# Work and Power

# Power

- In physics, power is defined as the rate of change of work.
- You could also think of it as the amount of energy per second applied.

$$P = \frac{W}{\Delta t}$$

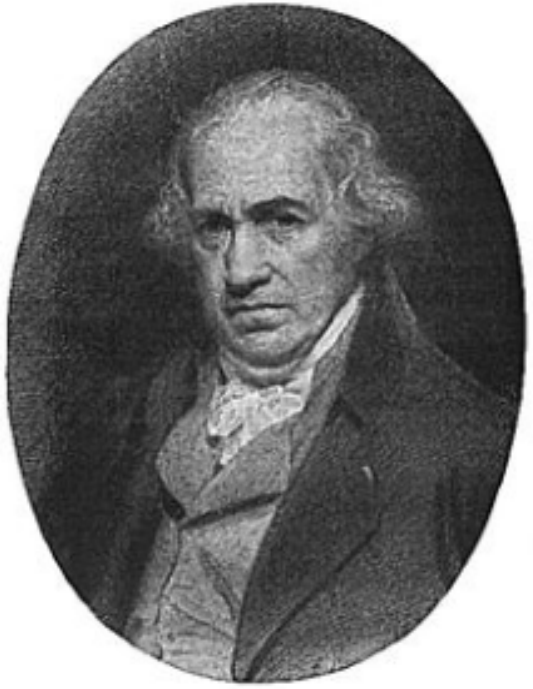
$$P = \frac{\Delta E}{\Delta t}$$

Where
P = power (J/s)
W = work (J)
E = energy (J)
t = time (s)

**The idea of power became important during the age of the first steam engines.**

**Scottish inventor James Watt worked to improve the then experimental steam engine, creating a viable engine from the Newcome engine.**

**This ushered in the Industrial Revolution.**



http://en.wikipedia.org/wiki/Image:Newcomen_atmospheric_engine_animation.gif

**Because horses were used at the time to power machines, the early unit of power was the horsepower.**

**However, because this unit was cumbersome, a new unit for power was named in honor of Watt:**

# 1 J/s = 1 watt = 1 W

**(in metric terms, 1 hp = 746 W)**

**A further formula can be derived using the definition of power and velocity:**

$$P = \frac{W}{\Delta t}$$

$$P = \frac{\vec{F}\vec{d}}{\Delta t}$$

and as $\vec{v} = \vec{d}/t$

$$\boxed{P = \vec{F}\vec{v}}$$

*Note: this derivation does not appear on your formula sheet!

**ex) You lift a 25.0 kg mass to your waist (0.800 m) in 1.20 s. What is your power output?**

**ex) A plane's engine exerts a thrust of $1.20 \times 10^4$ N to maintain a speed of 450 km/h. What power is the engine generating?**