ARJUNA NEET BATCH

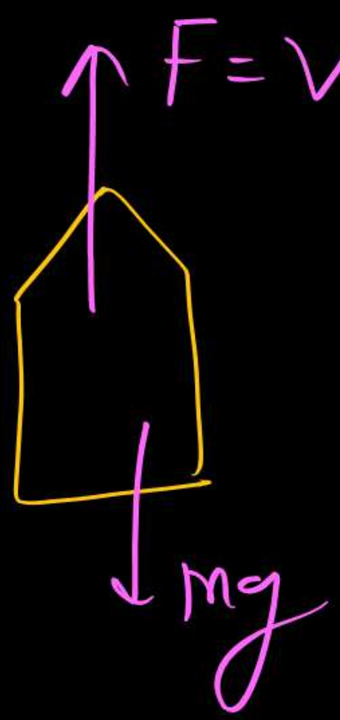
LAWS OF MOTION

LECTURE - 05

ToDays Goal

- question on Rocket Probm. ✓
- Connected body motion ✓
- Ph.D in Pulley block system

A 800 kg rocket is fired from earth so that exhaust speed is 1200 m/s. Then calculate mass of fuel burning per second, to provide initial thurst to overcome its weight. ($g = 10\ m/s^2$)

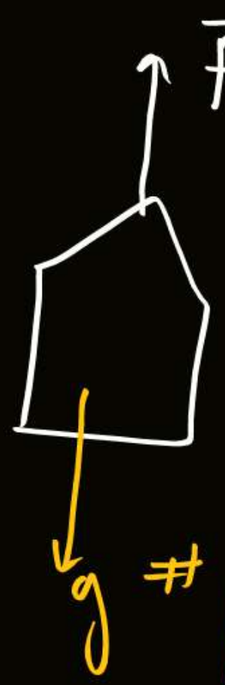


$\frac{dm}{dt} = ??$

$mg = V\frac{dm}{dt}$

$800 \times 10 = 1200\ \frac{dm}{dt}$

$\frac{80}{12} = \left(\frac{dm}{dt}\right)$



$$a_0 = \frac{F}{Mass_0} = \left(\frac{u\frac{dm}{dt}}{m_0}\right) - g$$

initial acln at time ($t = 0$)

at time 't'

$$a_t = \frac{\left(u\frac{dm}{dt}\right)}{m_0 - \frac{dm}{dt}t} - g$$

A cracker rocket is ejecting gases at a rate of 0.05 kg/s with a velocity 400 m/s. The accelerating force on the rocket is:

(a) 20 dyns
(b) 20 N
(c) 200 N
(d) Zero

$\frac{dm}{dt} = 0.05 \text{ kg/s}$

$u = 400 \text{ m/s}$

$F = u\frac{dm}{dt} =$

A rocket of mass 5700 kg ejected mass at a constant rate of 15 kg/s with constant speed of 12 km/s. The acceleration of the rocket 1 minute after the blast is (g = 10 m/s^2)

(a) 34.9 m/s^2 (b) 27.5 m/s^2

(c) 3.50 m/s^2 (d) 13.5 m/s^2

$$a_t = \frac{u\frac{dm}{dt}}{M_0 - \frac{dm}{dt}\times t} - g$$

$$= \left[\frac{12\times10^3\times15}{5700-15\times60}\right] - 10$$

$$\frac{dm}{dt} = 15\,kg/s$$

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If the force on a rocket, that releases the exhaust gases with a velocity of 300 m/s is 210 N, then the rate of combustion of the fuel is:

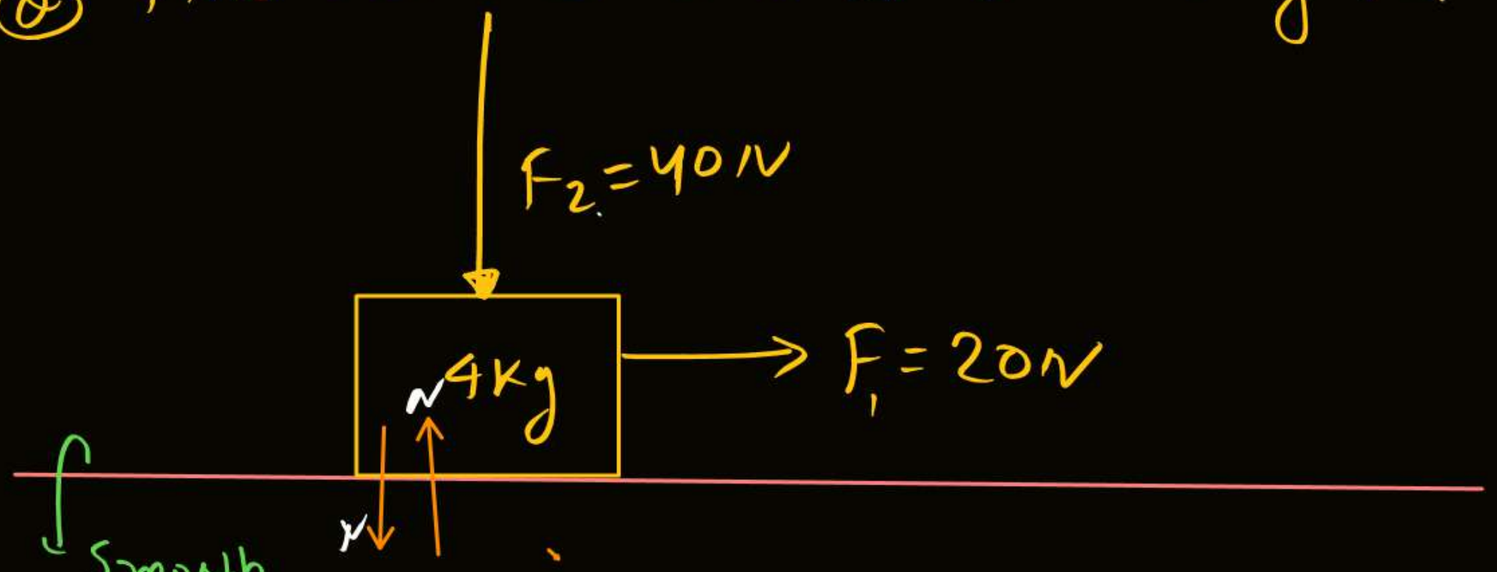
(a) 0.07 kg/s
(b) 1.4 kg/s
(c) 0.7 kg/s
(d) 10.7 kg/s

$$F = u\frac{dm}{dt}$$

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

question on Dynamics [Newton 2nd Law]

(Q) find acc^n of block of mass 4kg ??

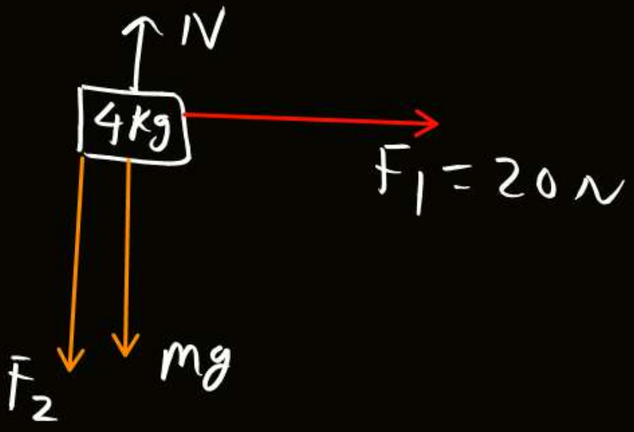


$\vec{F} = \frac{d\vec{P}}{dt}$

m = cost^n.

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

F.B.D of block



$\Sigma F_y = 0$ $\quad a_y = 0$

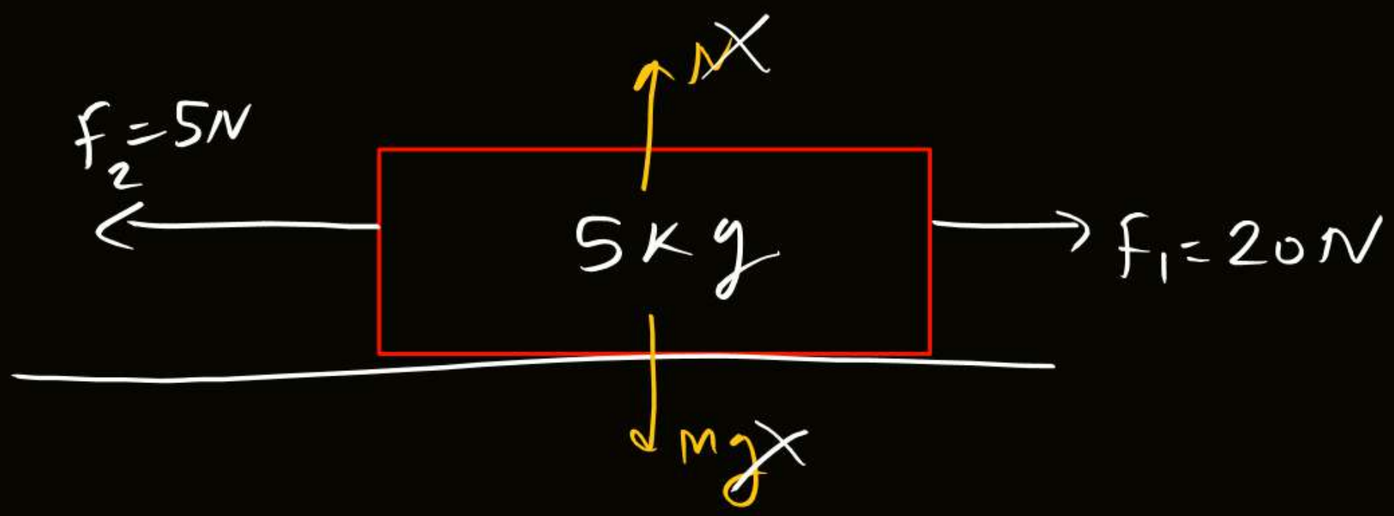
$N = F_2 + mg = [40 + 40]$

$= 80N$

$\Sigma F_x = M a_x$

$20 = 4 \times a_x$ $\quad a_x = 5 m/s^2$

find acc^n of 5kg ??



$$\Sigma F_x = m \Sigma a_x$$

$$15 = 5\, a_x$$

$$a = 3\ m/s^2$$

* find acc^n of 5kg

$$\Sigma F_x = m\, a_x$$

$$30 = 5 \times a_x$$

$$a_x = 6\ m/s^2$$

Figure shows a uniform rod of length 30 cm having a mass 3.0 kg. The rod is pulled by constant forces of 20 N and 32 N as shown. Find the force exerted by 20 cm part of the rod on the 10 cm part (all surfaces are smooth) is:

(a) 36 N

(b) 12 N

(c) 64 N

(d) 24 N

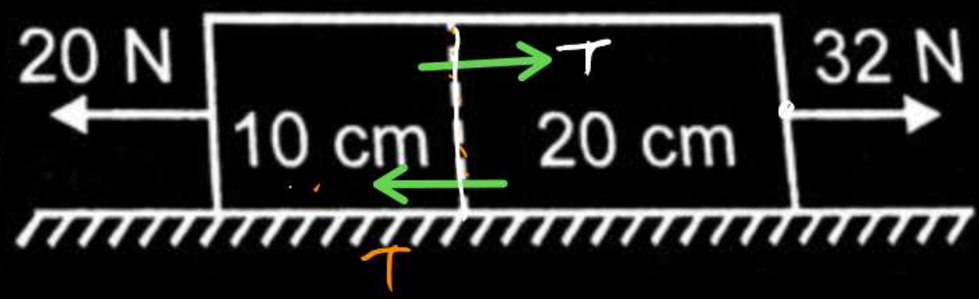
F.B.D of (2kg) → 32

T

$32 - T = ma$

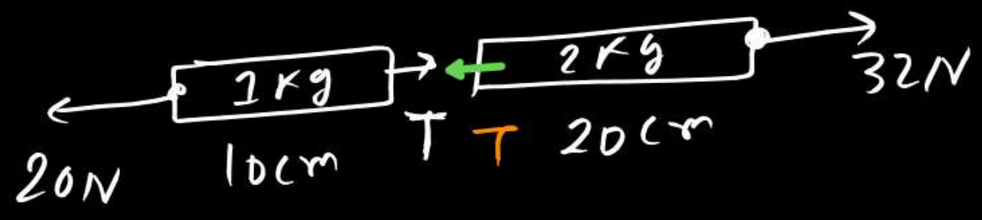
$32 - T = 2 \times 4$

$T = 32 - 8 = 24N$



$acc^n = \frac{\text{Fnet Pulling force}}{\text{net mass}} = \frac{12}{3}$

$a = 4 m/s^2$

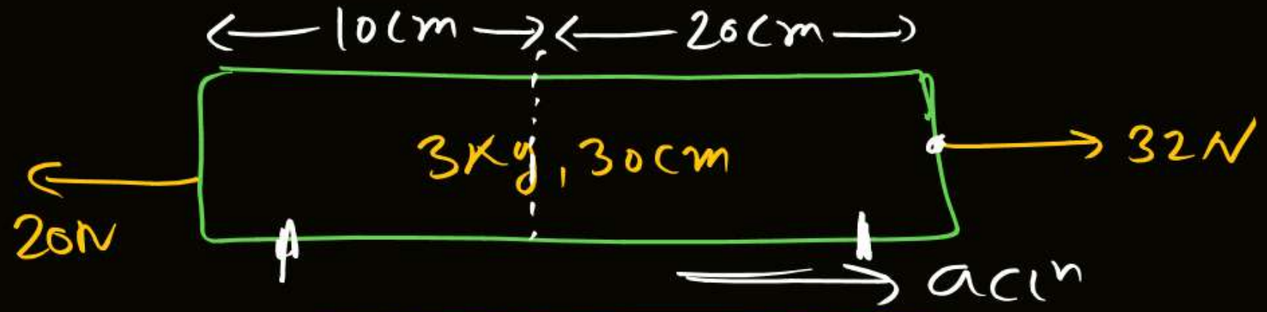


$T - 20 = ma$

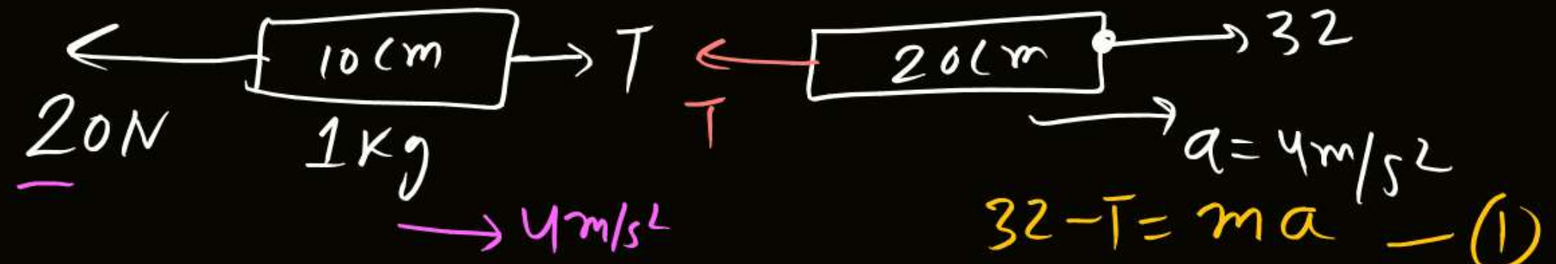
$T = 20 + 1 \times 4 = 24N$

IMP*

$\Rightarrow 20 < T < 32$

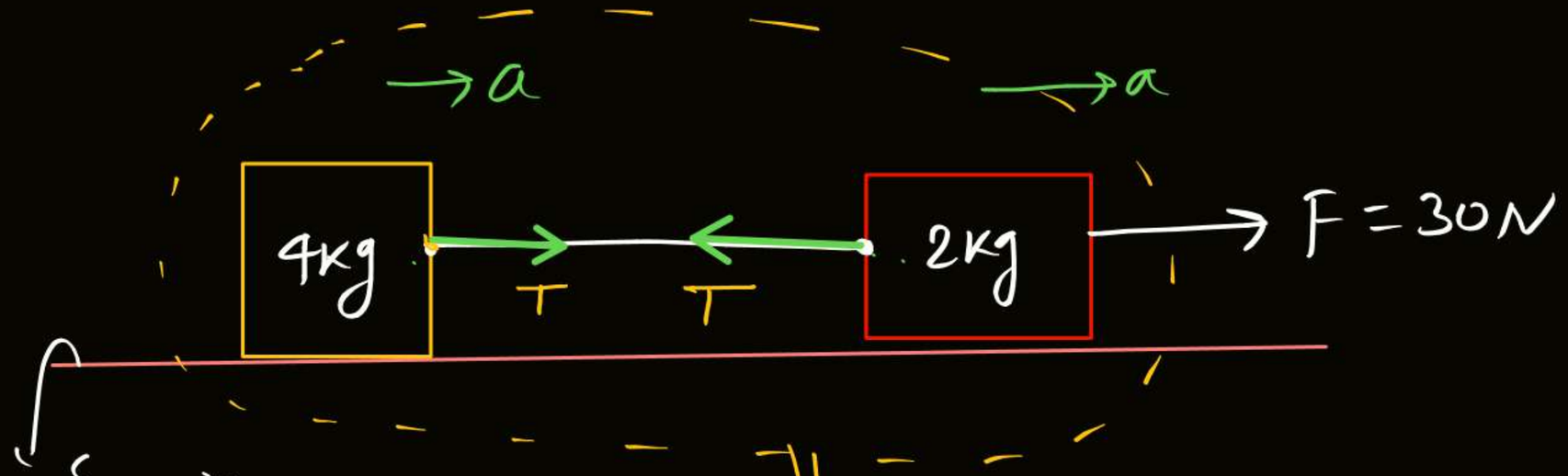


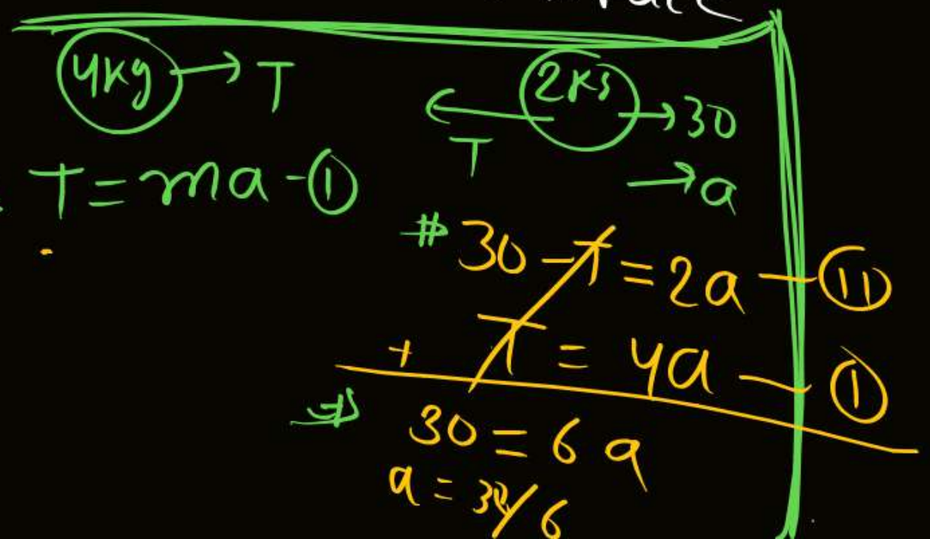
$$\# \quad a = \frac{F_{net}}{m} = \frac{12}{3} = 4 m/s^2$$



$$32 - T = ma \quad \text{— (1)}$$

⑥ find acc^n of 4kg and 2kg . and Tension in string which is b/w 2kg & 4kg.





6kg → F = 30N

$a = \frac{F}{m} = \frac{30}{6} = 5 m/s^2$

F.B.D of 4kg

4kg → T

$F = ma$

$T = 4 \times 5 = 20N$

T_1 and T_2 in the given figure are

(a) 28 N, 48 N

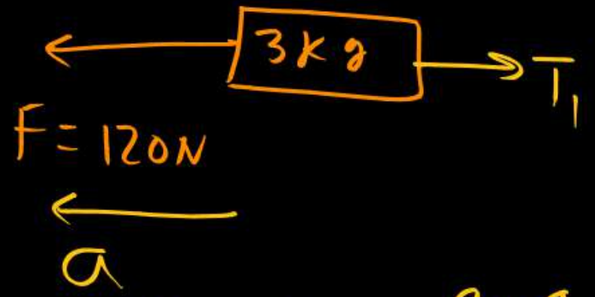
(b) 48 N, 28 N

(c) 96 N, 56 N

(d) 56 N, 96 N

$= MR^2$

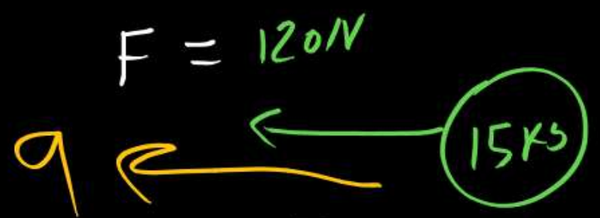
F.B.D of 3kg



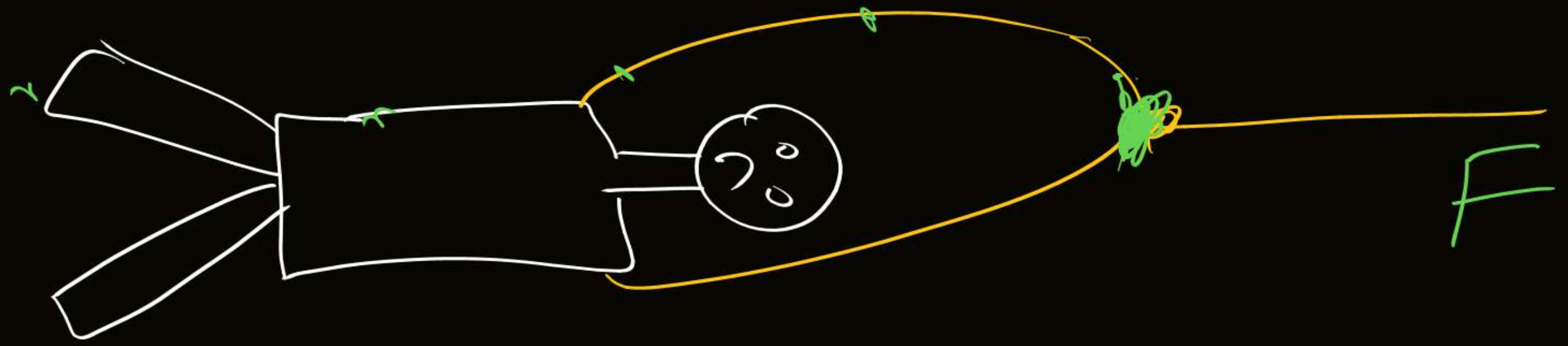
$120 - T_1 = 3 \times a$

$120 - T_1 = 3 \times 8$

$T_1 = 120 - 24 = 96\,N$



$a = \frac{F}{m} = \frac{120}{15} = 8\,m/s^2$


F

Arrangement of two block system is as shown. The net force acting on 1 kg and 2 kg blocks are (assuming the surface to the frictionless) respectively

(a) 4 N, 8 N

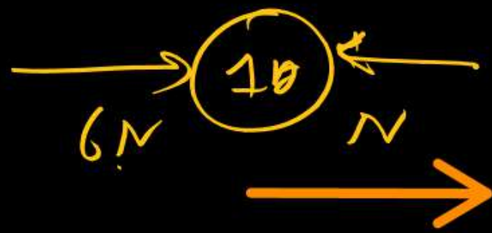
(b) 1 N, 2N

(c) 2 N, 4 N

(d) 3 N, 6 N

NEET

F.B.D of 1kg

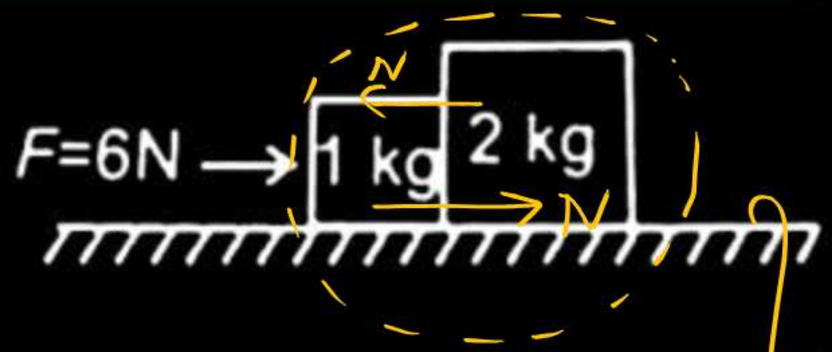


$6 - N = ma$

$6 - N = 1 \times 2$

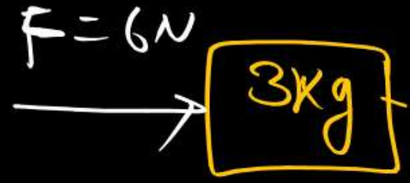
$6 - 2 = N$

$N = 4\,N$



$u = 0$

Smooth



$a = \frac{F}{m} = \frac{6}{3} = 2\,m/s^2$

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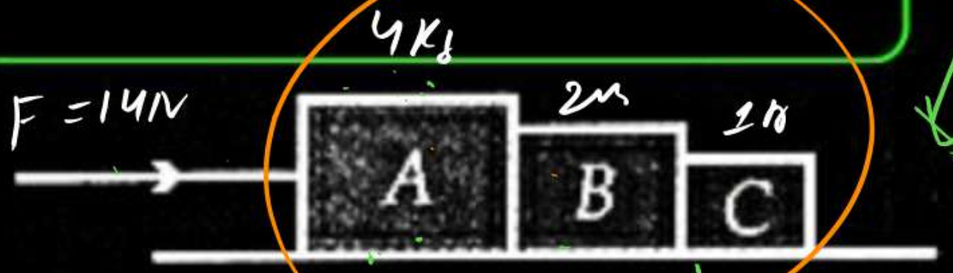
Three blocks A, B and C of masses 4 kg, 2 kg and 1 kg respectively, are in contact on a frictionless surface, as shown. If a force of 14 N is applied on the 4 kg block, then the contact force between A and B is [AIPMT-2015]

(a) 18 N
(b) 2 N
(c) 6 N
(d) 8 N



$a = \frac{F}{m} = \frac{14}{7} = 2\ m/s^2$

mR^*

$14 - 8 = 6N$

ARJUNA

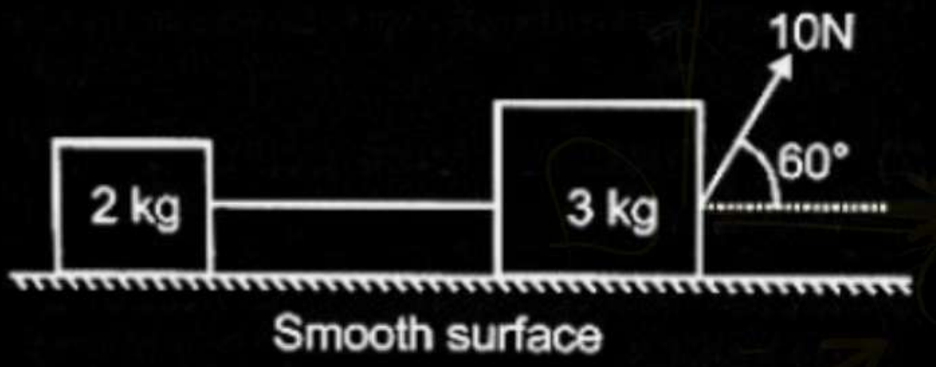
Figure shows two blocks connected by a light inextensible string as shown in figure. A force of 10 N is applied on the bigger block at 60° with horizontal, then the tension in the string connecting the two masses is

(a) 5 N

(b) 2 N

(c) 1 N

(d) 3 N



ARJUNA

Two blocks are in contact on a frictionless table. One has mass *m* and the other 2m. A force F is applied on 2m as shown in the figure. Now the same force F is applied from the right on m. In the two cases respectively, the ratio of force of contact between the two blocks will be :

(a) same

(b) 1 : 2

(c) 2 : 1

(d) 1 : 3

Case-1

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

F.B.D of (m)

(m) → N_1

$N_1 = \frac{2mF}{3m} = \frac{F}{3}$

Case-2

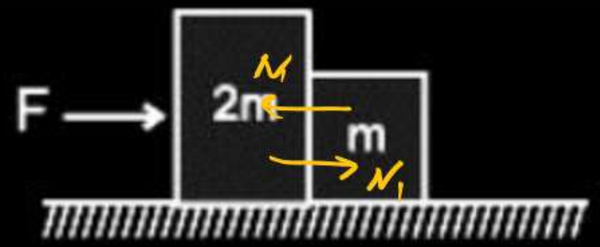
$a = \frac{F}{3m}$

F.B.D of (2m)

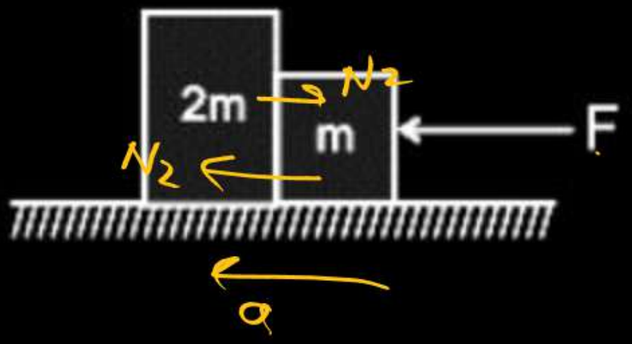
$N_2 = 2m\left(\frac{F}{3m}\right)$

$= \frac{2F}{3}$

Case-1



Case-2



What will be the tension T_1 and T_2 in the given figure?

H.W

$a = 6\ m/s^2$

$T_1 = 36\ N$

$T_2 = 60\ N$

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Find force applied on base of lift by 20 kg block.

F·B·D OF 20kg

$F = ma$

$N - mg = ma$

$N = mg + ma$

$= 20[10+2] = 240\,N$

Tension in the rope at the rigid support is ($g = 10\ m/s^2$)

(a) 760 N

(b) 1360 N

(c) 1580 N

(d) 1620 N

F.B.D of (A)

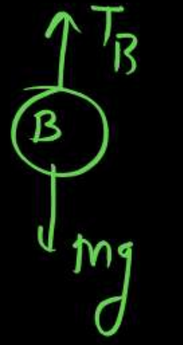
$a = 2\ m/s^2$

$T_A - mg = ma - (1)$

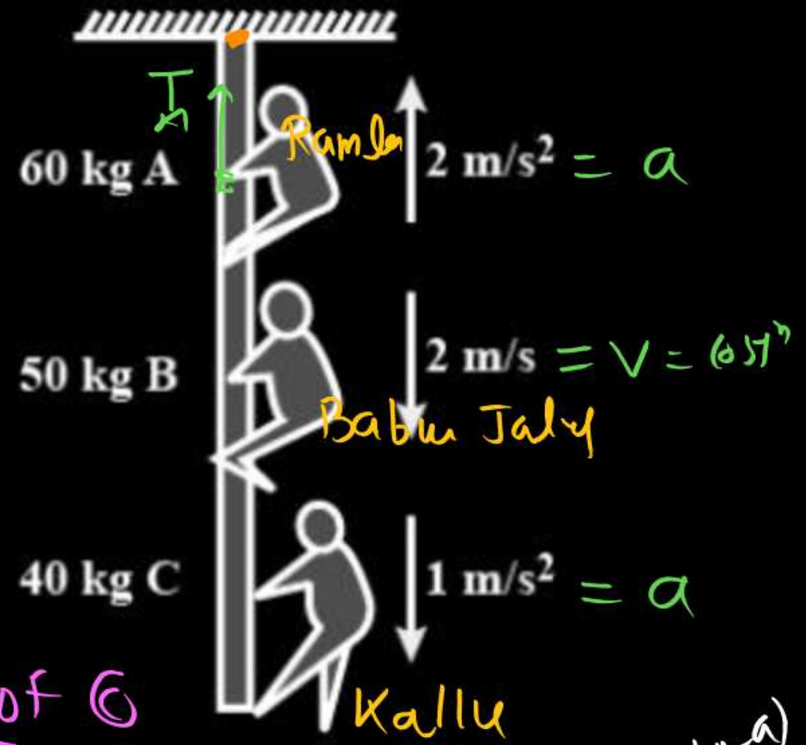
$T_A = m(g+a) = 60[10+2]$

$= 720N$

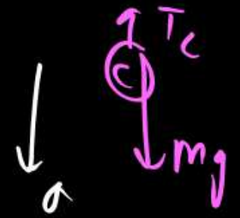
F.B.D



$T_B = mg = 50 \times 10 = 500N$



F.B.D of (C)



$mg - T_C = ma$

$T_C = mg - ma = m(g-a)$

$= 60 \times g = 360N$

If ($M_2 > M_1$) then find acceleration of M_1 and M_2 and Tension in string.

String & Pulley are Ideal

frictionless & massless

Schools

for m_2

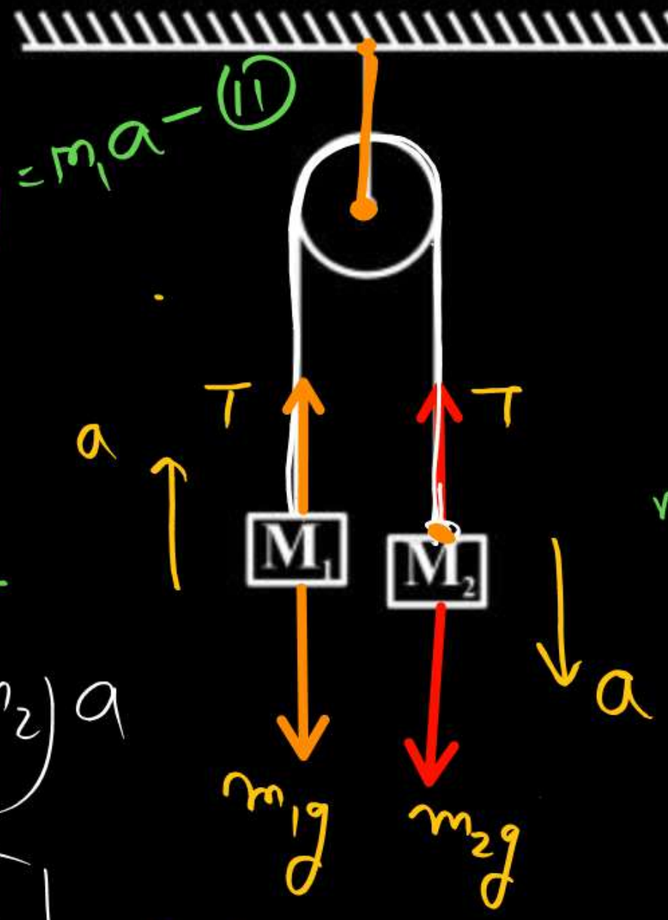
$m_2 g - T = m_2 a \quad -(i)$

for m_1

$T - m_1 g = m_1 a \quad -(ii)$

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

$$a = \left(\frac{m_2 - m_1}{m_1 + m_2}\right) g = \text{Const}^n$$



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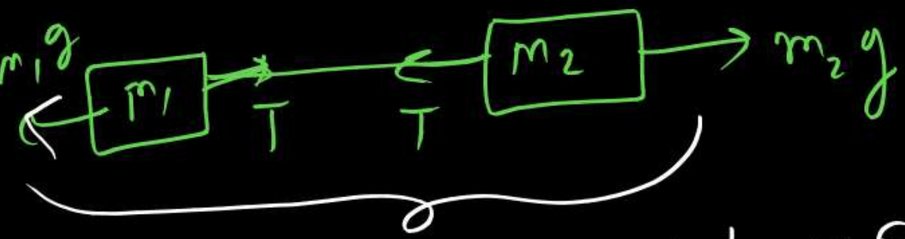


$$a = \frac{\text{net unbalance for}}{\text{net ma}}$$

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

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

MR*
If $m_1 = m_2$
$a = 0$ ✓

(ii) $a = \left(\frac{m_2 + m_1}{m_2 - m_1}\right) g = \frac{1}{0} = \infty$

(iii) $a = \frac{2 m_1 m_2}{m_1 + m_2} g$ (dimⁿ wrong)

using eqⁿ ①

$m_2 g - T = m_1 a$

Put the value of a.

M.W

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

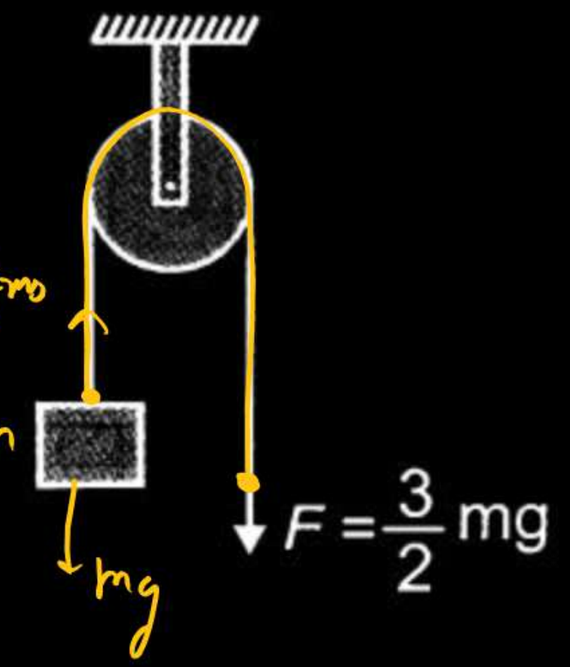
N the arrangement shown, the mass m will ascend with an acceleration (Pulley and rope are massless)

(a) Zero

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

(c) g

(d) $2g$



$\frac{3}{2}mg - mg = ma$ ↑

$\frac{mg}{2} = ma$

$a = g/2$

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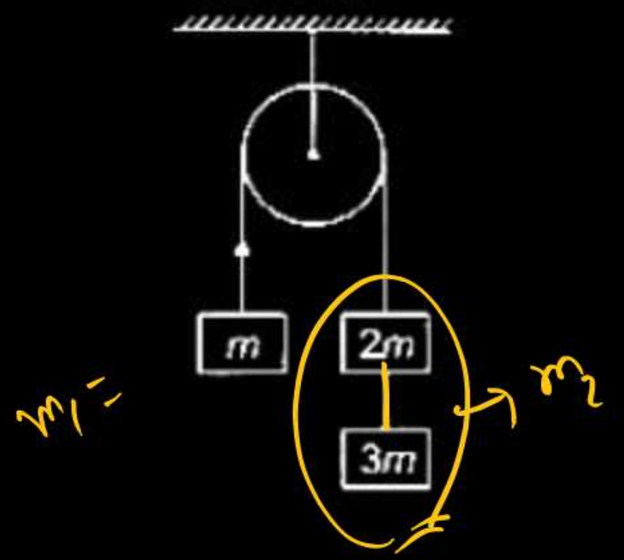
In the figure given below, with what acceleration does the block of mass m will move? (Pulley and strings are massless and frictionless)

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

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

(c) $\frac{2g}{3}$

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



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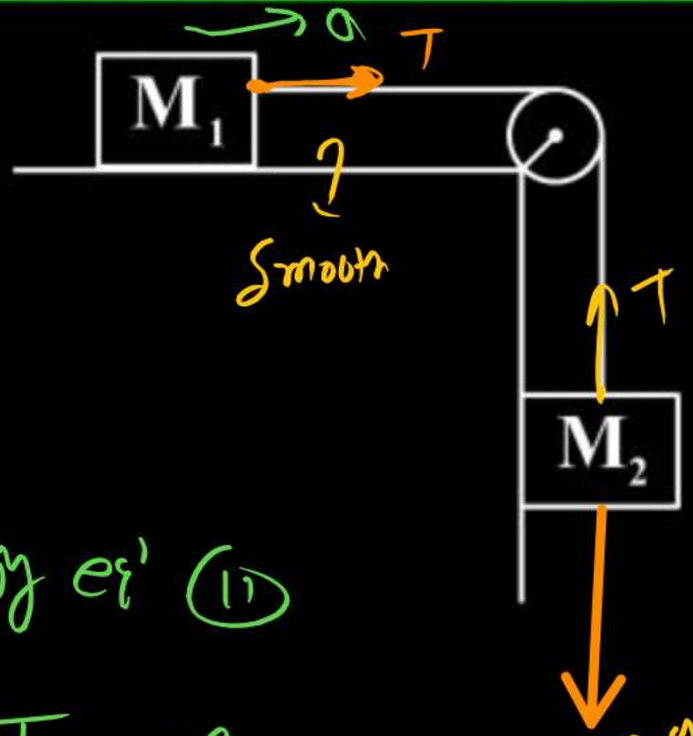
Find acceleration of Block M_1 and M_2 and tension in string.



$m_2g - T = m_2a$ — (I)

$T = m_1a$ — (II)

a

$+ \quad + \quad +$

$m_2g = (m_1 + m_2)a$

$$a = \frac{m_2 g}{m_1 + m_2}$$

Using eq' (II)

$T = m_1a$

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

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THANK YOU ☺