GCSE Physics Key Facts - Energy

Energy Changes & Energy Storage

Energy can be stored in a number of ways e.g. chemical potential energy (foods and fuels), gravitational potential energy (when objects are lifted against gravity) and elastic potential energy (in objects that are stretched or compressed)

Moving objects have kinetic energy.

Kinetic Energy equation:

$E_k = {}^1/_2\ m\ v^2$

E_k = kinetic energy in Joules, m = mass in kg, v = speed in m/s

Elastic potential energy Equation:

$E_e = ½\ k\ e^2$

assuming limit of proportionality hasn't been exceeded
elastic potential energy, *E*e, in joules, J
spring constant, *k*, in newtons per metre, N/m
extension, *e*, in metres, m

Gravitational potential energy equation:

g.p.e. = mass × gravitational field strength × height
$Ep = m\ g\ h$

gravitational potential energy, *E*p, in joules, J
mass, *m*, in kilograms, kg
gravitational field strength, *g*, in newtons per kilogram, N/kg
,height, *h*, in metres, m

The specific heat capacity of a substance is the amount of energy needed to raise the temperature of 1 kg of the substance by 1^0C

Specific Heat Capacity equation:

$\Delta E = m\ c\ \Delta \vartheta$

change in thermal energy, Δ*E*, in joules, J
mass, *m*, in kilograms, kg
specific heat capacity, *c*, in joules per kilogram per degree Celsius J/kg °C
temperature change, $\Delta\vartheta$, in degrees Celsius, °C

Power is the rate at which energy is transferred or the rate at which work is done

Power Equations:

P = E/t

P = power in Watts, E = energy in Joules, t = time in seconds

Power Equations:

P = W/t

P = power in Watts, W = work done in Joules, t = time in seconds

An energy transfer of 1 Joule per second is the same as a power of 1 Watt

Energy Transfer in a System

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

In all systems, energy is wasted (stored in less useful ways). Wasted energy can be reduced through lubrication and thermal insulation

The higher the thermal conductivity of a material the higher the rate of energy transfer by conduction across the material.

A building cools down at a faster rate if the walls are thinner or if the thermal conductivity of the material is higher.

The more efficient an energy transfer is, the less wasted energy there is. Efficiency can be given as a number between 0 and 1 (0% to 100% efficient)

Recall and use these equations for efficiency:

Efficiency = useful output energy/total input energy

Efficiency = useful power output/total power input

HT only: Energy transfers can be made more efficient e.g. by reducing friction on moving parts of machines using oil or lubricants.

National and Global Energy Resources

The main energy resources available for use on Earth include:
fossil
fuels (coal, oil and gas), nuclear fuel, biofuel, 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

Geothermal energy comes from the energy released by **radioactive substances** deep in earth. Heats up surrounding rocks (often volcanoes). Power stations pump steam down to

Energy resources are used in transport, electricity generation and heating

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Fossil fuels ***Disadvantages*** =Non-renewable, producea **carbon dioxide** (which increases global warming) and **sulphur dioxide** (makes acid rain).	**Nuclear fuel = uranium & plutonium** (nuclear fission.) ***Advantages*** -No pollutant gases, more energy per kg of source, reliable ***Disadvantages*** -Non-renewable; makes radioactive waste (may leak into ground) and accidents could release and spread radioactive material.
Biofuels – made from plant material. ***Advantages*** – renewable; carbon neutral (CO_2 taken in by plants growing = CO_2 produced when plants burn); no acid rain, ***Disadvantages*** - less space to grow crops for food-food shortages, destruction of habitats to grow plants, slower-crops must grow	**Solar panels Advantages** – renewable, energy is free, useful for remote places or when only small amount needed, no running cost, no fuel is burnt. **Disadvantages** – expensive to buy, need lots of them and sunshine (i.e. not at night) to make enough power.
Geothermal energy comes from the energy released by **radioactive substances** deep in earth. Heats up surrounding rocks (often volcanoes). Power stations pump steam down to these which drives **turbines**.	**Water & wind** can turn turbines directly (e.g. tidal ,wave, hydroelectric power). ***Advantages*** = Renewable ***Disadvantages*** = don't produce a constant supply of electricity, often noisy, unsightly, may destroy habitats