~~Problem 54~~
Chapter 7

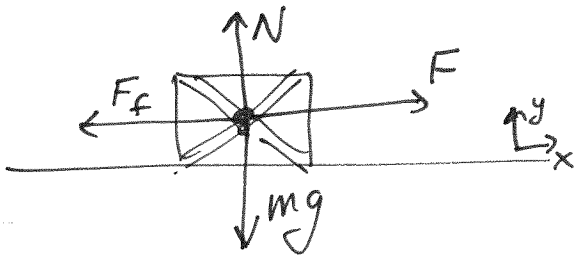
Problem 54

$m = 5.0\ kg$

$a = 2.0\ m/s^2$

$\mu_k = 0.50$

$d = 10\ cm$



a) Find the work done by the horizontal force

By Newton's 2nd Law

$$\Sigma \vec{F} = m\vec{a}$$

$$\vec{F}_f + \vec{N} + \vec{W} + \vec{F} = m\vec{a}$$

with +x in the horizontal to the right,

$$-F_f \hat{i} + N\hat{j} - mg\hat{j} + F\hat{i} = ma\hat{i}$$

x-dir: $-F_f + F = ma$ (#1)

y-dir: $N - mg = 0 \longrightarrow N = mg$ (#2)

Using the ~~definition~~ equation of friction

$$F_f = \mu N = \mu mg \quad (\#3)$$

Sub into Equation (#1) and solve for F.

$$-\mu mg + F = ma \rightarrow F = ma + \mu mg$$

$$F = m(a + \mu g) = (5.0\ kg)(2.0\ m/s^2 + 0.50(9.8\ m/s^2))$$

$$F = 34.5\ N$$

Work is Then

$$W_F = F \cdot d \cos\theta = (34.5N)(0.10m)\cos 0^\circ$$

$$\boxed{W_F = 3.45\ J}$$

b) Find the work done by friction.

The frictional force ~~is~~ from equation (#3) is

$$F_f = \mu mg = (0.50)(5.0kg)(9.8\ m/s^2) = 24.5N$$

Work is Then

$$W_{fric} = F_f \cdot d \cos\theta = (24.5N)(0.10m)\cos(180^\circ)$$

$$\boxed{W_{fric} = -2.45\ J}$$

c) ~~Net force~~ Work by Net force

$$W_{total} = W_F + W_{Fric} = 3.45\ J - 2.45\ J = \boxed{1.0\ J}$$

d) Change in Kinetic energy By Work energy Theorem $W = \Delta K \rightarrow \boxed{\Delta K = 1.0\ J}$