

# Power

**Power** is the amount of **energy** transferred or **work done** by, or to, a **system** every second.

One **joule** of energy transferred in one second = one **watt** of power.

We can calculate the power in a system using the equation:

$$\text{power} = \frac{\text{energy transferred}}{\text{time}}$$

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

$$\text{power} = \frac{\text{work done}}{\text{time}}$$

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

- $P$  = power (unit: watt, W)
- $E$  = energy (unit: joule, J)
- $t$  = time (unit: second, s)
- $P$  = power (unit: watt, W)
- $W$  = work done (unit: joule, J)
- $t$  = time (unit: second, s)

## NAILIT!



Have you noticed that both energy and work done are measured in joules (J)? In physics, work done is just another way of transferring energy between the energy stores of a system. They both cause changes in the system. You can find more about work done in the Forces chapter.

## MATHS SKILLS

You will need to remember and apply the equations on this page.

## WORKIT!

Jasmine was late for school yesterday, so she ran upstairs to her classroom which was 15 m up from the ground floor. It took her 5 seconds. Today, Jasmine is on time, so she walks to her classroom and takes 20 seconds to climb the stairs. What was Jasmine's power output on both days, if her mass is 52 kg? Assume the gravitational field strength is 10 N/kg. (3 marks)

Use the equation for gravitational potential energy to work out the energy as

$$E_p = m g h = 52 \text{ kg} \times 10 \text{ N/kg} \times 15 \text{ m} \\ = 7800 \text{ J (1)}$$

So, her power is:

$$P (\text{running}) = \frac{E_p}{t} = \frac{7800}{5} = 1560 \text{ W (1)}$$

When Jasmine goes upstairs the same amount of energy is transferred from the chemical store associated to her body to the gravity store when she's on top of the stairs.

$$g = 10 \text{ N/kg}$$

$$P (\text{walking}) = \frac{E_p}{t} = \frac{7800}{20} = 390 \text{ W (1)}$$

## CHECKIT!

- You need to boil a glass of water using a microwave oven. Which power rating will be the quickest? Explain your answer.  
a 650 W      b 850 W
- How much energy is transferred by an 11 W light bulb every second when it is turned on?
- An 1100 W electric drill takes 6.3 seconds to drill a hole in a wall. How much energy has been transferred to the kinetic energy store and the thermal energy store in that time?