

## 6.1 Energy

<https://www.youtube.com/watch?v=zBAY2jktaa8&list=PLoeKqZ0YqLkuZ9v2vjsIFZUhzITnZJo-p>

### Energy Stores

I can list the main **energy stores**: 8KG CEMENT

- Kinetic
- gravitational potential
- Chemical
- elastic potential
- magnetic
- electrostatic
- nuclear
- thermal

I can identify which energy stores increase and decrease in different situations

I can describe how energy is **transferred** by:

- heating
- radiation
- electrical work
- mechanical work

### Conservation of Energy

I can explain that energy cannot be created or destroyed

I can explain that energy is often transferred to less useful stores

I can use Sankey diagrams

I can explain the difference between **useful** and **wasted** energy

### Gravitational Potential Energy

I can explain what affects gravitational potential energy

I can use the equation: **GPE = mass × gravitational field strength × height**

I know that on Earth, gravitational field strength is about **9.8 N/kg** (often rounded to 10 N/kg)

### **Kinetic Energy**

- I can explain what affects kinetic energy
- I can use the equation: **kinetic energy =  $0.5 \times \text{mass} \times \text{speed}^2$**
- I can explain why speed has a very large effect on kinetic energy

### **Elastic Potential Energy**

- I can describe examples of elastic deformation
- I can explain the difference between **elastic** and **inelastic** deformation
- I can use the equation: **elastic potential energy =  $0.5 \times \text{spring constant} \times \text{extension}^2$**

### **Energy Efficiency**

- I can explain what is meant by **efficiency**
- I can calculate efficiency using:
  - $\text{useful energy output} \div \text{total energy input}$
  - $\text{useful power output} \div \text{total power input}$
- I can express efficiency as a decimal or percentage
- I can explain ways to reduce unwanted energy transfers

## **National and Global Energy Resources**

- I can describe the main energy resources:
  - fossil fuels
  - biofuel
  - wind
  - solar
  - hydroelectric
  - geothermal
  - tidal
  - nuclear
  
- I can compare **renewable** and **non-renewable** resources
  
- I can evaluate different energy resources using:
  - reliability
  - environmental impact
  - cost
  - response time



## **Retrieval + Exam Questions**

### ◆ **Quick Recall**

1. Name four energy stores.
2. What is meant by energy transfer?
3. What is the unit of energy?

### ◆ **Understanding**

5. Why is energy said to be conserved?
6. Why are no appliances 100% efficient?
7. Why is solar power not always reliable in the UK?

### ◆ **Application**

8. A box is lifted onto a shelf. Explain the energy transfers involved.
9. A car brakes suddenly. Where does the kinetic energy go?

### ◆ **Maths Skills**

10. A 2 kg mass is lifted 5 m. Calculate the gain in GPE.
11. A car of mass 1000 kg travels at 20 m/s. Calculate its kinetic energy.

## 6.2 Electricity

<https://www.youtube.com/watch?v=1MDbK4yFgUw&list=PLoeKqZ0YqLktFzfsEiVfKATuEGtZxFLfN>

### Charge, Current and Potential Difference

- I can explain what electric charge is
- I can explain that current is the rate of flow of charge
- I can use the equation:  $\text{current} = \text{charge} \div \text{time}$
- I know current is measured in amperes (A)
- I know charge is measured in coulombs (C)
- I can explain what potential difference means
- I know potential difference is measured in volts (V)

### Current, Resistance and Voltage

- I can use the equation: **potential difference = current  $\times$  resistance**
- I know resistance is measured in **ohms ( $\Omega$ )**
- I can explain what happens when resistance increases
- I can explain why current decreases if resistance increases for a fixed potential difference

### Circuit Symbols and Circuit Diagrams

- I can recognise and draw symbols for:
  - Cell / battery
  - switch
  - lamp
  - resistor
  - variable resistor
  - diode
  - LED
  - thermistor
  - LDR
  - voltmeter
  - ammeter
  - fuse

## Series Circuits

- I can describe how current behaves in a series circuit
- I can describe how potential difference behaves in a series circuit
- I can calculate total resistance in a series circuit
- I can explain what happens if one component is removed

## Parallel Circuits

- I can describe how current behaves in a parallel circuit
- I can explain that potential difference is the same across each branch
- I can compare series and parallel circuits
- I can explain why homes are wired in parallel

## Resistance

- I can explain what resistance does in a circuit
- I can interpret **current-potential difference graphs** for:
  - resistor
  - filament lamp
  - diode
- I can explain why a filament lamp has changing resistance
- I can explain why a diode only works in one direction

## Required Practical – Resistance

- I can describe how to investigate how resistance changes
- I can explain how a thermistor works
- I can explain how an LDR works
- I can explain practical applications of thermistors and LDRs

## Electrical Power

I can use the equations:

$$\text{power} = \text{current} \times \text{potential difference}$$

$$\text{power} = \text{current}^2 \times \text{resistance}$$

$$\text{power} = \text{potential difference}^2 \div \text{resistance}$$

I know power is measured in watts

## Domestic Electricity

I can explain the difference between **AC** and **DC**

I know UK mains electricity is **about 230 V and 50 Hz AC**

I can explain why mains electricity can be dangerous

I can describe the wires in a plug:

- live
- neutral
- earth

I can explain the role of the **fuse** and **circuit breaker**

I can explain why appliances have different fuse ratings

## Energy Transfers in Appliances

I can use the equation: **energy transferred = power × time**

I can calculate energy use in joules and in kilowatt-hours

I can explain what a kilowatt-hour means

I can calculate electricity cost



## Retrieval + Exam Questions

### ◆ Recall

1. What is current?
2. What is the unit of potential difference?
3. What is resistance measured in?
4. What does a fuse do?
5. What is the difference between AC and DC?

### ◆ Understanding

1. Explain why current is the same at all points in a series circuit.
2. Why is potential difference the same across branches in parallel?
3. Why does a filament lamp's resistance increase as it gets hotter?
4. Why are houses wired in parallel?
5. Why is mains electricity dangerous?

### ◆ Application

1. A lamp in a series circuit goes out when another lamp is removed. Explain why.
2. Why is an LDR useful in a street light?
3. Why is a thermistor useful in a thermostat?
4. Why would a high-power appliance need a higher fuse rating?

### ◆ Maths / Data Skills

1. A charge of 12 C flows in 3 s. Calculate the current.
2. A resistor has a potential difference of 6 V and current of 2 A. Calculate resistance.
3. An appliance uses 230 V and 3 A. Calculate power.
4. A 1000 W kettle works for 120 s. Calculate energy transferred.
5. A heater uses 2 kW for 3 hours. Calculate energy in kWh.

### ◆ 6-Mark

1. Compare series and parallel circuits.
2. Explain how resistance can change in different components.
3. Explain the dangers of mains electricity and how plugs and fuses reduce the risk.

## 6.3 Particle Model of Matter

<https://www.youtube.com/watch?v=py2wim8h89A&list=PLoeKqZ0YqLkvPGN06piZVcZWXiQy3-Hw1>

### Density

- I can define **density**
- I can use the equation: **density = mass ÷ volume**
- I know the units for density:
  - kg/m<sup>3</sup>
  - g/cm<sup>3</sup>
- I can rearrange the equation to find mass or volume
- I can explain density differences in solids, liquids and gases

### Internal Energy

- I can explain what is meant by **internal energy**
- I can describe internal energy as the total energy in particles
- I can explain the difference between:
  - kinetic energy of particles
  - potential energy of particles
- I can explain how heating changes internal energy

### Changes of State

- I can name changes of state:
  - melting
  - freezing
  - boiling
  - condensing
  - evaporating
  - sublimation
- I can explain changes of state using the particle model
- I can explain why mass is conserved during a change of state in a closed system
- I can describe the arrangement and movement of particles in solids, liquids and gases

## Specific Heat Capacity

- I can explain what **specific heat capacity** means
- I can use the equation: **change in thermal energy = mass × specific heat capacity × temperature change**
- I can explain why different materials heat up at different rates

## Specific Latent Heat

- I can explain what is meant by **specific latent heat**
- I can explain why temperature stays constant during a change of state
- I can describe latent heat of fusion and latent heat of vaporisation
- I can use the equation: **energy for a change of state = mass × specific latent heat**

## Particle Motion and Gas Pressure

- I can explain gas pressure in terms of particle collisions
- I can explain how increasing temperature increases gas pressure
- I can explain Brownian motion in simple terms
- I can link the particle model to expansion and contraction

## Retrieval + Exam Questions

### ◆ Recall

1. What is density?
2. What are the three states of matter?
3. What is internal energy?
4. What is specific heat capacity?
5. What is meant by latent heat?

### ◆ Understanding

1. Explain why gases have a low density.
2. Why does temperature stay constant when a substance is boiling?
3. Why do different materials heat up at different speeds?
4. Explain gas pressure using the particle model.
5. Why does heating a gas increase the pressure in a sealed container?

### ◆ Application

1. Why does ice float on water?
2. Why is water useful in radiators and cooling systems?
3. Why can a deodorant can be dangerous in a fire?
4. Explain why evaporation causes cooling.

### ◆ Calculations

15. A block has mass 240 g and volume 30 cm<sup>3</sup>. Calculate density.
16. 2 kg of a substance is heated. Its SHC is 500 J/kg°C and its temperature rises by 6°C. Calculate the energy transferred.
17. A 0.5 kg sample melts with a specific latent heat of 334,000 J/kg. Calculate the energy required.

### ◆ 6-Mark

1. Explain changes of state using the particle model.
2. Explain why heating affects the pressure of a gas.
3. Explain the difference between specific heat capacity and specific latent heat.

## 6.4 Atomic Structure

<https://www.youtube.com/watch?v=RzOV8LsQqxs&list=PLoeKqZ0YqLks3lCreaHj-iEJOOrRCyo>

### Atoms and Radiation

- I can describe the structure of an atom:
  - nucleus
  - protons
  - neutrons
  - electrons
  
- I can explain that some nuclei are **unstable**
  
- I can explain what **radioactive decay** is
  
- I can describe the three main types of nuclear radiation:
  - alpha
  - beta
  - gamma

### Properties of Radiation

- I can compare alpha, beta and gamma in terms of:
  - nature
  - charge
  - mass
  - penetrating power
  - ionising power
  - range in air
  
- I can explain how radiation is affected by electric and magnetic fields
  
- I can identify suitable shielding materials for each type of radiation

### Nuclear Equations

- I can complete nuclear equations for alpha decay
  
- I can complete nuclear equations for beta decay
  
- I can explain that gamma emission does not change atomic number or mass number

## Half-Life

- I can explain what half-life means
- I can interpret decay curves
- I can calculate the number of half-lives passed
- I can explain why radioactive decay is random but predictable for large samples

## Uses and Risks of Radiation

- I can describe uses of radioactive materials in:
  - smoke alarms
  - medical tracers
  - radiotherapy
  - sterilising equipment
- I can explain background radiation
- I can describe risks of exposure to ionising radiation
- I can explain contamination vs irradiation

## Retrieval + Exam Questions

### ◆ Recall

1. What is radioactive decay?
2. Name the three main types of nuclear radiation.
3. Which type of radiation is most ionising?
4. What is half-life?
5. What is nuclear fission?

### ◆ Understanding

1. Why is alpha radiation dangerous inside the body?
2. Why can gamma travel further than alpha?
3. Why is radioactive decay described as random?
4. Explain the difference between contamination and irradiation.
5. Why is shielding needed around radioactive sources?

### ◆ Application

1. Which radiation would be best for a smoke alarm? Why?
2. Why is gamma useful for treating cancer but also dangerous?
3. A radioactive sample has a half-life of 2 days. How much remains after 6 days?
4. Why is fission used now in power stations but fusion is not widely used yet?

### ◆ Calculations / Data

15. A sample has a count rate of 800 counts per minute. The half-life is 5 hours. What is the count rate after 15 hours?
16. Interpret a decay graph and identify the half-life.

### ◆ 6-Mark

1. Compare alpha, beta and gamma radiation.
2. Explain the risks and uses of radioactive materials.
3. Explain how nuclear fission occurs and why it can be used to generate electricity.