Work, Energy and Power

Energy

We already know that it appears in a number of different stores and may be transferred from one store to another. But what is energy? **Energy is the ability to do work**.

We can say that the work done is equal to the energy transferred

Work done = energy transferred $\boxed{W = E}$

Work Done

In Physics we say that work is done when a force moves through a distance and established the equation

Work Done = Force x Distance moved in the direction of the force $\boxed{W = Fs}$

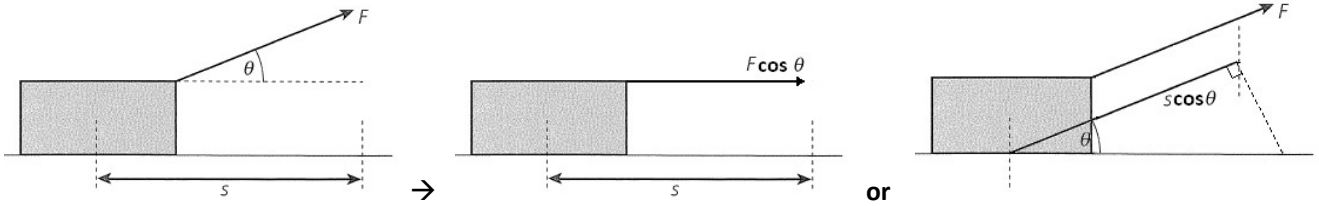
Work Done is measured in Joules, J
Force is measured in Newtons, N
Distance is measured in metres, m

The distance moved is not always in the direction of the force. In the diagram we can see that the block moves in a direction that is θ away from the 'line of action' of the force. To calculate the work done we must calculate the distance we move in the direction of the force or the size of the force in the direction of the distance moved. Both of these are calculated by resolving into horizontal and vertical components.

Work Done = Force x Distance moved in the direction of the force

Work Done = Size of Force in the direction of movement x Distance moved

$\boxed{Work\ Done = Fs\cos\theta}$



Power

Power is a measure of how quickly something can transfer energy. Power is linked to energy by the equation:

$\boxed{Power = \frac{Energy\ Transferred}{time\ taken}}$ $\boxed{P = \frac{\Delta E}{\Delta t}}$

Power is measured in Watts, W
Energy is measured in Joules, J
Time is measured in seconds, s

But Work Done = Energy Transferred so we can say that power is a measure of how quickly work can be done.

$\boxed{Power = \frac{Work\ Done}{time\ taken}}$ $\boxed{P = \frac{\Delta W}{\Delta t}}$

Now that we can calculate Work Done we can derive another equation for calculating power:

We can substitute $W = Fs$ into $P = \frac{W}{t}$ to become $P = \frac{Fs}{t}$ this can be separated into $P = F\frac{s}{t}$.

$\frac{s}{t} = v$ so we can write $\boxed{P = Fv}$

Velocity is measured in metres per second, m/s or ms^{-1}

Efficiency

We already know that the efficiency of a device is a measure of how much of the energy we put in is wasted.

Efficiency = $\frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$ this will give us a number less than 1

Useful energy means the energy transferred for a purpose, the energy transferred into the desired form.

Since power is calculated from energy we can express efficiency as:

Efficiency = $\frac{\text{useful output power of the device}}{\text{input power to the device}}$ again this will give us a number less than 1

To calculate the efficiency as a percentage use the following:

percentage efficiency = efficiency x 100%