ENERGY

energy stores & systems

- When energy is transferred to an object it is stored in an energy store
  - Thermal
  - Kinetic
  - Gravitational potential
  - Elastic potential
  - Chemical
  - Magnetic
  - Electrostatic
  - Nuclear
- Energy can be transferred:
  - Mechanically (force doing work)
  - Electrically (work done by moving charges)
  - Heating
  - Radiation (light or sound)
- A system is a single object or group of object
- When system changes, energy is transferred
- Can be transferred into or away from system, between objects in system or between different energy stores
- Closed systems-where no matter or energy enters or leaves, net change in total energy is always zero
- Work done = energy transferred

KINETIC & POTENTIAL STORES

- Anything moving has energy in its kinetic energy store
- Energy transferred to store when speeding up
- Energy transferred away when slowing down
- Greater mass & greater speed = more energy in store

EK = 0.5MV^2
KINETIC ENERGY(J) = 0.5 X MASS(KG) X SPEED^2 (M/S)^2

- Lifting object in gravitational field requires work
- This causes a transfer of energy to gpe store of object
- Higher it's lifted more energy is transferred to store

EP = MGH
GPE(J) = MASS(KG) X GRAVITATIONAL FIELD STRENGTH(N/KG) X HEIGHT(M)

- When object falls, energy in gpe store is transferred to kinetic energy store
- Energy lost from gpe store = energy gained in kinetic energy store (when there's no air resistance)
- Air resistance acts against all falling objects - so some energy is transferred to other energy stores

- Stretching or squashing an object transfers energy to its elastic potential energy store
- So long as the limit of proportionality has not been exceeded

energy in ep store can be found using:

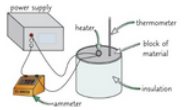
EE = 0.5KE^2
ELASTIC POTENTIAL ENERGY(J) = 0.5 X SPRING CONSTANT(N/M) X EXTENSION(M)

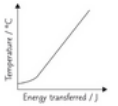
SPECIFIC HEAT CAPACITY

- The amount of energy needed to raise the temperature of 1kg of a substance by 1°C
- More energy needs to be transferred to thermal energy store of materials to increase their temperature than others
- Materials that need to gain lots of energy in their thermal energy stores to warm up also transfer lots of energy when they cool down -> they can 'store' lots of energy

- To investigate specific heat capacity:

1 Block of material with two holes in it (for heater and thermometer)
2 Measure mass of block then wrap in insulating layer to reduce energy transferred from block to surroundings
3 Insert heater and thermometer
4 Measure initial temperature of block then set pd of power supply to 10V
5 Turn on power supply and start a stopwatch
6 When power is turned on current in circuit does work on heater, transferring energy electrically from power supply to heater's thermal energy store
7 This energy is then transferred to material's thermal energy store by heating, causing block's temperature to increase
8 As block heats up, take readings of temperature and current every minute for 10 minutes (current should not change)
9 Turn off power supply
10 Using measurements of current and pd, calculate power supplied to heater, then calculate energy transferred to heater
11 Assuming all energy supplied to heater was transferred to block, you can plot a graph of energy transferred to thermal energy store of block against temperature
12 Finding gradient will give you specific heat capacity of material
13 Repeat experiment with different materials to compare





energy & power

CONSERVATION OF ENERGY & POWER

- Energy can be transferred usefully, stored or dissipated but can never be created or destroyed
- When energy is transferred between stores not all energy is transferred usefully into the store you want it to go to
- Some energy is always dissipated when an energy transfer takes place
- Power is rate of energy transfer/rate of doing work
- A powerful machine is one which transfers a lot of energy in a short space of time

P=E/T OR P=W/T
POWER(W) = ENERGY TRANSFERRED(J)/TIME(S) OR WORK DONE(J)/TIME(S)

CONDUCTION & CONVECTION

- Conduction is the process where vibrating particles transfer energy to neighbouring particles
- Energy transferred to object by heating is transferred to thermal store of object
- This energy is shared across kinetic energy stores of particles in object
- These particles vibrate more and collide with each other
- Energy is transferred between colliding particles' kinetic stores -> conduction
- Process continues until energy is transferred to other side where it's then transferred to kinetic store of surroundings
- Thermal conductivity is measure of how quickly energy is transferred through a material

- Convection is where energetic particles move away from hotter to cooler regions
- Happens in liquids & gases as particles are able to move so when region is heated particles move faster and space between them increases which decreases density of region
- Because liquids and gases can flow, warmer less dense regions rise above cooler denser regions
- If heat source is constant, convection current is created
- Radiators create convection currents in air of rooms
- Energy transferred from radiator to nearby air particles by conduction
- Air by radiator becomes warmer & less dense as particles move faster
- Warm air rises and is replaced by cooler air which is heated by radiator
- Warm air transfers energy to surroundings, then cools becomes denser and sinks and then is heated again

efficiency

REDUCING ENERGY WASTE

- Lubrication
  - Oil in a motor
  - Reduces friction
  - So less energy is lost (as heat) through friction
- Thermal Insulation
  - Double Glazing
  - Less useful thermal energy lost

- The efficiency is the ratio of the useful work done by a machine, engine, device, etc, to the energy supplied to it
- Often expressed as a percentage

EFFICIENCY = USEFUL POWER/ENERGY OUTPUT / TOTAL POWER/ENERGY INPUT

energy sources

RENEWABLE

- Infinite resource
- Sometimes unreliable
- Less environmental impact

Hydroelectric:
- Requires flooding of valley by building a big dam water allowed out through turbines
- No pollution
- Flooding affects environment (plant decay releases methane & CO2, habitat loss)
- Reliable
- Small scale

Geothermal:
- Volcanic areas or where hot rocks are near to surface (limited amount of suitable locations)
- Slow decay of radioactive elements deep inside the Earth
- Reliable
- Little damage to environment
- Used for electricity or heating buildings
- Construction of plant is high

Solar:
- Often used in remote places
- Small scale
- No pollution
- Only work in daytime
- Initial costs are high but no fuel costs & minimal running costs

Tidal:
- Tidal barrages across river estuaries
- No pollution
- Affects habitats
- Fairly reliable
- Initial costs fairly high, but no fuel costs & minimal running costs

Biofuel:
- Burnt to produce electricity
- Carbon neutral
- Fairly reliable
- Cost to refine is very high

Wave:
- Turbines on coast with generators
- No pollution
- Habitats affected
- Fairly unreliable
- Initial costs high, no fuel costs & minimal running costs
- Small scale

Wind:
- Wind turbines placed in exposed areas eg moors, coasts
- Each turbine has generator inside, blades turn generator & produce electricity
- No harmful emissions
- Visual & noise pollution
- Initial costs are high, but no fuel costs & minimal running costs
- No permanent damage to landscape

NON RENEWABLE

- Finite resource
- Provide most of our energy
- Reliable
- Enough to meet current demand
- Slowly running out
- Expensive to set up but cheaper to run so cost effective

Nuclear energy:
- No environmental impacts
- Produces lots of energy (nuclear fission)
- Nuclear waste is dangerous and difficult to dispose of
- Nuclear fuel is relatively cheap but overall cost is high
- Nuclear radiation is dangerous to humans

Fossil fuels (coal oil gas):
- Fossil fuels release CO2 -> greenhouse effect
- Fossil fuels release SO2 -> acid rain
- Coal mining ruins landscape and destroys habitats
- Oil spillages affect ecosystems