Newton's Laws

Every body continues in its state of rest or of uniform speed in a straight line unless acted on by a nonzero net force.

$$\mathbf{F} = 0 \Rightarrow \mathbf{v} = \text{const.}$$

The acceleration of an object is directly proportional to the net force acting on it and is inversely proportional to its mass. The direction of the acceleration is in the direction of the net force acting on the object.

$$\Sigma\mathbf{F} = m\mathbf{a}$$

Whenever one object exerts a force on a second object, the second exerts an equal and opposite force on the first.

$$\mathbf{F}_{AB} = -\mathbf{F}_{BA}$$

Force Diagrams

$F_{1x} = F_1 \cos 45.0° = 40.0N * 0.707 = +28.3N$

$F_{1y} = F_1 \sin 45.0° = 40.0N * 0.707 = +28.3N$

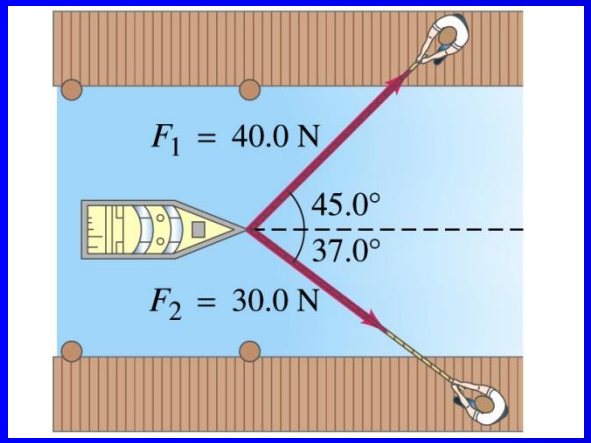
$F_{2x} = F_2 \cos 37.0° = 30.0N * 0.799 = +24.0N$

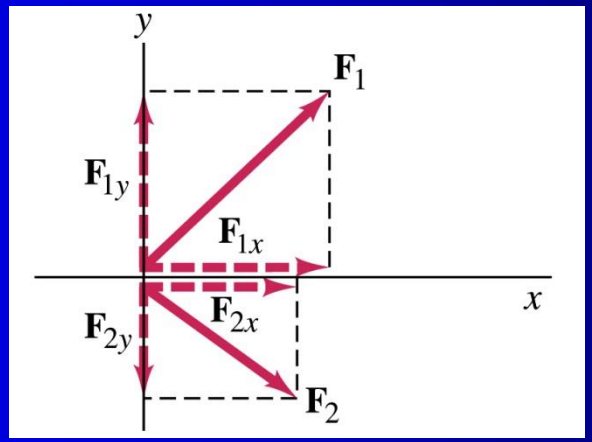
$F_{2y} = F_2 \sin 37.0° = 30.0N * 0.602 = -18.1N$

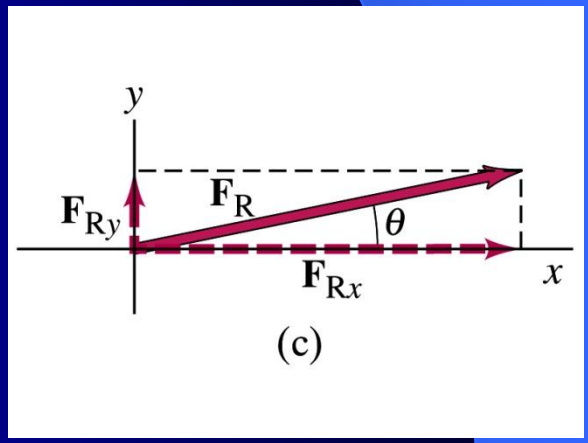
$F_{Rx} = F_{1x} + F_{2x} = 28.3N + 24.0N = 52.3N$

$F_{Ry} = F_{1y} + F_{2y} = 28.3N - 18.1N = 10.2N$

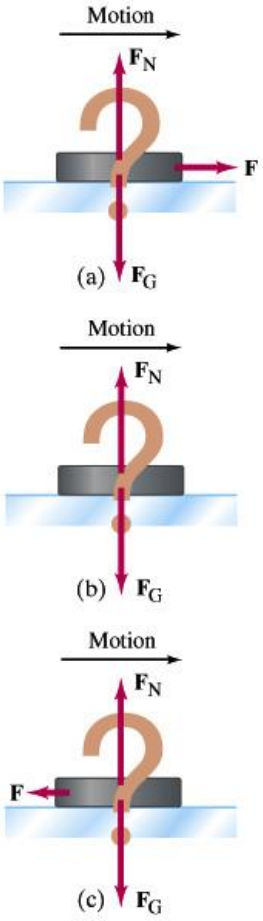
$F_R^2 = F_{Rx}^2 + F_{Ry}^2 \qquad \tan\theta = F_{Ry}/F_{Rx}$







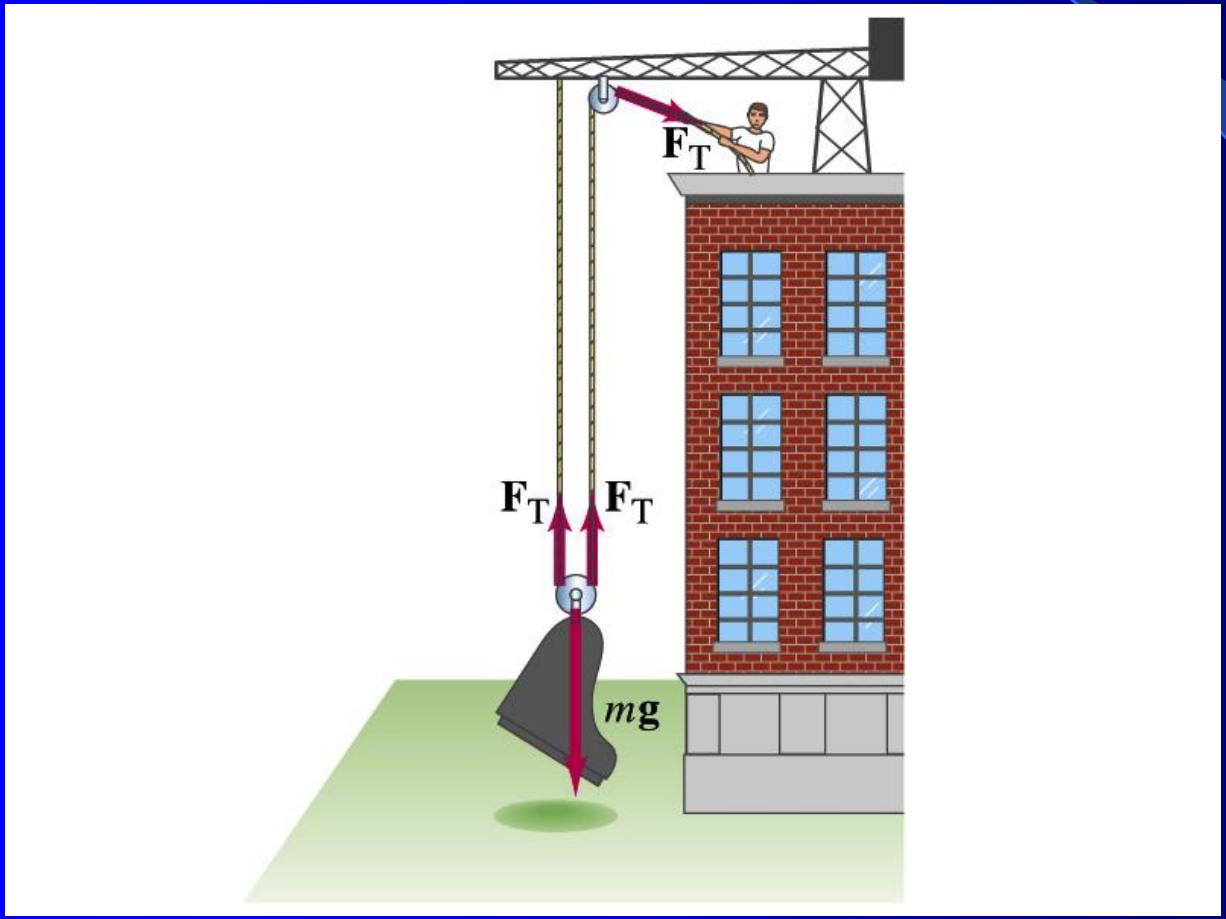
Conceptual Examples



Puck on a frictionless surface.

Which Force Diagram is correct?

Conceptual Examples

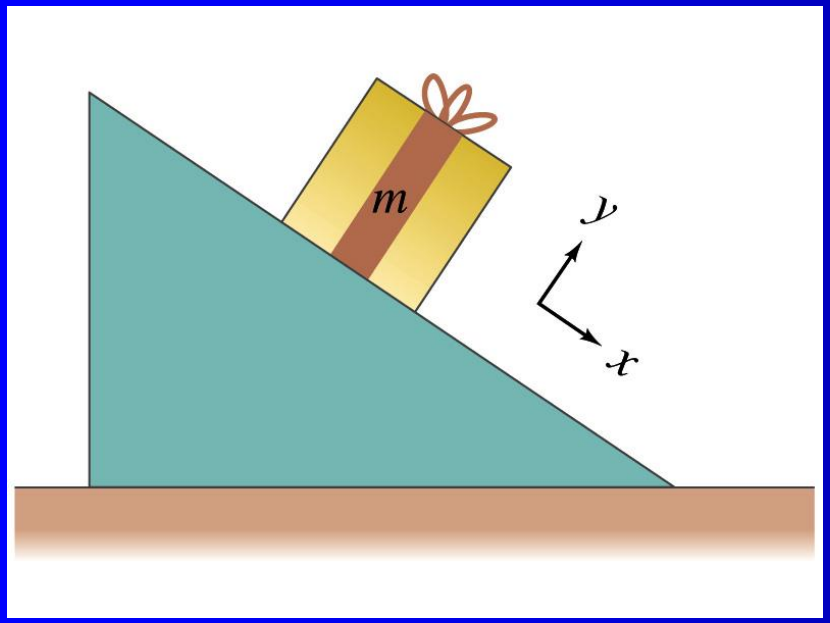


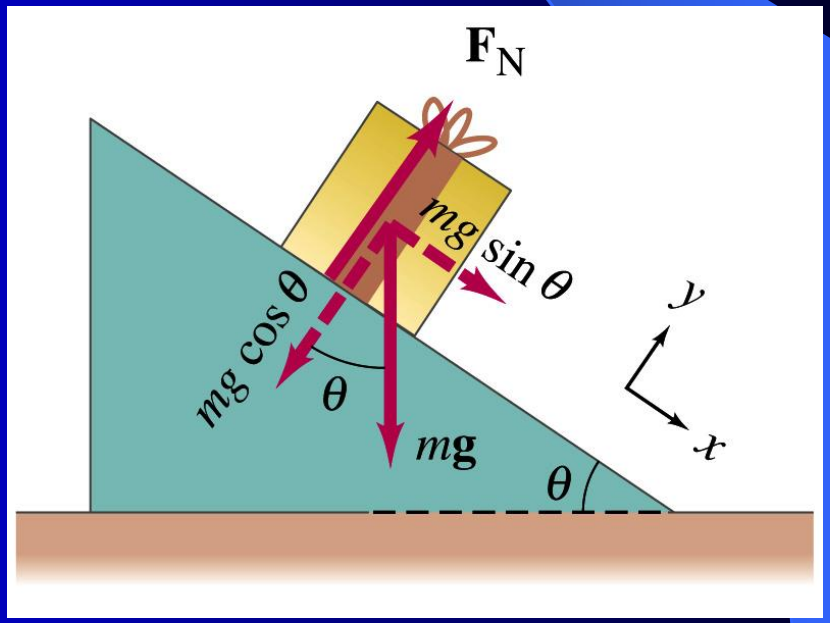
Using a pulley.

Why is it easier to pull up an object?

Quantitative Example

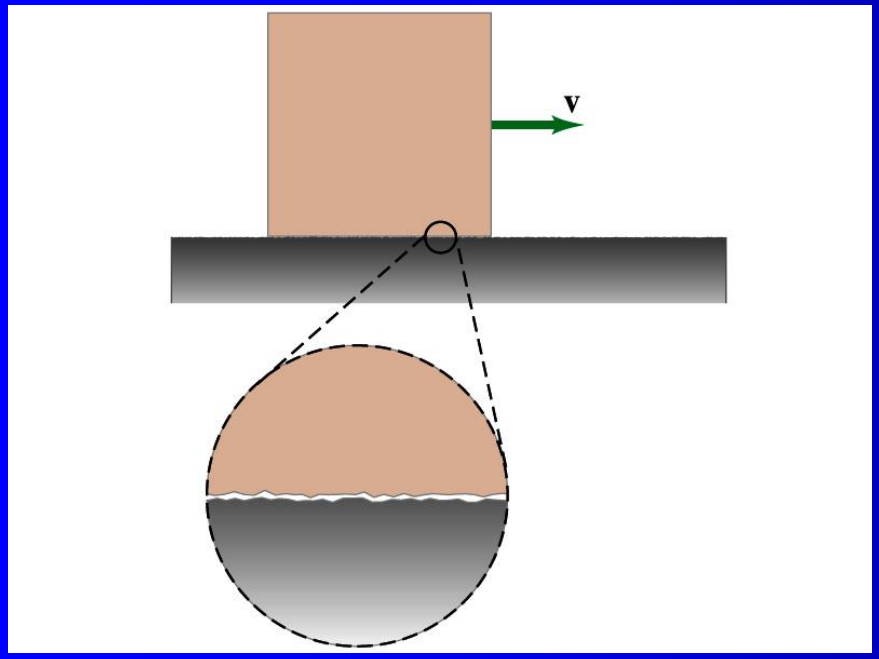
Box on a frictionless incline.
Draw Force Diagram.
Calculate motion of box

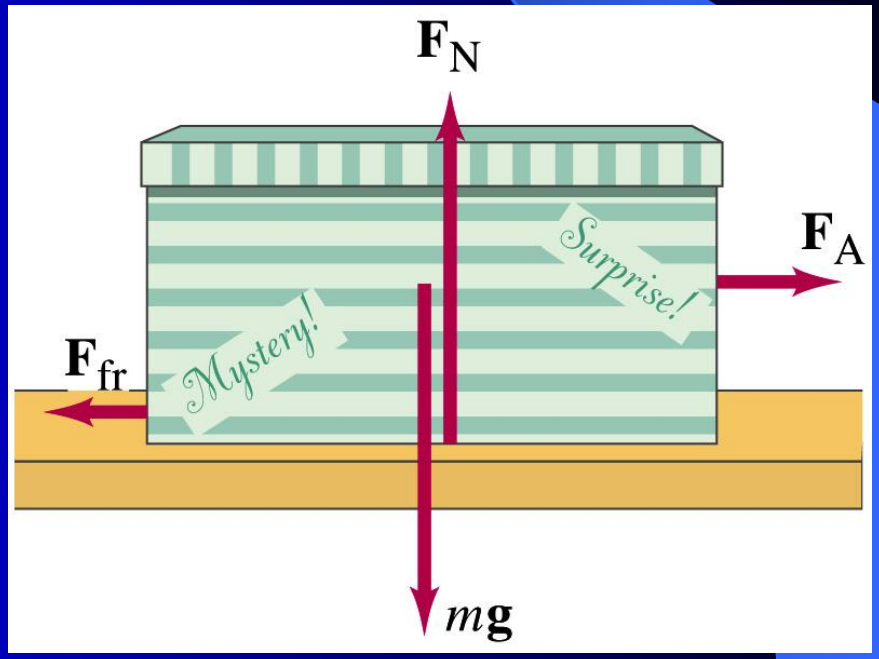




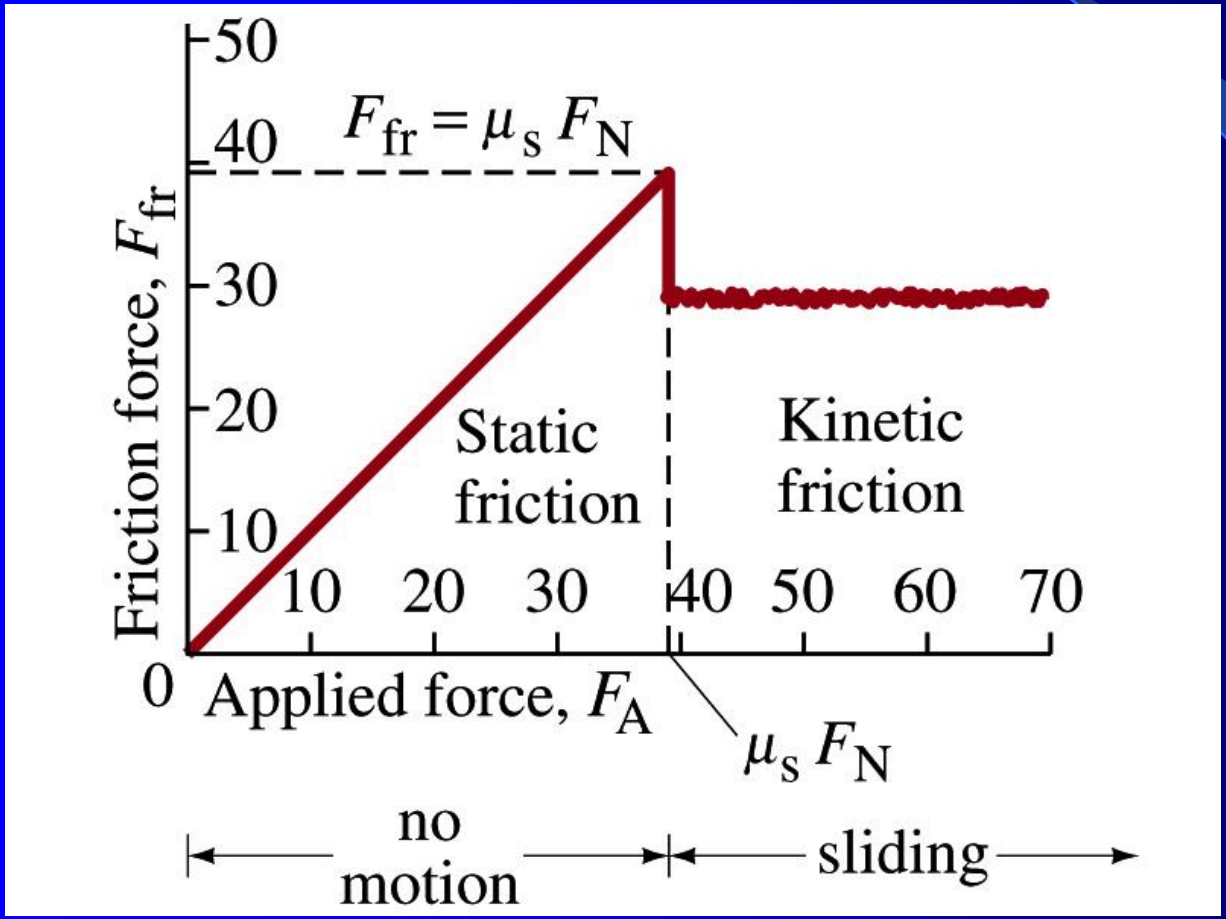
Friction

Why is there friction?
Kinetic versus static friction





Friction



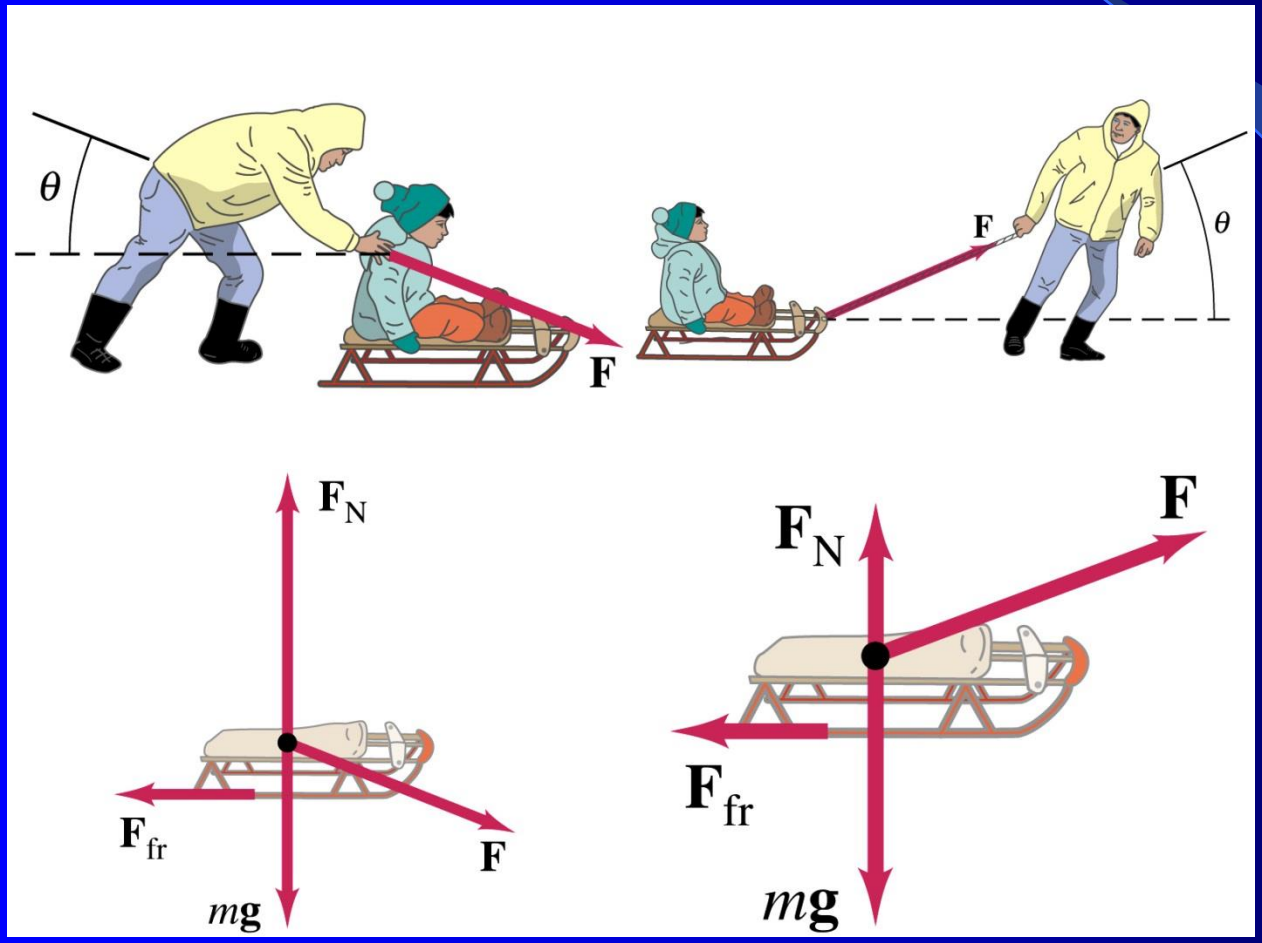
Static friction:

$F_{fr} \leq \mu_s F_N$

Kinematic friction:

$F_{fr} = \mu_k F_N$

Conceptual Example



To push or to pull a sled?

Why?