§6.2 Kinetic Energy + Work-Energy Theorem

Any object that moves has kinetic energy.

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

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

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m = 0.200 kg
v = 0 m/s or 27.0 m/s
E_k = ?

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

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

$\boxed{E_k = 0J}$ (at rest)

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

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

$\boxed{E_k = 72.9\ J}$

* NOTE: In order for the kinetic energy of the hockey puck to change from 0J to 72.9J work must have been done (i.e. a force acting on the puck during displacement)

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

$W = ma\Delta d \quad (F = ma)$

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

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

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

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

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

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

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

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

$W = \Delta E_k$ ← Work-Energy Theorem

Work is equal to the change in kinetic energy

* Work is POSITIVE if the E_k increases
Work is NEGATIVE if the E_k decreases.

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$m = 2.5\,kg$

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

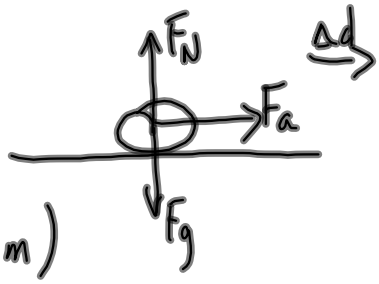
$\Delta d = 1.5\,m$

$v_1 = 0\,m/s$

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)

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

$W = E_{k_2}$

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

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

$120\,J = (2.5\,kg)v_2^2$

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

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

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$m = 75\,kg$

$v_1 = 8.0\,m/s$

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

$\Delta d = 5.0\,m$

$E_{k_2} = ??$

$W = \Delta E_k$

$F_{||}\Delta d = E_{k_2} - E_{k_1}$

$E_{k_2} = E_{k_1} + F_{||}\Delta d$ ← work done

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

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

$E_{k_2} = 2400\,J + 1000\,J$

E_{k_1} Work done

$E_{k_2} = 3400\,J$

$3.4 \times 10^3\,J$

TO DO

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