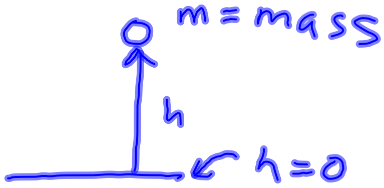
Energy

$E_p = mgh$

↑ gravitational potential energy



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

$g = 9.8 m/s^2$

Work = energy imparted

= Force x distance

= mg x h

= work required to lift an object of mass m a distance h.

Power = rate at which work is done (energy is transferred)

= Joules/sec

= Watts

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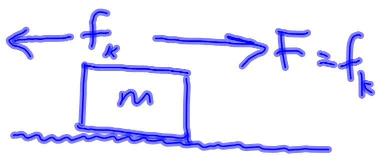
Work against a force



$\mu_k = 0.5$

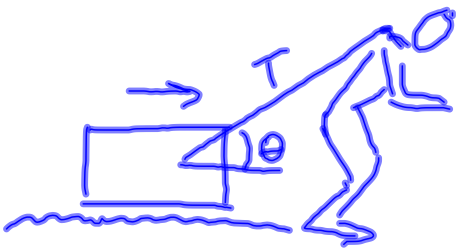
$f_k = \mu_k mg$

W = (Force applied) x (distance)

How much work to slide box 10 meters?
[20 kg box.]

$W = 0.5(20kg)(9.8m/s^2) \times (10 \text{ meters})$

$= 980 \text{ J}$



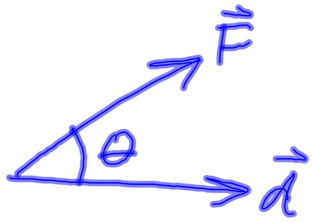
$W = (T\cos\theta) \times (\text{distance})$

$T\cos\theta = \mu_k mg$

$T = \frac{\mu_k mg}{\cos\theta}$

General Principle

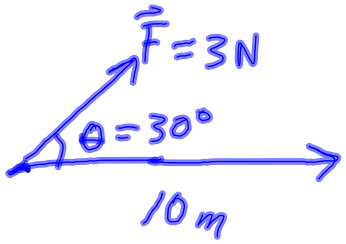
$$W = \vec{F} \cdot \vec{d}$$



$$\vec{F} \cdot \vec{d} = Fd\cos\theta$$

$\vec{F}$ = force vector

$\vec{d}$ = displacement vector



$$W = \vec{F} \cdot \vec{d} = Fd\cos\theta$$

$$= (3N)(10m)\cos(30^\circ)$$

$$= (3N)(10m)\left(\frac{\sqrt{3}}{2}\right)$$

$$= 15\sqrt{3} \text{ J}$$

$$= 26 \text{ J}$$

1 Joule = 1 Newton-meter

$$W = \begin{pmatrix} \text{Component of force applied in} \\ \text{direction of displacement} \end{pmatrix} \times \text{displacement}$$

$$F\cos\theta \quad \times \quad d$$

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Work & Kinetic Energy

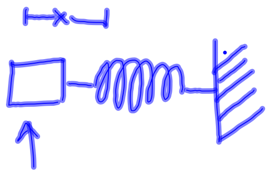
Q. How much work must a hockey stick do on a puck to increase puck's speed from v_i to v_f?

A. $W = E_{k_{after}} - E_{k_{before}}$

$$= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$= \frac{m}{2}(v_f^2 - v_i^2)$$

Hooke $F = -kx$



↑ restoring force

↑ equilibrium position

$E_p = \frac{1}{2}kx^2$

↑ Potential Energy of compressed spring

$F_g = mg$

$F = -kx$

$mg = kx$

$x = \frac{mg}{k}$

$$E_p = \frac{1}{2}kx^2$$

$$= \frac{1}{2}k\left(\frac{mg}{k}\right)^2$$

$$= \frac{1}{2}\frac{m^2g^2}{k}$$

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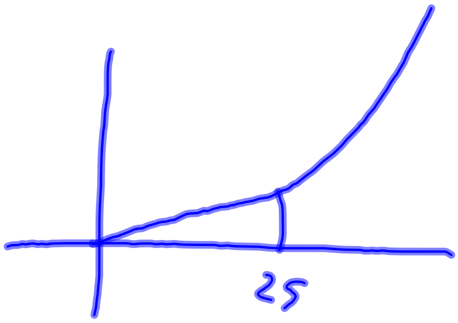
Air Resistance

$f_{air} = Dv^2$



$mg = f_{air}$

$mg = Dv^2$

D depends on cross sectional area of object

$v_{term} = \sqrt{\frac{mg}{D}}$ ← terminal velocity

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Work can be Posisitive or negative

$$W = \vec{F} \cdot \vec{d} = Fd\cos\theta$$