Name:_____

Year 9 Energy

	LESSON CONTENT	☺	😐	☹
1	Energy stores			
2	Energy transfers and Units			
3	Conservation of energy			
4	Efficiency			
5	Sankey diagrams			
6	Power			
7	Heat loss in homes			
8	Payback time			

Y9 ENERGY

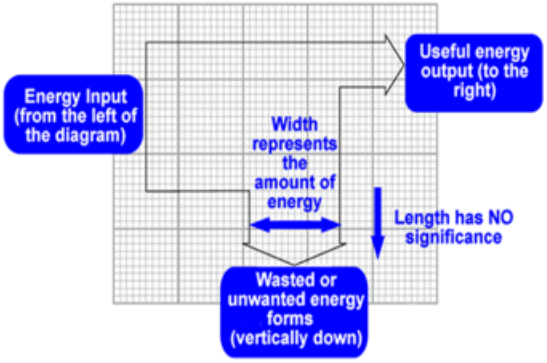
ENERGY STORES
- Thermal (or internal)
- Chemical
- Kinetic
- Gravitational potential
- Elastic potential
- Magnetic
- Electrostatic

ENERGY TRANSFER
Energy is transferred between energy stores:
- Mechanically (a force causing an object to move)
- Electrically (moving charges due to a potential difference)
- Heating (due to a temperature difference)
- Radiation (due to EM waves, e.g. light and mechanical waves, e.g. sound)

LAW OF CONSERVATION
- Energy CANNOT be created or destroyed; it can only be transferred usefully, stored or dissipated from one store to another.
- There is no net change in the energy in a CLOSED SYSTEM. ← Specific name for an object
- Mechanical work → results in an **INCREASE in temperature** or noise.
- Energy is **DISSIPATED** when this heat/noise is transferred into the **INTERNAL ENERGY STORE** of the **SURROUNDINGS**.
- These are stored in smaller and smaller amounts → NOT easy to recover / transfer to a useful form and so are **WASTED** → results in a very small INCREASE in temperature of the surroundings.

ENERGY TRANSFER BY DOING WORK
- **Throwing a ball upwards:** Force from a person does work. Energy is transferred from the CHEMICAL STORE of the person to the KINETIC STORE of the ball.
- **A ball is dropped:** Energy is transferred from the GRAVITATIONAL STORE to the KINETIC STORE. The gravitational force does work (MECHANICALLY).
- **A car braking to slow down:** The friction on the brakes does work. Energy is transferred from the car's KINETIC STORE to the THERMAL STORE of the surroundings.

A Sankey Diagram - a 'to scale' diagram representing energy transfers



ENERGY TRANSFER BY HEATING
- **A kettle boiling:** Water = system. Energy is transferred by heating to the water's THERMAL STORE.
- **A 2 object system** (water and heating element). Energy is transferred to the THERMAL STORE of the heating element ELECTRICALLY. This is then transferred to the THERMAL STORE of the water.

MORE ENERGY TRANSFERS
- **Changing motion – a bung on a string:** Kinetic energy store (string) → Kinetic energy store (bung). String doing work on the bung – MECHANICALLY.
- **Completing a circuit – a circuit with a bulb:** Chemical potential energy store (battery) → Thermal store (bulb). Energy is transferred to the THERMAL STORE bulb, ELECTRICALLY and by RADIATION (due to EM waves - light).
- **Stretched elastic band released:** Elastic energy store → Kinetic energy store – MECHANICALLY.

Units of energy: Joules (J)
1 kJ = 1000 J
kJ → J (x 1000)

EFFICIENCY = USEFUL OUTPUT ENERGY (J) / TOTAL INPUT ENERGY (J)
* Efficiency is less than 1.0 or 100% *

Y9 ENERGY

POWER (W) = ENERGY (J) / TIME (s)

1W = 1J/s
1 kW = 1000 W
1 kJ = 1000 J
hours → minutes → seconds
x60 x60

1. **Equation**
2. **Identify the variables**
3. **Substitution**
4. **Rearrange**
5. **Answer**
6. **Units**

Power calculations:
Calculate the power of a car that uses **6600J** of chemical energy store in **3s**.
- Power = Energy / Time
- Power = 6600J / 3s
- Power = **2200W**

Calculate the power of a person that does **8kJ** of work in **4 hours.**
- Power = Energy / Time
- Power = (8 kJ x 1000) / (4 h x60 x60)
- Power = 8000J / 14400 s
- **Power = 0.56 W (2 s.f.)**

Calculate the energy used by a **800W** washing machine in **1 minute**.
- Power = Energy / Time
- 800W = Energy / (1 min x 60)
- Energy= 800 W x 60
- **Energy = 48000 J (2 s.f.)**

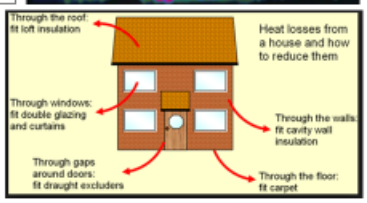
*** Remember to convert all variables into SI units and rearrange the equation where necessary ***

PAYBACK TIME (Years) = COST OF INSTALLATION (£) / ANNUAL SAVING (£)

THERMOGRAM: Shows the distribution of heat over the surface of a house.
- White, yellow and red areas: WARMEST → worst insulated
- Blue and green areas: COOLEST → best insulated

Poorly insulated house loses MORE ENERGY → COSTS MORE to heat → more pollution (carbon dioxide) created.

Factors that need to be considered when insulating a home?
- Where heat is lost from
- Cost
- Payback time
- Availability of materials
- Benefit and feasibility



WHERE LOST	ANNUAL SAVING (£)	METHOD OF INSULATION	COST OF INSTALLATION (£)	PAYBACK TIME (YEARS)
roof	250	fibre-glass in loft	300	300 / 250 = 1.2
walls	850 / 2.9 = 293	foam filled cavity	850	2.9
windows	100	double glazing	100 x 45 = 4500	45
doors	150	draught proofing	5	5 / 150 = 0.01

WORD	MEANING
Energy	Energy enables something to do physical work involving the application of a force.
Energy store	When energy is in one form or part of a system e.g. an object high up, or a stretched spring. Often referred to as potential energy.
System	An object or a group of objects.
Energy transfer	Process in which energy is moved from one store to another.

Chemical energy	The energy associated with a fuel.
Kinetic energy	The energy of a moving object.
Gravitational potential energy	The energy stored in an object that is raised above the ground.
Elastic potential energy	Energy that is stored in an object as a result of the object being stretched or compressed.
Thermal energy	Energy associated with a heated object.
Mechanical / physical energy	Energy due to an object's motion (kinetic) or position (potential).
Law of conservation of energy	The idea that energy cannot be created or destroyed, only transferred from one store to another.
Useful energy	Energy transferred in the desired store to do work.
Wasted energy	Energy transferred in a store that is not wanted.
Energy dissipation	Transfer of energy from a device as unwanted forms.
Joules (J)	SI unit of energy, symbol J
Kilojoule (kJ)	1000J is equivalent to 1 kJ
Sankey diagram	A graphic illustration / flow diagram of energy transfers that take place in a system. The width of the arrows is proportional to the size of the energy store.
Efficiency	Useful output energy transfer divided by the total input energy transfer – may be expressed as a percentage or decimal.
Power	The rate at which energy is transferred. It is the amount of energy moved from one store to another per unit time. **(P = E/t)**
Watt (W)	Unit of power (1kW = 1000W)
Payback time	The time it takes to save (in reduced electricity bills) the amount of money spent on installing a renewable resource for generating electricity. **(Payback time = cost of installation / annual saving)**
Insulation	Process of keeping heat, sound or electricity from spreading. It is also the material used to reduce the rate of heat transfer.
Draught excluders	A device (such as a strip of wood, or a long cylindrical cushion) placed at the bottom of a door to keep out draughts.
Cavity-wall insulation	Used to reduce heat loss through a cavity wall by filling the air space with a material (e.g. mineral wool or foam) that inhibits heat transfer.
Double glazing	Windows which have two layers of glass with a space between them, designed to reduce loss of heat and exclude noise.
Loft insulation	A material (e.g. fibre glass) that is laid across the loft to reduce the rate of heat transfer out of the roof.

EQUATIONS
Efficiency = Useful output energy transfer (J) / Total input energy transfer (J)
Power (W) = Energy (J) / Time (s)
Payback time (years) = Cost of installation (£) / Annual saving (£)