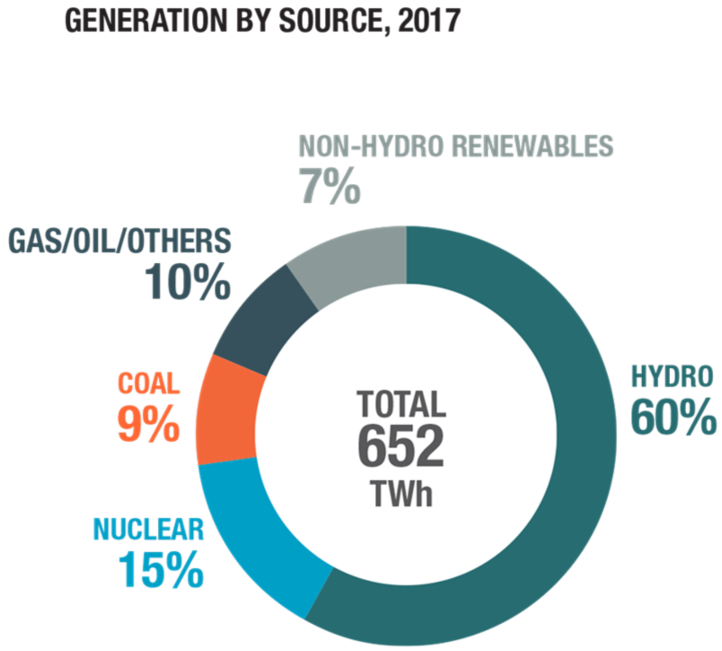
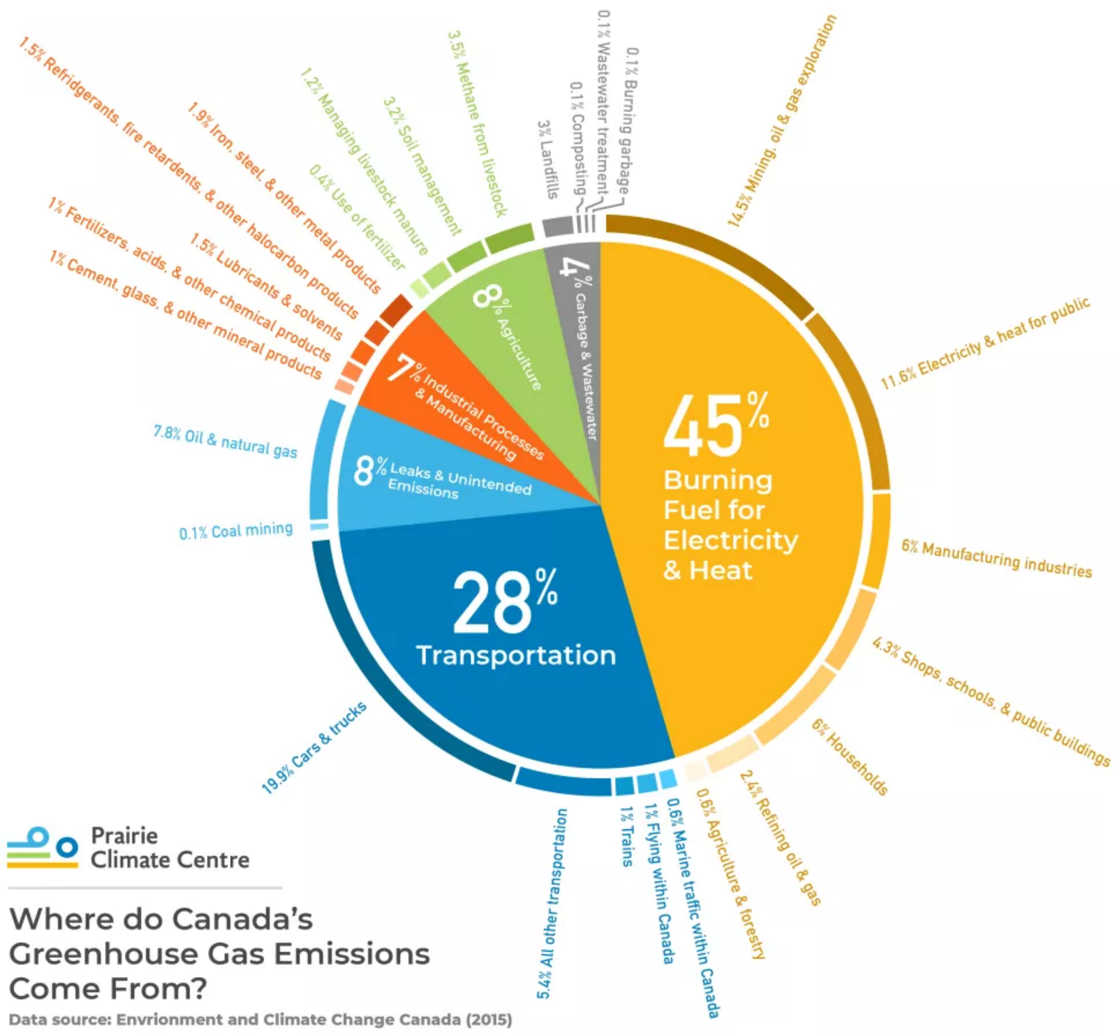
Energy

Kinematics	Dynamics	Energy
motion	force	work
$a = \frac{\Delta v}{\Delta t}$	$F_{net} = ma$	$\Delta E = F \times d$

a

Canada Electricity Generation





Brian Greene - World Science U - what is energy?

http://www.worldscienceu.com/science_unplugged/themes/basic-physics

https://physics.info/work/

Definitions

Energy : capacity to do work.

Energy is a property of an object.

Work : the energy transferred to an object by an applied force over a measured distance.

$$W = \Delta E = \vec{F} \times \Delta \vec{d}$$

work & energy are scalars.

units on work & energy

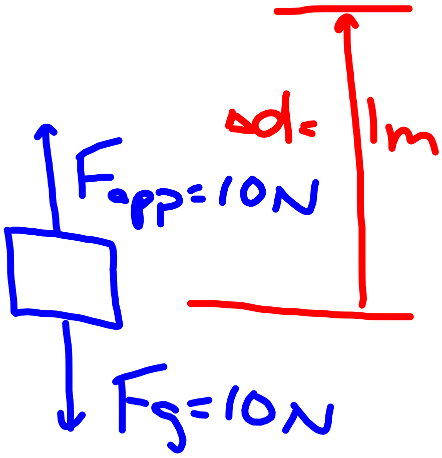
$$1 \text{ Joule} = 1 N \cdot m$$

Forms of Energy	Description
Kinetic	Energy of Motion
Thermal	Energy of motion of atoms and molecules
Gravitational Potential	A raised object has stored energy due to its position above a fixed reference point
for additional forms of energy see Table 1 on page 124 of your text	

Conditions on Work :

Force must be applied in the direction of the displacement.

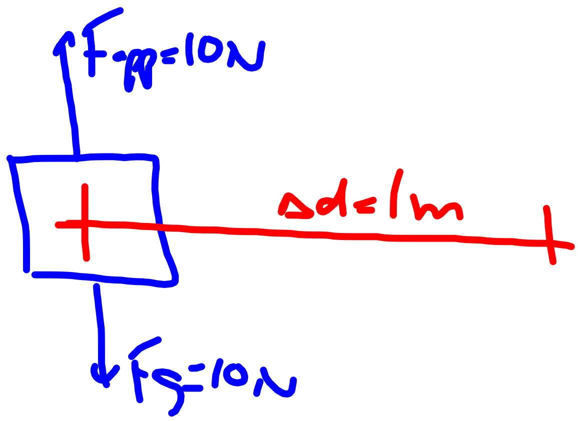
Lifting an Object



$W = \Delta E = F \times d$

$= 10\ J$

Moving an Object Horizontally

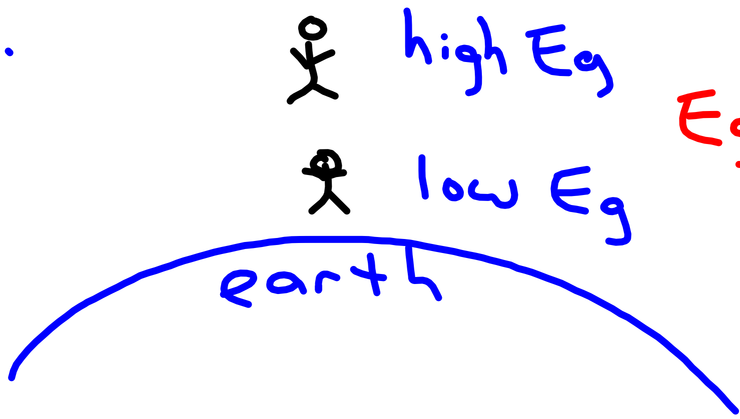


$W = \Delta E = 0\ J$

Mechanical Energy

Definition - Energy of position or motion

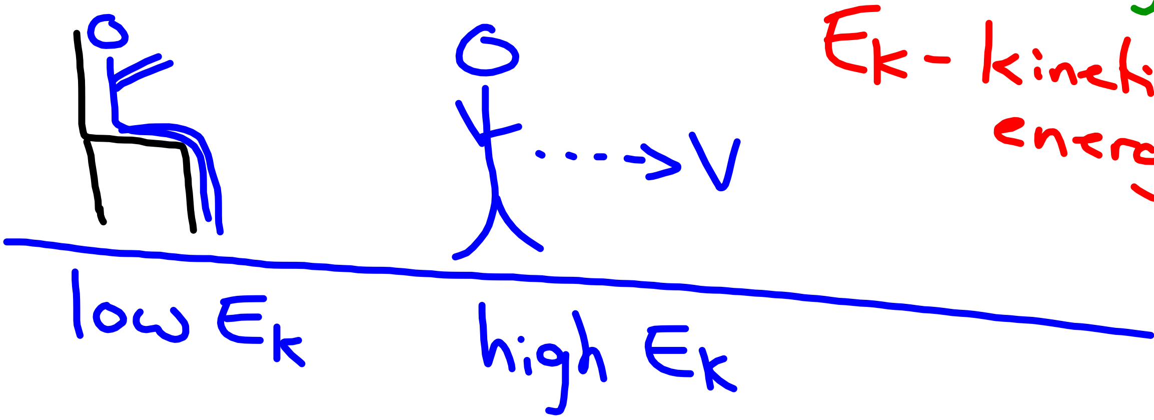
Gravitational Potential Energy - energy an object has due to its location in a gravitational field.



E_g - gravitational potential energy

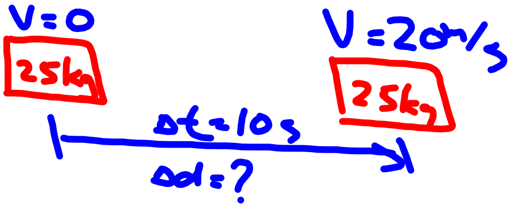
Kinetic Energy - energy an object has due to its motion relative to another object.

E_k - kinetic energy



Comparing Energy of Motion to Energy of Position

Energy of motion : ***What is the work required to accelerate a 25kg object from rest to 20m/s in 10s (assume no friction)?***



$W = \Delta E = F\Delta d$

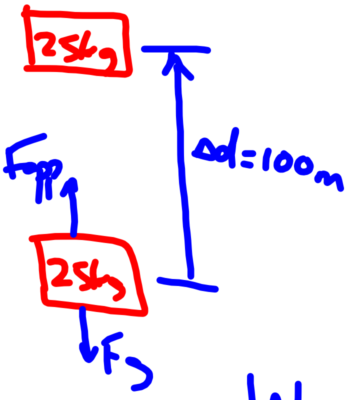
$F = ma = 25\left(\frac{20-0}{10}\right) = 50N$

$\Delta d = \left(\frac{V_1+V_2}{2}\right)\Delta t = \left(\frac{0+20}{2}\right)10$

$= 100m$

$W = 5000J$

Energy of position : ***What is the work required to lift a 25kg object 100m at constant velocity?***



$W = \Delta E = F\Delta d$

$F = mg$

$= (25kg)(9.8m/s^2)$

$= 245N$

$\Delta d = 100m$

$W = 24500J$

Energy of motion : ***What is the work required to accelerate an object of mass m kg from rest to velocity V m/s in time t seconds. (assume no friction)***

$W = \Delta E = F\Delta d$

$= (ma)(\Delta d)$

$= \left(m\left(\frac{V-0}{t}\right)\right)\left(\left(\frac{0+V}{2}\right)t\right)$

$= \left(\frac{mV}{t}\right)\left(\frac{Vt}{2}\right)$

$= \frac{mV^2}{2}$

Energy of position : ***What is the work required to lift an object of mass m to a height of h metres at constant velocity?***

$W = \Delta E = F\Delta d$

$= mg\Delta d$

$= mgh$

$g = 9.8m/s^2$ (earth)

Energy of motion : Kinetic Energy

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

this is the energy an object has due to its speed relative to a being at rest

in our example:

$m = 25\,kg$, $v = 20\,m/s$

$$E_k = \frac{1}{2}mv^2$$
$$= \frac{1}{2}(25)(20)^2$$
$$= 5000\,J$$

units:

$$kg \cdot (m/s)^2$$
$$= kg\,m^2/s^2 = J$$

Energy of position : Gravitational Potential Energy

$$E_g = mgh$$

this is the potential energy an object has at a height relative to fixed reference point.

in our example:

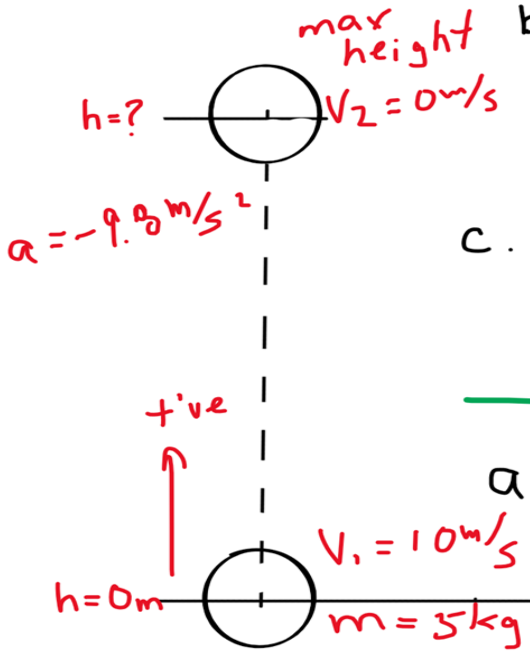
$m = 25\,kg$, $h = 100\,m$

$$E_p = mgh$$
$$= (25)(9.8)(100)$$
$$= 24500\,J$$

units:

$$kg \cdot m/s^2 \cdot m$$
$$= kg\,m^2/s^2 = J$$

A 5 kg ball is thrown straight up in the air at 10m/s. Calculate
a. the initial kinetic energy of the ball
b. the maximum height it travels
c. the potential energy at the top.



b. $\Delta d = \dfrac{v_2^2 - v_1^2}{2a}$ (5)

$= \dfrac{0 - 10^2}{2(-9.8)}$

$= 5.1\,m$

c. $E_g = mgh$

$= (5)(9.8)(5.1)$

$= 250\,J$

$E_k = 0$ (since $V = 0$)

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

$= \frac{1}{2}(5)(10)^2$

$= 250\,J$

$E_g = 0$ (since $h = 0$)