (see figure). The acceleration of the system in terms of acceleration due to gravity (g) is

- (a) g (b) $g/2$
 (c) $g/5$ (d) $g/10$





Example

MCQ type Question [+4 , -1]

Example

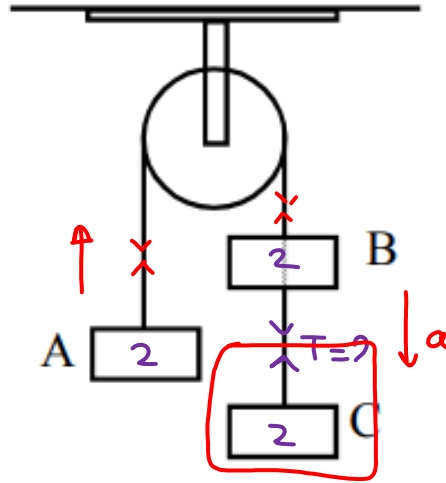
MCQ type Question [+4 , -1]

Three equal weights of mass 2 kg each are hanging on a string passing over a fixed pulley as shown in fig. What is the tension in the string connecting weights B and C.

- (1) Zero
 (2) 13.3 N
 (3) 3.3 N
 (4) 19.6 N

$$a = \frac{4g - 2g}{6}$$

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



$$T = \left(\frac{2m_1 m_2}{m_1 + m_2} \right) g = \frac{2(2)(2)}{4} \cdot g$$

$$= \underline{20N}$$

Blunder!

$$\begin{array}{c} \uparrow T \\ \downarrow 2g \\ \downarrow \frac{2g}{3} \end{array}$$

$$2g - T = 2 \frac{2g}{3}$$

$$T = 2g - \frac{2g}{3} = \frac{4g}{3}$$

$$T = \frac{40}{3} = \underline{13.33N}$$

Figure shows two pulley arrangements for lifting a mass m . In Case (a) the mass is lifted by attaching a mass $2m$ while in Case (b) the mass is lifted by pulling the other end with a downward force $F = 2mg$. If a_a & a_b are the accelerations of the two masses then (Assume string is massless and pulley is ideal)

A. $a_a = a_b$

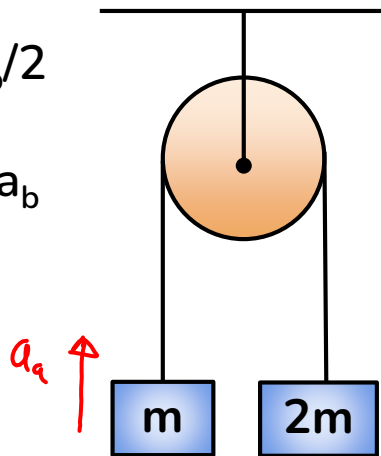
B. $a_a = a_b/2$

✓ C. $a_a = a_b/3$

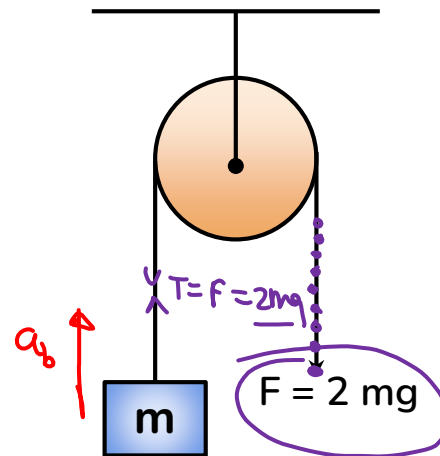
D. $a_a = 2 a_b$

$$a_b = \frac{2mg - mg}{m} = g //$$

$$a_a = \frac{2mg - mg}{3m} = g/3 //$$



Case (a)



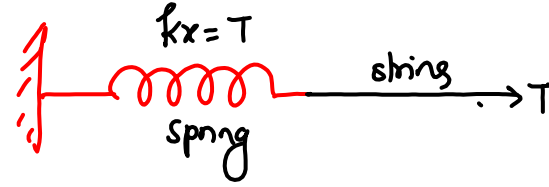
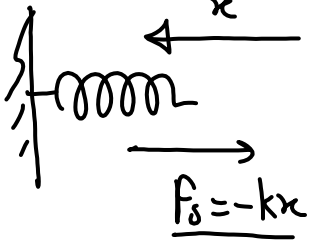
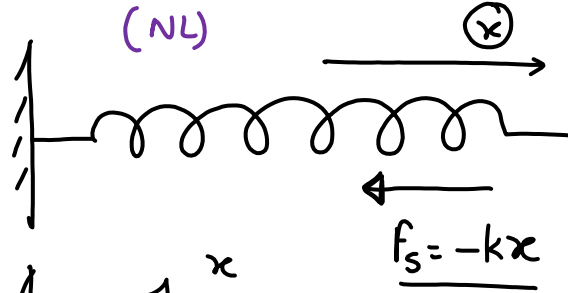
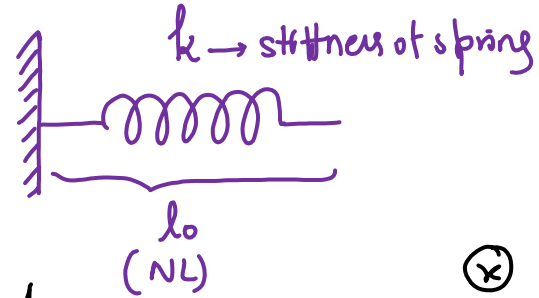
Case (b)



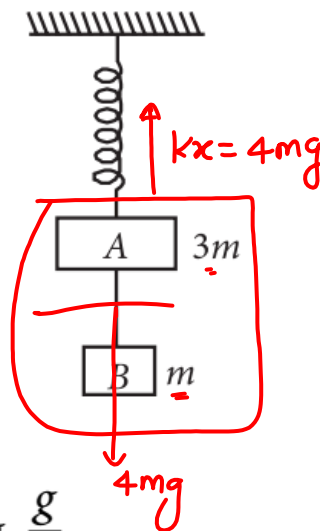
Example

MCQ type Question [+4 , -1]

Spring Force



Two blocks A and B of masses $3m$ and m respectively are connected by a massless and inextensible string. The whole system is suspended by a massless spring as shown in figure. The magnitudes of acceleration of A and B immediately after the string is cut, are respectively

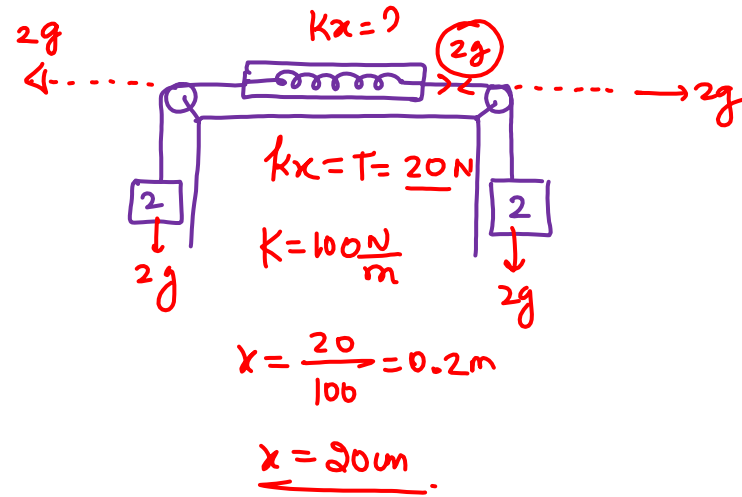
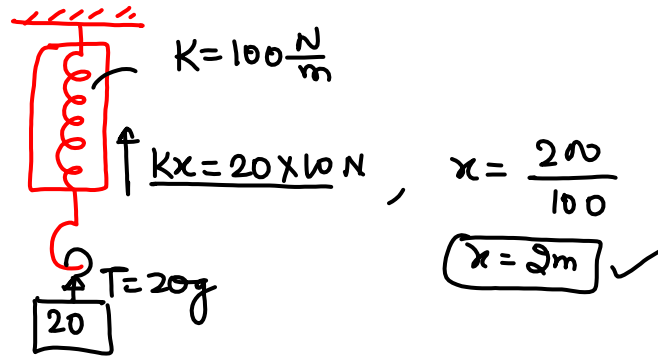


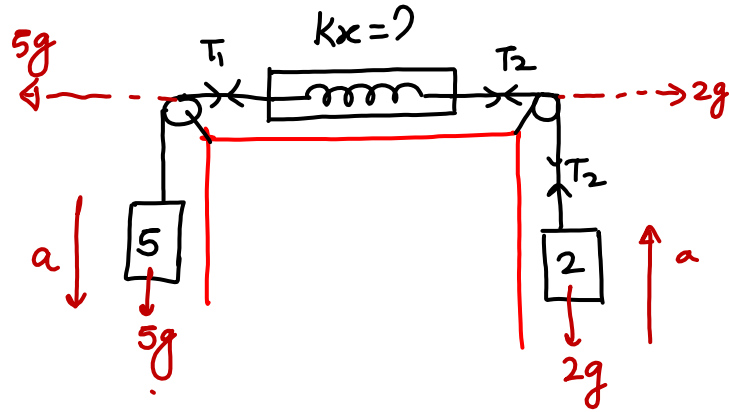
$$\begin{aligned}
 &\uparrow 4mg \\
 &\boxed{3m} \quad \downarrow 3mg \\
 &\quad \uparrow a = \frac{mg}{3m} = \frac{g}{3} \uparrow \\
 &\boxed{m} \\
 &\quad \downarrow mg \quad ; \quad \underline{a = g}
 \end{aligned}$$

- (a) $\frac{g}{3}, g$ (b) g, g (c) ~~$\frac{g}{3}, \frac{g}{3}$~~ (d) ~~$g, \frac{g}{3}$~~

(NEET 2017)

Reading in the spring :-





$$F_{net} = 5g - 2g = 3g$$

$$a = \frac{3g}{7}$$

$$T_2 - 2g = 2a$$

$$T_2 - 2g = 2\left(\frac{3g}{7}\right)$$

$$T_2 = \frac{6g}{7} + 2g$$

$$= \frac{20g}{7}$$

$$kx = \frac{20g}{7}$$

$$T_1 \leftarrow \text{spring} \rightarrow T_2$$

massless

$$T_1 - T_2 = m_p a$$

$$T_1 = T_2$$



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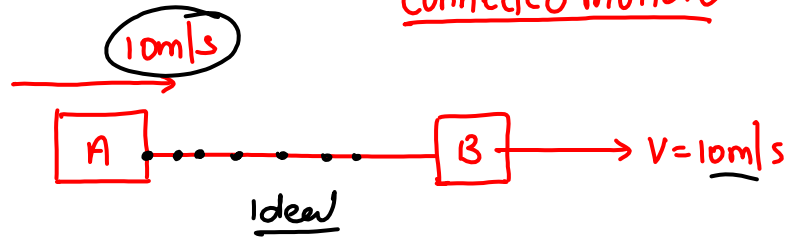


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Constraint Motion

Connected motion



velocity components along string = same

#

$$T(2a) = 2T(a)$$

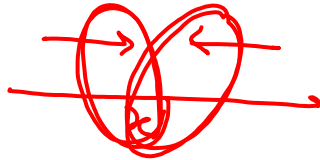
$$T_1 a_1 = T_2 a_2$$

$$T_1 x_1 - T_2 x_2 = 0$$

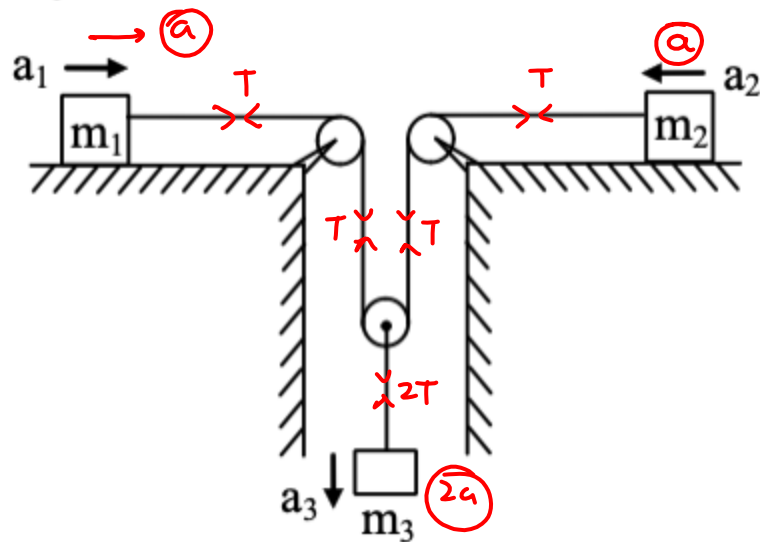
$$T_1 v_1 - T_2 v_2 = 0$$

$$T_1 a_1 - T_2 a_2 = 0$$

Work by T = 0



In the figure shown the relation between acceleration is -



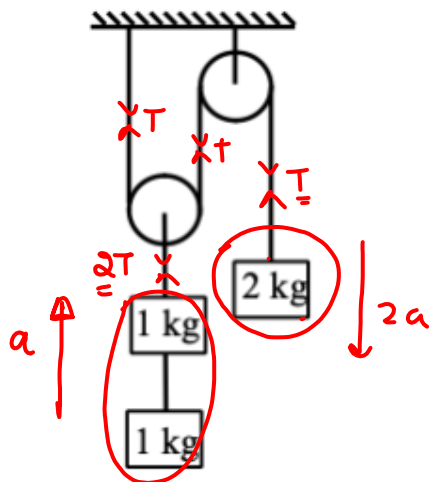
(A) $a_1 + a_2 + 2a_3 = 0$

(B) $a_1 + a_2 = 2a_3$

(C) $a_1 + a_2 = a_3$

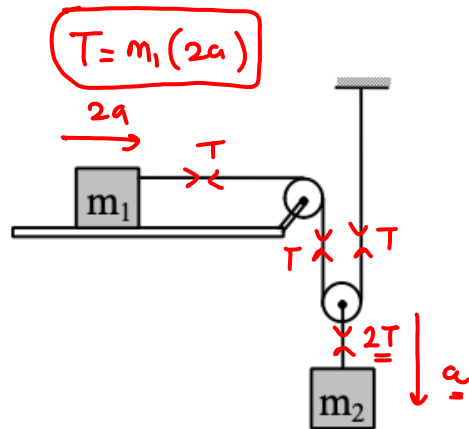
(D) $a_1 + a_2 + a_3 = 0$

The system of blocks and pulley as shown is released from rest. Then



- (A) blocks remain at rest
- (B) 2 kg block will move up
- ~~(C)~~ (C) 2 kg block will move down
- (D) None of these

If the surface is smooth, the acceleration of the block m_2 will be –



$$\begin{aligned}
 & \uparrow 2T \\
 & \downarrow m_2g \\
 & \downarrow a \\
 & m_2g - 2(2m_1a) = m_2a \\
 & m_2g = a(m_2 + 4m_1) \\
 & a = \frac{m_2g}{m_2 + 4m_1}
 \end{aligned}$$

(A) $\frac{m_2g}{4m_1 + m_2}$

(B) $\frac{2m_2g}{4m_1 + m_2}$

(C) $\frac{2m_2g}{m_1 + 4m_2}$

(D) $\frac{2m_1g}{m_1 + m_2}$



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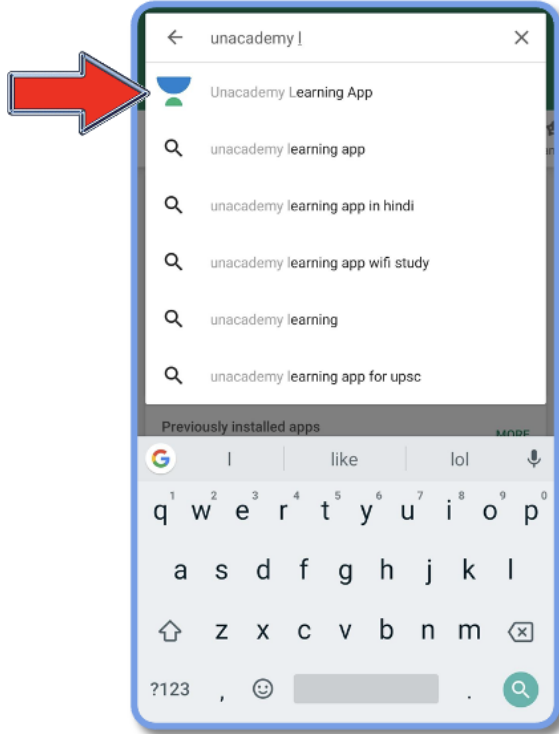
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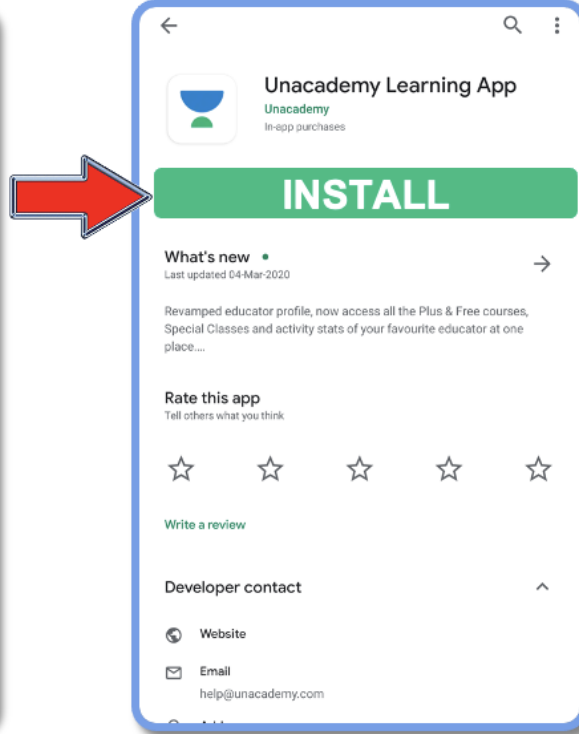
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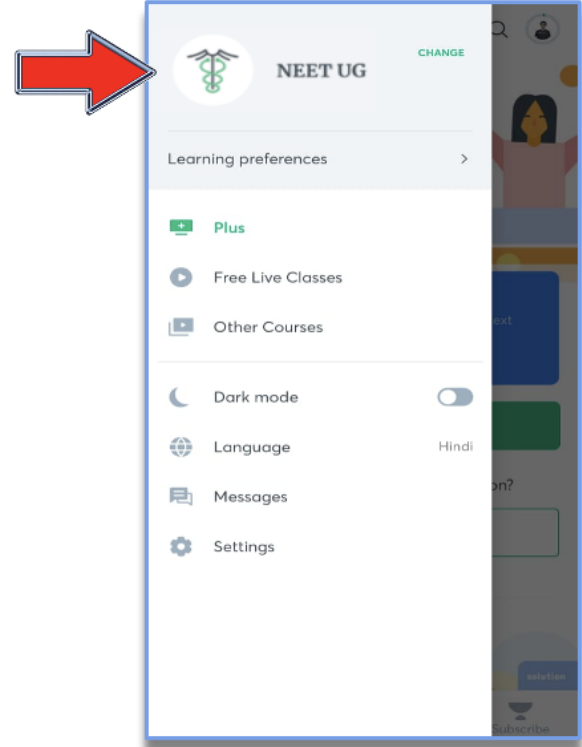
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