§6-2 Kinetic Energy + Work

Kinetic Energy is the energy that an object has due to its motion. It depends on the velocity and the mass.

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

Where E_K is the kinetic energy (J)
m is the mass (kg)
v is the velocity (m/s)

* E_K is a scalar quantity
* units: $1J = 1kg \cdot \frac{m^2}{s^2} = N \cdot m$

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

a) $E_{K_1} = ?$ (at rest)
b) $E_{K_2} = ?$ (27.0 m/s)

a) At rest ⇒ $E_K = 0J$

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

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

$E_K = 0J$

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

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

$E_K = 72.9J$

The hockey puck initially had no kinetic energy and now it has 72.9 J. Where did this energy come from?

Work was done and transferred energy to the puck (72.9J)

Work + Kinetic Energy

Recall: $W = F_{\parallel}\Delta d$ also $F = ma$

$W = ma\Delta d$

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

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

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

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

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

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

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

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

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

Work is equal to the change in energy

mp/242

$m = 2.5\,kg$

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

$\Delta d = 1.5\,m$

a) $W = ?$

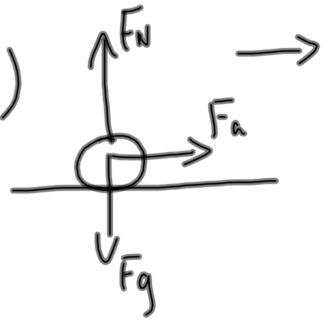
b) $v_2 = ?$ if $v_1 = 0$

$60\,J = \frac{1}{2} m v^2$

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

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

$W = 6.0 \times 10^1\,J$



b) $W = \Delta E_K$

$W = E_{K2} - \cancel{E_{K1}}^{\,0}$

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

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

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

$v_2 \doteq 6.9\,m/s$

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$m = 75\,kg$

$v_1 = 8.0\,m/s$

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

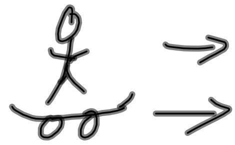
$\Delta d = 5.0\,m$

$E_{k2} = ?$

$W = \Delta E_k$

$F\Delta d = E_{k2} - E_{k1}$

$E_{k2} = F\Delta d + E_{k1}$



$E_{k2} = F\Delta d + \frac{1}{2}mv_1^2$

$E_{k2} = (2.0 \times 10^2\,N)(5.0\,m) + \frac{1}{2}(75\,kg)(8.0\,m/s)^2$

$E_{k2} = \underbrace{1.0 \times 10^3\,J}_{\text{work done}} + \underbrace{2.4 \times 10^3\,J}_{E_k \text{ at start}}$

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

TO DO:

1. PP|238 (E_k)
2. PP|245-246 (work-energy theorem)