Answer on Question 57864, Physics, Mechanics, Relativity

Question:

A $60.0\ kg$ crate rests on a level floor at a shipping dock. The coefficients of static and kinetic friction are 0.760 and 0.410, respectively. What horizontal pushing force is required to

a) just start the crate moving and

b) slide the crate across the dock at a constant speed?

Solution:

a) By the definition of the coefficient of static friction we have:

$$\mu_s = \frac{F_{appl}}{W} = \frac{F_s}{N},$$

here, F_{appl} is the horizontal pushing force, $W = mg$ is the weight of the crate directed downward, F_s is the static friction force directed opposite to the horizontal pushing force and equal to it, N is the force of reaction directed upward and equal to the weight of the crate.

From this formula we can find the horizontal pushing force required to just start the crate moving:

$$F_{appl} = F_s = \mu_s N = \mu_s mg = 0.760 \cdot 60\ kg \cdot 9.8\ \frac{m}{s^2} = 447\ N.$$

b) By the definition of the coefficient of kinetic friction we have:

$$\mu_k = \frac{F_{appl}}{W} = \frac{F_k}{N},$$

here, F_{appl} is the horizontal pushing force, $W = mg$ is the weight of the crate directed downward, F_k is the kinetic friction force directed opposite to the horizontal pushing force and equal to it, N is the force of reaction directed upward and equal to the weight of the crate.

From this formula we can find the horizontal pushing force required to slide the crate across the dock at a constant speed:

$$F_{appl} = F_k = \mu_k N = \mu_k mg = 0.410 \cdot 60\ kg \cdot 9.8\ \frac{m}{s^2} = 241\ N.$$

Answer:

a) The horizontal pushing force required to just start the crate moving is $447\ N$.

b) The horizontal pushing force required to slide the crate across the dock at a constant speed is $241\ N$.