Y9 Energy

Students should be able to calculate the amount of energy associated with a moving object, a stretched spring and an object raised above ground level.

The kinetic energy of a moving object can be calculated using the equation:

$$kinetic\ energy = 0.5 \times mass \times (speed)^2$$

$$\left[E_k = \frac{1}{2} m v^2\right]$$

kinetic energy, E_k, in joules, J

mass, m, in kilograms, kg

speed, v, in metres per second, m/s

The amount of gravitational potential energy gained by an object raised above ground level can be calculated using the equation:

$$g.p.e. = mass \times gravitational\ field\ strength \times height$$

$$\left[E_p = m\ g\ h\right]$$

gravitational potential energy, E_p, in joules, J

mass, m, in kilograms, kg

gravitational field strength, g, in newtons per kilogram, N/kg
(In any calculation the value of the gravitational field strength (g) will be given.)

height, h, in metres, m

The amount of elastic potential energy stored in a stretched spring can be calculated using the equation:

$$elastic\ potential\ energy = 0.5 \times spring\ constant \times (extension)^2$$

$$\left[E_e = \frac{1}{2} k\ e^2\right]$$

(assuming the limit of proportionality has not been exceeded)

elastic potential energy, E_e, in joules, J

spring constant, k, in newtons per metre, N/m

extension, e, in metres, m

A force does work on an object when the force causes a displacement of the object.

work done = force × distance
(moved along the line of action of the force)

$$[W = F\ s]$$

work done, W, in joules, J

force, F, in newtons, N

distance, s, in metres, m

Power is defined as the rate at which energy is transferred or the rate at which work is done.

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

$$\left[P = \frac{E}{t}\right]$$

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

$$\left[P = \frac{W}{t}\right]$$

power, P, in watts, W

energy transferred, E, in joules, J

time, t, in seconds, s

work done, W, in joules, J

An energy transfer of 1 joule per second is equal to a power of 1 watt.

Students should be able to give examples that illustrate the definition of power eg comparing two electric motors that both lift the same weight through the same height but one does it faster than the other.

Energy can be transferred usefully, stored or dissipated, but cannot be created or destroyed.

Students should be able to describe with examples where there are energy transfers in a closed system, that there is no net change to the total energy.

Whenever there are energy transfers in a system only part of the energy is usefully transferred. The rest of the energy is dissipated so that it is stored in less useful ways. This energy is often described as being 'wasted'.

Unwanted energy transfers can be reduced in a number of ways, for example through lubrication and the use of thermal insulation.

The energy efficiency for any energy transfer can be calculated using the equation:

$$efficiency = \frac{useful\ output\ energy\ transfer}{total\ input\ energy\ transfer}$$

Efficiency may also be calculated using the equation:

$$efficiency = \frac{useful\ power\ output}{total\ power\ input}$$

The main energy resources available for use on Earth include: fossil fuels (coal, oil and gas), nuclear fuel, bio-fuel, wind, hydro-electricity, geothermal, the tides, the Sun and water waves.

A renewable energy resource is one that is being (or can be) replenished as it is used.

The uses of energy resources include: transport, electricity generation and heating.