§6.2 Kinetic Energy & the Work-Energy Theorem

An object in motion has kinetic energy.... it is the energy of motion.

$$E_k = \frac{1}{2}mv^2$$

where E_k is kinetic energy $\left(kg\cdot\frac{m^2}{s^2} = J\right)$
m is the mass (kg)
v is the speed (m/s)

MP|237

$m = 0.200\,kg$
$V_1 = 0\,m/s$
$V_2 = 27.0\,m/s$

a) $E_{k_1} = ?$
b) $E_{k_2} = ?$

a) $E_k = \frac{1}{2}mv^2$

$E_k = \frac{1}{2}(0.200\,kg)(0)^2$

$\boxed{E_k = 0\,J}$ ← at rest

b) $E_k = \frac{1}{2}mv^2$

$E_k = \frac{1}{2}(0.200\,kg)(27.0\,m/s)^2$

$\boxed{E_k = 72.9\,J}$

* Work must be done on the puck to change its kinetic energy from 0J to 72.9J

Recall: $W = F_{\parallel} \Delta d \quad (F_{\parallel} = ma)$

$W = ma\Delta d$

$W = m\left(\frac{\Delta v}{\Delta t}\right)\left(v_{ave}\,\Delta t\right)$

$W = m(\Delta v)(v_{ave})$

$W = m(v_2 - v_1)\left(\frac{v_1 + v_2}{2}\right)$

$W = \frac{1}{2}m(v_2 - v_1)(v_1 + v_2)$

$W = \frac{1}{2}m(v_1 v_2 + v_2^2 - v_1^2 - v_1 v_2)$

$W = \frac{1}{2}m(v_2^2 - v_1^2)$

$W = \frac{1}{2}mv_2^2 - \frac{1}{2}mv_1^2$

$W = E_{k_2} - E_{k_1}$

$W = \Delta E_k$ ← WORK-ENERGY THEOREM

The work done on an object is equal to the change in kinetic energy.

If work is POSITIVE, then the energy increases.

work is NEGATIVE, then the energy decreases

MP 12.42

$m = 2.5\,kg$

$F_a = 4.0 \times 10^1\,N$

$\Delta d = 1.5\,m$

$v_1 = 0$

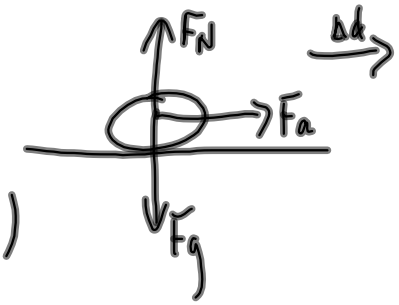
a) $W = ?$

b) $v_2 = ?$

a) $W = F_{||}\Delta d$

$W = (4.0 \times 10^1\,N)(1.5\,m)$

$\boxed{W = 6.0 \times 10^1\,J}$



b) $W = \Delta E_k$ (0)

$W = E_{k_2} - E_{k_1}$

$W = \frac{1}{2}mv_2^2$

$60\,J = \frac{1}{2}(2.5\,kg)v_2^2$

$v_2^2 = 48\,\frac{m^2}{s^2}$

$\boxed{v_2 = 6.9\,m/s}$

MP 12.4

$m = 75\,kg$

$v_1 = 8.0\,m/s$

$F_a = 2.0 \times 10^2\,N$

$\Delta d = 5.0\,m$

$E_{k_2} = ?$

$W = \Delta E_k$

$W = E_{k_2} - E_{k_1}$

$E_{k_2} = E_{k_1} + W$

$E_{k_2} = \frac{1}{2}mv_1^2 + F_{||}\Delta d$

$E_{k_2} = \frac{1}{2}(75\,kg)(8.0\,m/s)^2 + (2.0 \times 10^2\,N)(5.0\,m)$

$E_{k_2} = \underbrace{2400\,J}_{E_{k_1}} + \underbrace{1000\,J}_{W}$

$E_{k_2} = 3400\,J$

To DO

① PP 12.3 8

② PP 12.4 5-246