

Newton's 3rd Law

When one object exerts a force on a second object,

the second object simultaneously exerts an identical* force on the first object in the opposite direction.

* same magnitude & same kind of force

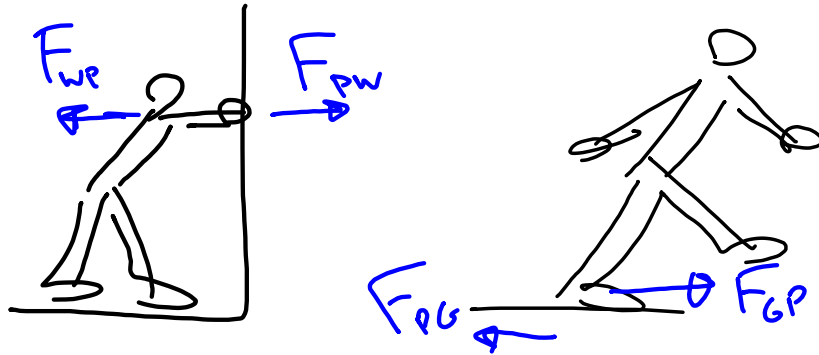
Action and reaction forces are always equal,
even if the resulting motion is not

NAMING FORCES

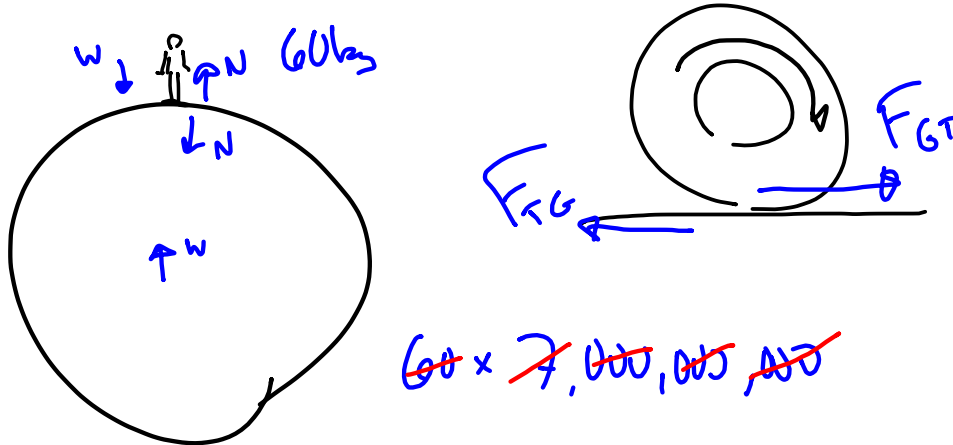
Who pushes whom, which way?

(avoid force naming the type of force until the end)

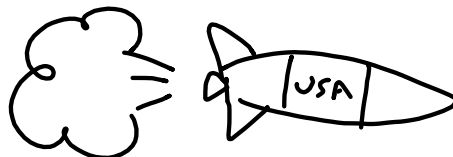
The person pushes the wall to the R The person pushes the ground to L
 The wall pushes the person to the L The ground pushes the person to R



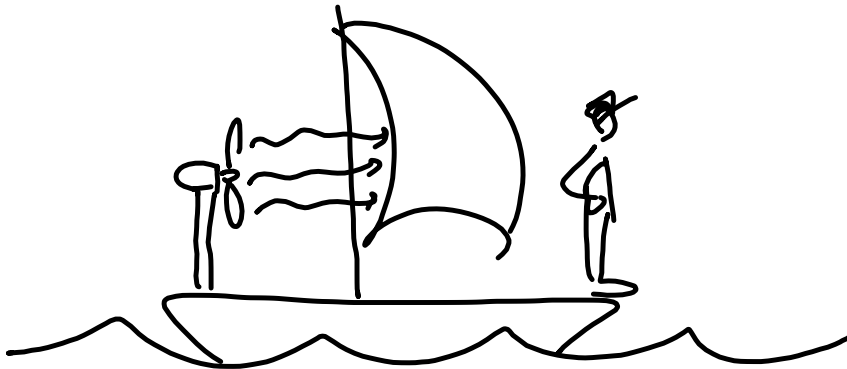
The person pushes the ground D The tire pushes the ground to L
 The ground pushes the person U The ground pushes the tire to R

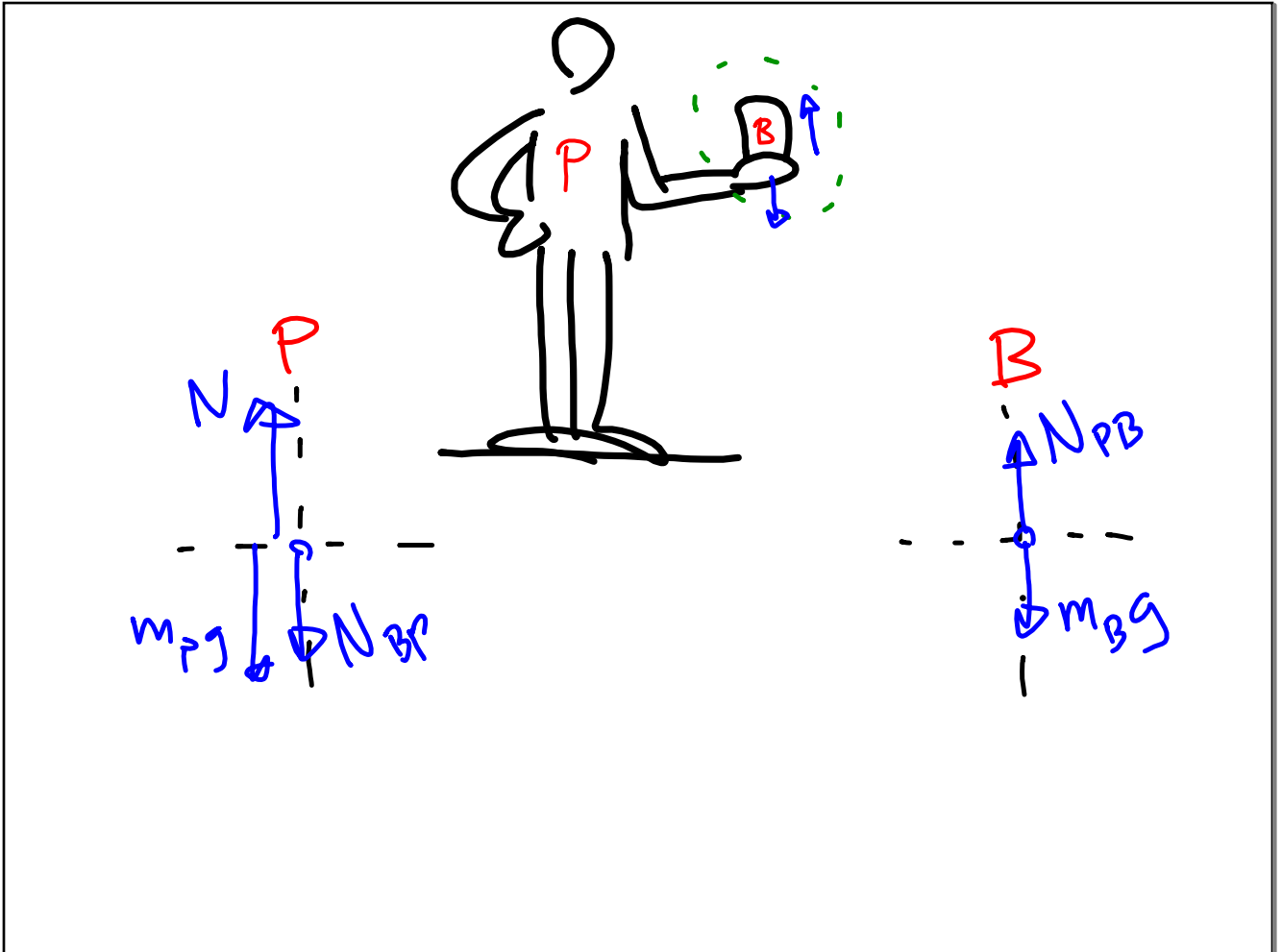


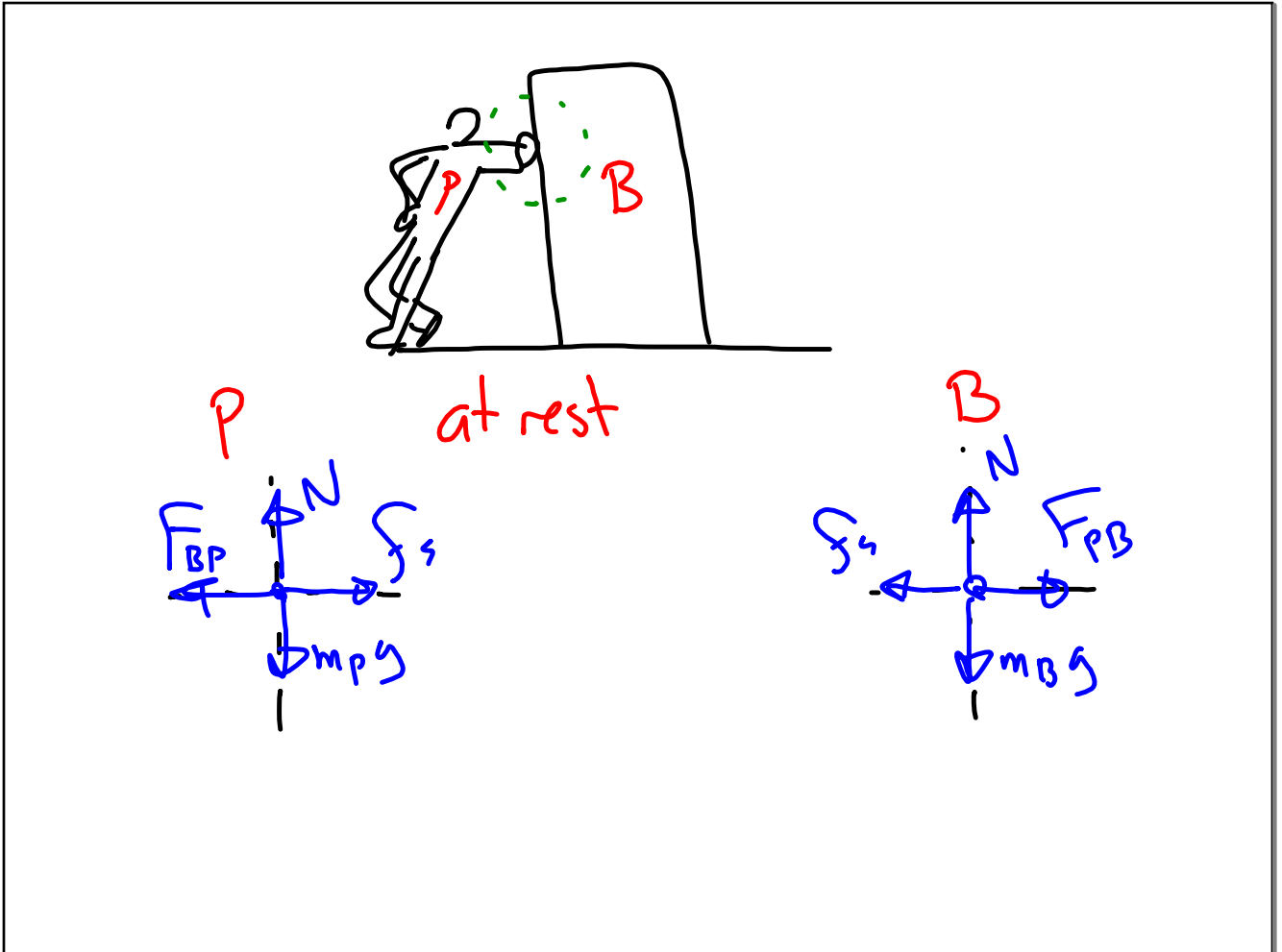
~~60 x 7,000,000,000~~
~~6,000,000,000,000,000,000,000,000,000,000,000,000 kg~~



Would this work?

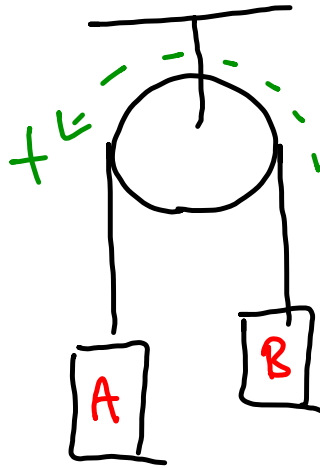
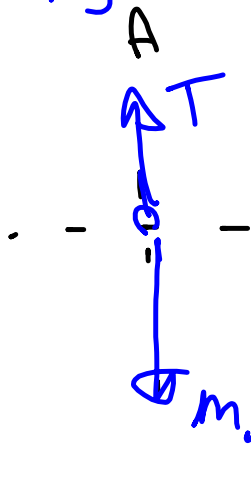






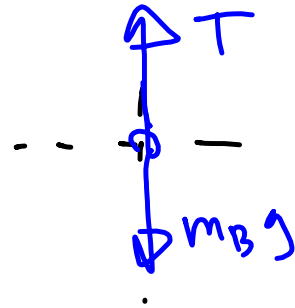
$$\sum F = ma$$

$$m_A g - T = m_A a$$



$$\sum F = ma$$

$$T - m_B g = m_B a$$



The diagram illustrates a physics problem involving two objects, B and P, connected by a rope. A tension force $T = 40\text{ N}$ is applied to the rope. The forces acting on each object are shown in free-body diagrams.

Free-body diagram for object B:

- Normal force N_B acting upwards.
- Weight $m_B g$ acting downwards.
- Friction force f_B acting to the left.
- Tension force $T = 40$ acting to the right.

Free-body diagram for object P:

- Normal force N_P acting upwards.
- Weight $m_P g$ acting downwards.
- Friction force f_P acting to the right.
- Tension force $T = 40$ acting to the left.

Newton's second law equations:

For object B:

$$\sum_i F = ma$$

$$T - f_B = m_B a$$

For object P:

$$\sum_i F = ma$$

$$f_P - T = m_P a$$

$\sum F = ma$
 $m_A g - T = m_A a$
 $(10)(10) - T = 10a$
 $100 - 5a = 10a$
 $100 = 15a$
 $\frac{100}{15} = a$
 $6.7 \frac{m}{s^2} = a$

$\sum F = ma$
 $T = m_B a$
 $T = 5a$
 $T = 33.5 N$

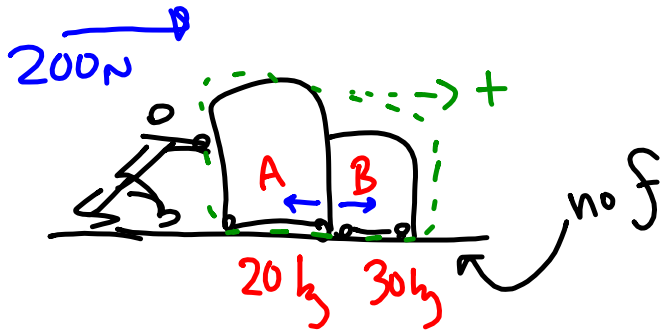
$a = 6.7 \frac{m}{s^2}$

$T_1 = 300\text{ N}$
 $a = ?$
 20 kg (Block A)
 40 kg (Block B)
 $T_2 = ?$

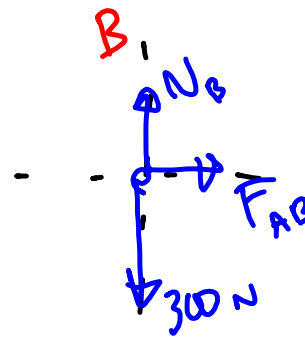
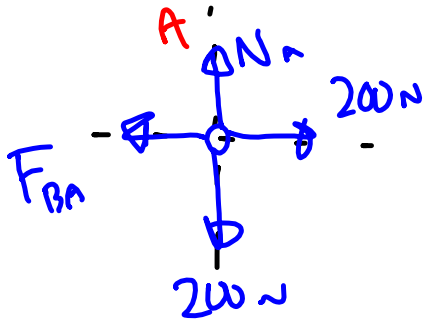
Free-body diagram for Block A:
 Upward force: $T_1 = 300\text{ N}$
 Downward force: T_2 and 200 N

Free-body diagram for Block B:
 Upward force: T_2
 Downward force: 400 N

Equations:
 $300 - T_2 - 200 = 20a$
 $100 - T_2 = 20a$
 $T_2 - 400 = 40a$



$$a = \frac{\sum F_{\text{EXT}}}{M_{\text{TOTAL}}} = \frac{200\text{N}}{50\text{kg}}$$



$$200 - F_{AB} = 20a$$

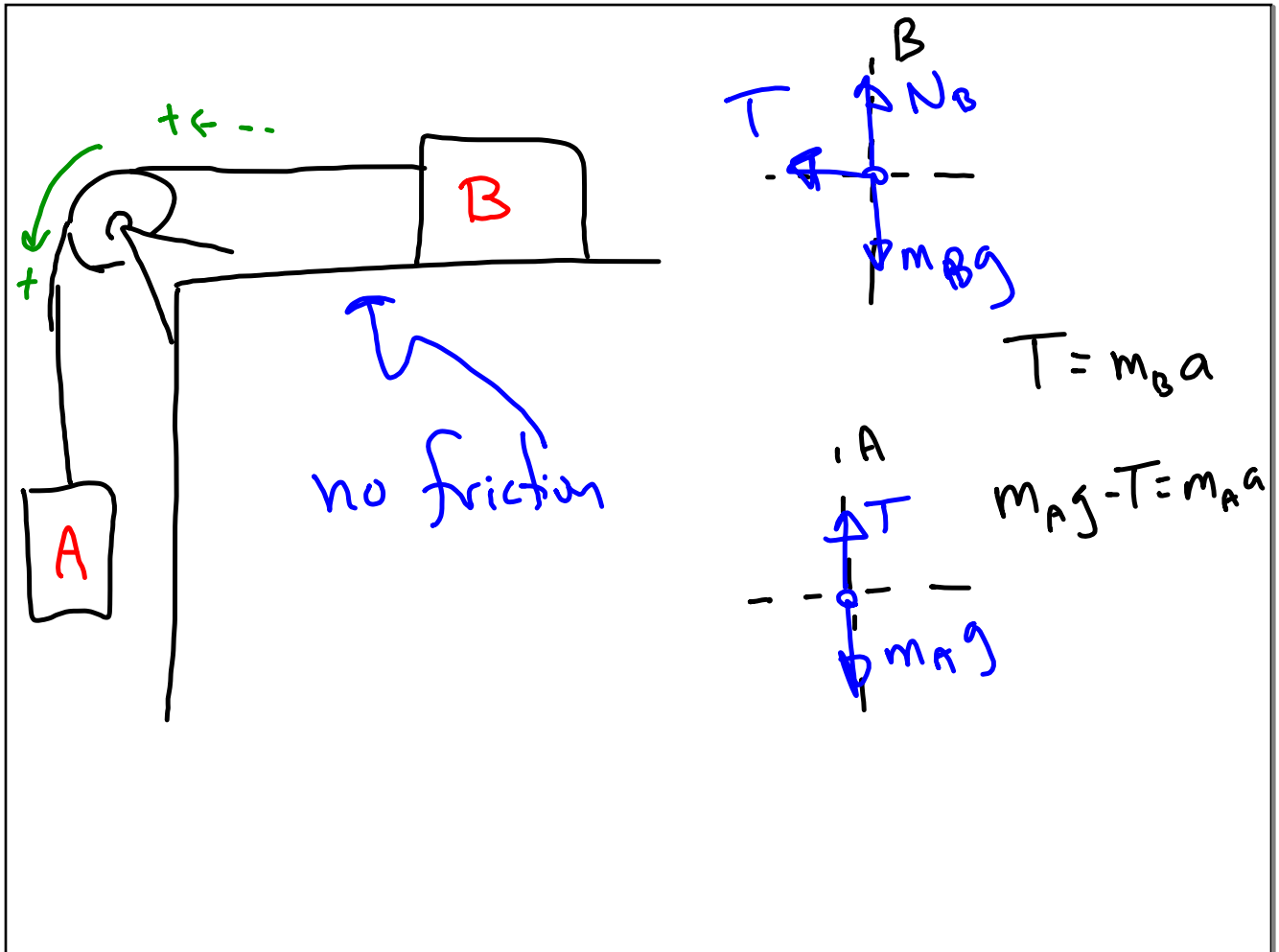
$$F_{AB} = 30a$$

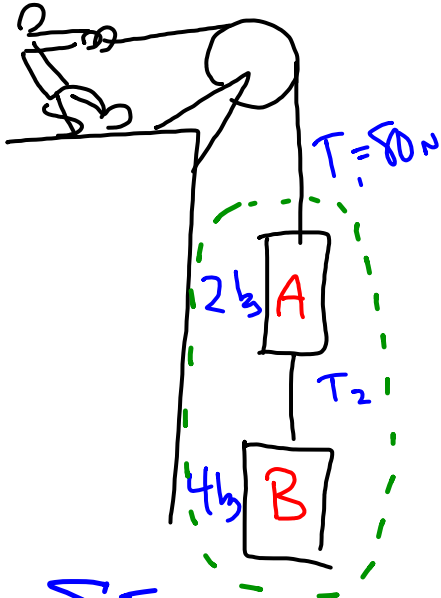
$$200 - 30a = 20a + 30a + 30a$$

$$F_{AB} = 30(4) = 120\text{N}$$

$$200 = 50a$$

$$4 \frac{\text{m}}{\text{s}^2} = a$$





$$a = \frac{\sum F_{\text{ext}}}{M_{\text{TOTAL}}} \quad \text{of } 60\text{ N}$$

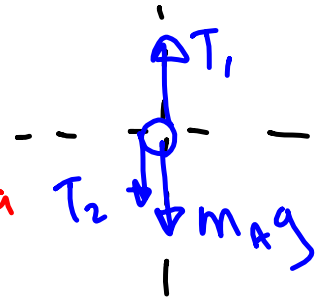
$$\frac{20}{6} = 3.3\text{ m/s}^2$$

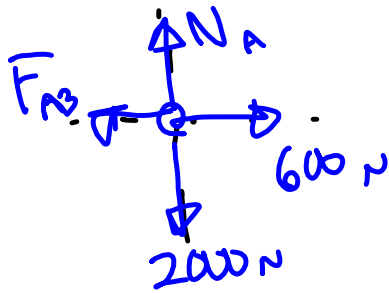
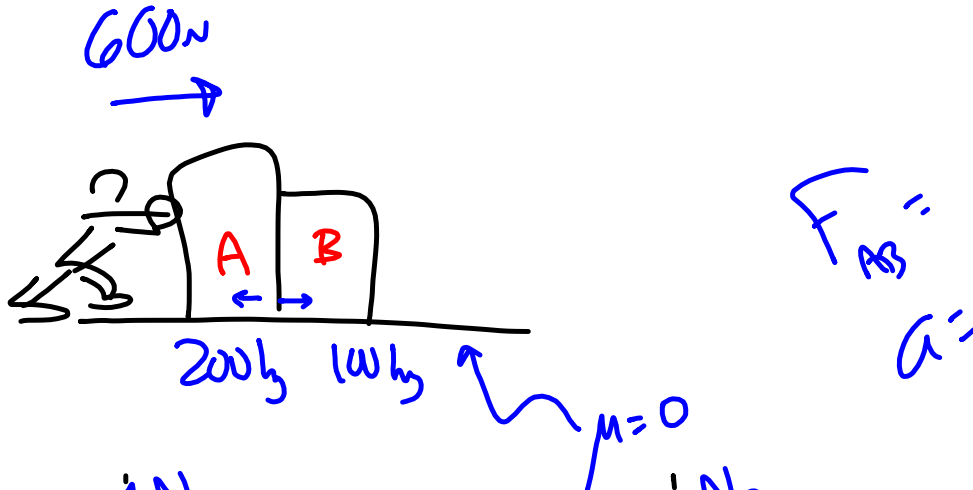
$$T_1 - T_2 - m_A g = m_A a$$

$$80 - T_2 - 20 = 2a$$

$$T_2 - m_B g = m_B a$$

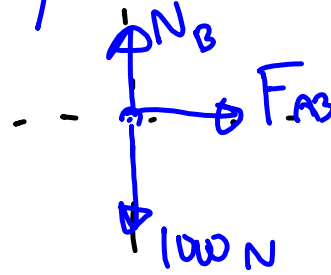
$$T_2 - 40 = 4a$$





$$\sum F = ma$$

$$600 - F_{AB} = 200a$$

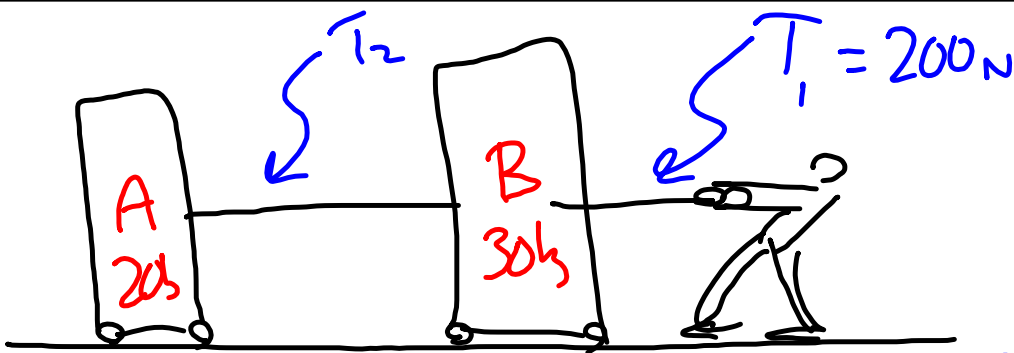


$$\sum F = ma$$

$$F_{AB} = 100a$$

$$F_{AB} = 200N$$

$F_{AB} =$
 $a =$



(no friction)

$a = ?$
 $T_2 = ?$

$$\sum_i F = ma$$

$$T_2 = 20a$$

$$\sum_i F = ma$$

$$200 - T_2 = 30a$$

$$T_2 = 20(4)$$

$$T_2 = 80\text{N}$$

$$200 - 20a = 30a$$

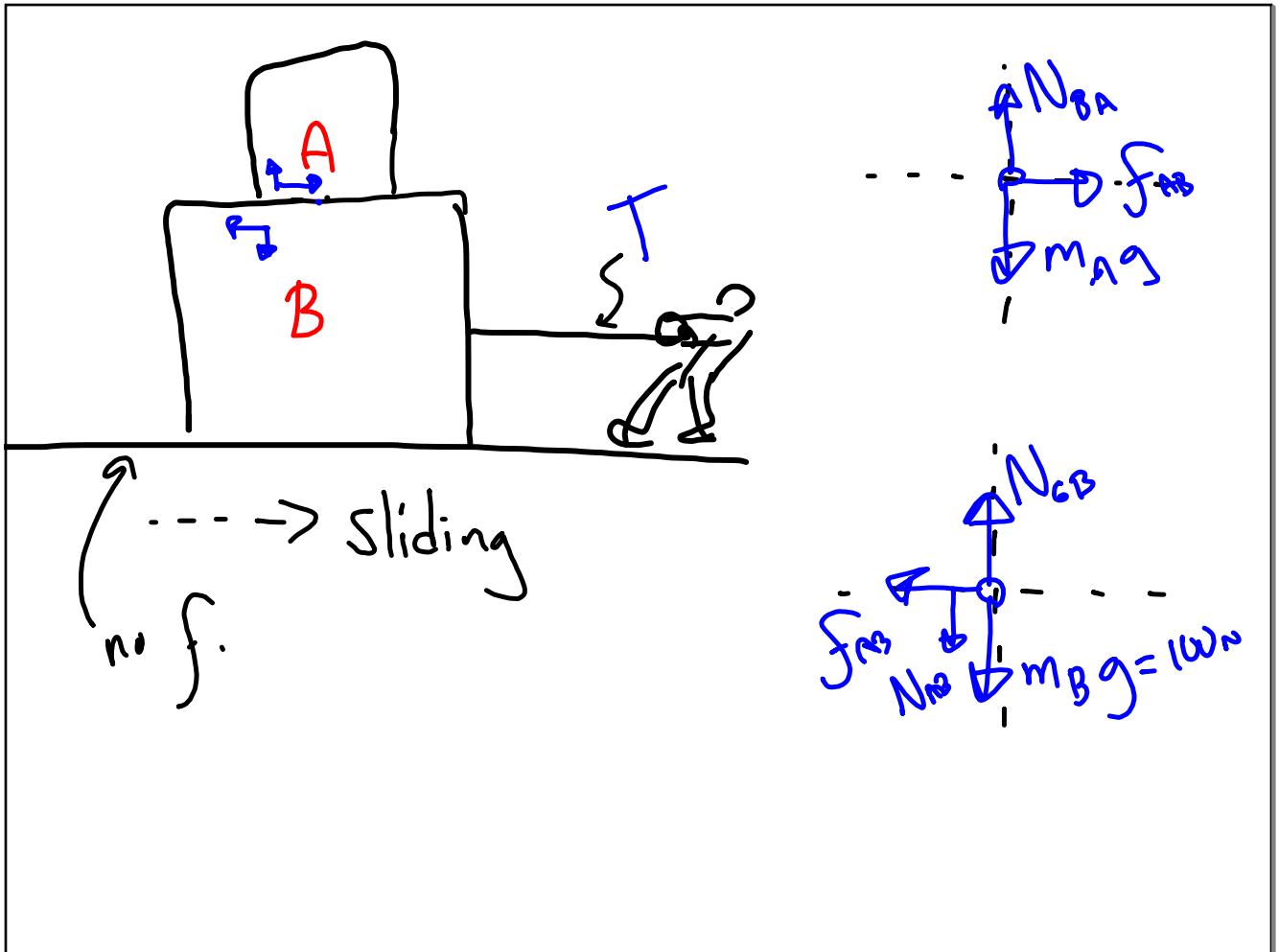
$$200 = 50a$$

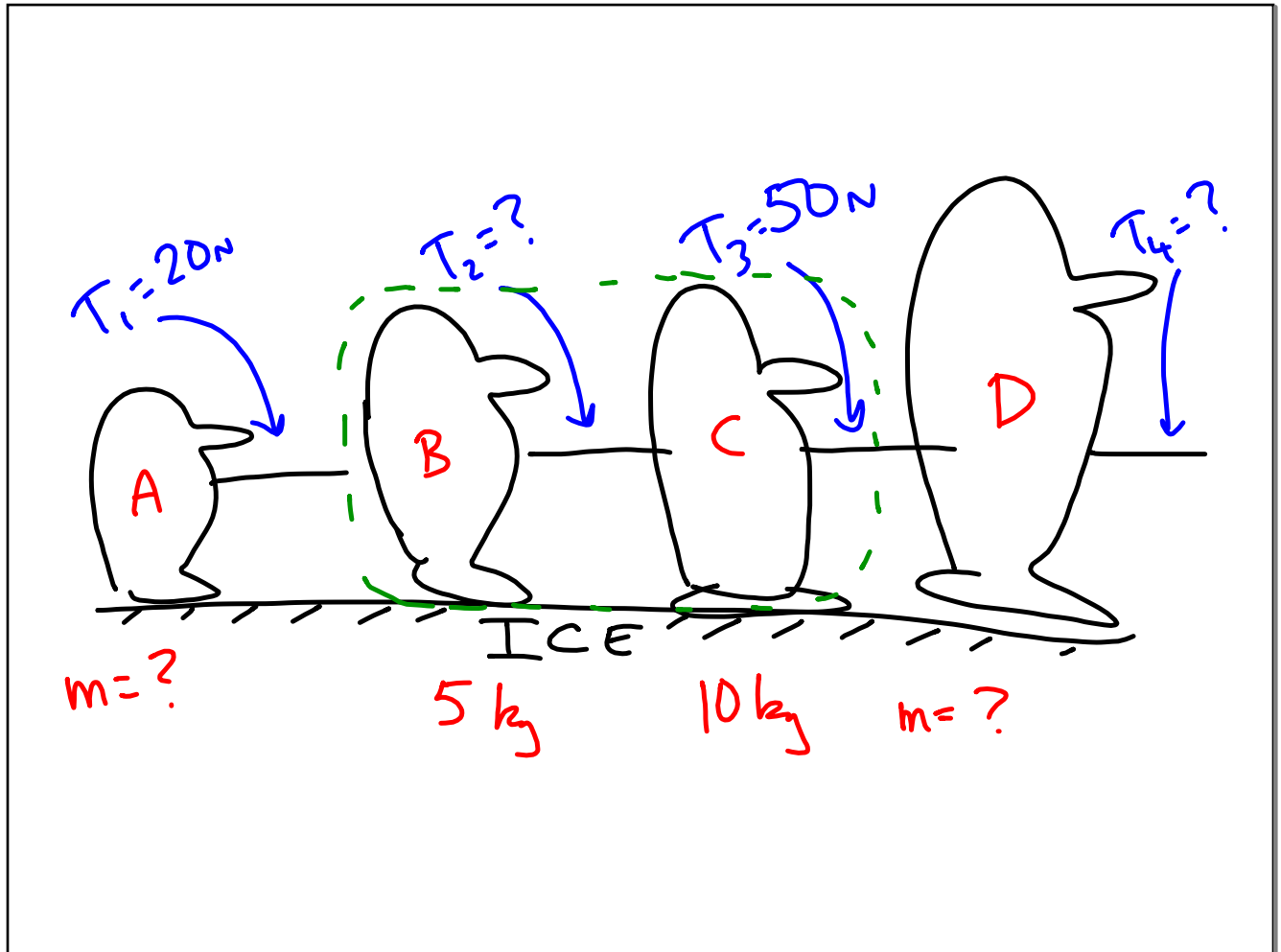
$$4 \frac{\text{m}}{\text{s}^2} = a$$

$$a = \frac{\sum F_{\text{ext}}}{M_{\text{tot}}}$$

$$= \frac{200}{50}$$

$$= 4 \frac{\text{m}}{\text{s}^2}$$





moving together
----->

$\mu_s = 0.2$

A 6 kg

B 10 kg

$T = 48\text{ N}$

$f = 0$

$\sum_i F = ma$

$48 - f_{AB} = 10a$

$\sum_i F = ma$

$f_{AB} = 6a$

$f_{AB} = 6(3) = 18\text{ N}$

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

$f_{AB} = ?$

$f_{s\text{max}} = \mu_s N$

$= (0.2)(60)$

$= 12\text{ N}$

