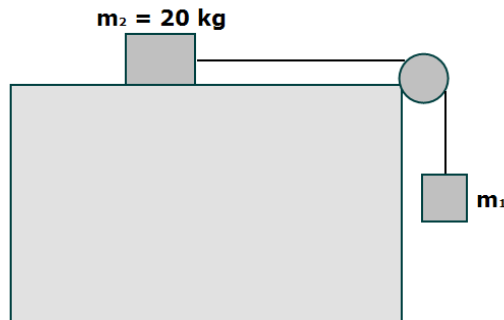


Dynamics: Solutions to the exercises

- 1** This system of two bodies is moving at constant velocity.
- a) If the value of the friction coefficient is $\mu=0.25$, determine the mass m_1 and the value of the tensions
- b) If the mass is $m_1 = 12$ kg, determine the friction coefficient and the value of the tensions

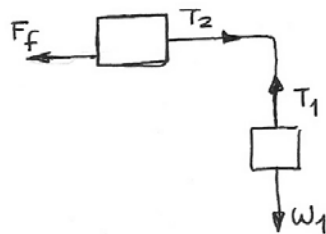


① a) "constant velocity" means $\rightarrow a=0$

Therefore, if we apply the Newton's equation we get that the net force (F_{net}) is 0:

$$a=0 \rightarrow F_{net} = m \times a = 0$$

The net force is a combination of forces:



$$F_{net}=0 = W_1 - T_1 + T_2 - F_f$$

$$F_f = \mu \times N = 0.25 \times 200\text{N} = 50\text{N}$$

$$N = W_2 = 200\text{N}$$

$$W_1 = F_f = 50\text{N} \rightarrow \boxed{m_1 = 5\text{ Kg}}$$

$$\boxed{T_1 = T_2 = W_1}$$

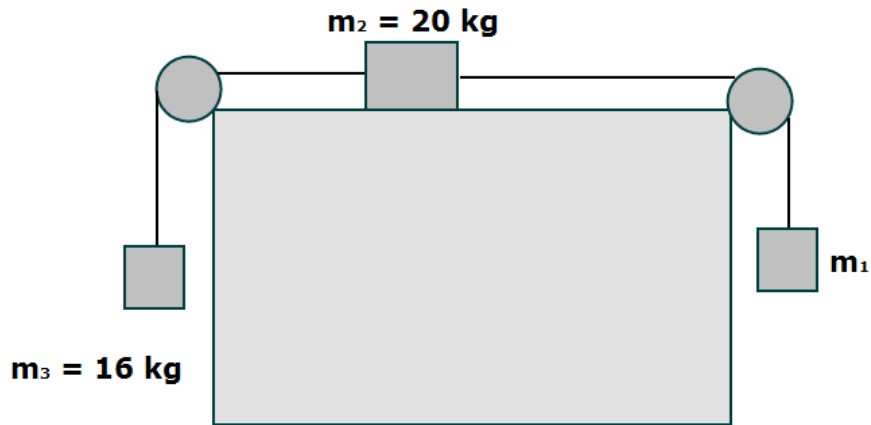
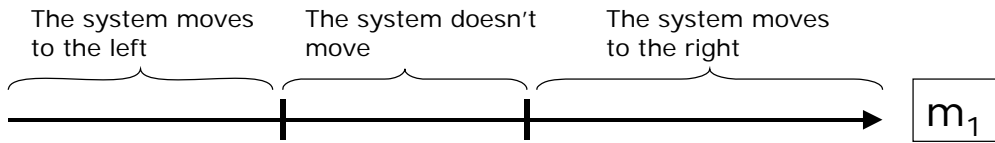
② $a=0 \rightarrow F_{net} = 0 = W_1 - T_1 + T_2 - F_f = 120\text{N} - F_f$

$$F_f = 120\text{N} = \mu \times 200\text{N}$$

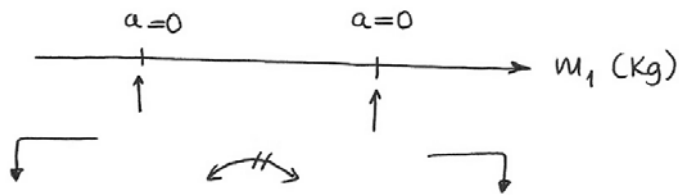
$$\rightarrow \mu = \frac{120\text{N}}{200\text{N}} = \boxed{0.6}$$

$$\boxed{T_1 = T_2 = W_1}$$

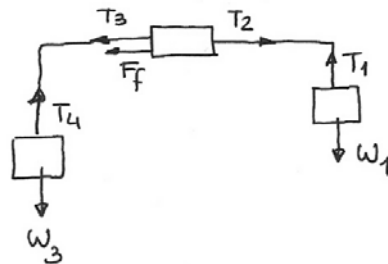
2 Study the motion of the system as a function of the value of m_1 :



$\mu=0.2$



a) $a=0$ $F_{net} = 0$



$$F_{net} = 0 = W_1 - T_1 + T_2 - T_3 - F_f + T_4 - W_3$$

$$F_{net} = 0 = W_1 - 40N - 160N$$

$$F_f = \mu \times N = 0.2 \times 200N = 40N$$

$$W_1 = 200N \rightarrow \boxed{m_1 = 20 \text{ Kg}}$$

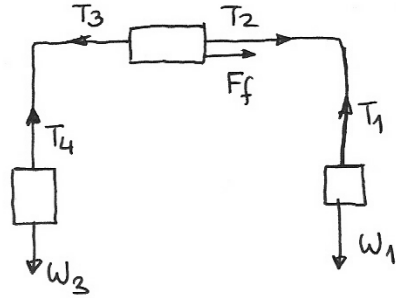
b)

$$a=0$$

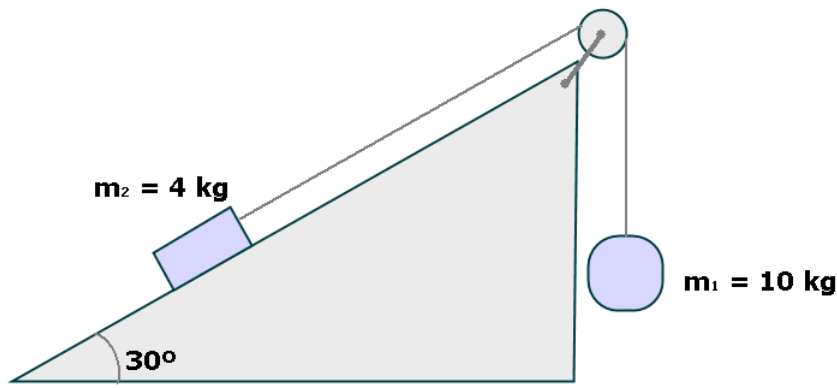
$$F_{net}=0 = W_3 - T_4 + T_3 - F_f - T_2 + T_1 - W_1$$

$$F_{net}=0 = 160\text{ N} - 40\text{ N} - W_1$$

$$W_1 = 120\text{ N} \rightarrow \boxed{m_1 = 12\text{ Kg}}$$



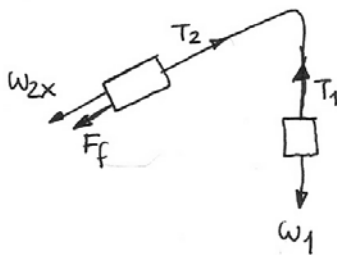
3 The acceleration of the system is $a=1.2\text{ m/s}^2$. Determine the value of the friction coefficient.



③ The net force will be:

$$F_{net} = m \times a = 14\text{ Kg} \times 1.2 \frac{\text{m}}{\text{s}^2} = 16.8\text{ N}$$

The net force is a combination of the following forces:



$$F_{net} = W_1 - T_1 + T_2 - W_{2x} - F_f = 16.8\text{ N}$$

$$W_1 = 100\text{ N}$$

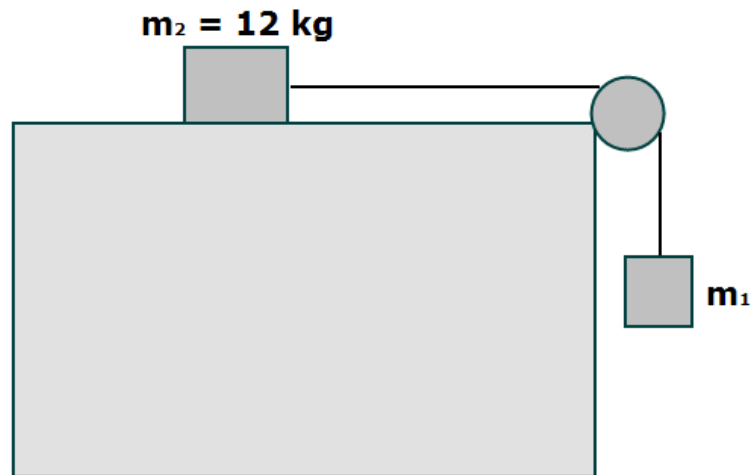
$$W_{2x} = 40\text{ N} \times \sin 30^\circ = 20\text{ N}$$

$$F_f = \mu \times N = \mu \times W_{2y} = \mu \times 40\text{ N} \times \cos 30^\circ = \mu \times 34.6\text{ N}$$

$$F_f = 100\text{ N} - 20\text{ N} - 16.8\text{ N} = 63.2\text{ N}$$

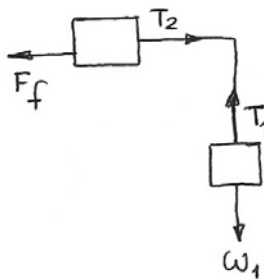
$$\mu = \frac{63.2\text{ N}}{34.6\text{ N}} = \boxed{1.82}$$

4 The acceleration of the system is $a=2 \text{ m/s}^2$. Determine the value of m_1 .



$\mu = 0.25$

④ The net force is: $F_{\text{net}} = (12 \text{ kg} + m_1) \times 2 \frac{\text{m}}{\text{s}^2} = 24 \text{ N} + m_1 \times 2 \frac{\text{m}}{\text{s}^2}$



$$F_{\text{net}} = W_1 - T_1 + T_2 - F_f = m_1 \times 10 \frac{\text{m}}{\text{s}^2} - 30 \text{ N}$$

$$F_f = 0.25 \times 120 \text{ N} = 30 \text{ N}$$

$$m_1 \times 10 \frac{\text{m}}{\text{s}^2} - 30 \text{ N} = 24 \text{ N} + m_1 \times 2 \frac{\text{m}}{\text{s}^2}$$

$$m_1 = \frac{54 \text{ N}}{8 \text{ m/s}^2} = \boxed{6.75 \text{ kg}}$$