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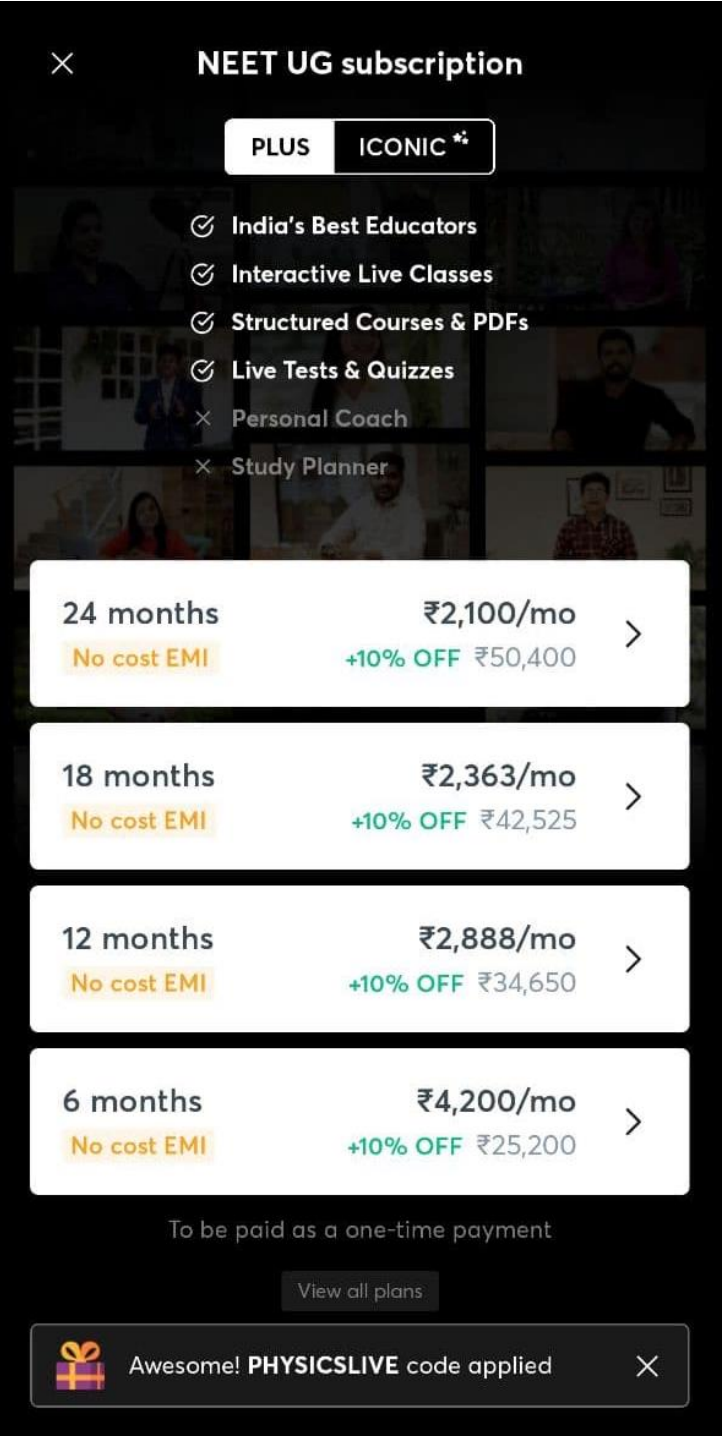


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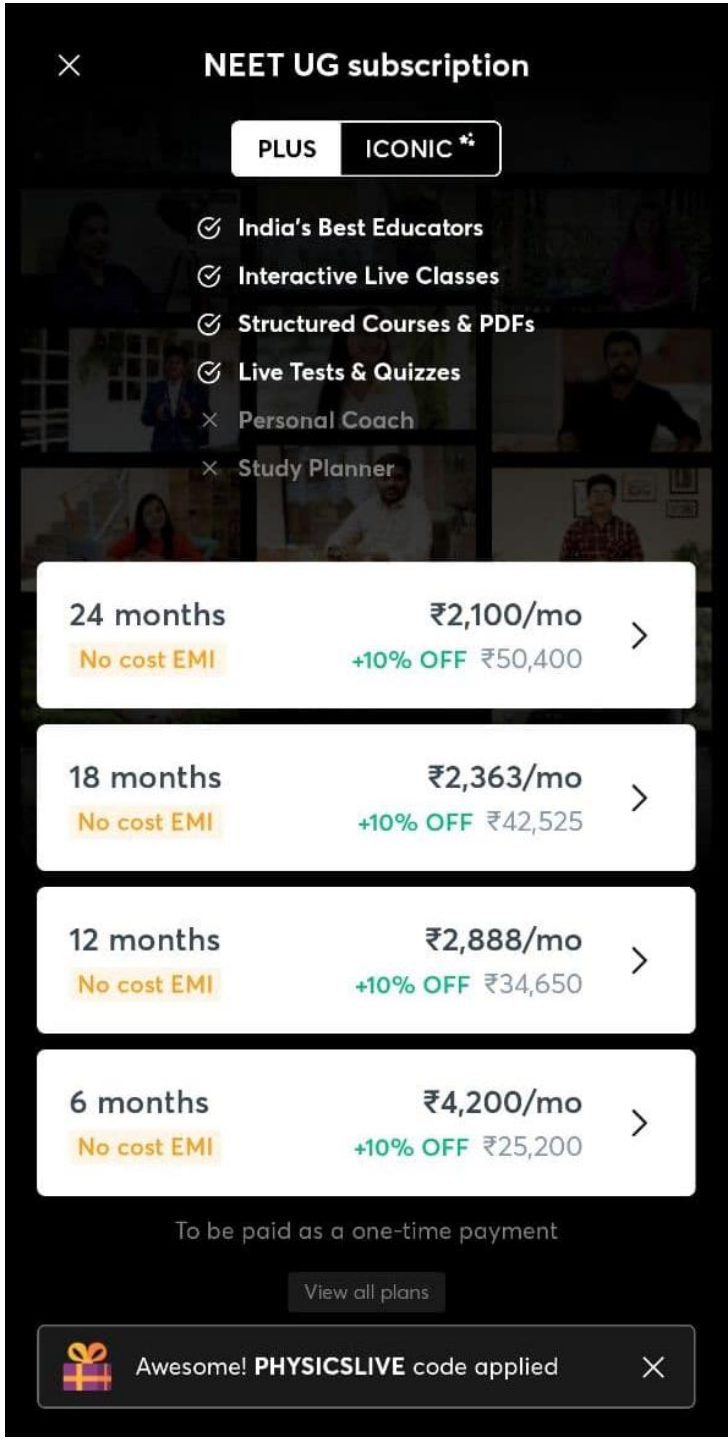

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# Physics DPP

## DPP-4 NLM: Newton's 2nd Law

## By Physicsaholics Team

Q) If a bullet of mass 5 gm moving with velocity 100 m /sec, penetrates the wooden block upto 6 cm. Then the average force imposed by the bullet on the block is

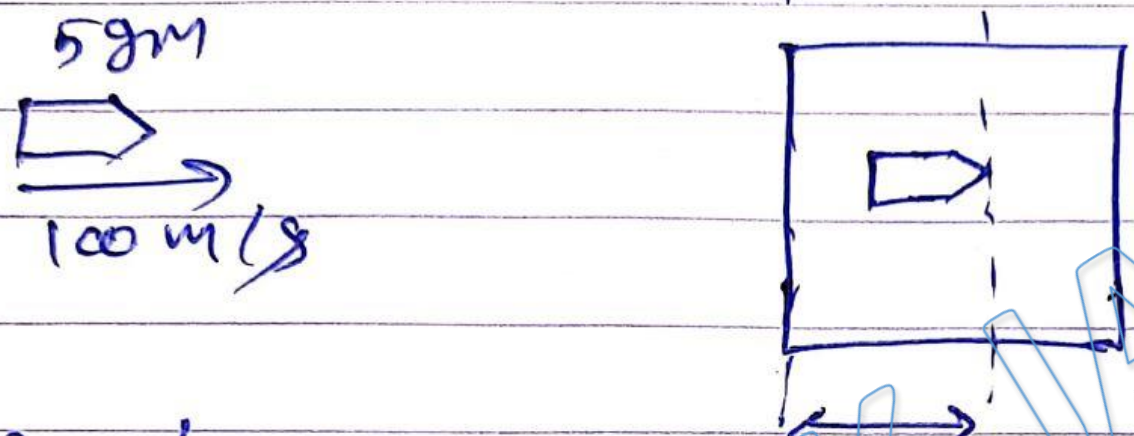
(a) $8300\ N$

(b) $417\ N$

(c) $830\ N$

(d) zero

Ans. b




$v^2 - u^2 = 2as$

$0 - (100)^2 = 2a(6 \times 10^{-2})$

$a = 83333.33 \ m/s^2$ (retardation)

$F = ma$

$F = 5 \times 10^{-3} \times 83333.33$

$F = 416.67 \ N \approx 417 \ N$

$\boxed{F = 417 N}$

Q) A vehicle of 100 kg is moving with a velocity of 5 m/sec. To stop it in $\frac{1}{10}$ sec, the required force in opposite direction is:

(a) 5000 N
(b) 500 N
(c) 50 N
(d) 1000 N

Ans. a

$$v = u + at$$

$$0 = 5 + a(t_0)$$

$$a = -50 \text{ m/s}^2$$

$$\therefore a = 50 \text{ m/s}^2 \text{ (retardation)}$$

$$F = mg$$

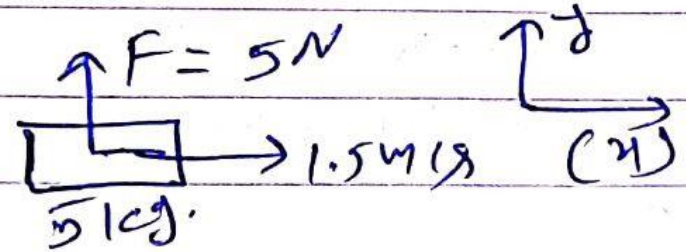
$$F = 100 \times 50$$

$$\boxed{F = 5000 \text{ N}}$$

Q) A block of mass 5kg is moving horizontally at a speed of 1.5 m/s. A perpendicular force of 5N acts on it for 4 sec. What will be the distance of the block from the point where the force started acting:

(a) 10 m
(b) 8 m
(c) 6 m
(d) 2 m

Ans. a




in x-dirⁿ.

$u = 1.5\ m/s$

$a = 0$

$\therefore v = 1.5\ m/s$

at $t = 4$ sec

$x = 1.5 \times 4$

$x = 6\ m.$

in y-dirⁿ

$u = 0$

$a = \frac{F}{m} = \frac{5}{5} = 1\ m/s^2$

$y = ut + \frac{1}{2}at^2$

$y = 0 + \frac{1}{2}(1)(4)^2$

$y = 8\ m.$

$\therefore d = \sqrt{x^2 + y^2}$

$d = \sqrt{6^2 + 8^2}$

$\boxed{d = 10\ m.}$

Q) Three equal weights of mass 2 kg each are hanging on a string passing over a fixed pulley as shown in the fig. What is the tension in the string connecting the weights B and C? ($g = 9.8\, m/s^2$)

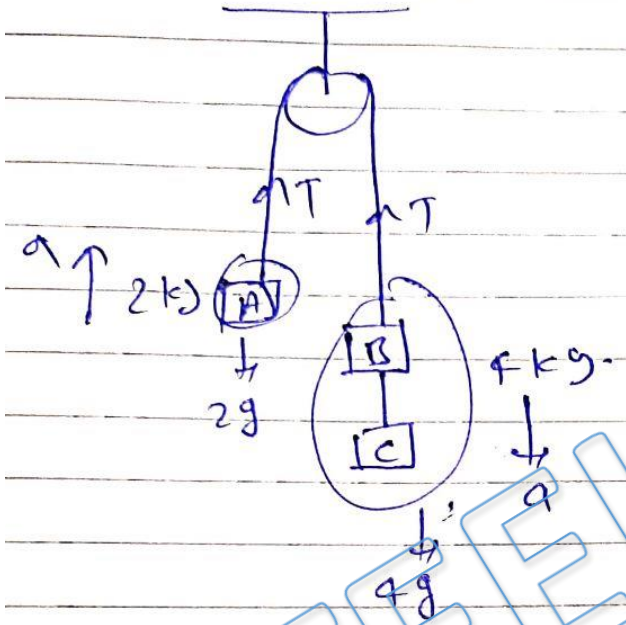

(a) zero

(b) 13 N

(c) 303 N

(d) 19.6 N

Ans. b




for Block A

$$T - 2g = 2a \quad -(1)$$

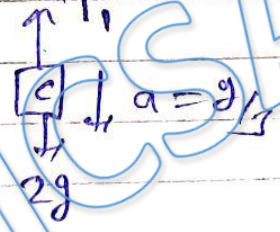
for block (B+C)

$$4g - T = 4a \quad -(2)$$

from (1) & (2)

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

for 'C'



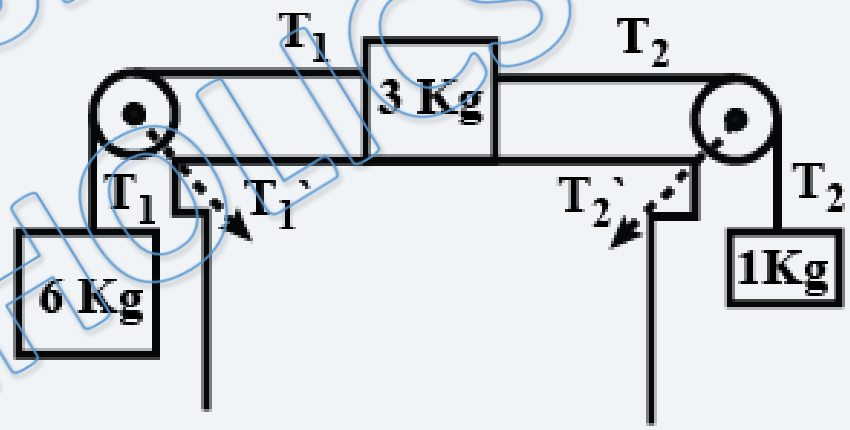

$T_1$ = Tension in the string connecting the weights B & C

$$2g - T_1 = 2\left(\frac{g}{3}\right)$$

$$T_1 = \frac{4g}{3}$$

$$\boxed{T_1 \simeq 13\ N}$$

Q) A system of three blocks are connected by strings as shown in figure. Calculate acceleration of each block and tension in the strings: ($g = 10\ m/s^2$)



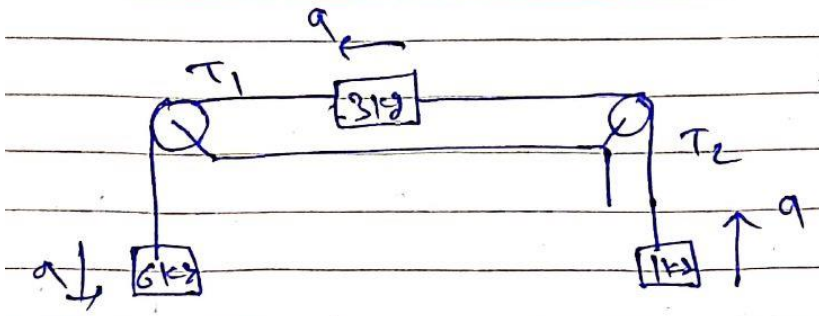

(a) $a = 5\ m/s^2, T_1 = 30N, T_2 = 15N$

(b) $a = 5\ m/s^2, T_1 = 15N, T_2 = 30N$

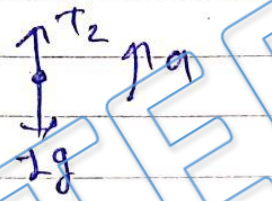
(c) $a = 2.5\ m/s^2, T_1 = 40N, T_2 = 20N$

(d) $a = 2.5\ m/s^2, T_1 = 20N, T_2 = 40N$

Ans. a

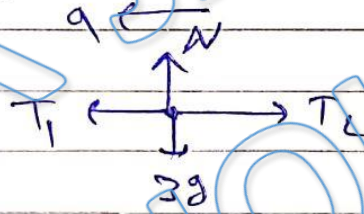



FBD of 1 kg.




$T_2 - g = a$ — ①

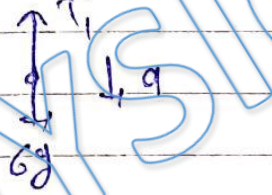
FBD of 3 kg




$N = 3g$

and $T_1 - T_2 = 3a$ — ②

FBD of 6 kg.




$6g - T_1 = 6a$ — ③

from eq$^n$ ①, ② & ③ $\Rightarrow$ $\boxed{a = 5\ m/s^2}$

$\boxed{T_1 = 30\ N}$ & $\boxed{T_2 = 15\ N}$

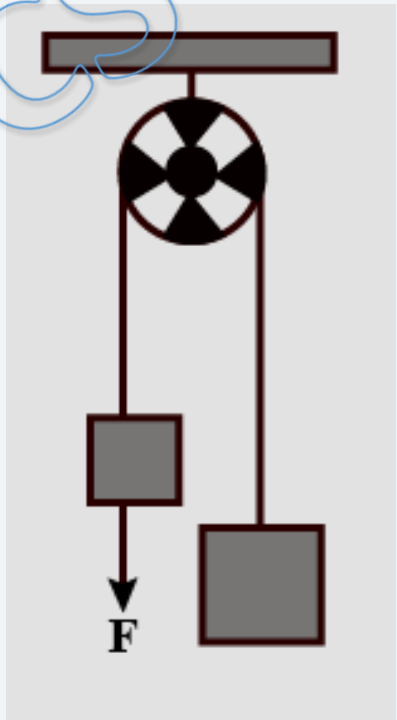
Q) Two unequal masses of 1kg and 2kg are connected by an inextensible light string passing over a smooth pulley as shown in the figure. A force F=20N is applied on 1kg block. Find the acceleration (in $m/s^2$) of either block: ($g = 10\ m/s^2$)

(a) $\frac{10}{3}$

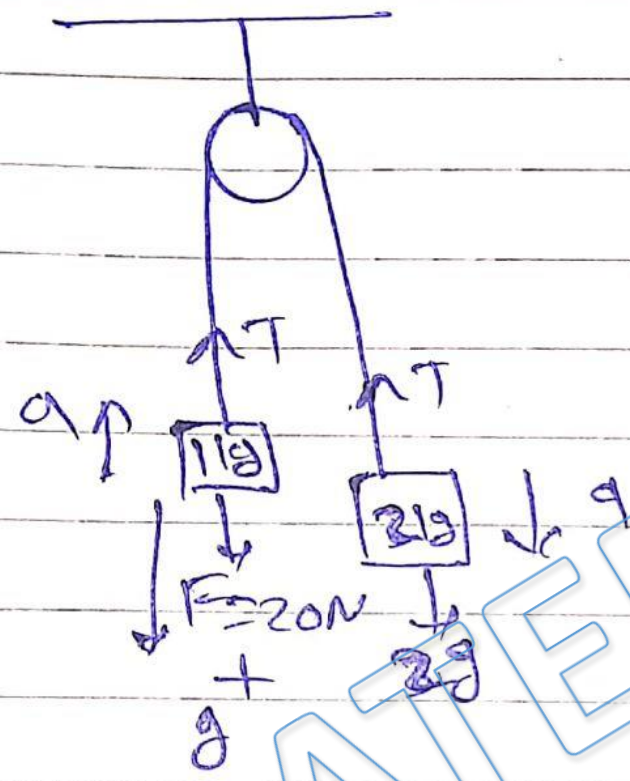
(b) $\frac{20}{3}$

(c) 10

(d) 20



Ans. a




$2g - T = 2a$ — (1)

$T - 20 - g = a$ — (2)

On adding eq (1) & (2)

(1) + (2) =

$2g - 20 - g = 3a$

$$a = -g/3$$

-ve sign shows that acceleration of 2kg block will be upward and of 1kg block will be downward.

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

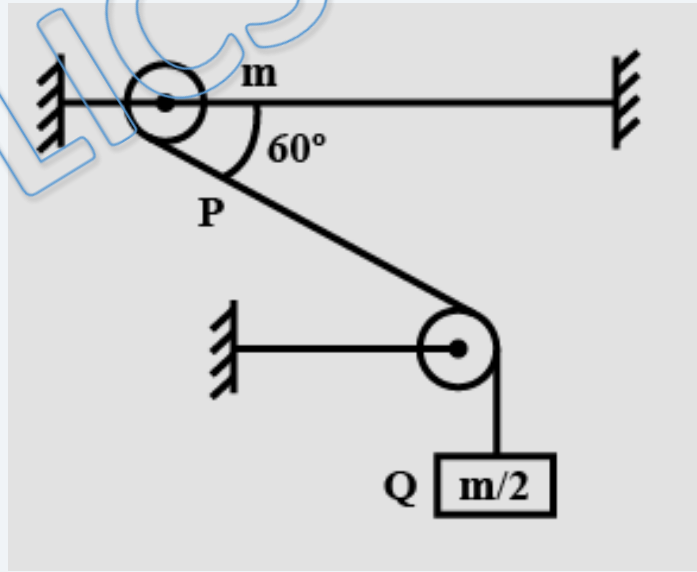
Q) A smooth ring P of mass m can slide on a fixed horizontal rod. A string tied to the ring passes over a fixed pulley and carries a block Q of mass (m/2) as shown in the figure. At an instant, the string between the ring and the pulley makes an angle $60^0$ with the rod. The initial acceleration of the ring is:

(a) $\frac{2g}{9}$

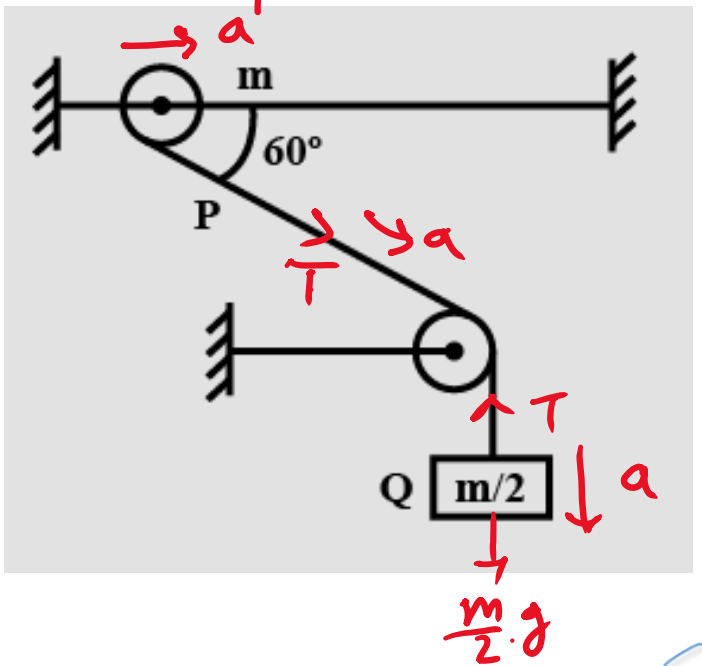
(b) $\frac{g}{6}$

(c) $\frac{2g}{6}$

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



Ans. a




$\frac{m}{2}g - T = \frac{m}{2}a$ — ①

$T\cos 60° = ma'$

$T = 2ma'$ — ②

$a'\cos 60° = a$

$\Rightarrow \boxed{a' = 2a}$ — ③

from eq$^n$ ①, ② & ③

$\frac{m}{2}g - 2ma' = \frac{m}{2}a$

$\frac{g}{2} = 2a' + a = 2(2a) + \frac{a}{2} = \frac{9a}{2}$

$\frac{g}{2} = \frac{9a}{2}$

$\boxed{a = \frac{g}{9}}$

$\Rightarrow \boxed{a' = \frac{2g}{9}}$

Q) Consider the situation shown in figure. Both the pulleys and the string are light and all the surfaces are smooth. Find the tension in the string: ($g = 10\ m/s^2$)

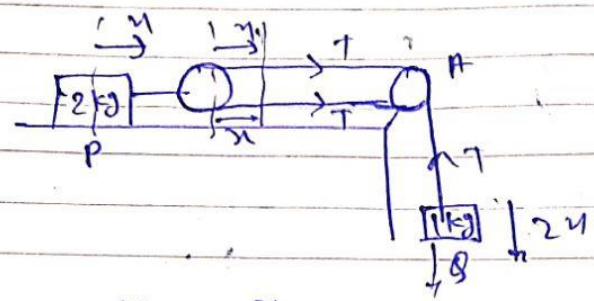

(a) $\frac{20}{3}N$

(b) $\frac{5}{3}\ N$

(c) $\frac{40}{3}\ N$

(d) $\frac{10}{3}\ N$

Ans. d




$x_P = x$

$x_Q = 2x$

$x_Q = 2x_P$

$v_Q = 2v_P$

$\boxed{a_Q = 2a_P}$ if $a_P = a$ then $a_Q = 2a$

for 'Q'

$g - T = 1(2a)$

$g - T = 2a$ — ①

for 'P'

$2T = 2(a)$

$T = a$ — ②

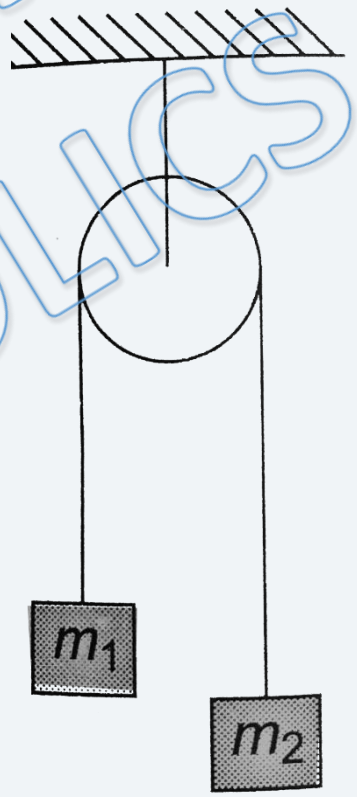
from ① & ②

$g - a = 2a$

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

$\boxed{a = \frac{10}{3}\ m/s^2}$ $\boxed{T = \frac{10}{3}\ N}$

Q) Two masses $m_1 = 5\ kg$ and $m_2 = 10\ kg$ are connected at the ends of an inextensible string passing over a frictionless pulley as shown. When the masses are released, then the acceleration of the masses will be:



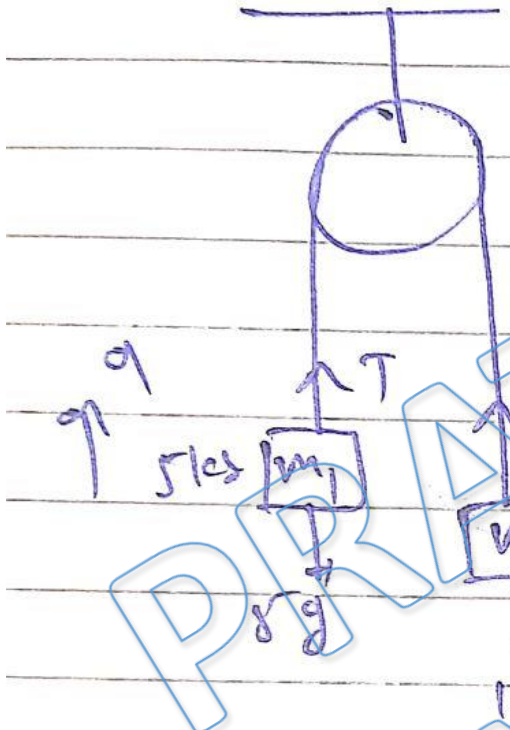

(a) $g$

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

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

(d) $\frac{g}{4}$

Ans. c




$10g - T = 10a$ — (1)

$T - 2g = 2a$ — (2)

$8g = 12a$

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

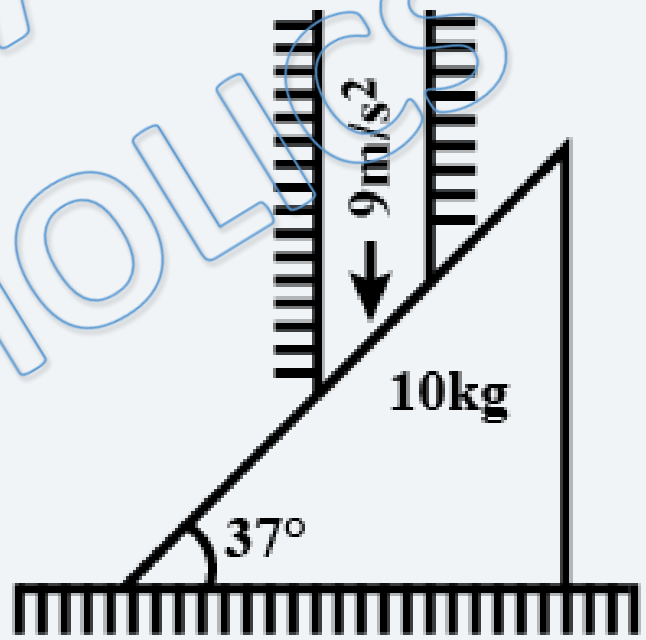
Q) System is shown in figure. All the surfaces are smooth. Rod is moved by external agent with acceleration 9 $m/s^2$ vertically downwards. Force exerted on the rod by the wedge will be:

(a) $120\ N$

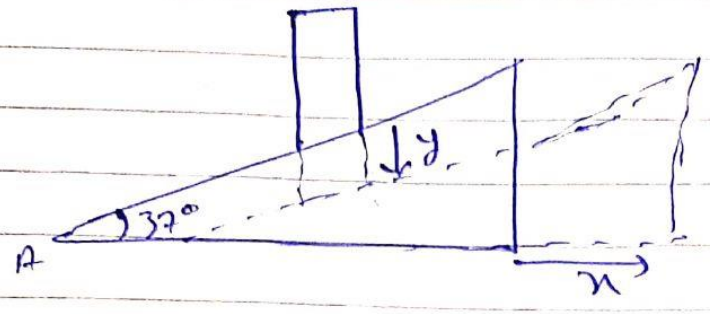
(b) $200\ N$

(c) $\frac{135}{2}\ N$

(d) $\frac{225}{2} N$

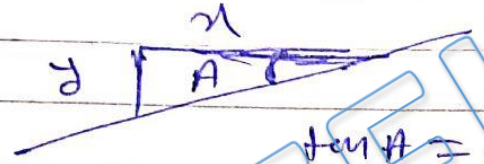


Ans. b




$y$ = vertical displacement of rod

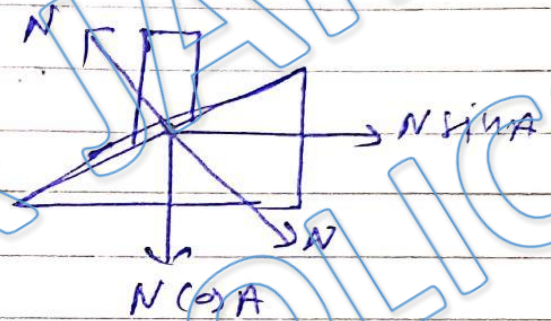
$x$ = Horizontal displacement of wedge




$$\tan A = \frac{y}{x}$$

$$y = x \tan A$$

$$\boxed{a_y = a_x \tan A} \quad \text{--- (1)}$$




$$N \sin A = M a_x$$

$$a_x = \frac{a}{\tan A}$$

$$N \sin A = \frac{Ma}{\tan A}$$

$$N\left(\frac{3}{5}\right) = \frac{10 \times 9.8}{3} \times 4$$

$$\boxed{N = 200\ N}$$

$M = 10$ kg

$a = 9$ m/s$^2$

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Q) A person of mass 50 kg stands on a weighing scale on a lift . If the lift is descending with a downward acceleration of $9m/s^2$. what would be the reading of the weighing scale? ($g = 10\ m/s^2$)

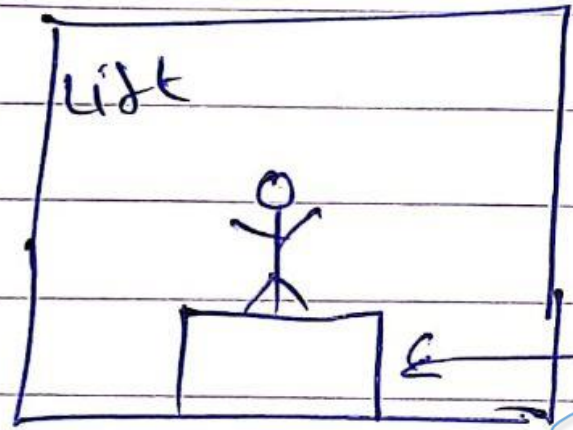
(a) $50\ kg$

(b) $25\ kg$

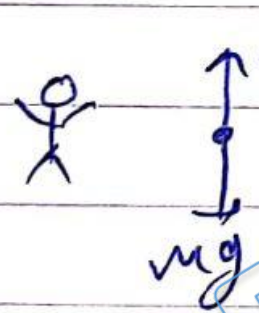
(c) $250\ kg$

(d) $5\ kg$

Ans. d




FBD of man




$$mg - N = m(g)$$

$$N = m(g - g) = m(1)$$

$$\boxed{N = 50\ N}$$

$N$ = Normal reaction between man & weighing machine.

Reading of weighing scale = $N = 50N$

or $\frac{50}{g} = \frac{50}{10} = 5$ kg wt.

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Chalo Niklo