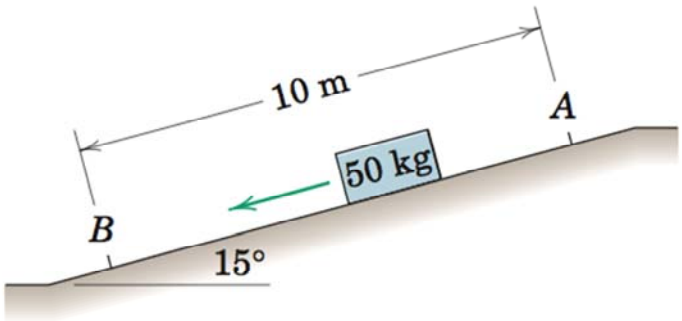
Question of the Day

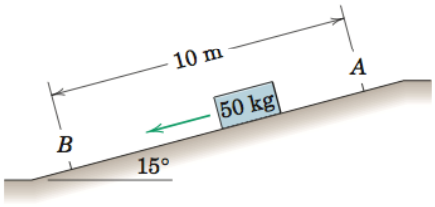


A ***50-kg*** crate is given an initial ***velocity*** of ***4 m/s*** down the chute at ***A***. The ***coefficient of kinetic friction*** is ***0.30***.

Determine the ***velocity v*** of the crate when it reaches the bottom of the chute at ***B***.

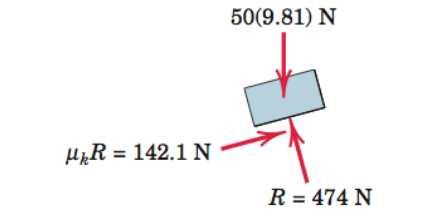
Sample Problem 3/11

Calculate the velocity v of the 50-kg crate when it reaches the bottom of the chute at B if it is given an initial velocity of 4 m/s down the chute at A. The coefficient of kinetic friction is 0.30.



Solution. The free-body diagram of the crate is drawn and includes the normal force R and the kinetic friction force F calculated in the usual manner. The work done by the weight is positive, whereas that done by the friction force is negative. The total work done on the crate during the motion is

$[U = Fs] \qquad U_{1\text{-}2} = 50(9.81)(10 \sin 15°) - 142.1(10) = -151.9 \text{ J}$



The work-energy equation gives

$$[T_1 + U_{1\text{-}2} = T_2] \qquad \tfrac{1}{2}mv_1^2 + U_{1\text{-}2} = \tfrac{1}{2}mv_2^2$$

$$\tfrac{1}{2}(50)(4)^2 - 151.9 = \tfrac{1}{2}(50)v_2^2$$

$$v_2 = 3.15 \text{ m/s} \qquad \textit{Ans.}$$

Since the net work done is negative, we obtain a decrease in the kinetic energy.

Helpful Hint

① The work due to the weight depends only on the *vertical* distance traveled.