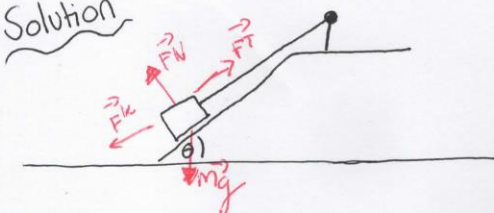


Q101

A crate is pulled up a slope at a constant velocity by a tow bar. The slope is inclined at 35° with respect to the horizontal. The force applied to the crate by the tow bar is parallel to the slope. The crate's mass is 75.0 kg , and the coefficient of kinetic friction between the crate and the snow is 0.320 . Find the magnitude of the force that the tow bar exerts on the box.

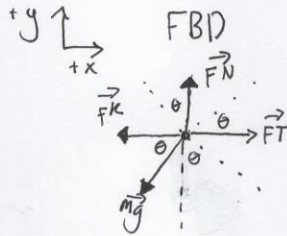
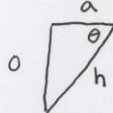
Solution



Knowns

mass - 75.0 kg
 $\mu_k - 0.320$
 $\theta - 35^\circ$

Tip: reorient the axis in your FBD to make algebra easier

$\sin = \frac{o}{h}$
 $\cos = \frac{a}{h}$

Sum up your forces in the x and y direction.

$$\sum \vec{F}_y = \vec{F}^N - \vec{m}\vec{g} \cos\theta = \vec{m}\vec{a} \quad (\text{constant velocity})$$

$$\sum \vec{F}_y = \vec{F}^N = \vec{m}\vec{g} \cos\theta$$

$$\sum \vec{F}_x = \vec{F}^T - \vec{F}^k - \vec{m}\vec{g} \sin\theta = \vec{m}\vec{a}$$

$$\sum \vec{F}_x = \vec{F}^T = \vec{F}^k + \vec{m}\vec{g} \sin\theta$$

$$\vec{F}^T = \mu_k \vec{F}^N + \vec{m}\vec{g} \sin\theta$$

plug $\sum \vec{F}_y$ into $\sum \vec{F}_x$

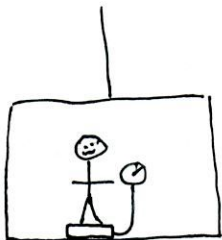
$$\vec{F}^T = \mu_k \vec{m}\vec{g} \cos\theta + \vec{m}\vec{g} \sin\theta$$

$$\vec{F}^T = \vec{m}\vec{g} (\mu_k \cos\theta + \sin\theta)$$

$$\vec{F}^T = (75.0 \text{ kg})(9.8 \text{ m/s}^2) [(0.320)(\cos 35^\circ) + \sin 35^\circ]$$

$\vec{F}^T = 614.2 \text{ N}$

An 85.0 kg person stands on a scale in an elevator. What is the apparent weight when the elevator is (a) accelerating downward with an acceleration of 1.23 m/s^2 , (b) moving upward at a constant speed, and (c) accelerating upward with an acceleration of 1.50 m/s^2 ?



a) $\sum \vec{F}_y = m\vec{a}_y$



$$F^N = (85 \text{ kg})(9.8 \text{ m/s}^2 - 1.23 \text{ m/s}^2)$$

$$F^N = 728.45 \text{ N}$$

b)

$$\sum \vec{F}_y = m\vec{a}_y$$

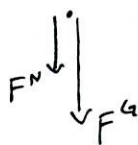


$$F^N = (85 \text{ kg})(9.8 \text{ m/s}^2)$$

$$F^N = 833 \text{ N}$$

c)

$$\sum \vec{F}_y = m\vec{a}_y$$



$$F^N = (85 \text{ kg})(9.8 \text{ m/s}^2 + 1.5 \text{ m/s}^2)$$

$$F^N = 960.5 \text{ N}$$