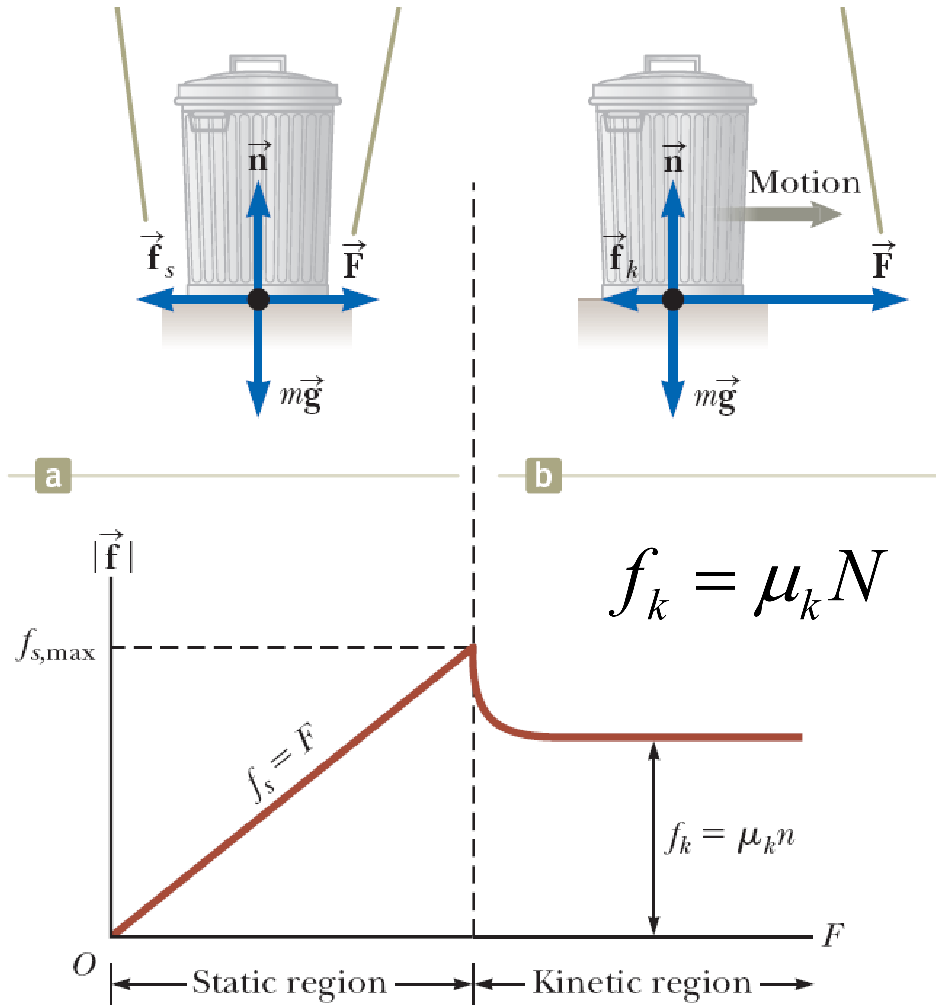
Static and Kinetic Friction (Chap5.8)

$$f_s \leq \mu_s N$$

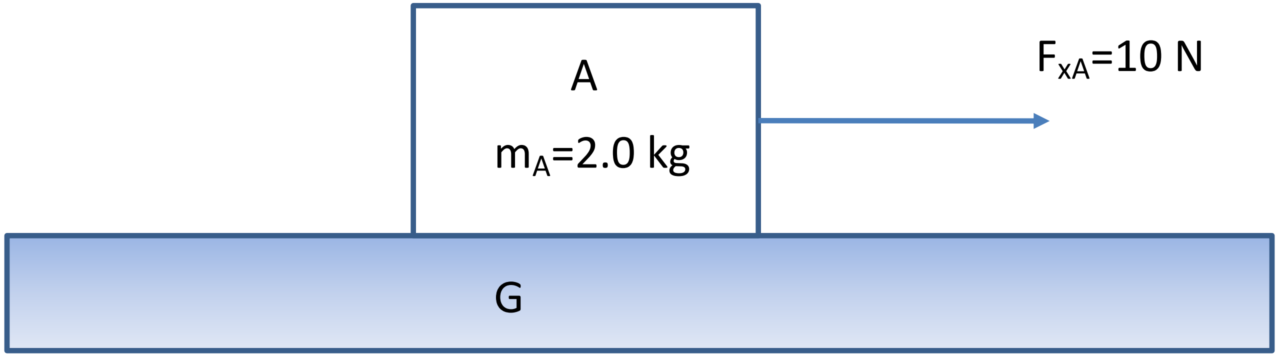
$$f_{s\_Max} = \mu_s N$$



$$f_k = \mu_k N$$

Static and Kinetic Friction (Chap5.8)

Box A is stationary. An external horizontal force of 10 N is applied on the box. Use $g=10 m/s^2$. What is the static frictional force? (direction and magnitude)

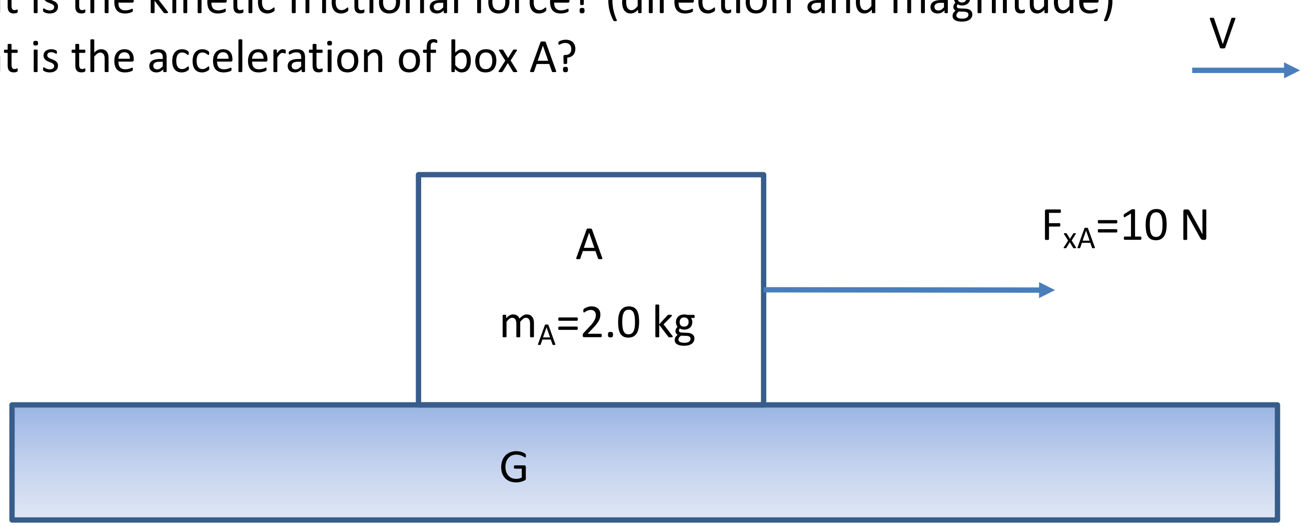


$$f_s \le \mu_s N$$

$$f_s\_Max = \mu_s N$$

Static and Kinetic Friction

Box A is moving to the right. An external horizontal force of 10 N is applied on the box. Use $g=10 m/s^2$. The kinetic frictional coefficient is $\mu_k=0.3$.
What is the kinetic frictional force? (direction and magnitude)
What is the acceleration of box A?



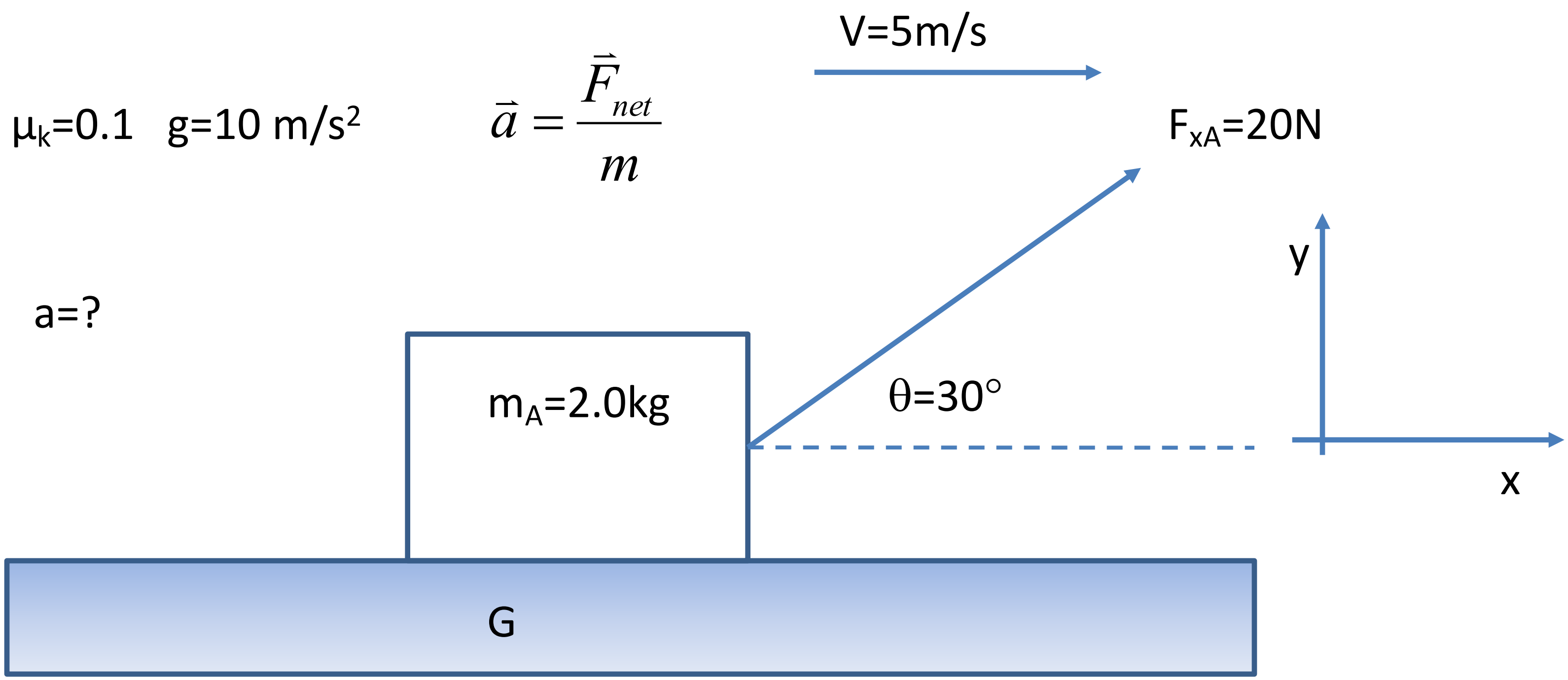
$$f_k = \mu_k N$$

Find acceleration from net force

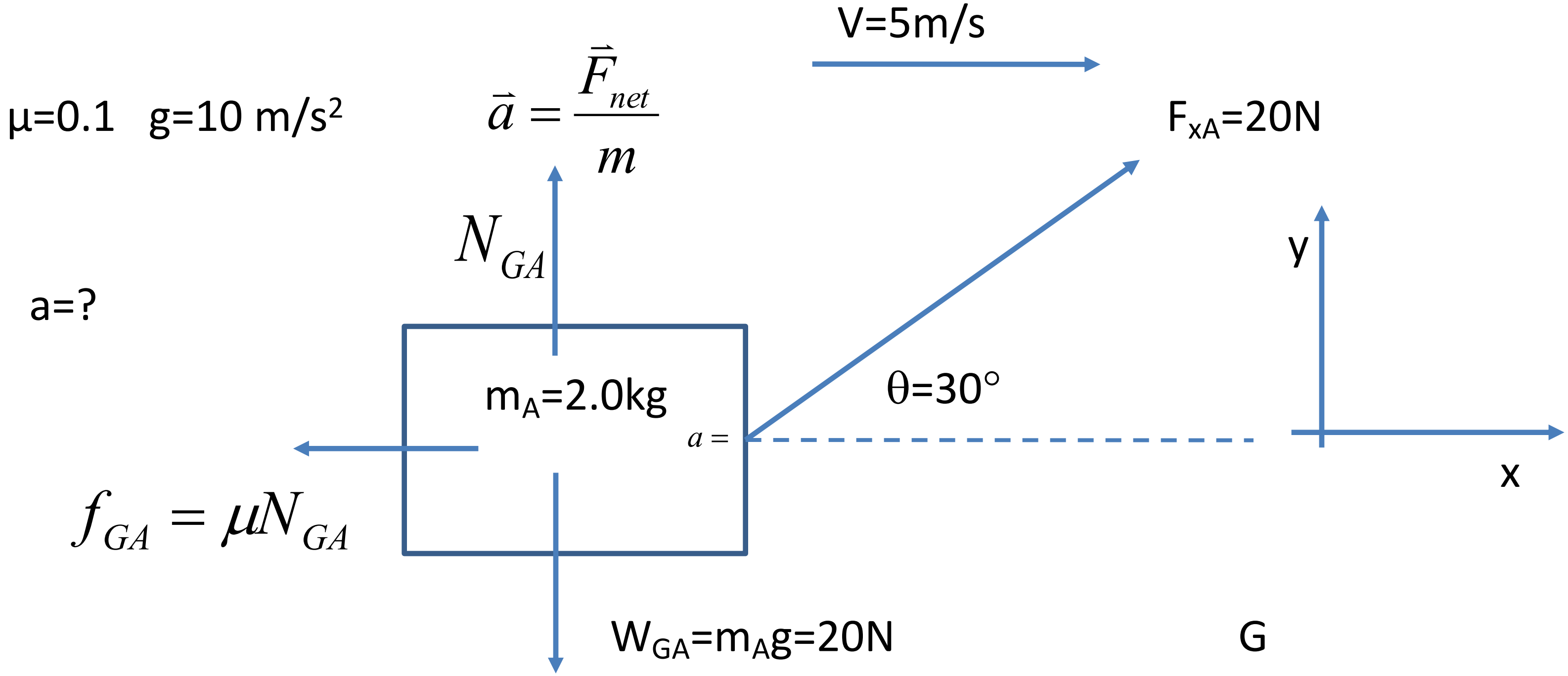
μ_k=0.1   g=10 m/s^2

$$\vec{a} = \frac{\vec{F}_{net}}{m}$$

a=?



Find acceleration from net force



$$\sum F_y = 0 = F_{xA}\sin(30°) + N_{GA} - W_{GA}$$

$$\sum F_x = F_{net} = F_{xA}\cos(30°) - f_{GA} = F_{xA}\cos(30°) - \mu \cdot N_{GA}$$

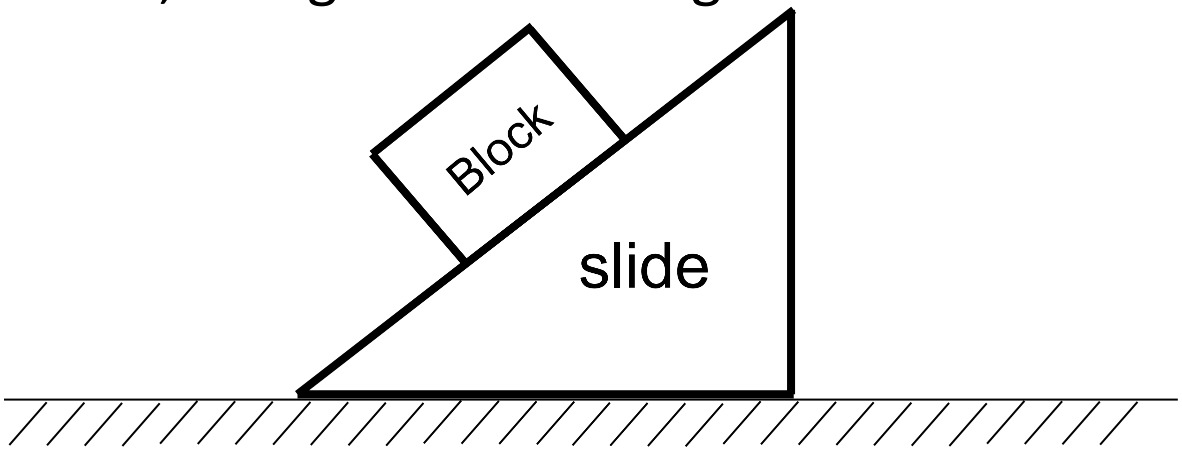
$$N_{GA} = W_{GA} - F_{xA}\sin(30°) = 2\times 10 - 20\times\sin(30°) = 10N$$

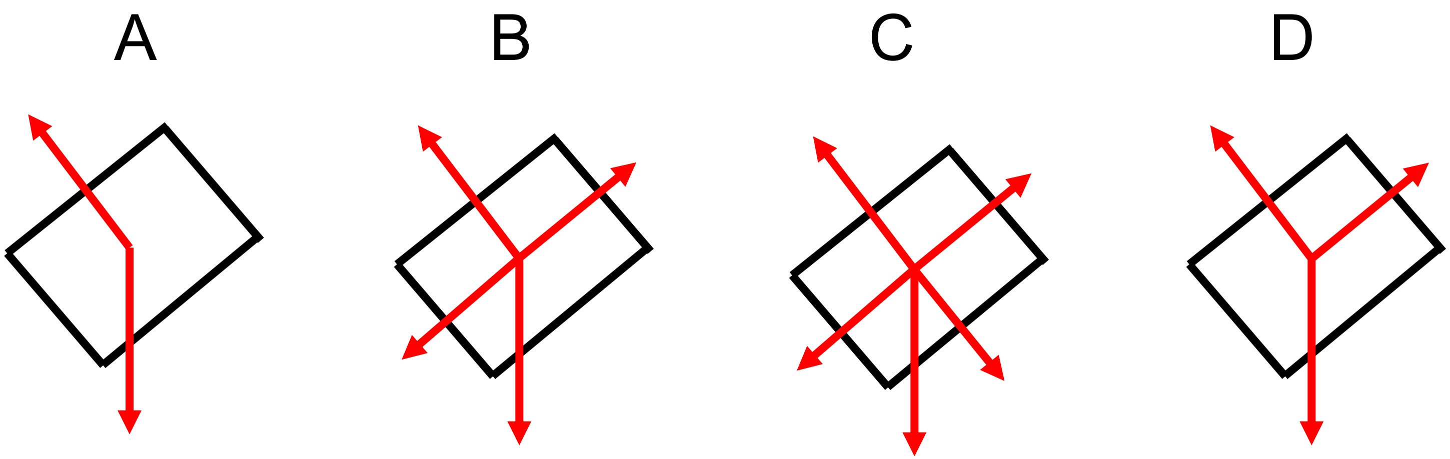
$$F_{net} = F_{xA}\cos(30°) - \mu \cdot N_{GA} = 20\times\cos(30°) - 0.1\times 10$$

$$= 20\times 0.866 - 1 = 16.32N$$

$$\vec{a} = \frac{\vec{F}_{net}}{m} = \frac{16.32}{2.0}\hat{i} \quad m/s^2$$

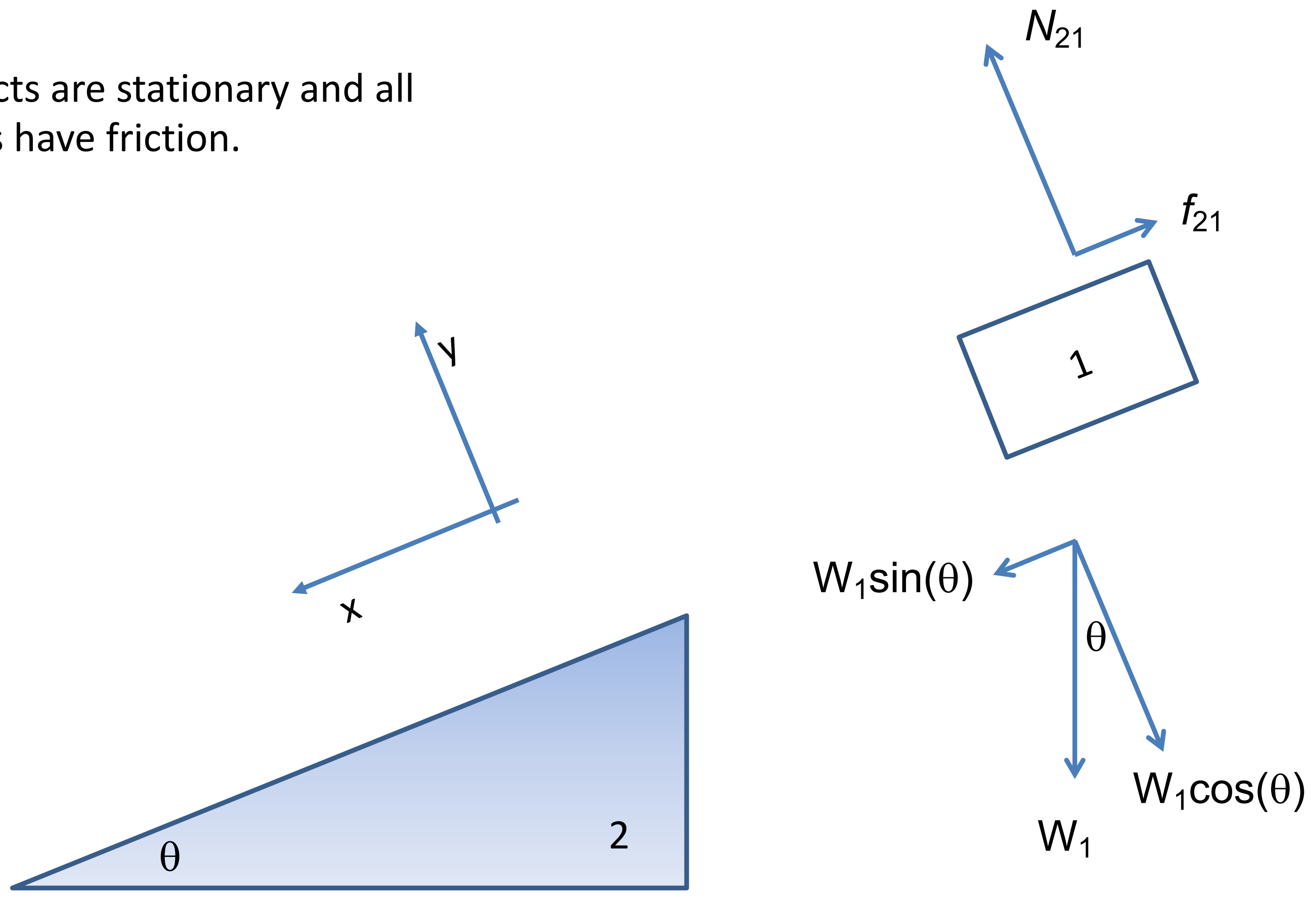
A block sits at rest and stays at rest on a motionless slide with frictional surfaces. Which of the following sketches most closely resembles the correct freebody diagram for all forces ***<u>acting on the block</u>***? Each red arrow represents a force. Observe their number and direction, but ignore their lengths.





Free Body Diagram

All objects are stationary and all surfaces have friction.

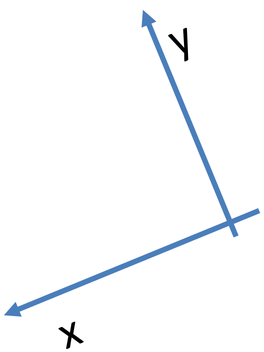


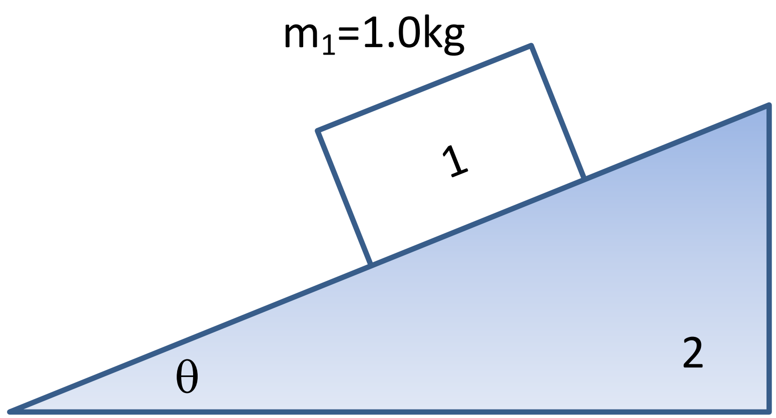
Inclined Plane

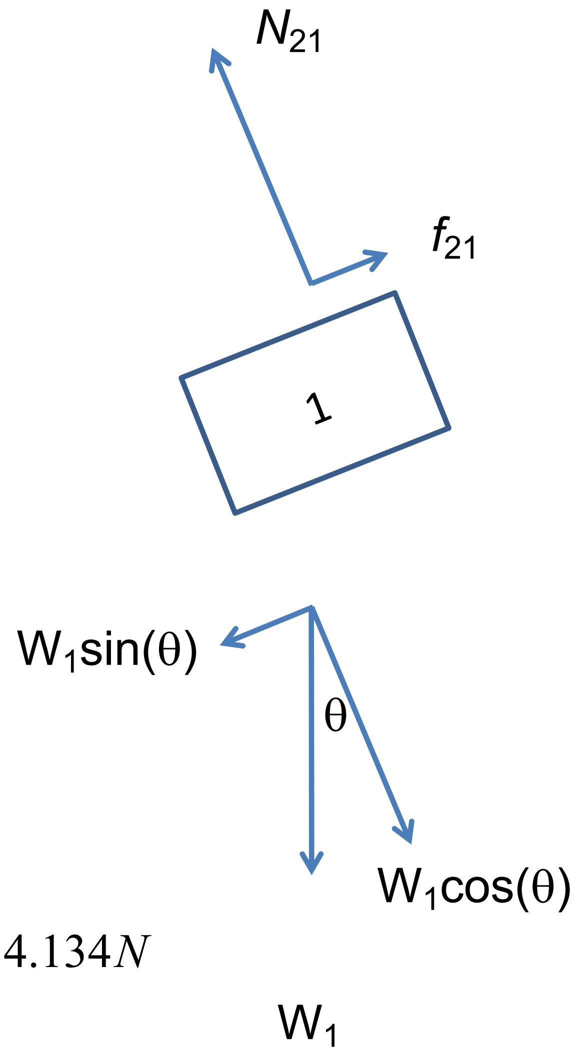
$$\vec{a} = \frac{\vec{F}_{net}}{m} \qquad f_k = \mu_k \cdot N$$

What is the acceleration of Box 1 along the inclined plane?

μ_k=0.1   g=10 m/s^2







$$\sum F_y = 0 = N_{21} - W_1 \cos(30°)$$

$$\sum F_x = F_{net} = W_1 \sin(30°) - f_{21} = W_1 \sin(30°) - \mu \cdot N_{21}$$

$$N_{21} = m_1 g \cos(30°) = 1.0 \times 10 \times 0.866 = 8.66N$$

$$F_{net} = m_1 g \sin(30°) - \mu_k \cdot N_{21} = 1.0 \times 10 \times 0.5 - 0.1 \times 8.66 = 4.134N$$

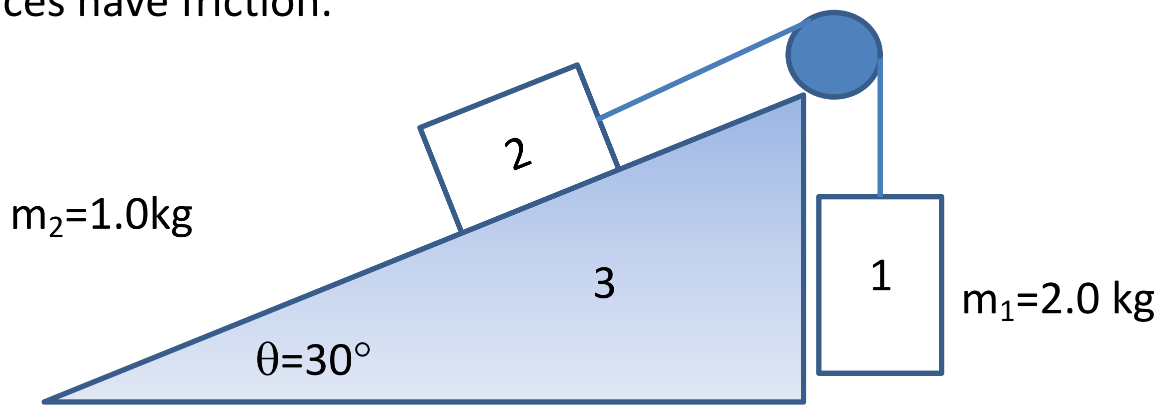
$$a = \frac{F_{net}}{m_1} = \frac{4.134}{1.0} = 4.134 m/s^2$$

Free Body Diagram

μ=0.1   g=10 m/s²

$$\vec{a} = \frac{\vec{F}_{net}}{m} \qquad f = \mu \cdot N$$

All objects are initially stationary
and all surfaces have friction.



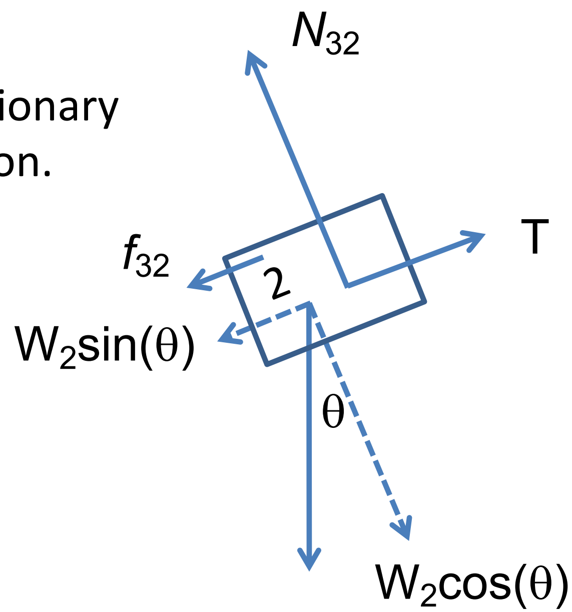
Free Body Diagram

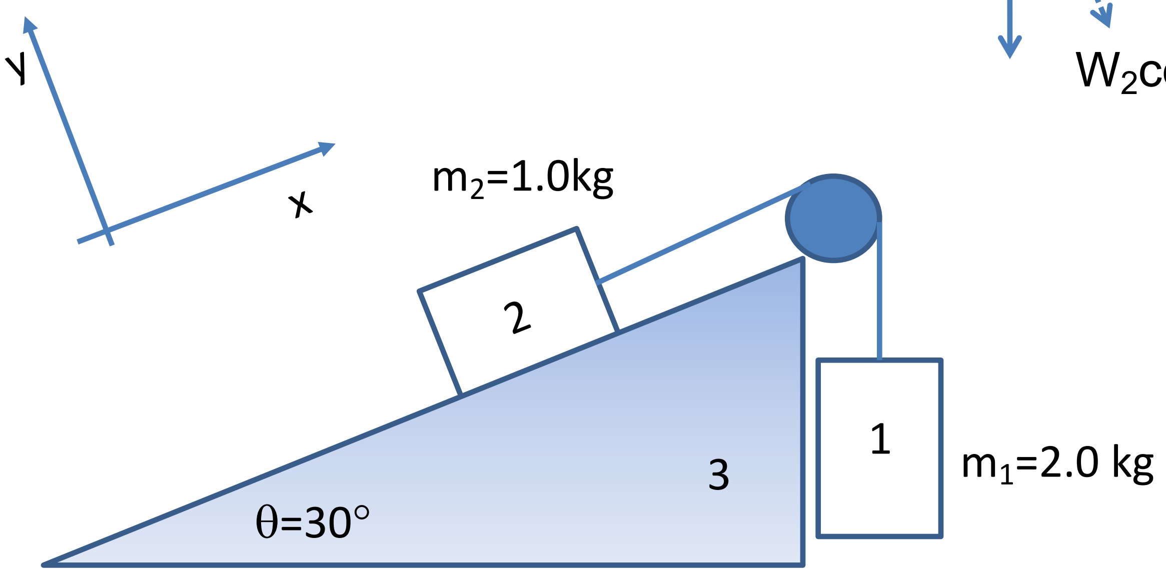
$$\vec{a} = \frac{\vec{F}_{net}}{m}$$

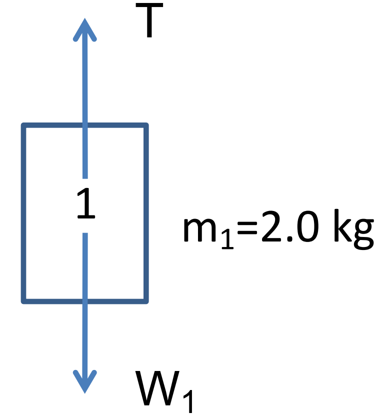
$$f = \mu \cdot N$$

$\mu=0.1$ $g=10\ m/s^2$

All objects are initially stationary and all surfaces have friction.







Object 2

$$\sum F_y = 0 = N_{32} - W_2\cos(30°) = 0$$

$$\sum F_x = F_{net} = T - W_2\sin(30°) - f_{32}$$

$$N_{32} = W_2\cos(30°) = m_2 g\cos(30°)$$

$$f_{32} = \mu \cdot N_{32}$$

$$F_{net2} = T - m_2 g\sin(30°) - \mu m_2 g\cos(30°) = m_2 a$$

Object 1

$$F_{net1} = m_1 g - T = m_1 a \;\Rightarrow\; T = m_1 g - m_1 a$$

$$\therefore \quad m_1 g - m_1 a - m_2 g\sin(30°) - \mu m_2 g\cos(30°) = m_2 a$$

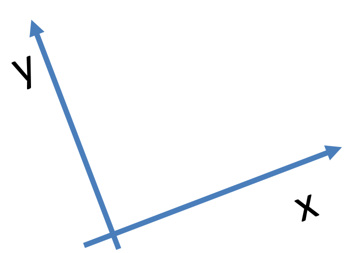
$$\therefore \quad m_1 g - m_2 g\sin(30°) - \mu m_2 g\cos(30°) = (m_2 + m_1)a$$

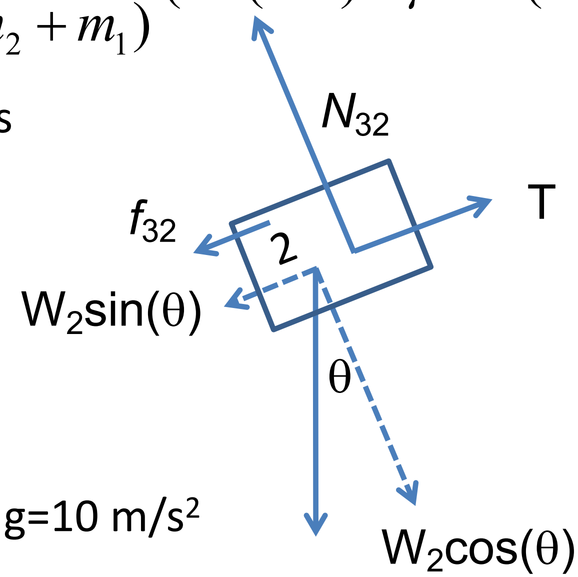
$$\therefore \quad a = \frac{m_1 g - m_2 g\sin(30°) - \mu m_2 g\cos(30°)}{(m_2 + m_1)}$$

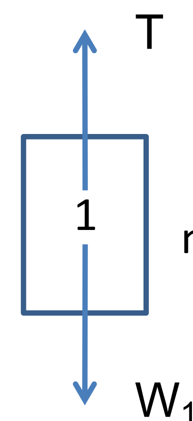
$$T = m_1 g - m_1 a$$

$$\therefore \quad a = \frac{m_1 g}{(m_2 + m_1)} - \frac{m_2 g}{(m_2 + m_1)}(\sin(30°) - \mu\cos(30°))$$

The magnitude of acceleration is the same for both objects







m_1=2.0 kg

μ=0.1 g=10 m/s^2