Work - recap!

$W = F_{\parallel} \Delta d$ (if the force is in the same dir as the motion)

$W = F \Delta d \cos\theta$ (if the force is not in the same dir)

W is the area under a F-d graph.

§6.2 Kinetic Energy + Work

Kinetic energy depends directly on the mass

Kinetic energy varies directly with the square of the velocity

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

where E_k is the kinetic energy (J)
m is the mass (kg)
v is the velocity (m/s)

mp 237

$m = 0.200\,kg$
$v_1 = 0$
$v_2 = 27.0\,m/s$

a) $E_{k_1} = ?$

b) $E_{k_2} = ?$

a) $E_{k_1} = \frac{1}{2}mv^2$

$E_{k_1} = \frac{1}{2}(0.200\,kg)(0)^2$

$E_{k_1} = 0\,J$ ← only objects in motion have kinetic energy.

b) $E_{k_2} = \frac{1}{2}mv_2^2$

$E_{k_2} = \frac{1}{2}(0.200\,kg)(27.0\,m/s)^2$

$E_{k_2} = 72.9\,J$

$kg \cdot \frac{m^2}{s^2} = kg \cdot \frac{m}{s^2} \cdot m = N \cdot m$

Recall: $W = F_{||}\Delta d$

$F = ma$

$W = ma\Delta d$

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

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

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

$W = \frac{1}{2}m(v_1v_2 + v_2^2 - v_1^2 - v_1v_2)$

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

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

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

$\boxed{W = \Delta E_k}$

$v = \frac{\Delta d}{\Delta t}$

$v_{ave} = \frac{\Delta d}{\Delta t}$

$\Delta d = v_{ave}\,\Delta t$

WORK-ENERGY THEOREM

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

MP 242

$m = 2.5\,kg$

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

$\Delta d = 1.5\,m$

$v_1 = 0$

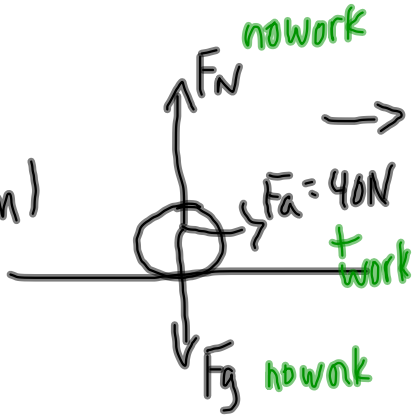
a) $W = ?$

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) $W = \Delta E_k$ (work-energy theorem)

$W = E_{k_2} - E_{k_1}$ (0)

$W = \frac{1}{2} m v_2^2$

$v_2^2 = \frac{2W}{m}$

$v_2^2 = \frac{2(6.0 \times 10^1\,J)}{2.5\,kg}$

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

MP|244

$m = 75\,kg$

$v_1 = 8.0\,m/s$

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

$\Delta d = 5.0\,m$

$E_{k2} = ?$

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

$W = (2.0 \times 10^2\,N)(5.0\,m)$

$W = 1.0 \times 10^3\,J$

$W = \Delta E_k$

$W = E_{k2} - E_{k1}$

$E_{k2} = E_{k1} + W$

E_{k2}: new energy; E_{k1}: energy to start with; W: energy transferred

$E_{k2} = \frac{1}{2} m v_1^2 + W$

$E_{k2} = \frac{1}{2}(75\,kg)(8.0\,m/s)^2 + 1.0 \times 10^3\,J$

$E_{k2} = 2400\,J + 1000\,J$

$E_{k2} = 3.4 \times 10^3\,J$

+ work => increase in energy

− work => decrease in energy

no work => no change in energy

To Do:

1. PP|238
2. PP|245-246
3. Assignment
4. Quiz Fri.

Draw a FBD showing all forces - state which ones do +/−/no work.

p275|15-22 (due Thurs)