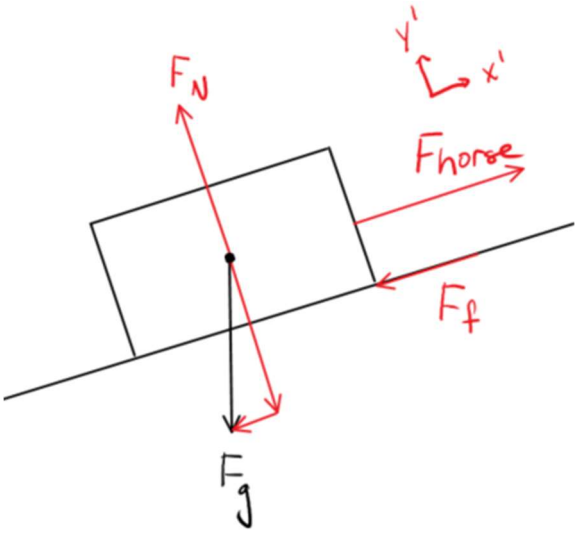
21-P-WE-AG-023

A horse can pull with a power of 745 Watts, or Joules per second. A horse is pulling a *M*-kg sled up a hill. The coefficient of kinetic friction between the sled and the snow is μ. Write the equation that describes the constant velocity of a sled being pulled by a horse as a function of the incline angle. (Use one or more of *m* for mass, *g* for gravity, *t* for theta, and *u* for coefficient of friction in your answer. Start your equation with *v*=.)

Hint: a change of axis is needed

ANSWER:

First, we draw the free body diagram.



Then, we write the force balance equation for this situation.

$$\sum F_{x'} = ma_{x'} = 0 = -F_g - F_f + F_h = -M \cdot g \cdot \sin(\theta) - \mu \cdot M \cdot g \cdot \cos(\theta) + \frac{745\ W}{v}$$

We rearrange to solve for *v*, the velocity.

$$velocity = \frac{745}{M \cdot g \cdot (\sin(\theta) + \mu \cdot \cos(\theta))} \frac{m}{s}$$