Forces and Work

Energy can't be created or destroyed, it can only be changed from one type into another type. We call this rule **conservation of energy**.

Work

Work and energy are the same thing. When a force moves something along any distance we say that work has been done and energy has been transformed (energy has been changed from one type to another type). The different kinds of energy that you will have met before are

- **Kinetic**
- **Potential**
- **Light**
- **Sound**
- **Nuclear**
- **Heat**
- **Electrical**
- **Chemical**

For example, if a box is pushed across the floor, work has to be done to overcome the force of friction between the floor and the bottom of the box that is opposing the movement.

How do we calculate the work done?

Energy transformed = work done = applied force x distance

We write this equation as

$$E_w = F \times d$$

Example:
A crate of mass 50 kg is pushed along a floor with a force of 20 N for a distance of 5 m. Calculate the work done.

Solution:
Use

$E_w = F \times d$

$= 20 \times 5$

$\underline{WD = 100 \text{ Nm}}$

But energy transformed = work done

Energy is measured in Joules (J) so Nm must be the same unit as J.

This means we can say that

$E_w = 100$ J

Note that the mass of the crate is not required to answer the question. The mass would be required if we needed to calculate the work done by *lifting* the crate but not by pushing it.

Example:
How far must a 5N force pull a 50g toy car if 30J of energy are transferred?

Solution:
Use

$E_w = F \times d$

Substitute in the known values

$30 = 5 \times d$

so $\underline{d = 6 \text{ m}}$

Example:
A man exerts a force of 2 kN on a boulder but fails to move it.
Calculate the work done.

Solution:
Use

WD = F x d d = 0 because the boulder does not move

= 2000 x 0

so

WD = 0

If an object does not move when the force is applied then no work is done. Work is only done if the object moves.