Energy

Sometimes it's potential

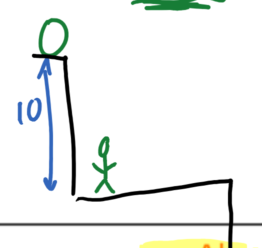
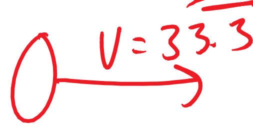
Sometimes it's kinetic

But, it's always conserved.

In this unit we will mainly look at two types of energy -- be aware that there are many other types as well.

- Gravitational
- Electrical
- Wave
- Chemical
- Nuclear
- Elastic
- Thermal

We will be using:

Potential Energy (E_p)	Kinetic Energy (E_k)
The energy stored in an object. 	The energy from movement. 
$mg\Delta h$	$\frac{mv^2}{2}$

Energy is defined as: The ability to do work.

The units of energy is: (Newton)(distance) = Nm = Joule = J

What is the potential energy (E_p) of a 70kg zombie on top of a 50m cliff?

$E_p = mgh$
$= 70(9.8)(50)$
$= 34\ kJ$

What is the kinetic energy (E_k) of that zombie after it falls for 10m?

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

$v_f^2 = v_i^2 + 2ad$
$= 2(-9.8)(-10)$
$v_f = -14\ m/s$

$E_k = \frac{(70)(14)^2}{2}$
$= 6860\ J$

Since we have defined energy to be the ability to do work, we should also define work.

$$w = \Delta E$$

That energy can be any type of energy. Again, in this unit we can expect the questions to be limited to potential and kinetic.

Eg: The Macho Man Randy Savage finds an unsuspecting Arts student and lifts him over his head so that he can body slam him. If the arts student weighs 67kg, and Randy picks him up to a height of 2.3m. What is the work done?

$m = 67 \quad h = 2.3$

$W = \Delta E = \frac{m\Delta v^2}{2} + mg\Delta h$

$\frac{m\Delta v^2}{2} = 0$

$= 67(9.8)(2.3 - 0)$
$= 1510\ J$

The Tesla model X weighs 2,100kg. It can go from 0→ 60mi/hr in 2.8s. What is the work done?

$$\frac{60\,mi}{hr} \cdot \frac{1.602\,km}{1\,mi} \cdot \frac{1\,hr}{3600\,s} \cdot \frac{1000\,m}{1\,km} = 26.7\,m/s$$

$$W = \Delta E = \frac{m\Delta v^2}{2} = \frac{2100(26.7-0)^2}{2} = 750\,kJ$$

This is the SR-71 Blackbird. Made in 1966. Still the fastest plane. Ever.

It can reach Mach 3^{+}.

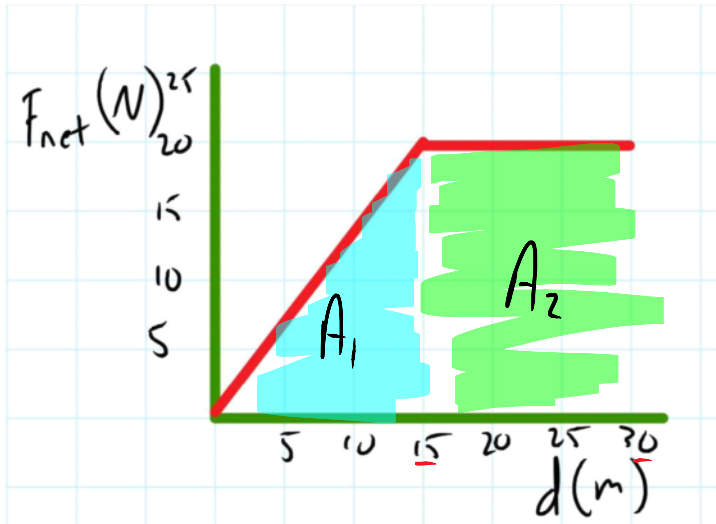
It takes off to a height of 500m. It attains a velocity of 50m/s and has a mass of 77,000kg.

How much work was done?

$$W = \Delta E = \Delta E_p + \Delta E_k$$
$$= mg\Delta h + \frac{m(\Delta v)^2}{2}$$
$$= 77000(9.81)(500) + \frac{77000(50)^2}{2}$$
$$= 474\,MJ$$

The area under a F_{net} vs distance graph will give you the work done.

The graph at right shows how much work Caleb has done. If he started from rest, what is his final velocity.



$$W = A_1 + A_2$$

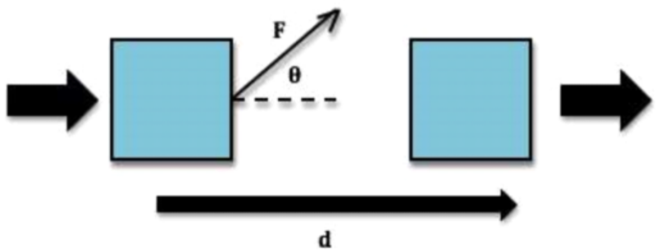
$$= \frac{bh}{2} + bh = \frac{15(20)}{2} + 15(20)$$

$$= 450\ J$$

For simple questions, work can be calculated as the force exerted times the distance travelled. By simple I mean that all of the force is perpendicular. The force is constant throughout the problem. Careful!!! This is a shortcut. Should you use shortcuts?

$w = Fd$

If the work is on an angle:



$w = Fd\cos(\theta)$

Alex pushes the lawnmower every weekend. He uses a force of 50N at an angle of 40°. One strip of his lawn is 7.5m. How much work is done?

$w = 50(7.5)\cos(40)$

$= 287\text{ J}$

$W = Fd\cos\theta$ = Area Under Graph = ΔE

↳ h/v