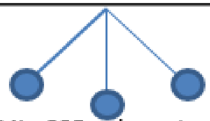
P1: Conservation and Dissipation of Energy Part A Knowledge Organiser

Energy stores	•Unit of energy is Joules, J •Energy can be stored in a variety of different energy stores and can be transferred from one store to another: •Chemical, kinetic, gravitational potential, elastic potential, thermal
The Law of Conservation of Energy	•Energy cannot be created or destroyed
Pendulum energy changes	Max GPE as highest  Max GPE as highest •Min GPE as lowest •Max KE as most GPE transferred to KE store
Closed system	•A system where no energy transfers take place into or out of the energy stores of the system.
Work	•Work is done on an object when a force causes the object to move
Energy and work	•Energy transferred = Work done
Work and friction	•Work need to be done to overcome friction between objects. •This is transferred as energy to the thermal energy stores of the objects that rub together and to the surroundings.
Examples of work overcoming friction	• Rubbing hands together • Brake pads/discs • Meteorites
Gravitational potential energy store	•Increases as an object is moved higher, decreases as an object is moved lower. •Work is done on the object against the gravitational force acting on it to move it higher.

Kinetic energy store	•The energy an object has because it is moving •Depends on the speed and mass of an object. •Faster = more KE •Heavier = more KE
Elastic potential energy store	•When work is done to stretch an elastic object, the energy is transferred to the EPE store of the object. •Bigger extension (stretch) = more EPE stored •Higher spring constant = more EPE stored •EPE = 0.5 x spring constant x extension^2 •E_e = 0.5 x k x e^2 *(given in exam)*

Key Equations To Learn	
Work Done, W	Work Done = Force x Distance W = F x s
Gravitational Potential Energy, E_p	GPE = Mass x Gravitational Field Strength x Height $E_p = m \times g \times \Delta h$
Kinetic Energy, E_k	KE = 0.5 x mass x speed^2 E_k = = 0.5 x m x v^2

Year 9 – Physics / P1

P1: Conservation and Dissipation of Energy Part B Knowledge Organiser (F)

Useful Energy	•Energy transferred to where it is wanted in the way it is wanted •Example: Electrical energy transferred to light energy in a light bulb.
Wasted Energy	•Energy that is not usefully transferred. •Example: Electrical energy transferred to thermal energy in a light bulb. •Wasted energy in machines is caused by friction, air resistance, electrical resistance and noise.
Dissipation	•Wasted energy is transferred to the internal energy of the surroundings and gets spread out. •Dissipated energy gets less and less useful the more it is spread out.
Efficiency	•How much of the energy transferred to a system is transferred usefully. •Can be a decimal (e.g. 0.25) or a percentage (e.g. 25%). •No device is ever more than 100% efficient → energy cannot be created so you can't get more out than you put in!
Electrical Appliance	•A device that transfers electrical energy into useful energy e.g. TV, toaster, motor, heater, kettle. •E.g. Lightbulb: Energy transferred usefully as light energy. The filament gets hot so energy is wasted as it gets transferred as thermal energy to the surroundings. •E.g. Kettle : Energy transferred to the thermal energy store of the water. Energy is wasted as the actual kettle gets heated. •Appliances are designed to be as efficient as possible to avoid wasting energy.

Power, P	•How much energy is transferred per second. •Measured in Watts, W. •More powerful device = more energy transferred per second.
Power and Efficiency	•Power can be used to work out efficiency because power is a rate of energy transfer. •Useful Power output = useful energy transferred per second. •Total power input = energy transferred per second. •Can also be a decimal or a percentage.
Wasted Power	•Power wasted = total power in – useful power out.

Key Equations To Learn	
Efficiency	Useful output energy ÷ Total input energy
Power, P	Power = Energy ÷ Time $P = E \div t$
Efficiency	Efficiency = Useful power out ÷ Total power in

Year 9 – Physics / P1 Foundation

P1: Conservation and Dissipation of Energy Part B Knowledge Organiser (H)

Useful Energy	•Energy transferred to where it is wanted in the way it is wanted •Example: Electrical energy transferred to light energy in a light bulb.
Wasted Energy	•Energy that is not usefully transferred. •Example: Electrical energy transferred to thermal energy in a light bulb. •Wasted energy in machines is caused by friction, air resistance, electrical resistance and noise.
Dissipation	•Wasted energy is transferred to the internal energy of the surroundings and gets spread out. •Dissipated energy gets less and less useful the more it is spread out.
Efficiency	•How much of the energy transferred to a system is transferred usefully. •Can be a decimal (e.g. 0.25) or a percentage (e.g. 25%). •No device is ever more than 100% efficient → energy cannot be created so you can't get more out than you put in!
Improving efficiency (H)	•Friction causing heating → lubricate moving parts •Resistance in circuits causing heating→ use wires with the lowest resistance possible •Air resistance/drag → streamlining •Noise → tighten loose parts to reduce vibration
Electrical Appliance	•A device that transfers electrical energy into useful energy e.g. TV, toaster, motor, heater, kettle. •E.g. Lightbulb: Energy transferred usefully as light energy. The filament gets hot so energy is wasted as it gets transferred as thermal energy to the surroundings. •E.g. Kettle : Energy transferred to the thermal energy store of the water. Energy is wasted as the actual kettle gets heated. •Appliances are designed to be as efficient as possible to avoid wasting energy.

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Key Equations To Learn	
Efficiency	Useful output energy ÷ Total input energy
Power, P	Power = Energy ÷ Time P = E ÷ t
Efficiency	Efficiency = Useful power out ÷ Total power in

Year 9 – Physics / P1 Higher

P2: Energy Transfer By Heating Knowledge Organiser

Thermal conductivity	•The rate at which thermal energy is transferred through a material. •The higher the rate of thermal conductivity of a material, the more energy is transferred through it per second •Metals have the highest thermal conductivity- they are the best conductors
Insulator	•A material that has a low thermal conductivity •Fibreglass and wool are good examples of insulators •Energy transfer through insulators is as low as possible •Thick layers of insulators work best to reduce the rate of energy transfer
Specific Heat Capacity, c	•The amount of energy needed to to change the temperature of 1kg of a substance by 1°C •Measured in J/ kg °C •The higher the SHC, the more energy needed to raise its temperature •Use $c = \Delta E \div (m \times \Delta\theta)$ to find the SHC of a material •Heavier objects increase in temperature more slowly when heated.
Storage heater	•These have special bricks of material with a high SHC inside •They are heated overnight when electricity is less expensive •The energy is released slowly over the course of the day.
Solar panels	•Absorb IR energy from the Sun •This can be used to heat water directly •A solar cell panel generates electricity •This means we need to use less electricity or gas to heat our houses •Fitted on South facing roof so that it absorbs as much IR as possible over the day

Cavity Wall Insulation	•Reduces the rate of energy transfer through the outer walls of a house •The cavity is the space between two layers of the wall of the house •The insulation is a foam that is pumped into the cavity and traps air in small pockets •The foam is a better insulator than the air it replaced, so reduces the rate of energy transfer by conduction through the walls.
Double Glazing	•Have two panes with a layer of dry air or a vacuum between them •Reduces the rate of energy transfer by conduction as dry air is a good insulator •A vacuum also reduces the rate of energy transfer by convection as there are no particles in a vacuum •Thicker panes of glass have lower thermal conductivity
Aluminium foil behind radiators	•Reduces energy transfer by radiation as IR energy from the heater is reflected back into the room away from the wall

Key Equations To Learn	
Energy Transferred	Energy transferred = mass x SHC x temp change $\Delta E = m \times c \times \Delta\theta$

P2: Energy Transfer By Heating Knowledge Organiser (Triple)

Thermal conductivity	•The rate at which thermal energy is transferred through a material. •The higher the rate of thermal conductivity of a material, the more energy is transferred through it per second •Metals have the highest thermal conductivity- they are the best conductors
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Specific Heat Capacity, c	•The amount of energy needed to to change the temperature of 1kg of a substance by 1^0C •Measured in J/ kg ^{0}C •The higher the SHC, the more energy needed to raise its temperature •Use $c = \Delta E \div (m \times \Delta\theta)$ to find the SHC of a material •Heavier objects increase in temperature more slowly when heated.
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Aluminium foil behind radiators	•Reduces energy transfer by radiation as IR energy from the heater is reflected back into the room away from the wall
Infrared Radiation	•All objects emit and absorb IR radiation •The hotter the object, the more IR it emits in a given time. •At a constant temperature, an object absorbs and emits radiation at the same rate. •Objects at constant temp emit radiation across a continuous range of wavelengths. •The intensity of the radiation emitted depends on the temperature of the object, i.e. the hotter the object the higher the peak intensity

Key Equations To Learn	
Energy Transferred	Energy transferred = mass x SHC x temp change $\Delta E = m \times c \times \Delta\theta$

P2: Energy Transfer By Heating Knowledge Organiser (Triple)

Black Body Radiation	•A perfect black body is an object that absorbs all of the radiation incident on it. •A perfect black body doesn't reflect or transmit any radiation. •Black Body radiation is the radiation emitted by a perfect black body. •Good absorbers are also good emitters, so perfect black bodies are the best possible emitters of IR radiation.
Radiation and Earth's Temperature	•The Earth's temperature is affected by many things. These include the absorption of IR radiation from the Sun, and the emission of IR radiation from the Earth's surface and atmosphere. •IR from the Sun can be reflected back into space from the Earth's surface, absorbed by the Earth's surface or absorbed by the Earth's atmosphere •IR can also be emitted from the Earth's surface and from the Earth's atmosphere into space.

Key Equations To Learn	
Energy Transferred	Energy transferred = mass x SHC x temp change $\Delta E = m \times c \times \Delta\theta$

P3 Energy Resources Knowledge Organiser

Power stations	•Electricity is generated in power stations •In fossil fuel power stations, coal, oil or natural gas are burned. •Fossil fuels are non-renewable energy resources	Hydroelectric power	•Water is stored in reservoirs high up. When it is released the water flows down and turns the generators at the bottom of the hill •A renewable energy resource
Bio fuels	•Fuels that come from living or recently living sources e.g. Animal waste, ethanol from fermented sugar cane, methane from decaying rubbish or woodchip •Renewable energy resources •Carbon neutral because the amount of carbon dioxide released when the fuel is burned had already been taken in by the organism when living.	Tidal power	•Water from high tide is trapped behind a barrage and then released back into the sea. It turns generators as it flows over them. •A renewable energy resource.
Nuclear fuel	•Uranium and plutonium are nuclear fuels •Non-renewable energy resource •They release heat energy when they undergo nuclear fission (splitting up) and this heat energy is used to heat the water in a nuclear power station •Advantages: no carbon dioxide emissions, lots of energy transferred per kg of uranium than from fossil fuels •Disadvantages: the used fuel rods contain radioactive waste which stay radioactive for centuries and are difficult to store safely, accidents in a nuclear reactor could release radioactive material into the environment.	Solar energy	•Solar cells use light energy from the Sun to generate electricity •A renewable energy resource •Advantages: low/no running cost, no greenhouse gas emissions, useful in remote places or when small amounts of electricity are needed •Disadvantages: expensive to buy, need lots of solar cells to generate enough electricity to be useful, unreliable in cloudy areas •Solar heating panels use energy from the Sun to heat water for hot water in houses
Wind power	•Wind turns a wind turbine, which turns a generator to generate electricity. •Renewable energy resource •Advantages: no greenhouse gas emissions •Disadvantages: only generate electricity when there is wind, have to be placed carefully to reduce noise and visual pollution	Geothermal energy	•Radioactive substances in the Earth release heat energy which heats the rock above. Water is pumped down and heated to produce steam to turn generators. •A renewable energy resource •Advantages: no greenhouse gas emissions, cheap to run •Disadvantages: Expensive to set up
Wave power	•Uses waves to move a floating generator move up and down to generate electricity •Renewable energy resource •Advantages: no greenhouse gas emissions •Disadvantages: don't produce a constant supply of electricity, difficult to connect to the shore with cables, can disrupt tidal patterns which might impact marine life	Energy supply and demand	•Energy demands vary depending on the time of day •Different energy resources are used to meet these demands •Different energy resources have different start up times.