FRICTION

21 September 2020 13:36

FRICTION:

Tends to prevent sliding b/w surfaces in contact.

→ Static
→ Kinetic.

Static: Surfaces have a tendency to slide.

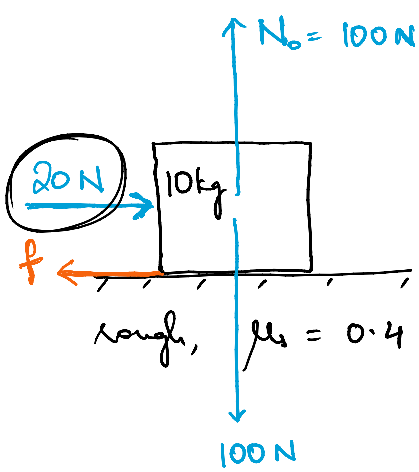
- → normal reaction
- → μ.

μN.

Self-adjusting.

(i) Is f required to act. → Imagine the situation without f.
(ii) How much is reqd. to prevent sliding
(iii) Is that much friction available/ possible?

$\mu_s N$ → max. static friction. ($f_{limiting}$).



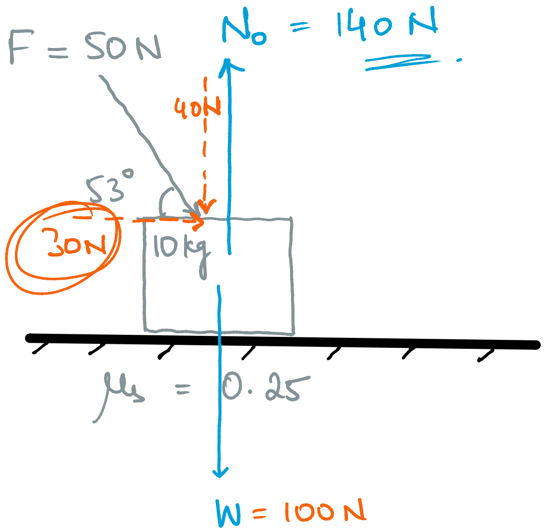
sliding force is present

(i) Block at rest. ($f = 0$)

(ii) Horizontal force of 20 N acts on the block.

$f_{req} = 20$ N. ✓

$f_{lim} = (0.4)(100) = 40$N



Does the block slide or not ?
If it does not, calc. the f acting on it.

(i) f will act.

(ii) $f_{req} = 30\text{ N}$

(iii) $f_{lim} = \mu_s N$

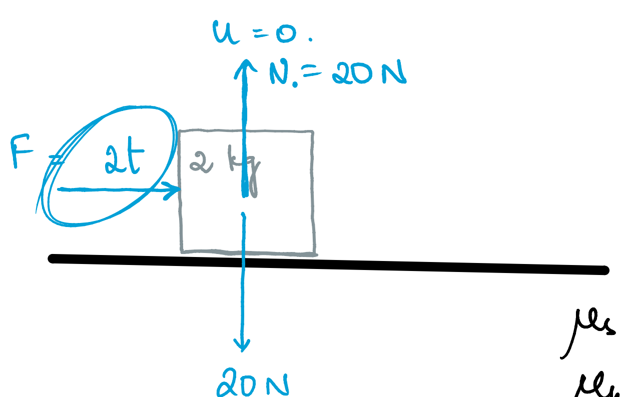
$= (0.25)(140) = 35\text{ N}$

f acting = 30 N.

Kinetic: Surfaces that are sliding relative to each other.

$$f_k = \mu_k N$$

$\mu_s > \mu_k$ $\mu_s = \mu_k$



$\mu_s = 0.5$

$\mu_k = 0.4$

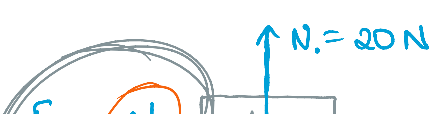
(i) Calc. the time when the block starts sliding

(ii) Calc. speed of the block at t = 10 s.

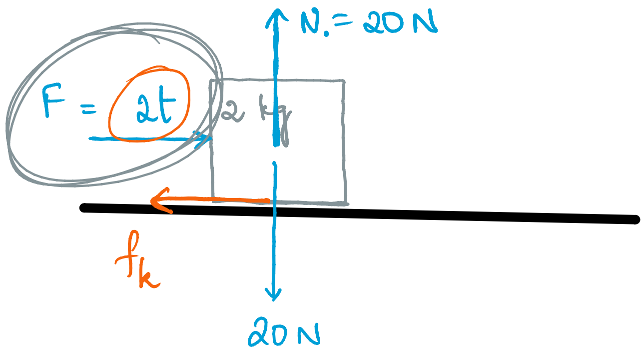
$f_{lim} = (0.5)(20) = 10\text{ N}.$

(i) $2t > 10$

$t > 5\text{ s}$



$t \geq 5\text{ s}$



$t \geq 5\ s$

$f_k = (0.4)(20) = 8\ N.$

$F_{net} = (2t - 8) = 2a$

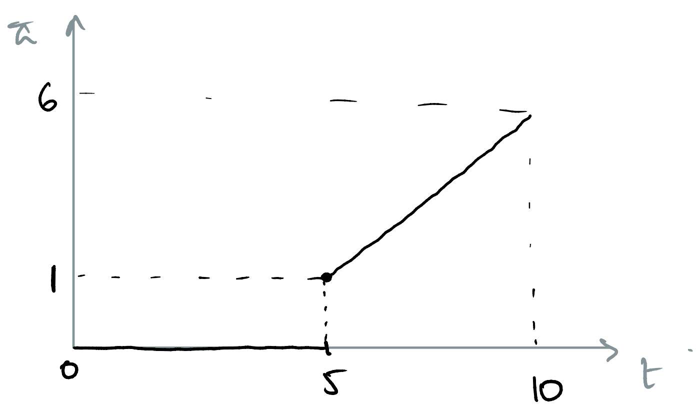
$a = t - 4$ ✓ after 5s.

$\Delta \bar{V} = \int \bar{a}\, dt \rightarrow \bar{V} - 0 = \int_5^{10} (t-4)\, dt = \left[\frac{t^2}{2} - 4t\right]_5^{10}$

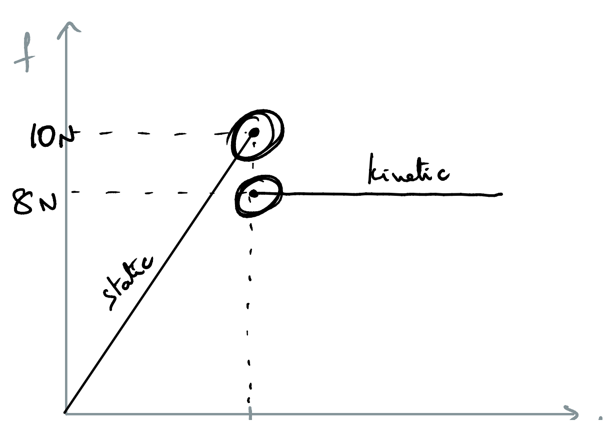
$= 10 - (12.5 - 20) = 17.5\ m/s$

Draw $\bar{a}$-t graph upto 10 s.

$t - 4$ after $t = 5s$.



Draw f-t graph upto 10 s.

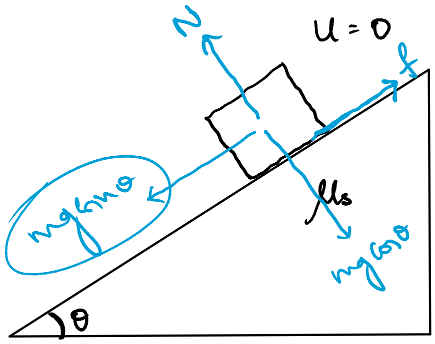


$f_k = 8N.$

$\mu_s = ?$

$\mu_s = ?$

$\mu_k = ?$



$mg\sin\theta > \mu_s N$ · $mg\cos\theta$

$\tan\theta > \mu_s$

$\theta = \tan^{-1}(\mu_s)$

angle of repose.

Contact force ?

↳ Resultant of (N) & (f)

↓

90°.

$F_c = \sqrt{N^2 + f^2}$.

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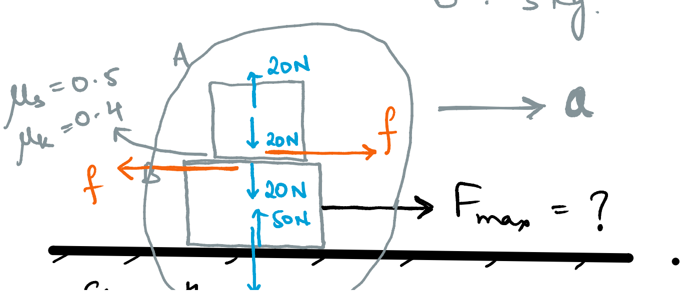
u = 0.

A : 2 kg

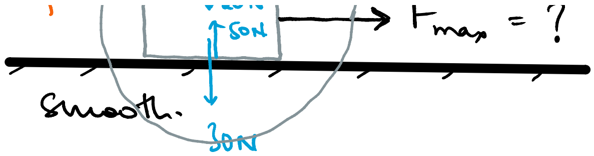
B : 3 kg.



(i) if F = 5N

Calculate accns. of the blocks and friction acting between them.

(a) f tries to stop both blocks



ⓐ f tries to stop both blocks

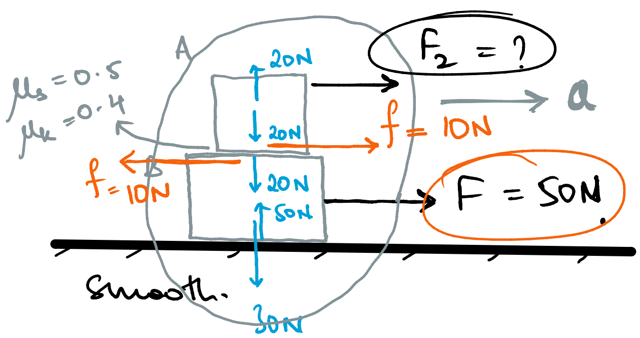
ⓑ f tries to make them slide together. ✓

→ Assume the blocks move together

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

$f_{req} = (2)(1) = 2N$ ✓

f_{lim}: $(0.5)(20) = 10N$

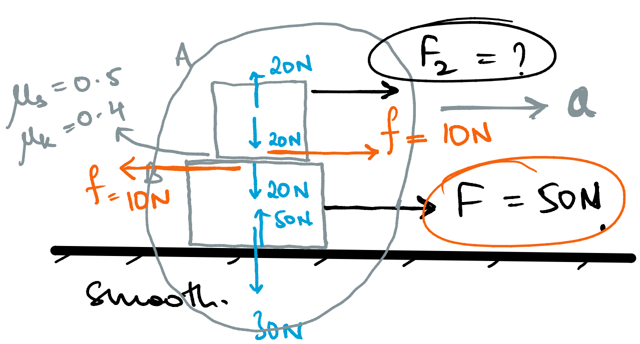


F_{max} = ? ⇒ the blocks slide together ?

If $f = 10N$, $a_A = \frac{10}{2} = 5 m/s^2$

a_{max} of system $= 5 m/s^2$ ⇒ they slide together.

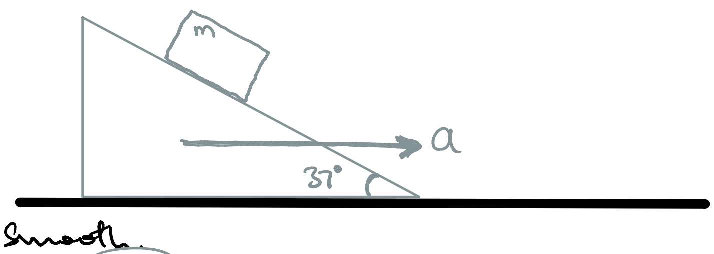
$F_{max} = 25 N$

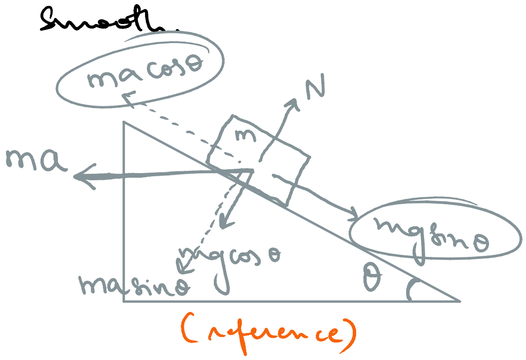


Calculate min & max. values of F_2 such that the blocks slide together

ⓘ a = ? ⇒ the block

does not slide on it.





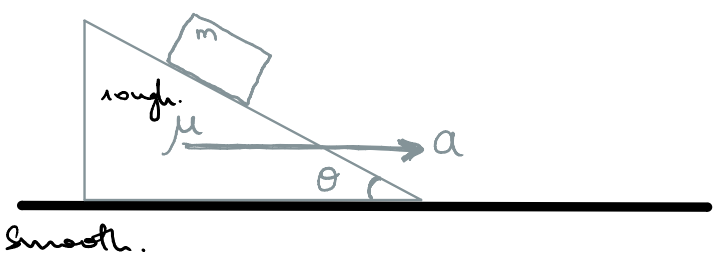
⇒ Block must be in eqb wrt wedge.

$$F_{pseudo} = (m_{object})(a_{frame})$$

opp. to a_{frame}.

$ma\cos\theta = mg\sin\theta$

$a = g\tan\theta$.



Derive the range of acceleration a such that the block does not slide on the wedge.