

## AP Physics Practice – Forces with Inclines

A skier is pulled up a slope by a tow bar at a constant velocity. The slope is inclined at  $25.0^\circ$  with respect to the horizontal. The force applied to the skier by the tow bar is parallel to the slope. The skier's mass is  $55.0 \text{ kg}$ , and the coefficient of kinetic friction between the skis and the snow is  $0.120$ . Find the magnitude of the force that the tow bar exerts on the skier.

Given: constant speed  
 $\theta = 25.0^\circ$   
 $m = 55.0 \text{ kg}$   
 $\mu_k = 0.120$



$$F_{gx} = F_g \sin \theta$$

$$F_{gy} = F_g \cos \theta$$

Want:  $F_T$

Calculations:

constant speed  $\Rightarrow$  equilibrium  $\Rightarrow$  up forces = down forces  
 left forces = right forces

$$F_N = F_{gy}$$

$$F_N = F_g \cos \theta$$

$$F_{KF} + F_{gx} = F_T$$

$$F_{KF} + F_g \sin \theta = F_T$$

Weight:  $F_g = mg$

Kinetic Friction:  $F_{KF} = \mu_k F_N$

$$F_N = mg \cos \theta$$

$$\mu_k F_N + mg \sin \theta = F_T$$

$$\mu_k mg \cos \theta + mg \sin \theta = F_T$$

$$F_T = (0.120)(55.0)(9.8) \cos(25.0) + (55.0)(9.8) \sin(25.0)$$

$$F_T = 286.4112 \text{ N}$$

$$\boxed{F_T = 290 \text{ N}}$$

Conclusion: The tow bar exerts a force of 290 N on the skier.