YAKEEN NEET 2.0

2026

Laws of Motion

PHYSICS | Lecture 13

By - Saleem Ahmed Sir

Todays Goal

- Friction

10:21

← Laws of Motion 12 : Questions Pra...

Video

Popular Doubts | Awaiting Doubts | Shared Doubts | Slides

$F_{thrust} - mg = ma$

$-v_{rel}\frac{dm}{dt} - mg = m\frac{dv}{dt}$

$\frac{dv}{dt} = -\frac{v_{rel}}{m}\frac{dm}{dt} - g$

$\int_u^v dv = \int_{m_0}^{m} -v_{rel}\frac{dm}{m} - \int_0^t g\,dt$

$v - u = -v_{rel}\ln\frac{m}{m_0} - gt$

$v = u - gt + v_{rel}\ln\left(\frac{m_0}{m}\right)$

$m = m_0 - \lambda t$

upwards from rest under gravity. The rocket burns fuel at the rate of 10 kg per second. The burnt matter is ejected vertically downwards with a speed of 2000 m/s relative to the rocket. Find the velocity of the rocket after 1 min of start.

Sol.

$v = u - gt + \ln\left(\frac{m_0}{m}\right)v_{rel}$

$v = 0 - 10\times60 + \ln\left(\frac{1000}{600}\right)\times 2000$

$t=0,\ a = \frac{2000\times10 - 10000}{1000}$

$a = 10$

$1000 - 600 = 400$

Cutting of Spring

If at $t=0$, Lower spring is cut then find acc. of each block at $t=0^+$ (Just after)

Sol.

$F_{sp} = 3mg$

$a = \frac{3mg - mg}{m} = 2g\uparrow$

$t = 0^+$

B $a = g$

Cutting of Spring

400

- $\vec{J} = \Delta\vec{p} = \vec{p}_f - \vec{p}_i = \int \vec{F}\,dt = \vec{F}\Delta t$ → const

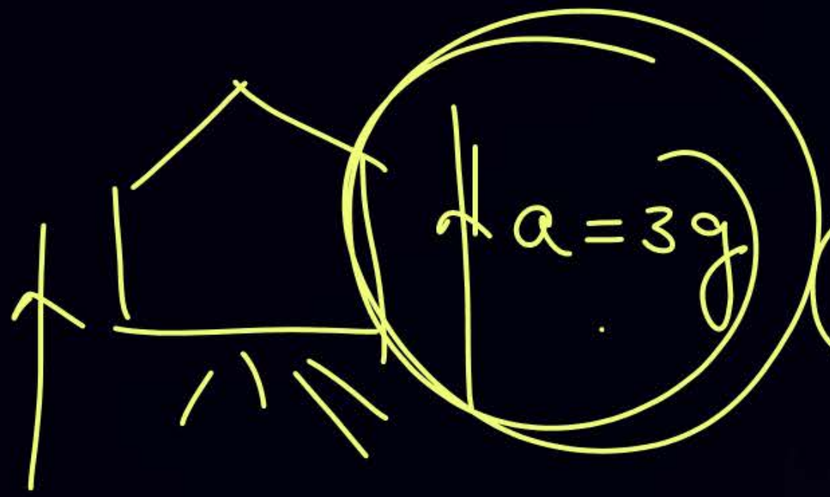
→ Area

$F_{th} = v_{rel}\frac{dm}{dt}$

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

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

-



$F_{thr} - mg = ma$

$v_{rel}\frac{dm}{dt} - mg = m(3g)$

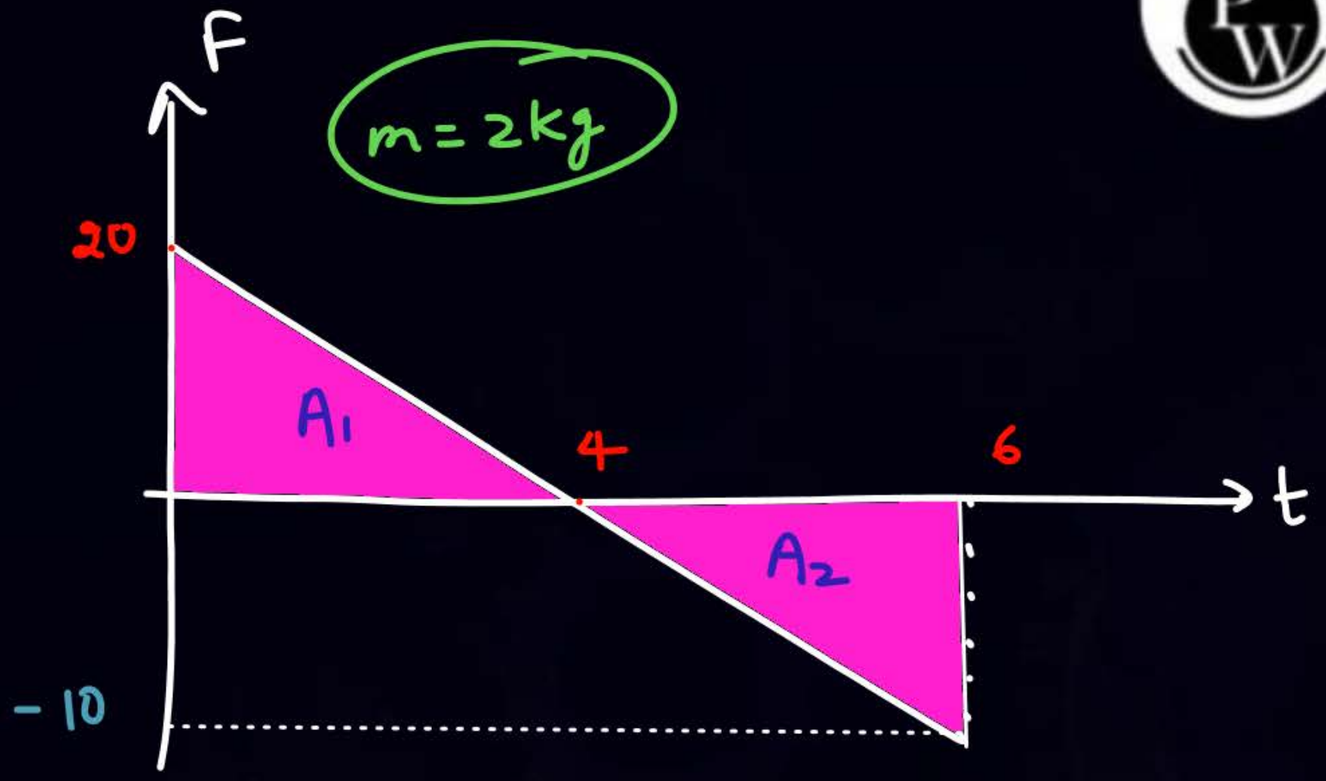
$$v = u - gt + v_{rel} \ln\left(\frac{m_i}{m_f}\right)$$

$$v = u - gt + v_{rel} \ln\left(\frac{m_0}{m}\right)$$

Q

At $t=0$, rest

$t=6$, $KE = ?$

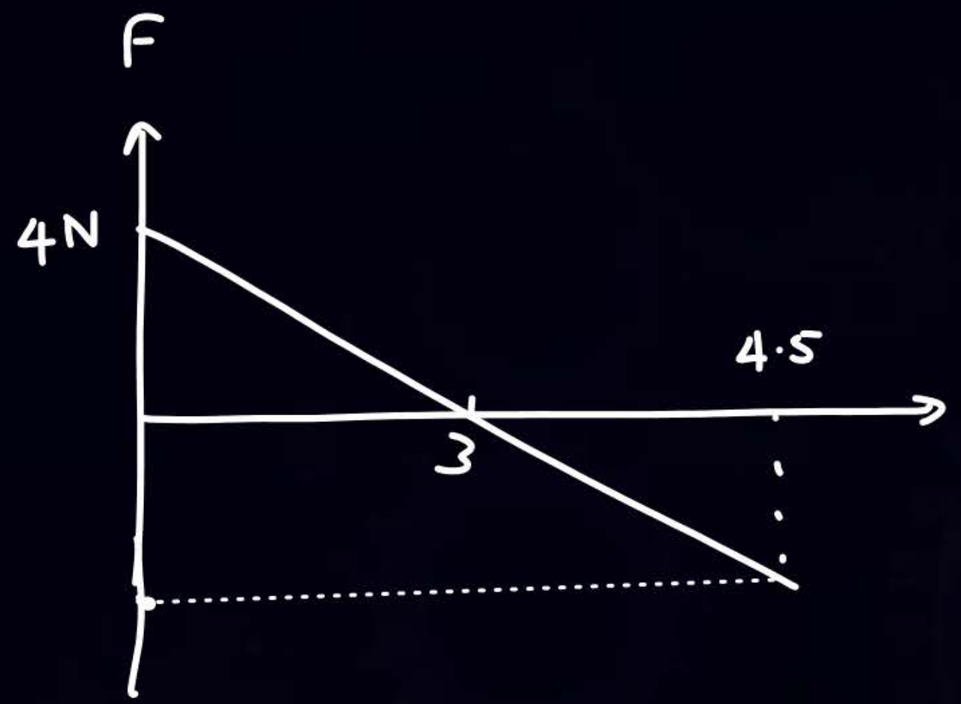


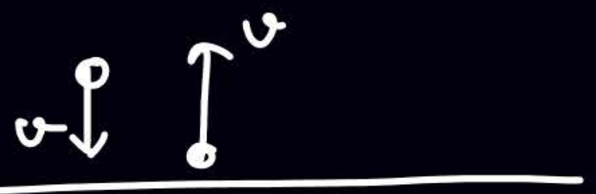
$$2v - 0 = \frac{1}{2}\times 20\times 4 - \frac{1}{2}\times 2\times 10$$

$$\boxed{v = 15}$$

$$KE = \frac{1}{2}\times 2\times (15)^2 = \underline{225}$$

Q JEE Adv. 2010





$\Delta p =$

$\Delta p = 0$ ✗

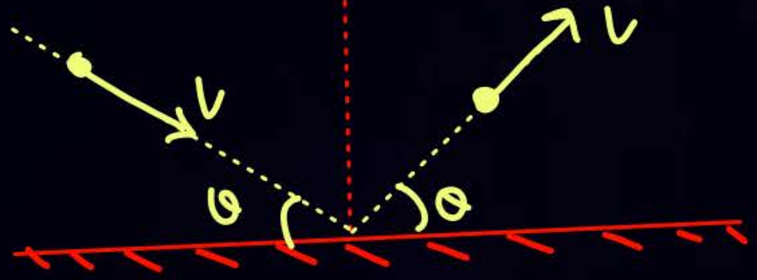
$\Delta p = 2mv$

$\langle \vec{N} \rangle = \frac{\Delta p}{\Delta t} = \frac{2mv}{\Delta t}$

$\Delta p =$

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

EXPLANATION



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

Avg val

Frichon

$$f = \frac{dP}{dt} \longrightarrow \frac{\Delta P}{\Delta t}$$

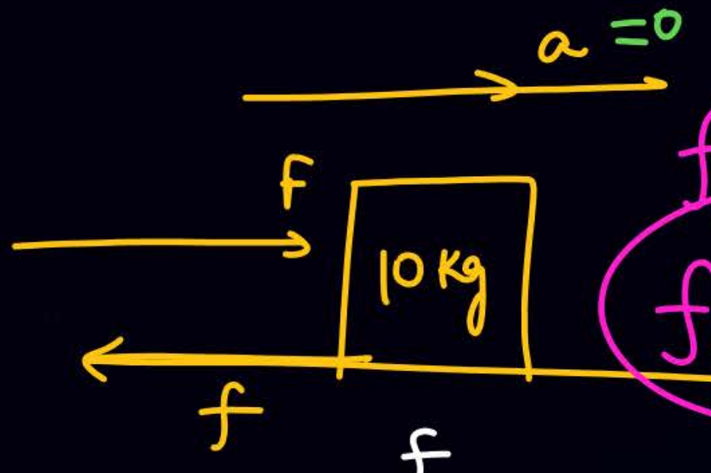
$$a = \frac{dv}{dt} \longrightarrow \frac{\Delta v}{\Delta t}$$

$$v = \frac{dx}{dt} \longrightarrow \frac{\Delta x}{\Delta t}$$

$$i = \frac{dq}{dt} \longrightarrow \frac{\Delta q}{\Delta t}$$

Friction

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



$f_k \propto N$

$f_k = \mu_k N$

F	a	f
0	0	0
10N	0	10
20N	0	20
30	0	30
39.999	0	39.999
40	0	40
40.001	✓	✓
42	✓	✓
44	✓	✓
50	✓	✓
60	✓	✓

(पहले)

Static friction

Area पर Independent

Const 'f'

Kinetic friction

Static friction

- It oppose relative motion
- It has an upper limit $(f_s)_{max}$

$$(f_s)_{max} \propto N$$

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

μ_s → coff. of static friction

- $f_s \longrightarrow$ Variable Self adjusting
- It act where there is no relative motion blw contact surface

· Independent on area.

Kinetic friction

- It oppose the relative motion
- It value is constant.

or SKC

/

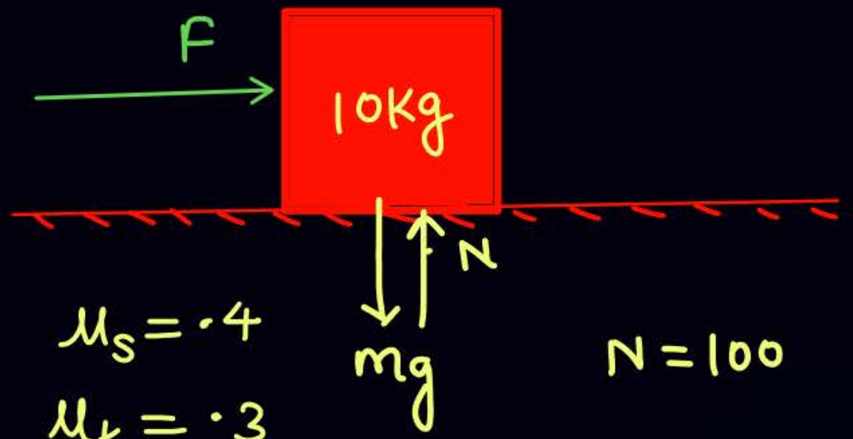
$$f_k \propto N$$

$$\boxed{f_k = \mu_k N = \text{Const}}$$

- It act when there is relative motion b/w Contact surface.

· Independent on area.

Q



① what is max. value of static friction.

Sol^n $(f_s)_{max} = \mu_s N = \cdot 4 \times 100 = 40N$

Iska matlab block ko move karane ke liye effectively min. 40N force ki jaruraat hai

40^+

② what is value of kinetic friction

$f_k = \mu_k N = \cdot 3 \times 100$

$f_k = 30$

Iska matlab agar block fisal/move kar raha hai to uspar friction 30N Lagega.

Q

$\mu_s = .4$

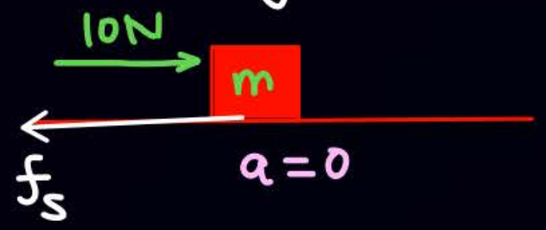
$\mu_k = .3$

Find the a, f in following cases

① $F = 10N$,

$a = 0$

$f_s = 10N$



② $F = 20N$

$a = 0$

$f_s = 20$

③ $F = 30N$

$a = 0$

$f = 30N$

④ $F = 39.9999$

$a = 0$

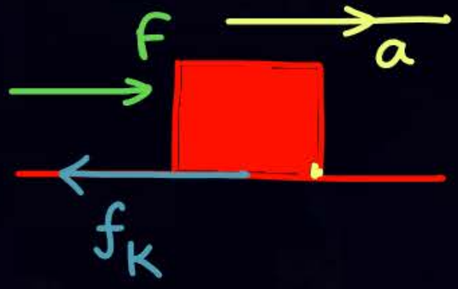
$f = 39.9999$

$(f_s)_{max} = 40$

$f_K = 30$

⑤ $F = 40 \Rightarrow a = 0 \Rightarrow f = 40 = (f_s)_{max}$

⑥ $F = 40.001$



$a = \frac{F - f}{m}$ move ✓

$a = \frac{40.001 - 40}{10} = .0001$

$a = \frac{F - f_K}{m} = \frac{40.001 - 30}{10} = \frac{10.001}{10}$

$= 1.0001$

⑦ $F = 50N$

$a = \frac{50 - 30}{10} = 2$

⑧ $F = 90N$

a

Q

$\mu_s = \cdot 4$

$\mu_k = \cdot 3$

Find the a, f in following cases

⑥ $F = 40.001$

$$a = \frac{F - f_k}{m} = \frac{40.001 - 30}{10}$$

$$= 1.001$$

$f_k = 30$

$(f_s)_{max} = 40$

$f_K = 30$

⑦ $F = 50N$

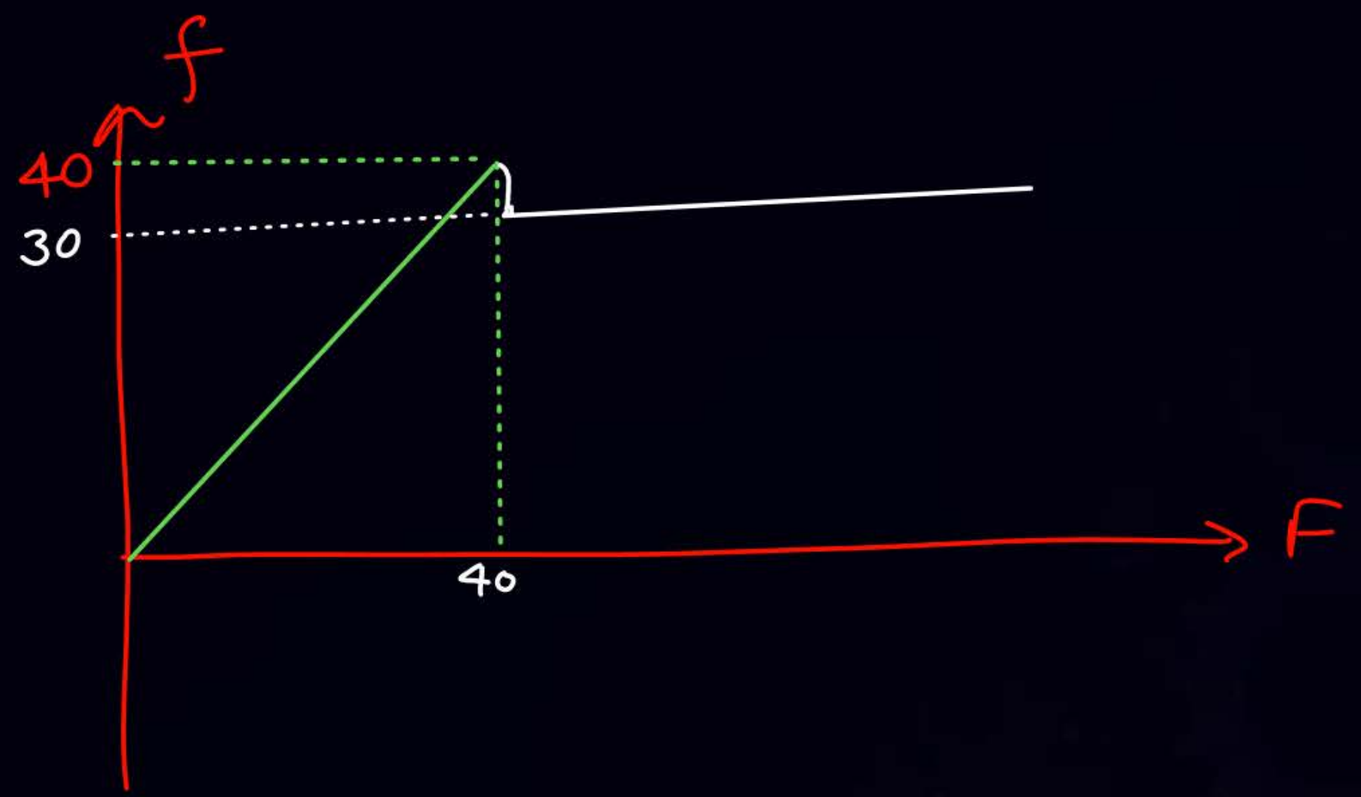
$$a = \frac{F - f_k}{m} = \frac{50 - 30}{10} = 2$$

$f_k = 30$

⑧ $F = 90N$,

$$a = \frac{90 - 30}{10} = 6$$

$f_k = 30$


f
40
30
40
F

Q

$(f_s)_{max} = 60$

$f_k = 50$

$\mu_s = .6$

$\mu_k = .5$

find f & a

① $F = 10N$
$a = 0$
$f_s = 10$

② $F = 20$
$a = 0$
$f_s = 20$

③ $F = 59.99$ $a = 0$, $f = 59.99$

④ $F = 61$, $a = \frac{61-50}{10} = 1.1$, $f_k = 50$

⑤ $F = 70$ $a = \frac{70-50}{10} = 2$, $f_k = 50$

⑧ $F = 80$

$a = \frac{80-50}{10} = 3$, $f_k = 50$

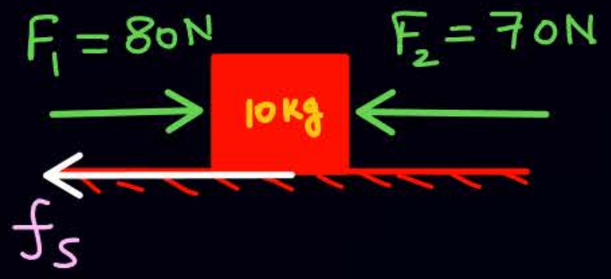
Q

$\mu_s = 0.6$
$\mu_k = 0.5$

$(f_s)_{max} = 60$
$f_k = 50$

(a)

(Saheem Bhaia Style)



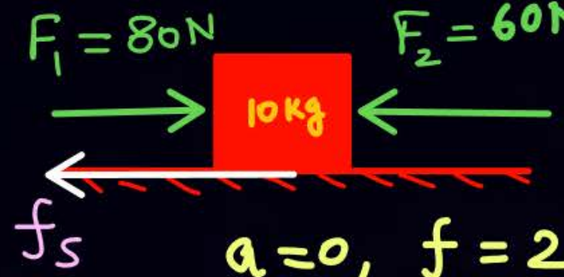
$a = 0$

$f_s = 10$

$80 = 70 - f_s$

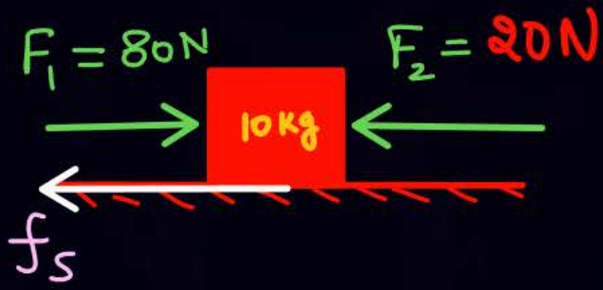
$f_s = 10$

(b)



$a = 0, \quad f = 20 = f_s$

(c)



$a = 0$

$f = 60 = (f_s)_{max}$

(d)

$f_k = 50,$

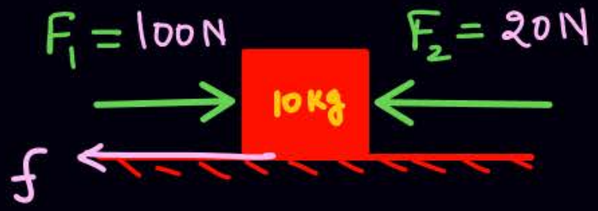
$a = \frac{80 - 10 - 50}{10} = 2$

Q

$\mu_s = 0.6$
$\mu_k = 0.5$

$(f_s)_{max} = 60$
$f_k = 50$

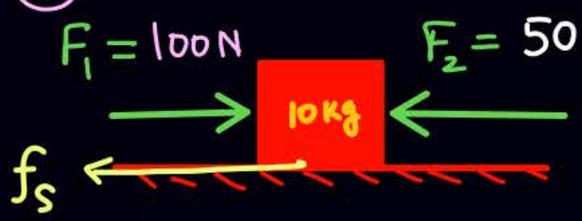
(e)



$a = \frac{80-50}{10} = 3$

$f = 50$

(f)

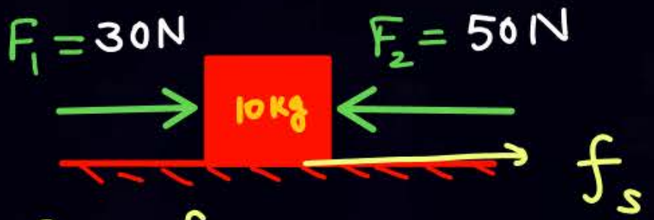


$a = 0, \quad f = 50$

(g)

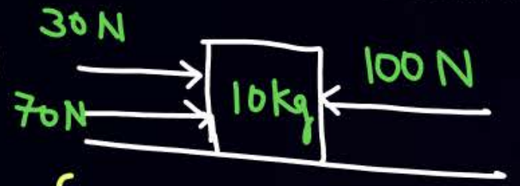
$a = 0, \quad f_s = 40$

(h)



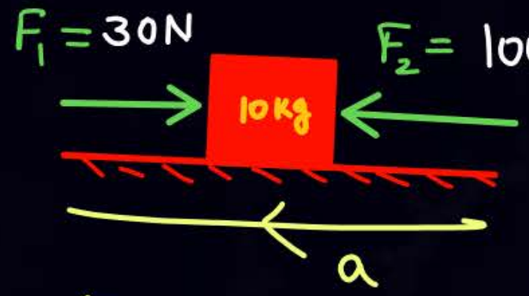
$a = 0, \quad f = 20$

(j)



$f = 0, \quad a = 0$

(i)



$f_k = 50$

$a = \frac{70-50}{10}$

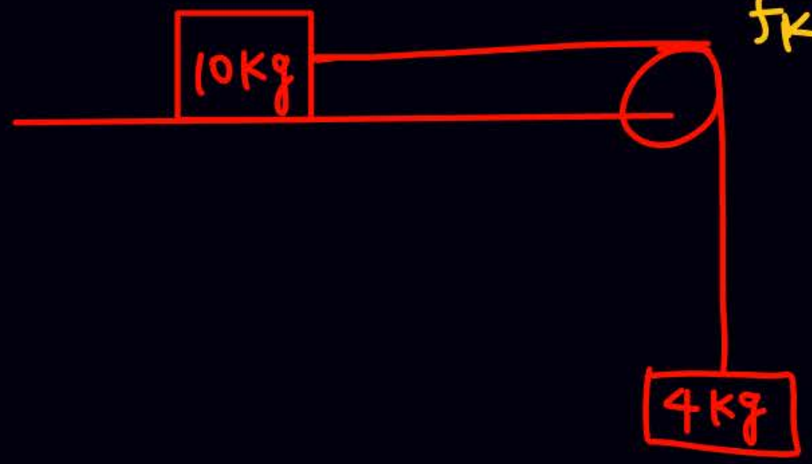
$a = 2$

$\mu_k = 0.5$
$\mu_s = 0.6$

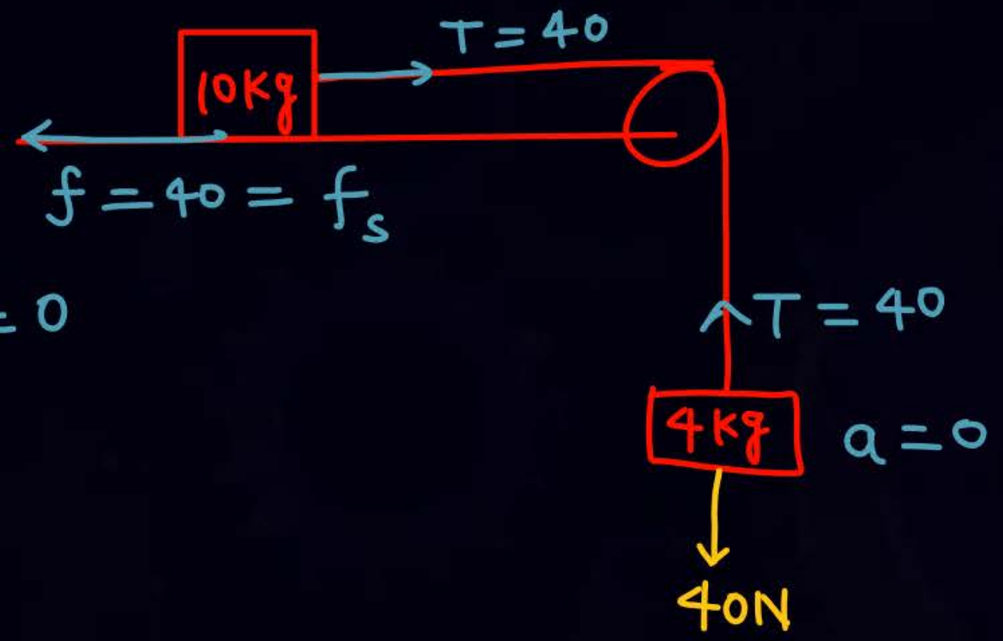
$(f_s)_{max} = 60$

$f_k = 50$

Q



Soln

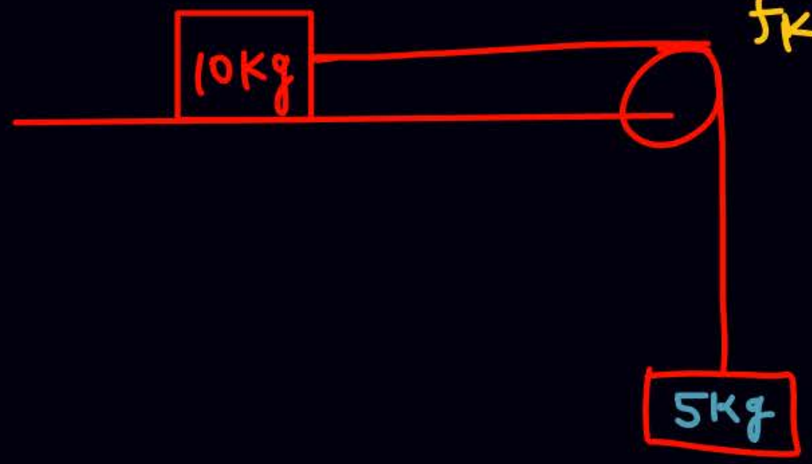


$\mu_k = .5$
$\mu_s = .6$

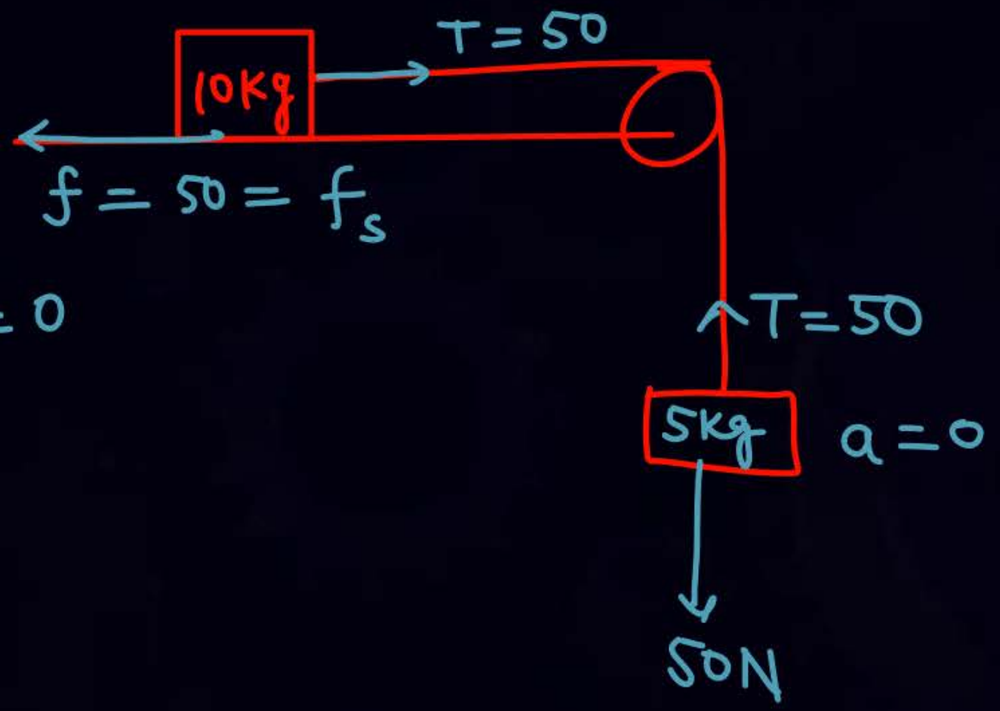
$(f_s)_{max} = 60$

$f_k = 50$

Q



Sol^n

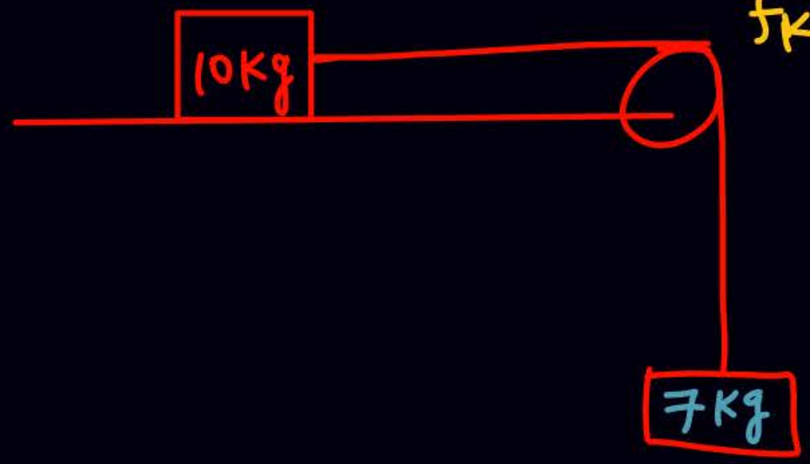


$\mu_k = \cdot 5$
$\mu_s = \cdot 6$

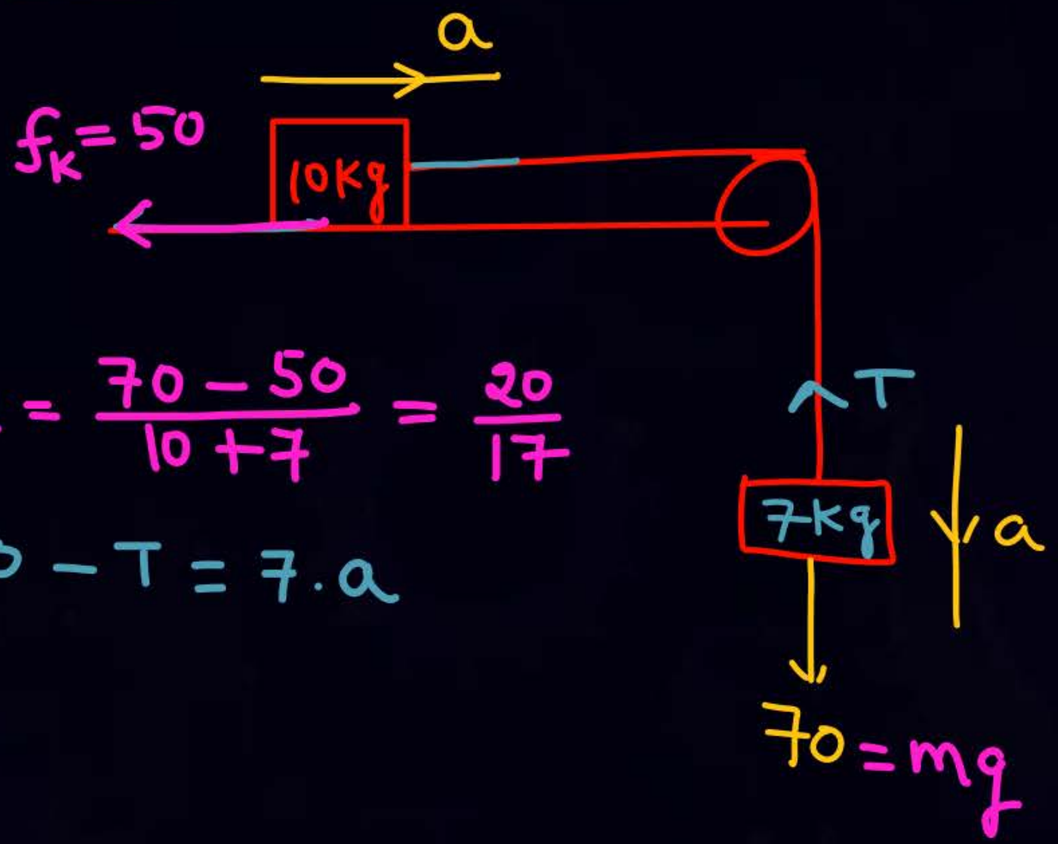
$(f_s)_{max} = 60$

$f_k = 50$

Q



Soln



$$a = \frac{70 - 50}{10 + 7} = \frac{20}{17}$$

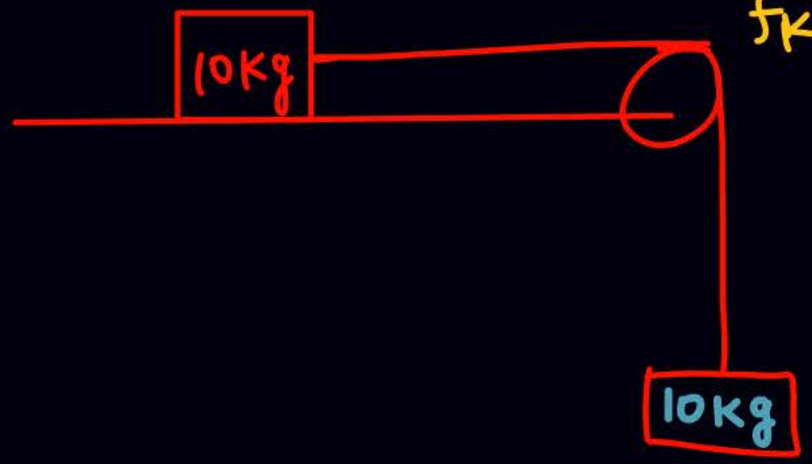
$$70 - T = 7 \cdot a$$

$\mu_k = .5$
$\mu_s = .6$

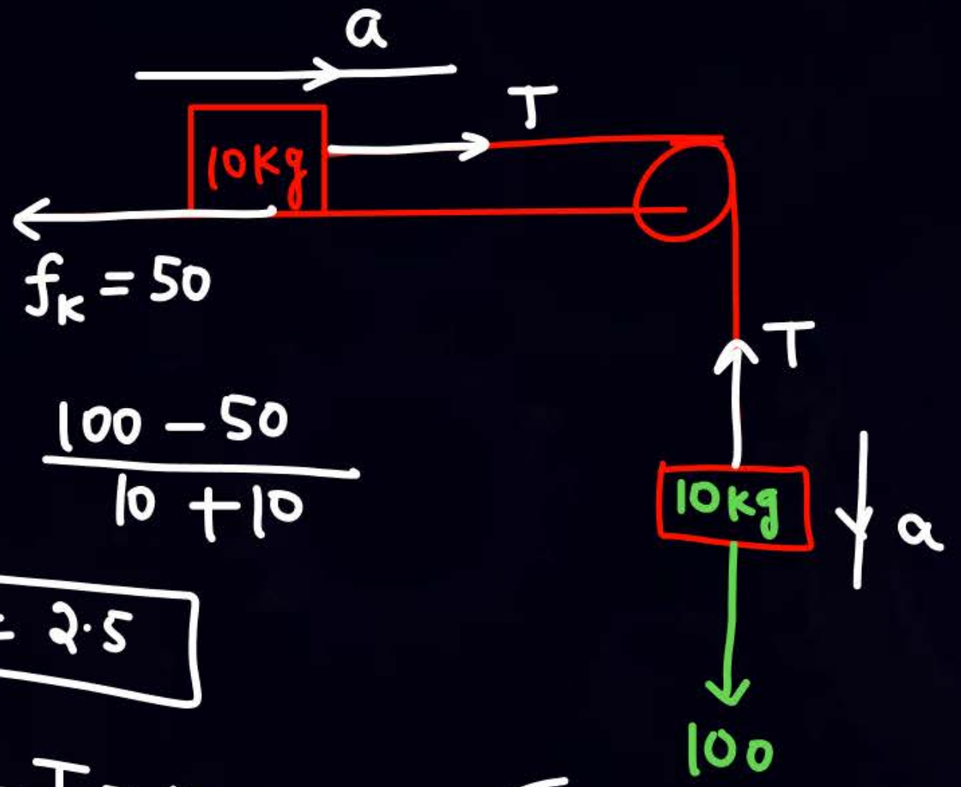
$(f_s)_{max} = 60$

$f_k = 50$

Q



Sol^n



$$a = \frac{100 - 50}{10 + 10}$$

$$\boxed{a = 2.5}$$

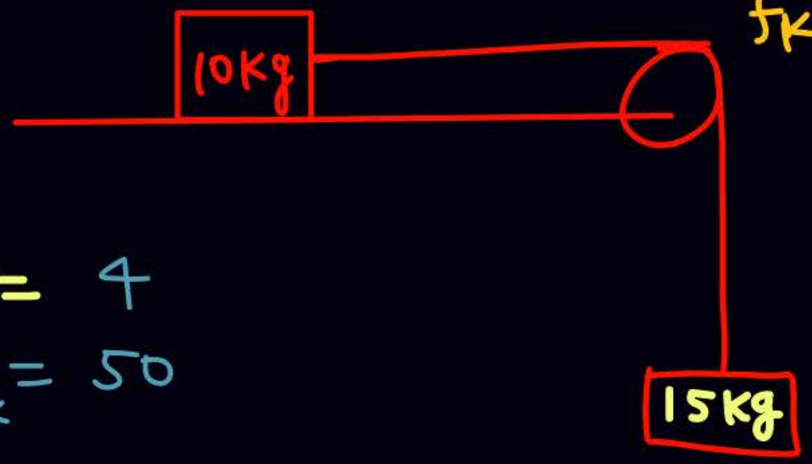
$mg - T = ma$ ✓

$\mu_k = \cdot 5$
$\mu_s = \cdot 6$

$(f_s)_{max} = 60$

$f_k = 50$

Q

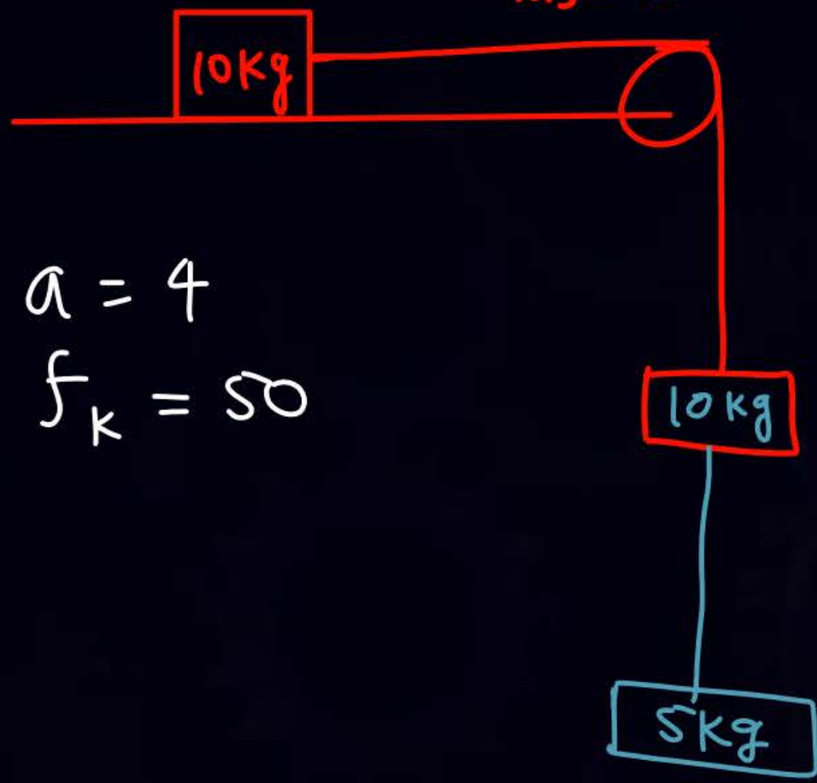


$a = 4$

$f_k = 50$

Q

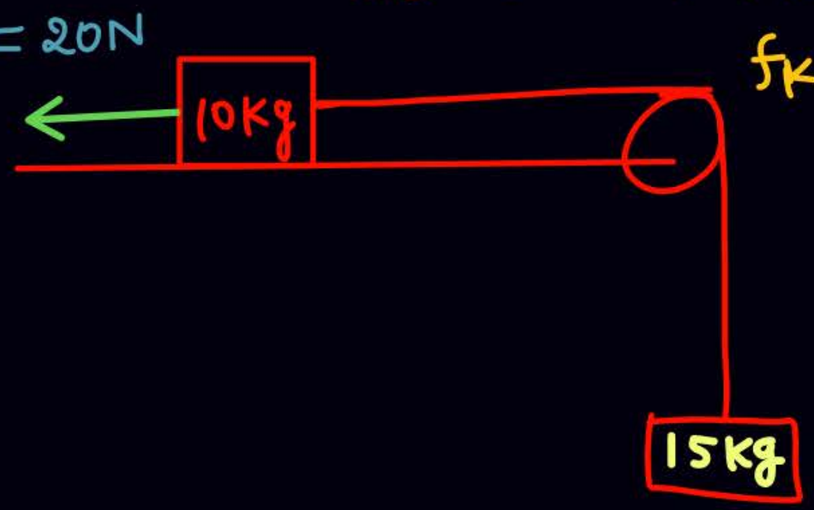
$\mu_k = \cdot 5$
$\mu_s = \cdot 6$



$a = 4$

$f_k = 50$

Q

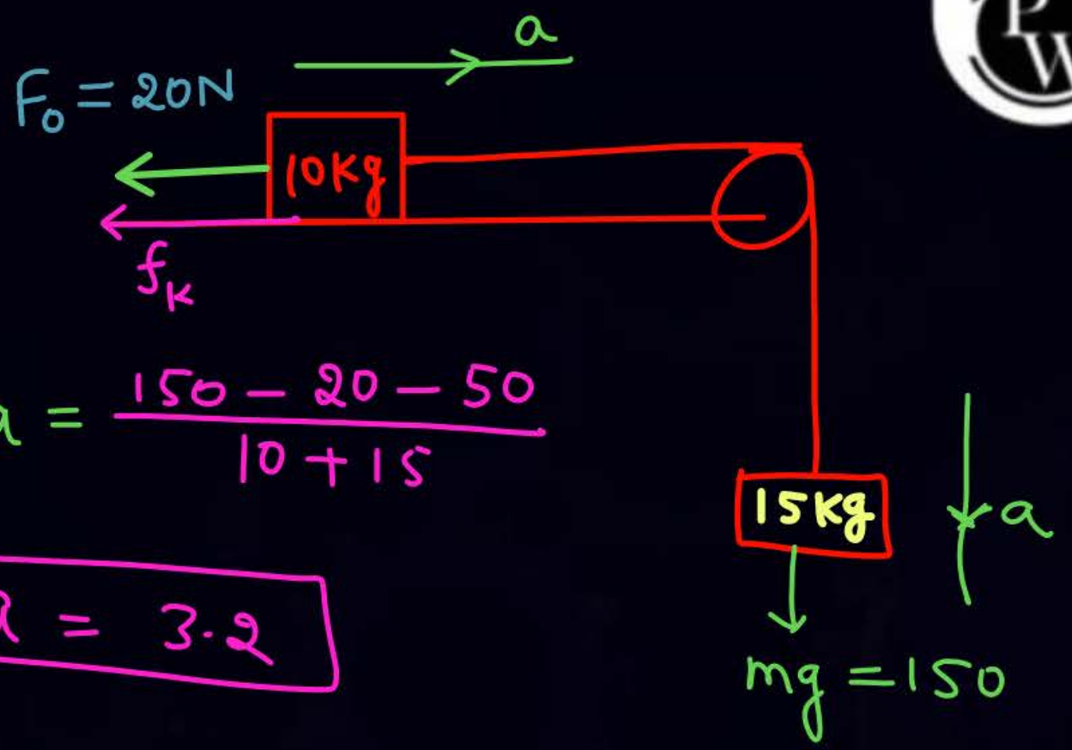


$\mu_k = .5$
$\mu_s = .6$

$(f_s)_{max} = 60$

$f_k = 50$

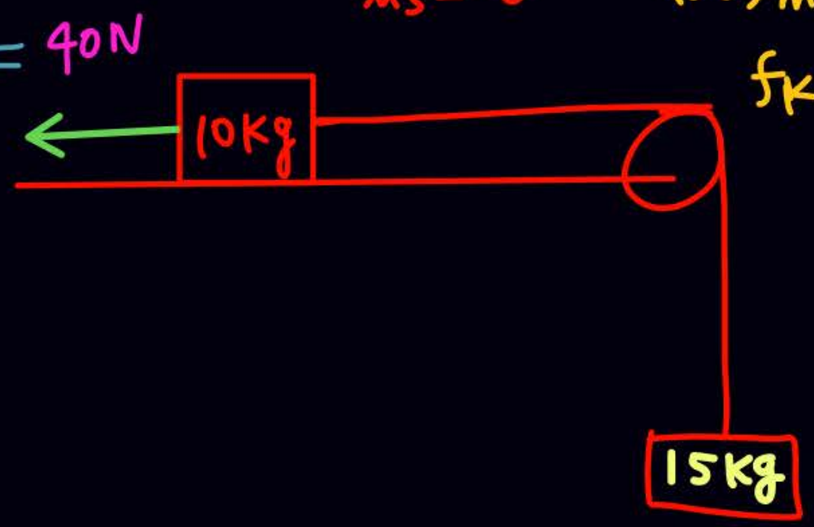
Sol



$$a = \frac{150 - 20 - 50}{10 + 15}$$

$$a = 3.2$$

Q

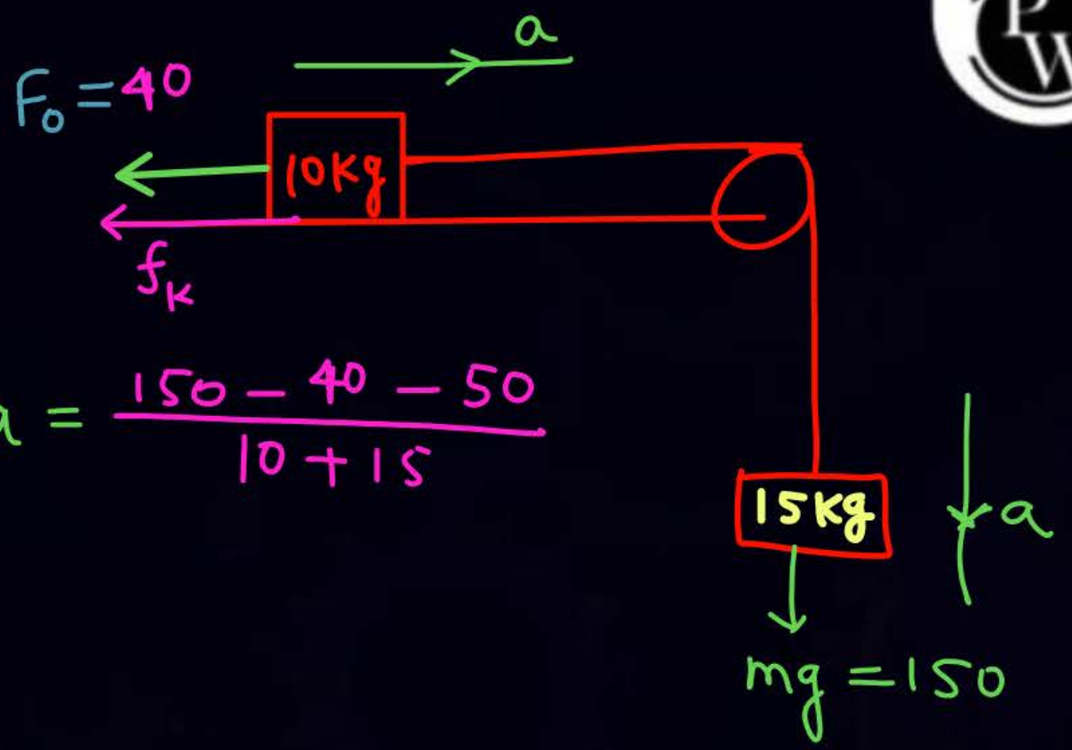


$\mu_k = .5$
$\mu_s = .6$

$(f_s)_{max} = 60$

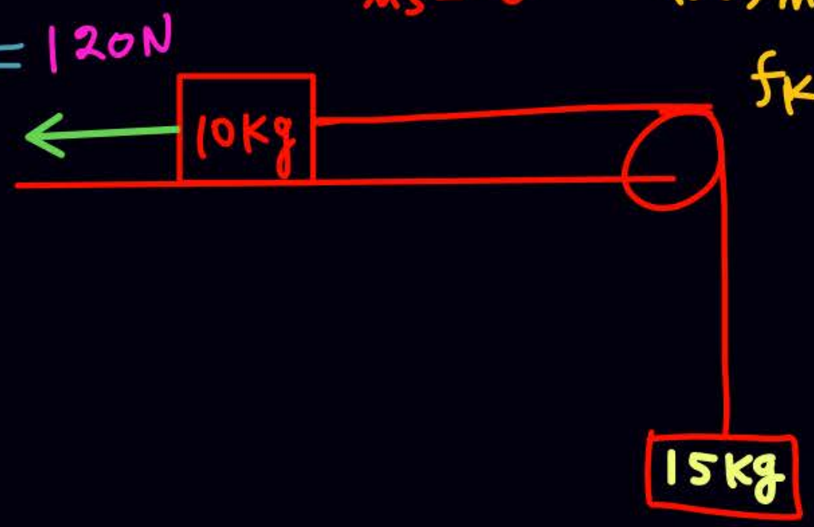
$f_k = 50$

Sol



$$a = \frac{150 - 40 - 50}{10 + 15}$$

Q

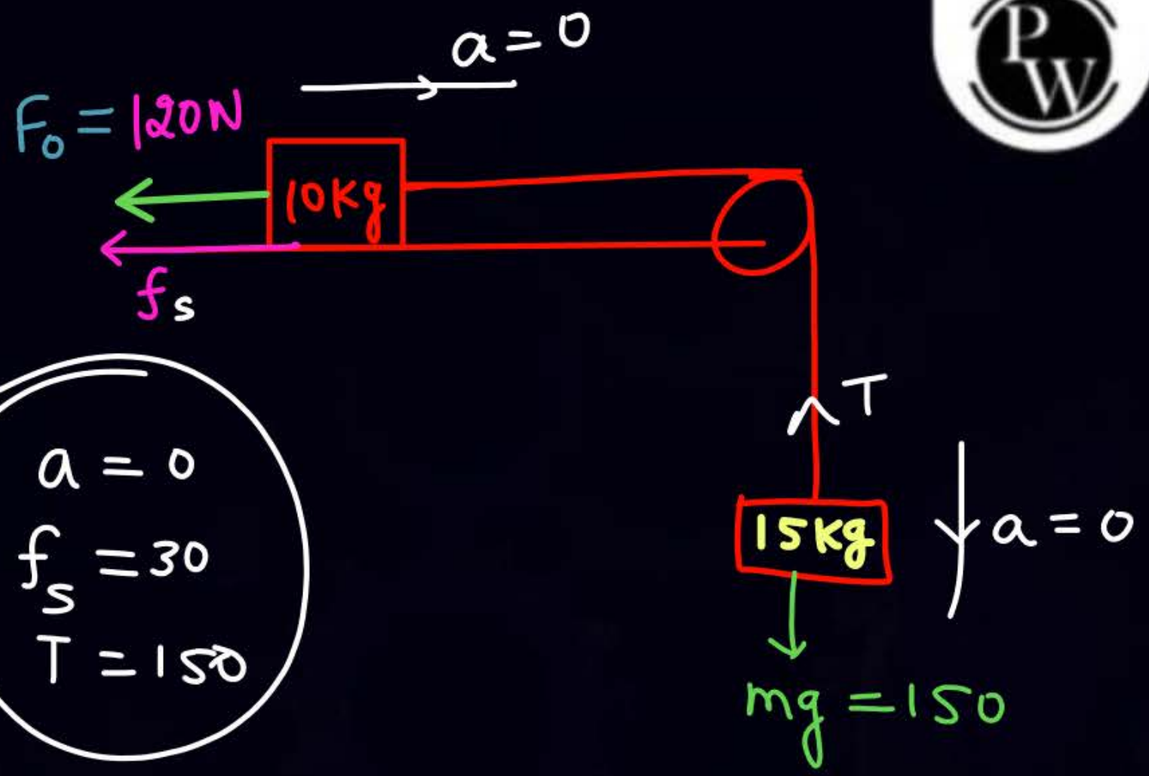


$\mu_k = .5$
$\mu_s = .6$

$(f_s)_{max} = 60$

$f_k = 50$

Sol

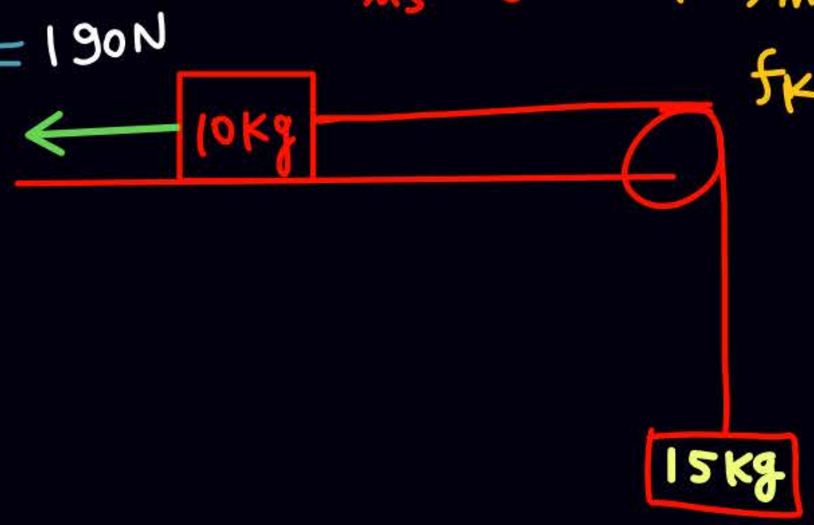


$a = 0$

$f_s = 30$

$T = 150$

Q

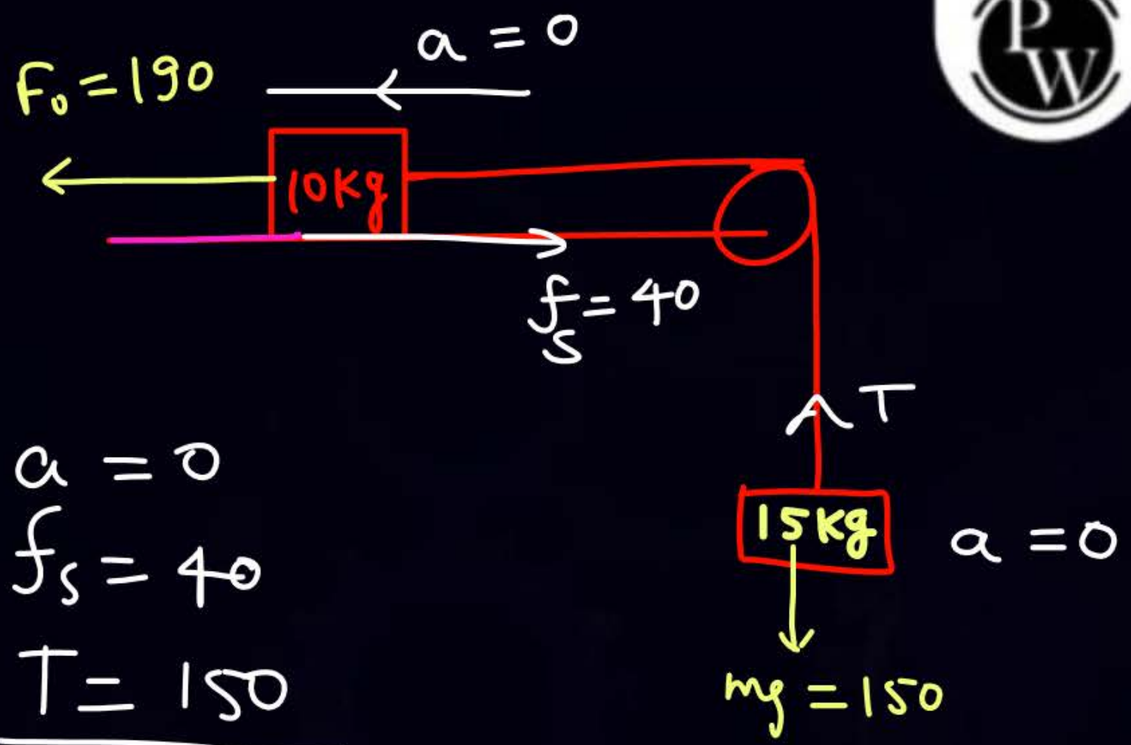


$\mu_k = .5$
$\mu_s = .6$

$(f_s)_{max} = 60$

$f_k = 50$

Sol

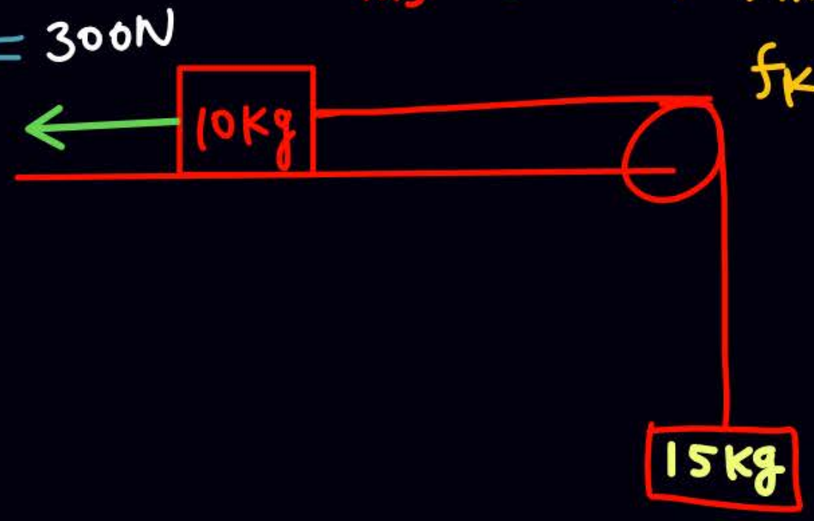


$a = 0$

$f_s = 40$

$T = 150$

Q

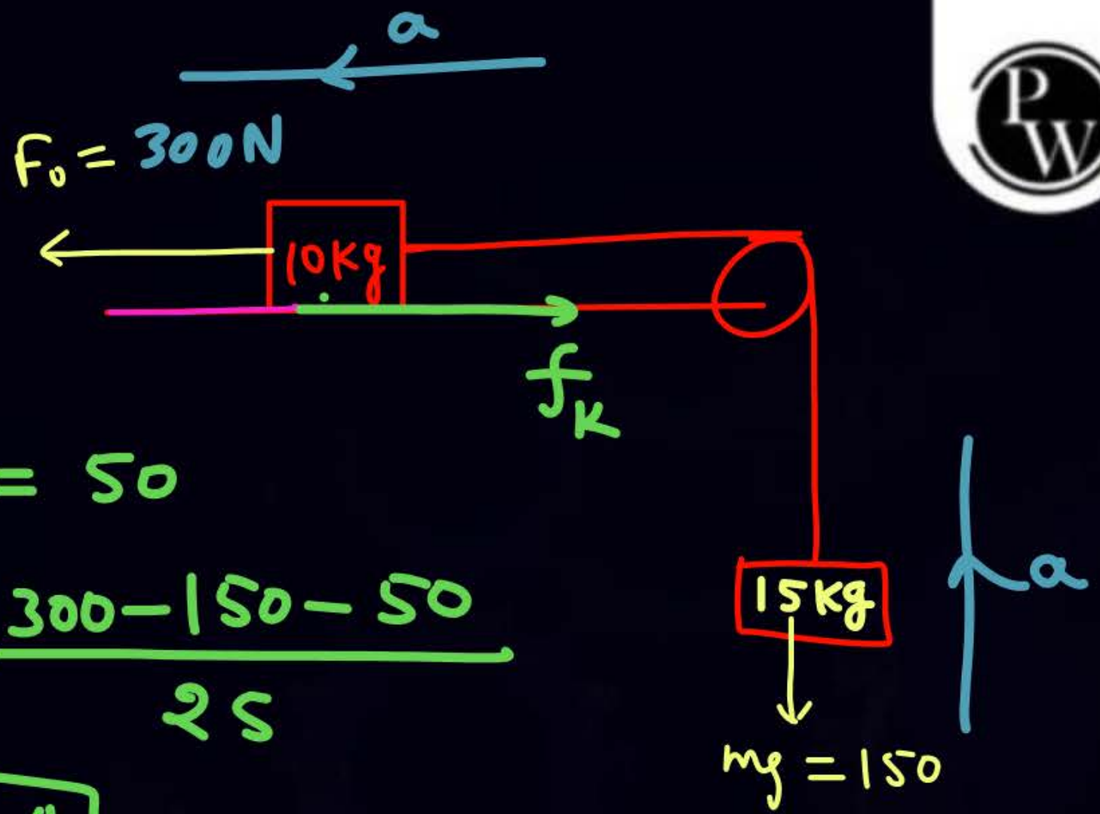


$\mu_k = \cdot 5$
$\mu_s = \cdot 6$

$(f_s)_{max} = 60$

$f_k = 50$

Sol

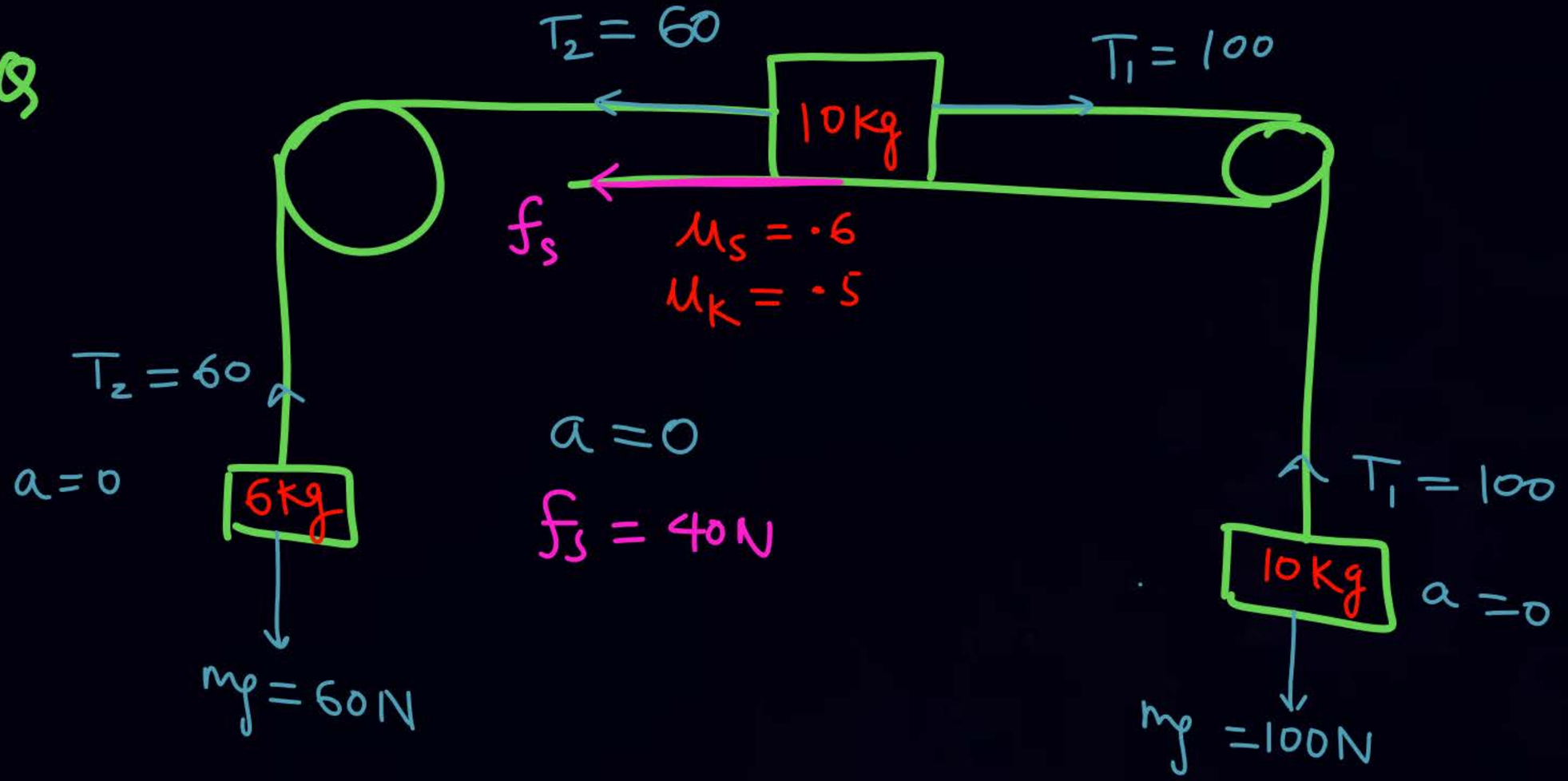


$$f_k = 50$$

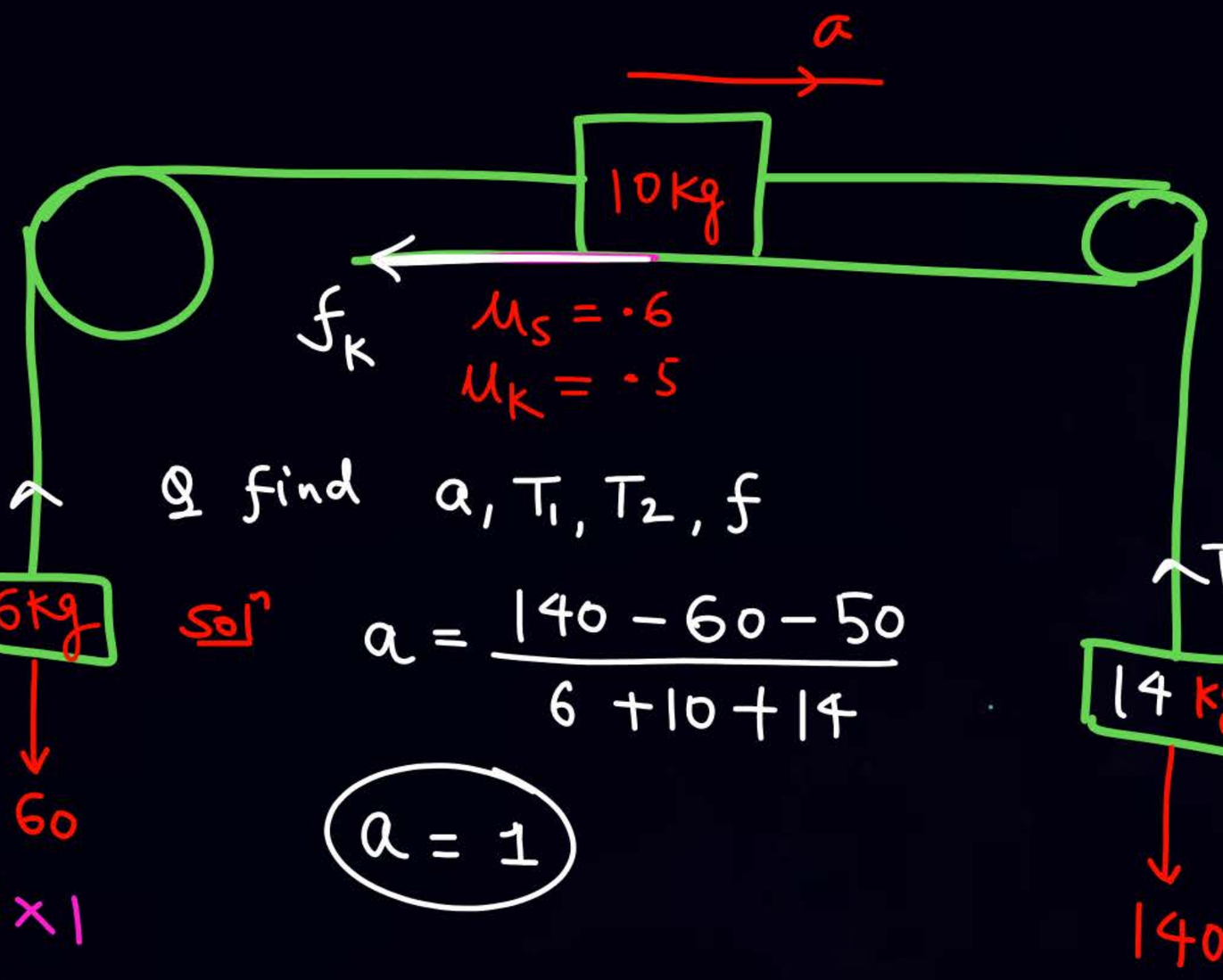
$$a = \frac{300 - 150 - 50}{25}$$

$$\boxed{a = 4}$$

Q


$T_2 = 60$
$T_1 = 100$
10kg
f_s
$\mu_s = .6$
$\mu_k = .5$
$T_2 = 60$
$a = 0$
6kg
$mg = 60N$
$a = 0$
$f_s = 40N$
$T_1 = 100$
10kg
$a = 0$
$mg = 100N$

Q



Q find a, T_1, T_2, f

Sol^n

$$a = \frac{140 - 60 - 50}{6 + 10 + 14}$$

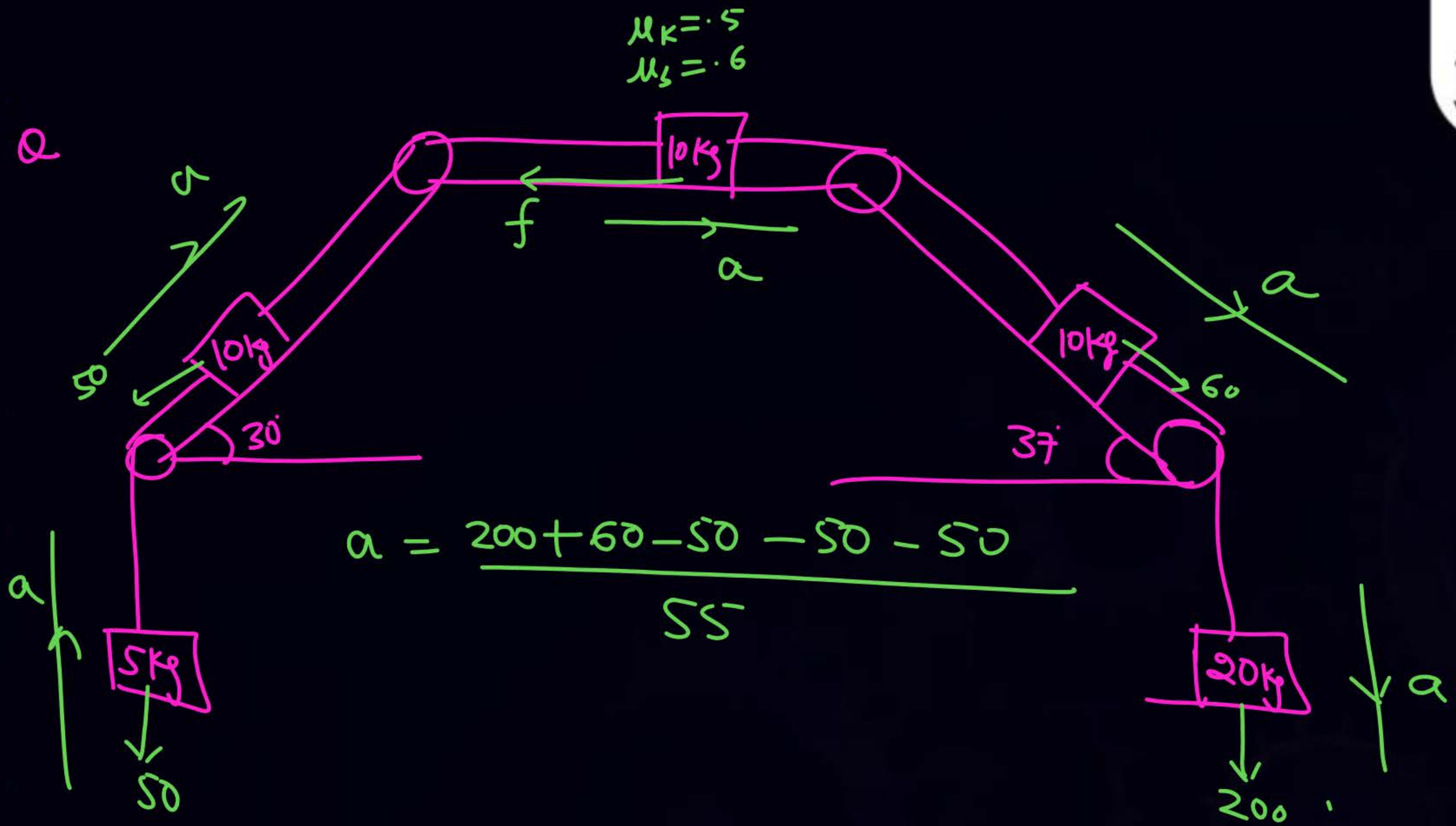
$$a = 1$$

$T_2 - 60 = 6 \times 1$

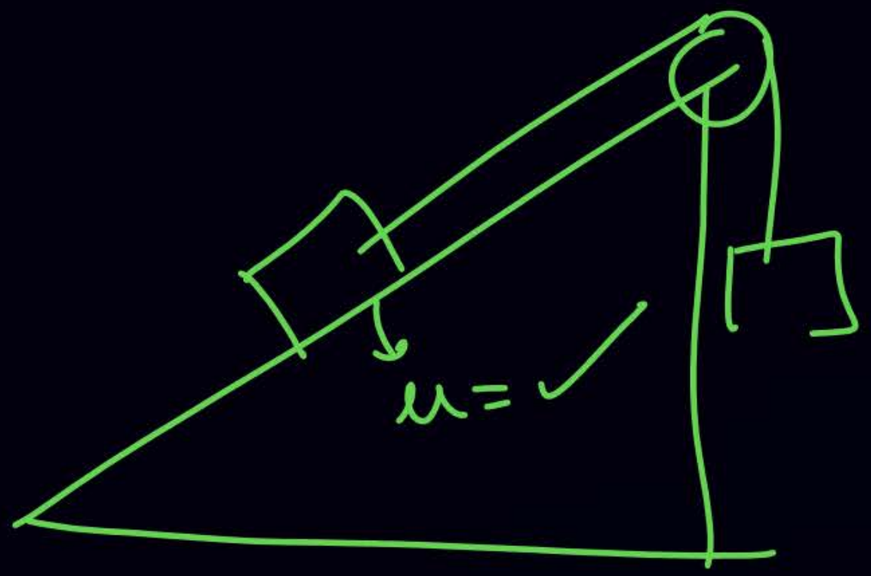
$T_2 = 66$

$140 - T_1 = 14 \times 1$

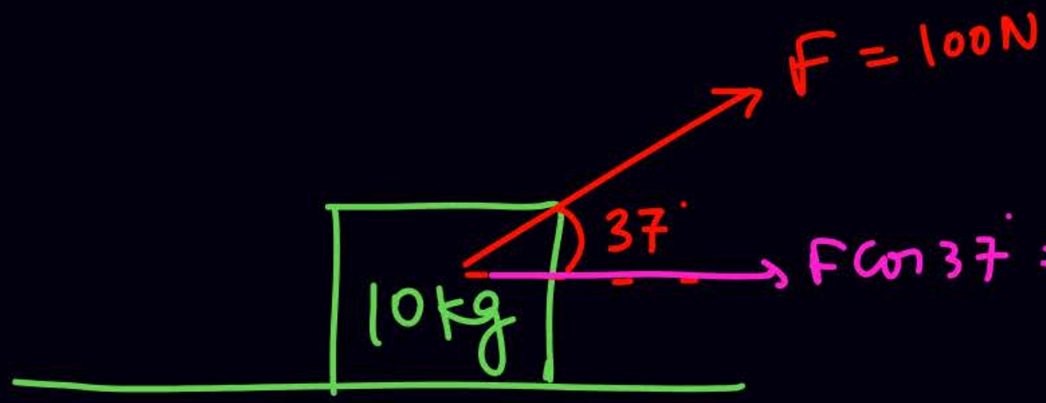
$T_1 = 126$



$$a = \frac{200 + 60 - 50 - 50 - 50}{55}$$


μ=

Q



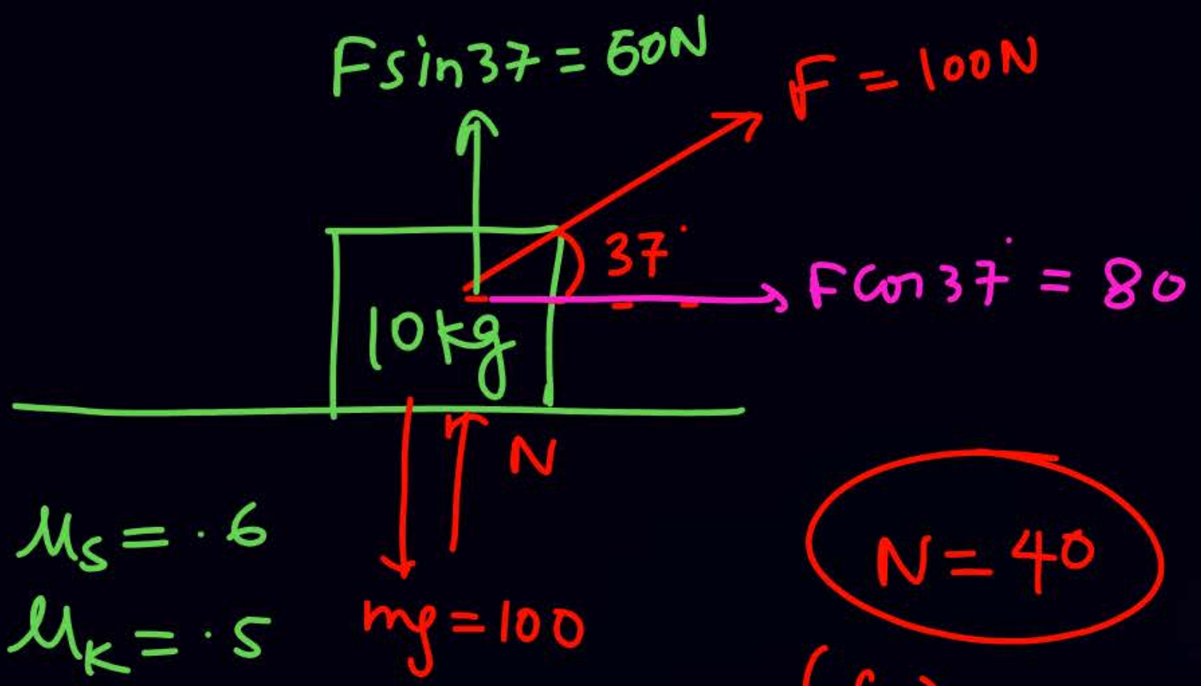
$\mu_s = .6$

$\mu_k = .5$

$$a = \frac{80 - 60}{10} = 2$$

$$a = \frac{80 - 50}{10} = 3$$

Q



$\mu_s = .6$

$\mu_k = .5$

$N = 40$

$(f_s)_{max} = .6 \times 40 = 24$

$f_k = .5 \times 40 = 20$

$a = \frac{80 - 20}{10} = 6$

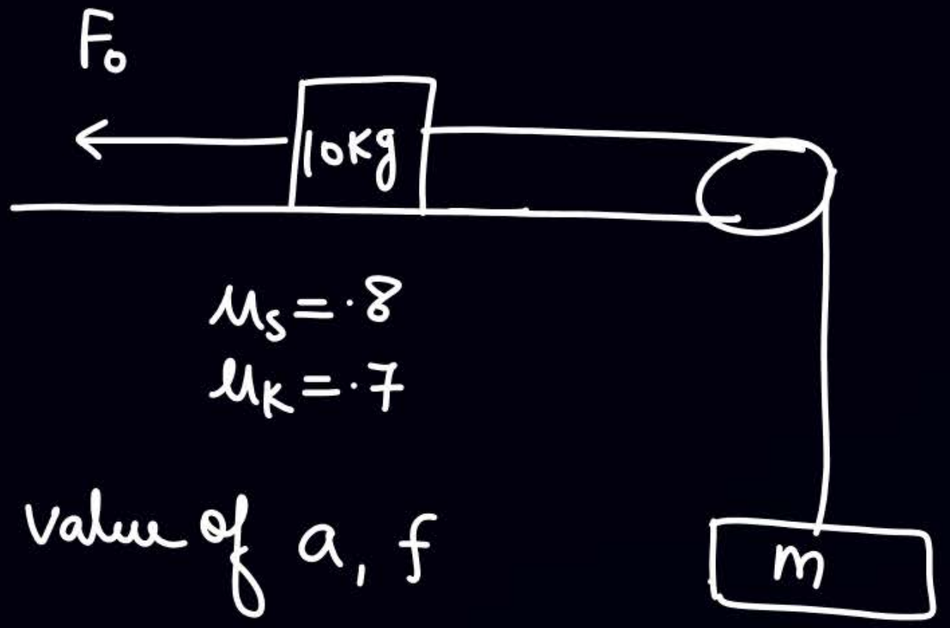
Q Find value of friction, acc, nature of friction.

$\mu_s = .8$

$\mu_k = .7$

F_1	F_2	a	f
60N	0		
160N	100N		
200N	250N		
200N	240N		
100N	20N		
20N	100N		
80N	80N		
40N	60N		

Q



$\mu_s = .8$

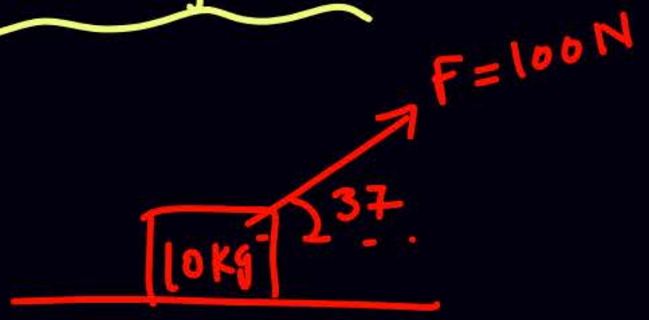
$\mu_k = .7$

find value of a, f

F_0	m	a	f
0	10kg		
10N	10kg		
20N	10kg		
40N	10kg		
60N	10kg		
80N	10kg		
100N	10kg		
120N	10kg		
170N	10kg		
180N	10kg		
200N	10kg		

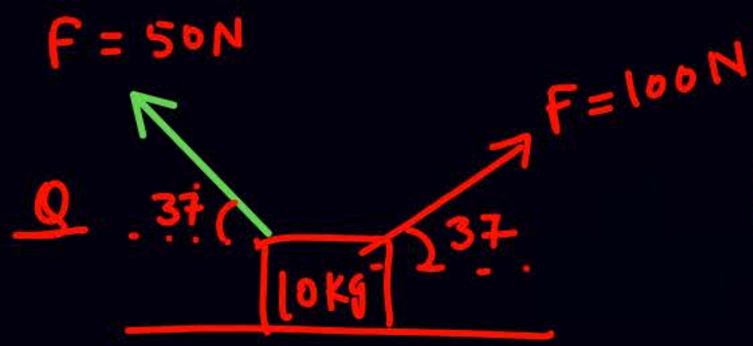
find a & frictim

Q



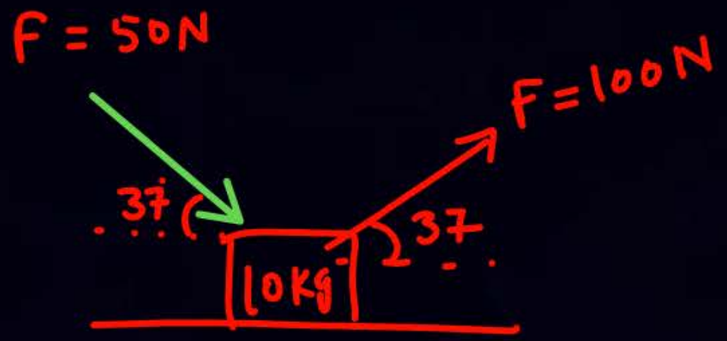
$\mu_s = .4$
$\mu_k = .3$

Q



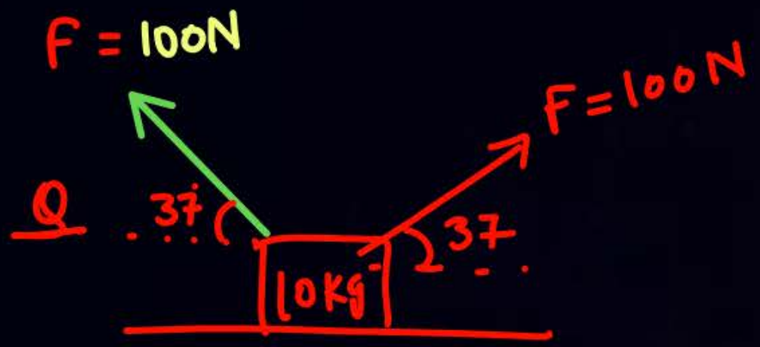
$\mu_s = .4$
$\mu_k = .3$

Q



$\mu_s = .4$
$\mu_k = .3$

Q



$\mu_s = .4$
$\mu_k = .3$

Homework

- Ques are attached solve them sincerely.
- KPP
- DPP
- HCV ⟶ how you can solve of NLM.

THANK YOU