Physics 1: Energy

Section 1: Energy stores and methods of transfer

1 Chemical store	Energy stored as chemicals waiting to **react.**
2 Kinetic store	Energy stored in objects that **move.**
3 Gravitational Potential store	Energy stored in objects raised up against the force of **gravity.**
4 Elastic Potential store	Energy stored in an object that have been **stretched.**
5 Internal store	Energy stored in the movement of particles. It is a combination of the **kinetic** energy of the particles and the **potential** energy of particles that are apart from each other. Can be modified by **heating** or **cooling**.
6 Nuclear store	Energy stored in the **nuclei** of atoms that can fuse (nuclear fusion) or split (nuclear fission).
7 Magnetic store	Energy stored in **magnets** that are **attracting** or **repelling.**
8 Electrostatic store	Energy stored in **electric charges** that are **attracting** or **repelling**.
9 Mechanical transfer	Energy transferred when a **force moves through a distance**.
10 Electrical transfer	Energy transferred when a **charge moves**.
11 Radiation transfer	Energy transferred by **electromagnetic radiation**.
12 Heat transfer	Energy transferred when an object is **heated.**

Section 2: Equations to learn

Calculation	Equation	Symbol equation	Units
13 Kinetic energy store	Kinetic energy = 0.5 x mass x velocity^2	$E_k = 0.5\ m\ v^2$	Energy – Joules (J) Mass – kilograms (kg) Velocity – metres per second (m/s)
14 Gravitational potential energy store	Gravitational potential energy = mass x gravitational field strength x height	$E_p = m\ g\ h$	Energy – Joules (J) Mass – kilograms (kg) Gravitational field strength – Newtons per kilogram (N/kg) Height – metres (m)
15 Power	Power =energy transferred ÷ time	$P = \frac{E}{t}$	Power – Watts (W) Energy transferred – Joules (J) Time – seconds (s)
16 Power	Power = work done ÷ time	$P = \frac{W}{t}$	Power – Watts (W) Work done – Joules (J) Time – seconds (s)
17 Efficiency	Efficiency = $\frac{\text{useful energy output}}{\text{total energy input}}$		Energy – Joules (J)
18 Efficiency	Efficiency = $\frac{\text{useful power output}}{\text{total power input}}$		Power – Watts (W)

Section 3: Energy Resources

Resource	Renewable?	Uses	Advantages	Disadvantages
19 Fossil Fuels	Non-Renewable	Electricity, transport, heating	**Reliable** – electricity can be generated all of the time. Relatively **cheap** way of generating electricity.	Produces **carbon dioxide**, a greenhouse gas that causes **global warming.** Can produce **sulphur dioxide**, a gas that causes **acid rain.**
20 Nuclear Fuel	Non-Renewable	Electricity	Produces **no carbon dioxide** when generating electricity. **Reliable** – electricity can be generated all of the time.	Produces **nuclear waste** that remains **radioactive** for thousands of years. **Expensive** to build and **decommission** power stations.
21 Bio Fuel	Renewable	Heating, electricity	**Carbon neutral**. **Reliable** – electricity can be generated all of the time.	Production of fuel may damage ecosystems and create a **monoculture**.
22 Wind	Renewable	Electricity	**No CO_2** produced while generating electricity.	**Unreliable** – may not produce electricity during **low wind**. **Expensive** to construct.
23 Hydroelectricity	Renewable	Electricity	**No CO_2** produced while generating electricity.	Blocks rivers stopping **fish migration**. **Unreliable** – may not produce electricity during **droughts**.
24 Geothermal	Renewable	Electricity, heating	Does not damage **ecosystems**. **Reliable** source of electricity generation.	Fluids drawn from ground may contain **greenhouse gases** such as **CO_2** and **methane**. These contribute to **global warming**.
25 Tidal	Renewable	Electricity	**No CO_2** produced while generating electricity.	**Unreliable** – **tides vary**. May damage **tidal ecosystem** e.g. mudflats.
26 Waves	Renewable	Electricity	**No CO_2** produced while generating electricity.	**Unreliable** – may not produce electricity during **calm** seas.
27 Solar	Renewable	Electricity, heating	**No CO_2** produced while generating electricity.	**Unreliable** – does not produce electricity at **night**. Limited production on **cloudy** days. **Expensive** to construct.

Section 4: Key terms

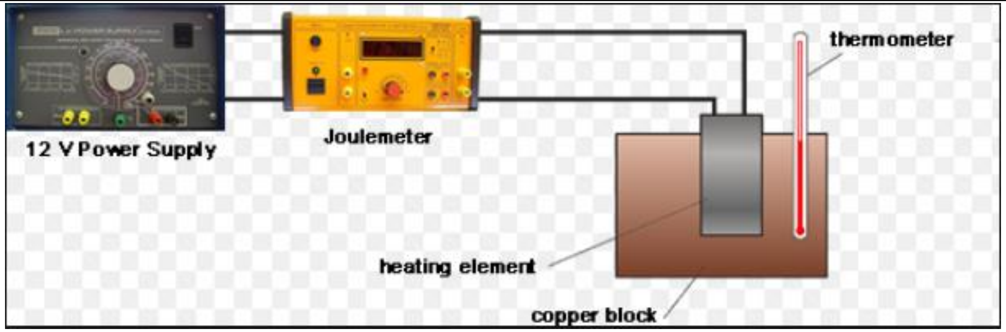
28 Dissipation	Energy becoming **spread out** instead of in a concentrated store. "Wasted" energy.
29 Lubrication	A method of reducing unwanted energy transfers by application of a **lubricant** (e.g. **oil**) to **reduce friction**. Occurs in machines.
30 Insulation	A method of reducing energy transfers by the use of **insulators** (non-conductive material). Occurs in buildings.
31 Conservation of energy	The law that states that **energy cannot be created or destroyed**.
32 Specific heat capacity	The energy needed to raise **1kg** of a material by **1^{o}C**.

Section 5: Equations to use

Calculation	Equation	Symbol equation	Units
33 Elastic Energy	Elastic Energy = 0.5 spring constant x extention^2	$E_k = 0.5\ k\ e^2$	Energy – Joules (J) Extension – meters (m) Spring Constant – Newtons per metre (N/m)
34 Specific Heat Capacity	Thermal Energy = mass x specific heat capacity x temperature change	$E = m\ C\ \Delta\Theta$	Energy – Joules (J) Mass – Kg Temperature - ◦C S.H.C - J/Kg◦C

Section 6: Specific Heat Capacity Required Practical

35 Equipment



36 Method

1. Weigh the block on the balance. Connect the immersion heater to the 12-volt supply in series with a Joulemeter.
2. Insert the immersion heater in the aluminium block and place the thermometer into its hole. Before switching on for the experimental run, wait for five minutes before taking the temperature of the block. Switch on the heater and start the clock.
3. Leave the heater switched on until a rise of about 10°C is achieved. Switch off the heater and continue to monitor the temperature until it begins to fall. Note temperature.
4. Record the number of Joules off the Joulemeter.
5. Use the formula $E = m\ C\ \Delta\Theta$ to calculate the specific heat capacity of the block.
6. Repeat for other materials.

37 Possible causes of error and improvements

- Not all of the heat from the immersion heater will be heating up the aluminium block, some will be lost to the surroundings.
- More energy has been transferred than is needed for the block alone, as some is transferred to the surroundings. This causes the calculated specific heat capacity to be higher than for one kilogram (kg) of aluminium alone.

Section 7: Improving the Efficiency of Energy Transfers

38 Reducing Friction

- When on object moves past another , frictional forces act against the motion of the object.
- This causes some of the energy to be wasted as heat and the energy transfer is less efficient.
- The effect of friction can be reduced by lubricating the surfaces something like oil.

39 Thermal conductivity

Thermal conductivity is a measure of how easily energy is transferred through a material by conduction.

Materials with low thermal conductivity, allow little energy to be transferred through them. These materials make good insulators.

40 Investigating Insulators – SEPARATES ONLY

1. Place a small beaker into a larger beaker.
2. Fill the small beaker with hot water from a kettle.
3. Put a piece of cardboard over the beakers as a lid. The lid should have a hole suitable for a thermometer.
4. Place a thermometer into the smaller beaker through the hole.
5. Record the temperature of the water in the small beaker and start the stopwatch.
6. Record the temperature of the water every 2 minutes for 20 minutes.

Repeat steps 1-6, each time packing the space between the large beaker and small beaker with the chosen insulating material.

7. Plot a graph of temperature (y-axis) against time (x-axis).