Nishant Jindal

FRICTION

Q.1 A block of mass $1\ \text{kg}$ is place on a rough inclined plane at angle $\theta = 45^\circ$ (30°) will with horizontal. The block is connected with a straight as shown in Fig. If $\mu_s = 3/4$, find the tension in string.

(String)

$F_{ext} = mg\sin 30^\circ = 1 \times 10 \times \frac{1}{2}$

$= 5N$

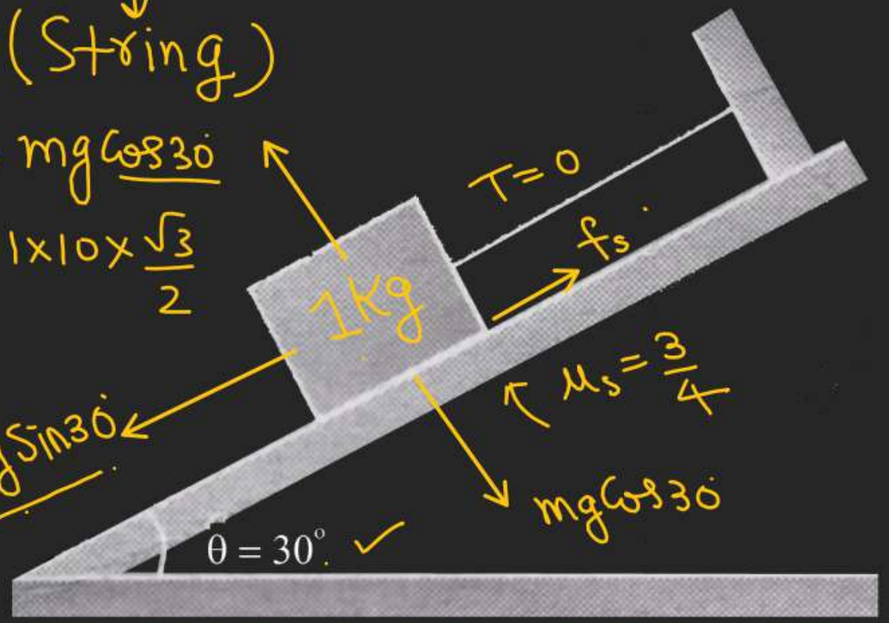
$(f_s)_{max} = \mu_s mg\cos 30^\circ$

$= \frac{3}{4} \times 1 \times 10 \times \frac{\sqrt{3}}{2}$

$= \frac{15\sqrt{3}}{4}$...

$F_{ext} < (f_s)_{max}$

$f_s = F_{ext} = 5N$ ✓



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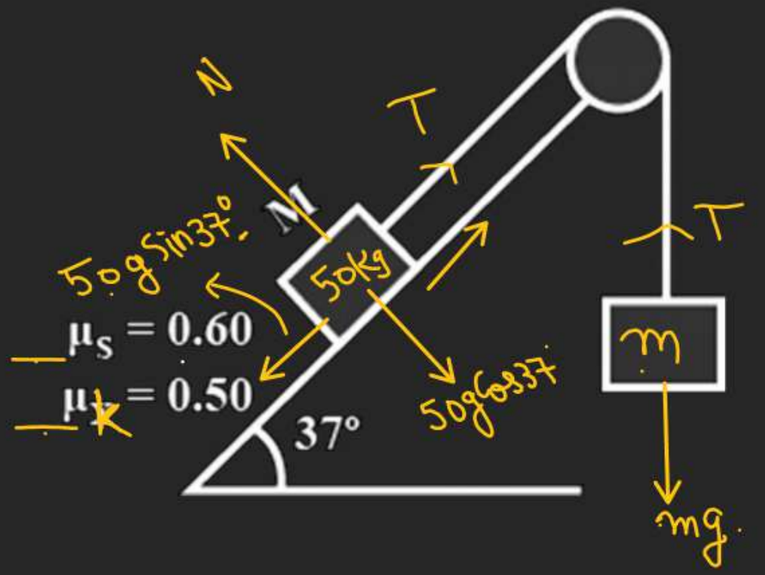
FRICTION

Q.3 Two blocks M and m are arranged as shown in Fig. If $M = 50\ kg$, then determine the minimum and maximum values of mass of block m to keep the heavy block M stationary.



Sol^n –

$(f_s)_{max} = \mu_s N$

$= 0.60 \times 400$

$= 240N$

Minimum

$N = 50 \times 10 \times \frac{4}{5}$

$N = 400$ Newton ✓

$50g \sin 37° = 50 \times 10 \times \frac{3}{5}$

$= 50 \times 6$

$= 300$ Newton

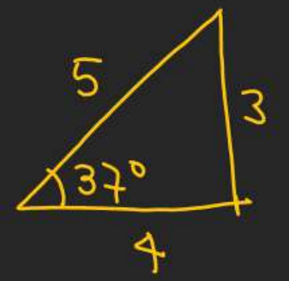
For block not to Slide.

$300 = 240 + T$

$mg = T = 60\ N$

$m = 6kg$ ✓

(minimum value)



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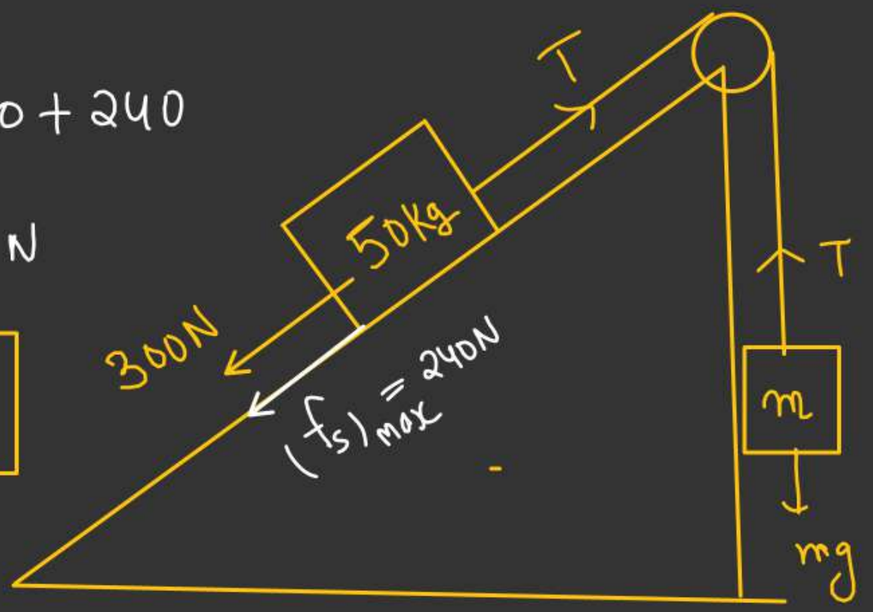
For $m \rightarrow$ maximum

$$mg = 300 + 240$$

$$mg = 540 \text{ N}$$

$$m = 54 \text{ Kg}$$



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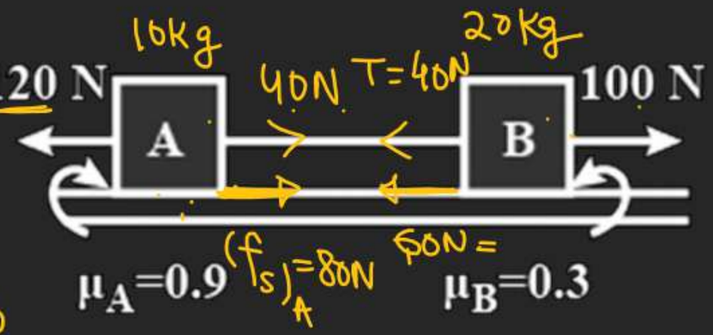
FRICTION

Q.4 Two blocks A and B of mass $m_A = 10\ kg$ and $m_B = 20\ kg$ are place on rough horizontal surface. The blocks are connected with a string. If the coefficient of friction between block A and ground is $\mu_A = 0.9$ and between block B and ground is $\mu_B = 0.3$, find Fig. the tension in the string in situation as shown in Fig. Forces $120\ N$ and $100\ N$ start acting when the system is at rest?

$T = 40N$ ✓

$(f_s)_{max\ of\ A} = 0.9 \times 10 \times 10 = 90N$

$(f_s)_{max\ of\ B} = 0.3 \times 20 \times 10 = 60N$



Nishant Jindal

FRICTION

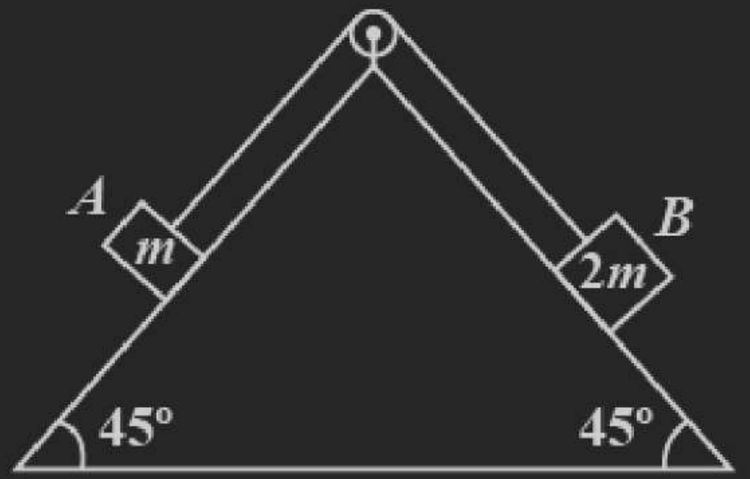
H.W.

Q.5 Block A of mass m and block B of mass $2m$ are placed on a fixed triangular wedge by means of a light and inextensible string and a frictionless pulley as shown in Fig. The wedge is inclined at 45° to the horizontal on both sides. The coefficient of friction between the block A and the wedge is $2/3$ and that between the block B and the wedge is $1/3$. If the system of A and B is released from rest, then find,

a. the acceleration of A

b. tension in the string

c. the magnitude and direction of the frictional force acting on A



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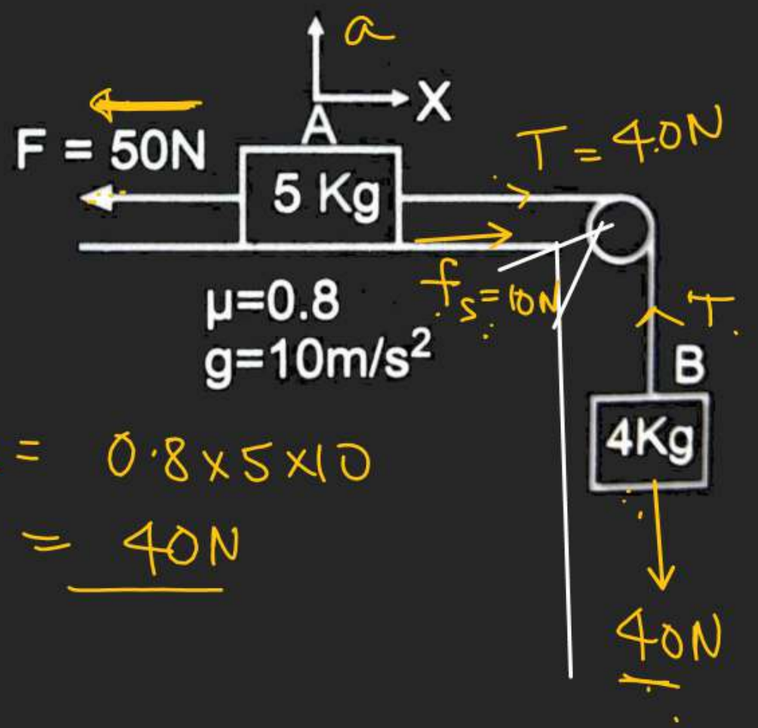
FRICTION

Q.1 Find the acceleration of the block and magnitude and direction of frictional force between block A and table, if block A is pulled towards left with a force of 50 N.

$a = 0$

$f_s = 10N$



$(f_s)_{max} = 0.8 \times 5 \times 10$

$= 40N$

Nishant Jindal

FRICTION

Q.2 The 10 kg block is resting on the horizontal surface when the force ' F ' is applied to it for 7 second. The variation of ' F ' with time is shown. Calculate the maximum velocity reached by the block and the total time ' t ' during which the block is in motion. The coefficient of static and kinetic friction are both 0.50.

$$F = \begin{cases} 25t & 0 < t \leq 4 \\ 40 & 4 < t \leq 7 \end{cases}$$

$(f_s)_{max} = 10 \times 0.5 \times 10$

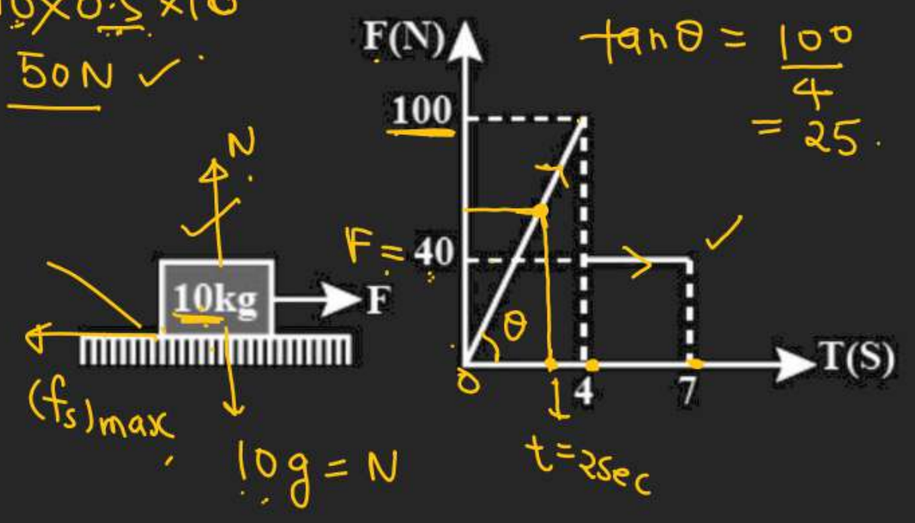
$= 50\,N$ ✓

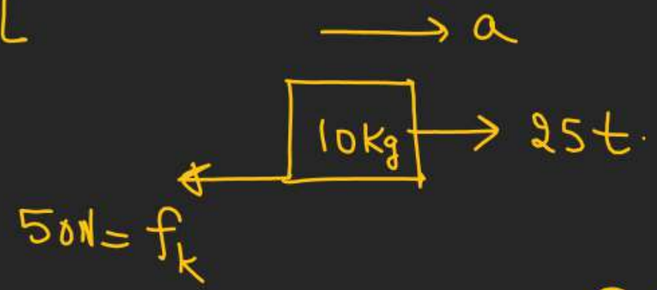
$F = 25t$

$F = (f_s)_{max}$

$25t = 50$

$\boxed{t = 2\,sec}$





$25t - 50 = 10a$

$a = \left(\frac{25}{10}t - 5\right) = \left(\frac{5}{2}t - 5\right)$

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$0 < t \leq 4$ sec

$$a = \frac{5}{2}t - 5 \quad \text{✗}$$

$$\frac{dv}{dt} = \left(\frac{5}{2}t - 5\right)$$

$$\int_0^v dv = \int_2^4 \left(\frac{5}{2}t - 5\right) dt$$

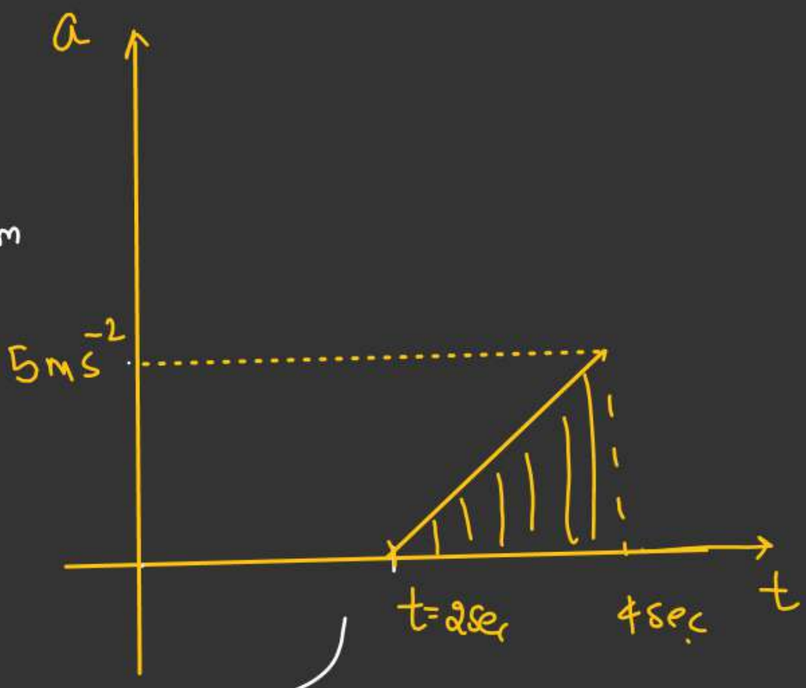
$$v = \frac{5}{2}\int_2^4 t\,dt - 5\int_2^4 dt$$

$$v = \frac{5}{2}\left[\frac{t^2}{2}\right]_2^4 - 5[t]_2^4$$

$$v = \frac{5}{4}(16-4) - 5(4-2)$$

$$v = (5\times 3 - 10) = 5 \text{ m/s} \quad \text{✓}$$

M-2



Area of trapezium

$= \Delta V$

$= V - 0$

$$\frac{1}{2}[5+10]\times 2 = V$$

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

[Area under a Vs t]

$$\Delta V = 5 \text{ m s}^{-2}$$

FRICTION

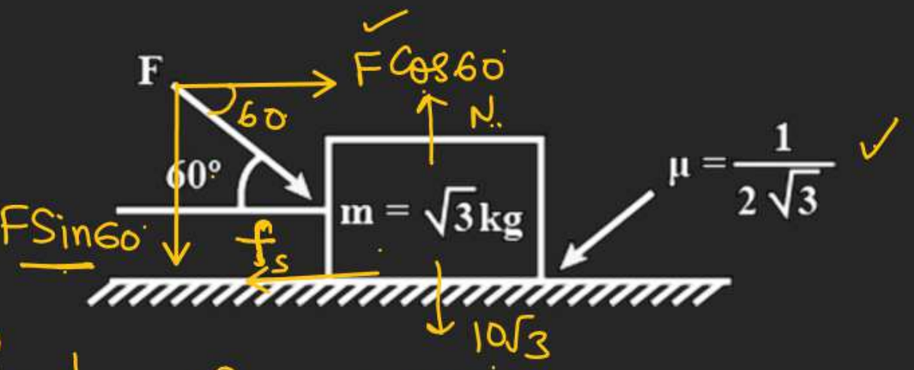
Q.6 What is the maximum value of the force F such that the block shown in the arrangement, does not move [illegible]:

(a) 20 N

(b) 10 N

(c) 12 N

(d) 15 N



For block not to move.

$F\cos 60^\circ = f_s$

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

$F_{max} = 20N$

$(f_s) \le (f_s)_{max}$

$\frac{F}{2} \le \frac{1}{2\sqrt{3}}\left[10\sqrt{3} + \frac{F\sqrt{3}}{2}\right]$

$\frac{F}{2} \le 5 + \frac{F}{4}$

$\frac{F}{4} \le 5$

$F \le 20N$