The Telford Langley School

ENSURING EXCELLENCE

# Combined Physics Foundation Paper 1

**Name:** _____

**Topic 1:** Energy

**Topic 2:** Particle Model

**Topic 3:** Electricity

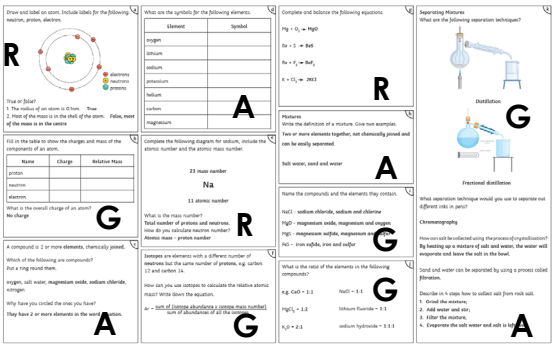
**Topic 4:** Atomic Structure

# Exam Date: Thursday 22nd May 2025

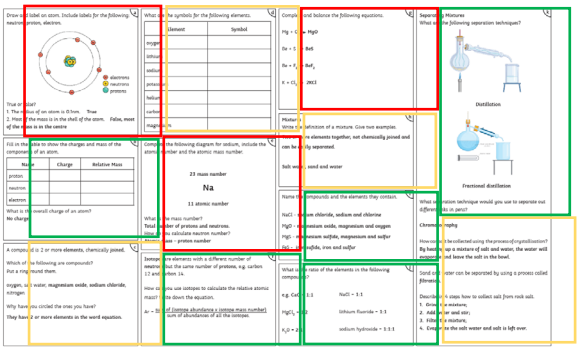
## Instructions

This booklet has been separated according to the topic that will be covered in the exam.

1. Go through the revision mat for the topic and rate each box according to your understanding of that content. Use a typical RAG rating or 3 different colours of highlighter.
   **For example:**




**OR**



R = Red ☹ Low understanding

A = Amber 😐 Some Understanding

G = Green 😊 Good Understanding

2. Cut along the dotted lines of the question card template provided. Then produce a set of revision questions and answers for that topic – you should focus on those you have rated as red or amber on the revision mat. **For example:**

| **Front** | **Back** |
| --- | --- |
| What is the mass number of an atom? | The total number of protons and neutrons found in the nucleus |

3. Fold along the line indicated on the following page and glue where indicated to create a storage pocket for your question cards.
4. Regularly test yourself using your question cards or ask someone to test you and return them to your storage pocket for safekeeping after each use.

a

Describe what a system is.

**It is an object or group of objects.**

b

Describe energy store changes for the following objects:

**A football that has been kicked upwards.**

As the ball moves upwards, the kinetic energy store of the ball **decreases** and the **gravitational potential energy** store of the ball increases.

**A squash ball hitting a wall.**

When the ball hits the wall, the kinetic energy store of the ball **decreases** and the **elastic potential energy** store increases. Some of the energy is also transferred to the surroundings. The thermal energy store of the **surroundings** increases and some of the energy is carried by sound waves.

**A car accelerating.**

As the car moves, the chemical energy store of the petrol **decreases** and the **kinetic energy store** of the car increases. Some of the energy is also transferred by **sound** waves to the surroundings and the **thermal** energy store of the surroundings also increases.

**A car decelerating.**

As the car slows down, the **kinetic** energy store decreases and the **thermal** energy store of the surroundings and brakes **increases**. Some of the energy is also transferred by **sound** waves to the surroundings.

**Bringing water to the boil.**

The electric current transfers some of the **energy** and the **thermal** energy store of the water increases, which increases the **kinetic** energy stores of the particles that make up the water.

c

What is the equation linking kinetic energy, mass and speed?

**kinetic energy = $\frac{1}{2}$ × mass × (speed)²**

Write the units for the following:

kinetic energy: **($E_k$), joules, J**

mass: **(m), kilograms, kg, grams, g**

speed: **(v), metres per second, m/s**

A toy car moving down a ramp has a kinetic energy store. Give two more examples of objects with kinetic energy stores.

**(These are just a few examples. There will be many more.)**

**Parachute falling through the air.**

**Gas particles moving in the air.**

d

What is the equation linking elastic potential energy, spring constant and extension?

**elastic potential energy = $\frac{1}{2}$ x spring constant x (extension)²**

Write the units for the following:

elastic potential energy: **($E_e$), joules, J**

spring constant: **(k), newtons per metre, N/m**

extension: **(e), metres, m**

A tennis ball that has been squashed has an elastic potential energy store. Give two more examples of objects with elastic potential energy stores.

**(These are just a few examples. There will be many more.)**

**Stretched elastic band.**

**Extended spring.**

e

What is the equation linking gravitational potential energy, mass, gravitational field strength and height?

**gravitational potential energy = mass x gravitational field strength x height**

Write the units for the following:

gravitational potential energy: **($E_p$), joules, J**

mass: **(m), kilograms, kg**

gravitational field strength: **(g), newtons per kilogram, N/kg**

height: **(h), metres, m**

An apple on a tree is an example of an object that has a gravitational potential energy store. Give two more examples.

**(These are just a few examples. There will be many more.)**

**Plant pot on a windowsill.**

**Aeroplane in the sky.**

f

What is the equation linking change in thermal energy, mass, specific heat capacity and temperature change?

**change in thermal energy**

**= mass x specific heat capacity x temperature change**

Write the units for the following:

change in thermal energy: **(ΔE), joules, J**

specific heat capacity: **(c), joules per kilogram per degree Celsius, J/kg °C**

Write a definition for specific heat capacity.

**The amount of energy needed to increase the temperature of a 1kg material by 1°C.**

g

Power is:

**the rate at which energy is transferred;**

**and the rate at which work is done.**

What is the equation linking power, energy transferred and time?

**power = energy transferred ÷ time**

What is the equation linking power, work done and time?

**power = work done ÷ time**

Write the units for the following:

power: **(P), watts, W**

energy transferred: **(E), joules, J**

time: **(t), seconds, s**

work done: **(E), joules, J**

The power output of a hairdryer is 2000W. How much energy is transferred per second?

**2000 joules per second.**

An LED bulb has a power rating of 8W, a halogen bulb has a power rating of 28W but they both have a similar brightness. What is the difference?

**The LED bulb transfers less energy per second than the halogen bulb.**

a

What is the law of conservation of energy?

**Energy cannot be created or destroyed. It can be transferred, stored or dissipated.**

Define dissipation.

**Energy being transferred to the surroundings.**

b

For the following situations, name the useful energy transfers and the type of energy that is dissipated to the surroundings (wasted):

**picture on a television screen.**

useful: **chemical energy stores → thermal energy stores, and light and sound carry energy to the surroundings.**

energy dissipated as: **thermal energy stores of the surroundings**

**printer**

useful: **chemical energy stores → kinetic energy stores**

energy dissipated as: **thermal energy stores and some is carried by sound waves to the surroundings.**

**mobile phone**

useful: **chemical energy stores → thermal energy stores and light and sound waves carry the energy to the surroundings**

energy dissipated as: **thermal energy stores of the surroundings**

c

For the following situations, suggest methods to reduce unwanted energy transfers and what the unwanted energy transfers are.
Hot water stored in a tank.

**Insulation around the water tank. Reduces dissipation of energy to the surroundings into thermal energy stores.**

Moving parts in a car.

**Lubricating the moving parts. Reduces dissipation of energy to the surroundings into thermal energy stores.**

d

Describe how thermal conductivity of a material affects how it transfers energy by conduction.

**If a material has a high thermal conductivity, it will transfer heat via conduction at a much quicker rate.**

e

How is energy lost from a building? What factors affect this?

**Energy is transferred to thermal energy stores of the surroundings. The factors that affect this are the thermal conductivity of the walls and the thickness of them.**

f

What is the equation linking efficiency, useful output energy transfer and total input energy transfer?

**efficiency = useful output energy ÷ total imput energy transfer**

What is the equation linking efficiency, useful power output and total power input?
**efficiency = useful power output ÷ total power output**

When energy is transferred in a closed system, what happens to the total amount of energy?
**Total energy does not change.**

How can the efficiency of an energy transfer be increased?

**By increasing the useful output by reducing the wasted energy.**

g

Which lorry is more energy efficient and why?

**The red lorry is streamlined and so is more energy efficient . It wastes less energy due to air resistance and so has a higher useful output energy.**

h

List the main energy resources.

**Fossil fuels (coal, oil and gas) N** **Nuclear fuel N** **Biofuel R**

**Wind R** **Hydroelectricity R** **Geothermal R**

**Tidal R** **Waves R** **Sun R**

i

Define renewable and non-renewable energy resources.

**A renewable energy resource can be replenished.**

**A non-renewable energy resource will eventually run out.**

j

For the energy resources that you have listed, write an R next to those that are renewable and N next to those that are non-renewable.

Except for oil, all energy resources are used for electricity generation. Which are used for heating?

**Geothermal, solar, fossil fuels (coal, oil and gas)**

k

My main areas for improvement are:

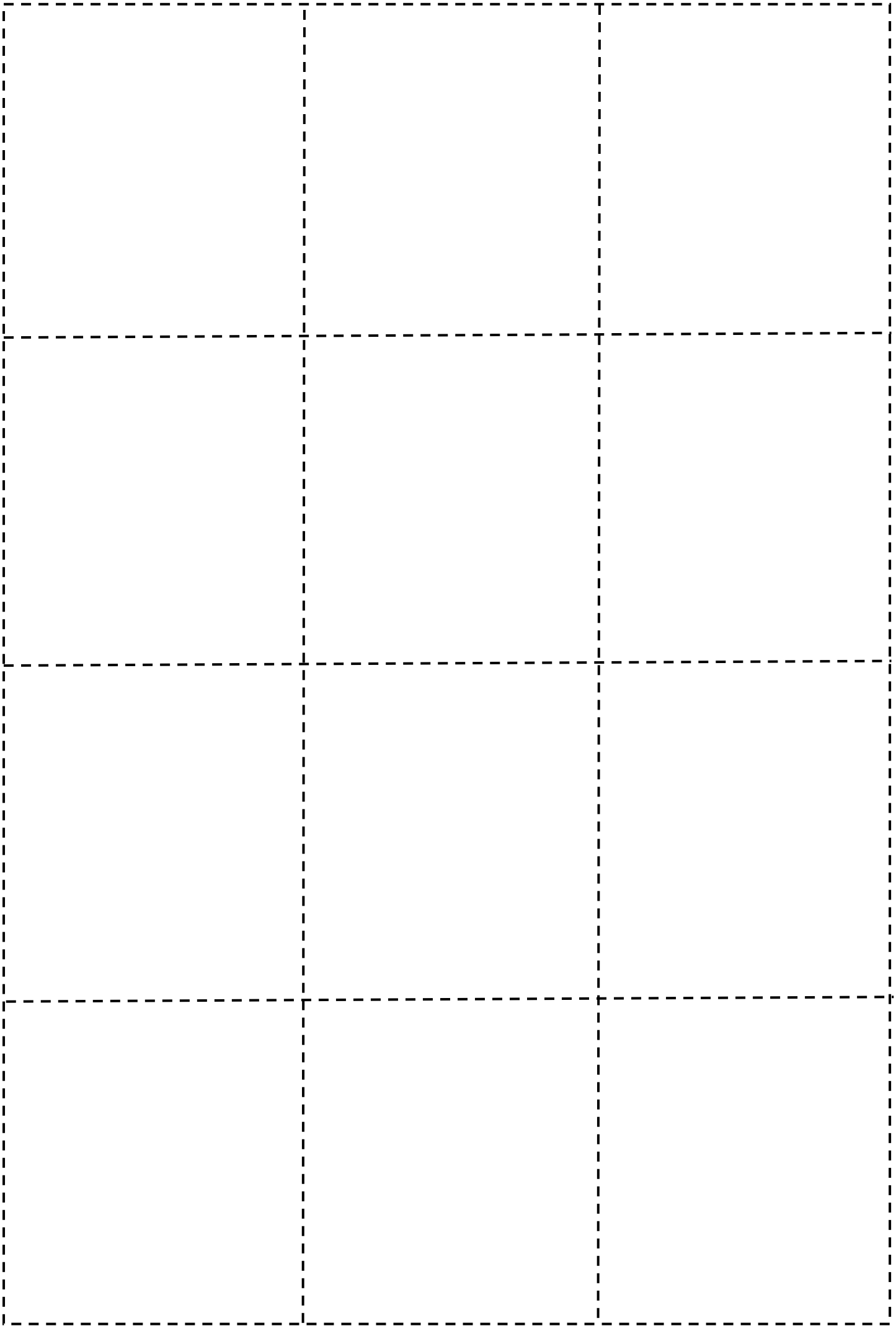
_____

_____

_____

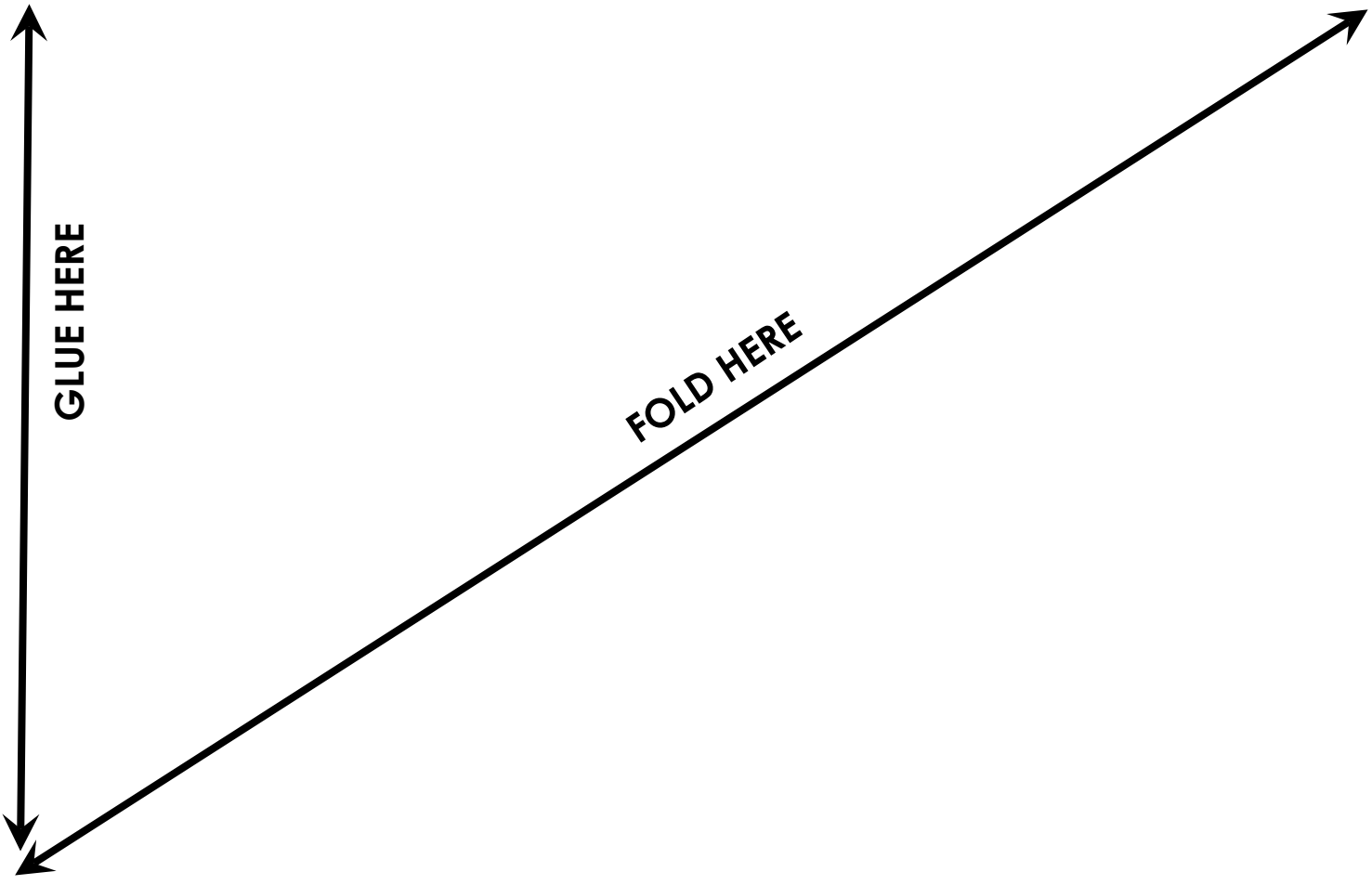
l

| Energy Resource | Environmental Impact – what does it produce that is harmful/can it affect wildlife/is a lot of land needed/does it have any environmental impact? | Reliable/Unreliable – do you always get the same amount of energy? |
|---|---|---|
| Coal | Produces carbon dioxide, a greenhouse gas, and sulfur dioxide which contributes to acid rain. | Reliable. |
| Oil | Produces carbon dioxide, nitrogen dioxide and sulfur dioxide. If it is spilt there can be disastrous environmental consequences. | Reliable. |
| Gas | Produces carbon dioxide. | Reliable. |
| Nuclear | Produces radioactive waste. | Reliable. |
| Biofuel | A lot of land is needed for growing the fuel. | Reliable. |
| Wind | Can be noisy and the turbines are dangerous for birds. | Unreliable. |
| Hydroelectricity | Large areas of land is needed and can cause disruption to ecosystems. | Reliable. |
| Geothermal | None. | Reliable. |
| Tidal | Can affect habitats. | Not always reliable due to changing tides. |
| Waves | Can affect habitats. | Unreliable. |
| Solar | None. | Unreliable. |



# Topic 1: Energy

# Question Card Storage



**a**

What is the equation linking density, mass and volume?

**density = mass ÷ volume**

**b**

Write the symbols and units for the following:

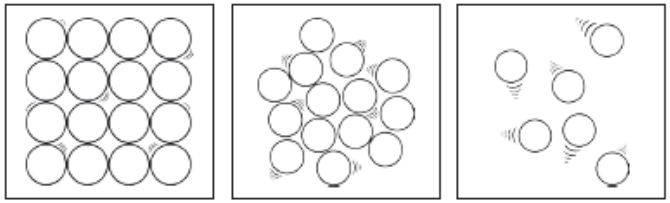
density: **(ρ) kilograms per metre cubed, kg/m³**

mass: **(m), kilograms, kg**

volume: **(V), metres cubed, m³**

**c**

Draw the particle models for solids, liquids and gases.



**d**

| State of Matter | Shape | Structure | Movement of Particles |
|---|---|---|---|
| Solid | Particles are packed close together and have a definite shape. | Regular – fixed pattern and size. | Particles vibrate in a fixed position. |
| Liquid | Particles are close together and take the shape of the container. No definite shape. | Irregular – fixed size but not a fixed pattern. | Particles vibrate and move over one another. |
| Gas | Particles are far apart and take the shape of the container. No definite shape. | Irregular – no fixed size or pattern. | Particles move around rapidly. |

**e**

Describe the displacement technique used to determine the volume of an irregularly shaped object.

**Fill a displacement vessel/eureka can with water. Put the spout of the can over a measuring cylinder. Put the irregularly shaped object into the can and measure the volume of water displaced.**

**f**

When substances change state, their mass is conserved. What does this mean?

**The mass of the substance does not change once it has changed state.**

Describe how to determine the volume of a regularly shaped object.

**width × length × height**

**g**

What is an internal system?

**An internal system is one in which the energy is stored by the particles within it.**

**h**

Define internal energy.

**This is the total kinetic and potential energy of the particles that make up that system.**

**i**

List some factors that affect the increase of temperature of a system.

**Mass of the substance.**

**Type of material being heated.**

**Energy input.**

**j**

Explain the differences in density of solids, liquids and gases.

**Solids are very dense because the particles are so closely packed together and there are strong forces of attraction between them. Liquids are less dense than solids, but more dense than gases because the particles are very close together and attract one another. Gases are the least dense and have very weak forces of attraction only when they collide.**

**k**

Define specific heat capacity.

**The amount of energy needed to cause a 1°C rise in 1kg of a substance.**

**l**

What is the equation linking change in thermal energy, mass, specific heat capacity and temperature?

**change in thermal energy = mass x specific heat capacity x temperature change**

**m**

Write the units and symbols for the following:

energy: **(E), Joules, J**

mass: **(m), kilograms, kg**

specific heat capacity: **(c), Joules per kg per degree Celsius, J/kg oC**

temperature change: **(Δ ), degrees Celsius, oC**

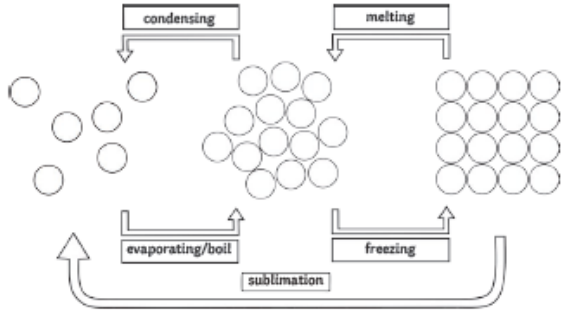
**n**

Fill in the blanks using these words: state, energy, increases, particles, temperature.

When a substance is heated up, the **energy** stored in the system **increases** by increasing the energy of the **particles**. There is either an increase in the **temperature** of the system or there is a change of **state**.

**o**

Label the diagram with the terms used for changes of state.




**p**

Why is a change of state referred to as a physical change and not a chemical change?

**If the changes are reversed then the material will recover its origina properties.**

a

Define latent heat.

**Latent heat is the energy required for the change of state of a substance.**

b

What is the equation linking energy for a change of state, mass and specific latent heat?

**Energy for a change of state = mass x specific latent heat**

Write the symbol and unit for the following:

specific latent heat: **(L), joules per kilogram, J/kg**

c

What is the difference between specific heat capacity and specific latent heat?

**Specific heat capacity is the amount of energy required to increase the temperature of a substance, whereas specific latent heat is the energy needed to change the state of a substance with no temperature change.**

d

What is the equation that links pressure and volume?

**pressure x volume = constant**

List the symbols and units for the following:

pressure: **(p), pascals, Pa**

volume: **(V), metres cubed, $m^3$**

e

Explain the effect of an increase in temperature on the pressure of a gas in a container.

**An increase in temperature causes more collisions of the gas particles with the walls of the container. This causes an increase in the force on the walls of the container over a particular area and so increases the pressure.**

f

For the heating and cooling curve (shown in section i), what are the terms used to describe the changes of state for:

B➔C **Melting**

D➔E **Evaporating/Boiling**

E➔D **Condensing**

C➔B **Freezing**

g

What is happening to the particles between A-B, C-D and E-F?

**They are gaining kinetic energy and spreading out more.**

How are kinetic energy of particles and temperature related?

**As the temperature increases the kinetic energy of the particles increases.**

h

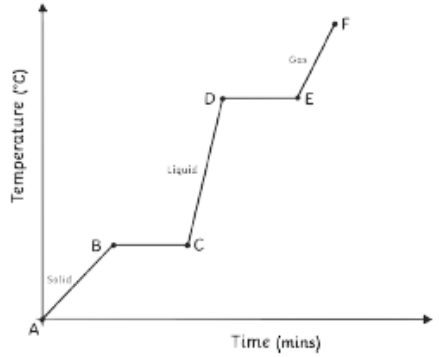
Using the diagram, explain the effect of an increase of volume on pressure.

(a) High pressure (b) Low pressure

**An increase in volume causes the particles to spread out more and so the number of collisions on the walls of the container decreases. So, there is less force exerted on the container over a certain area and therefore a lower pressure.**

i

What are the states of matter for the diagonal sections of the graph? Add labels to the graph below.




j

Fill in the blanks:

Specific latent heat of fusion: the amount of energy needed to change **1kg** of a substance from a solid to a **liquid** with no change of temperature.

Specific latent heat of vaporisation: the amount of energy needed to change 1kg of a substance from liquid to **gas** with no change of **temperature**.

k

My main areas for improvement in this topic are:

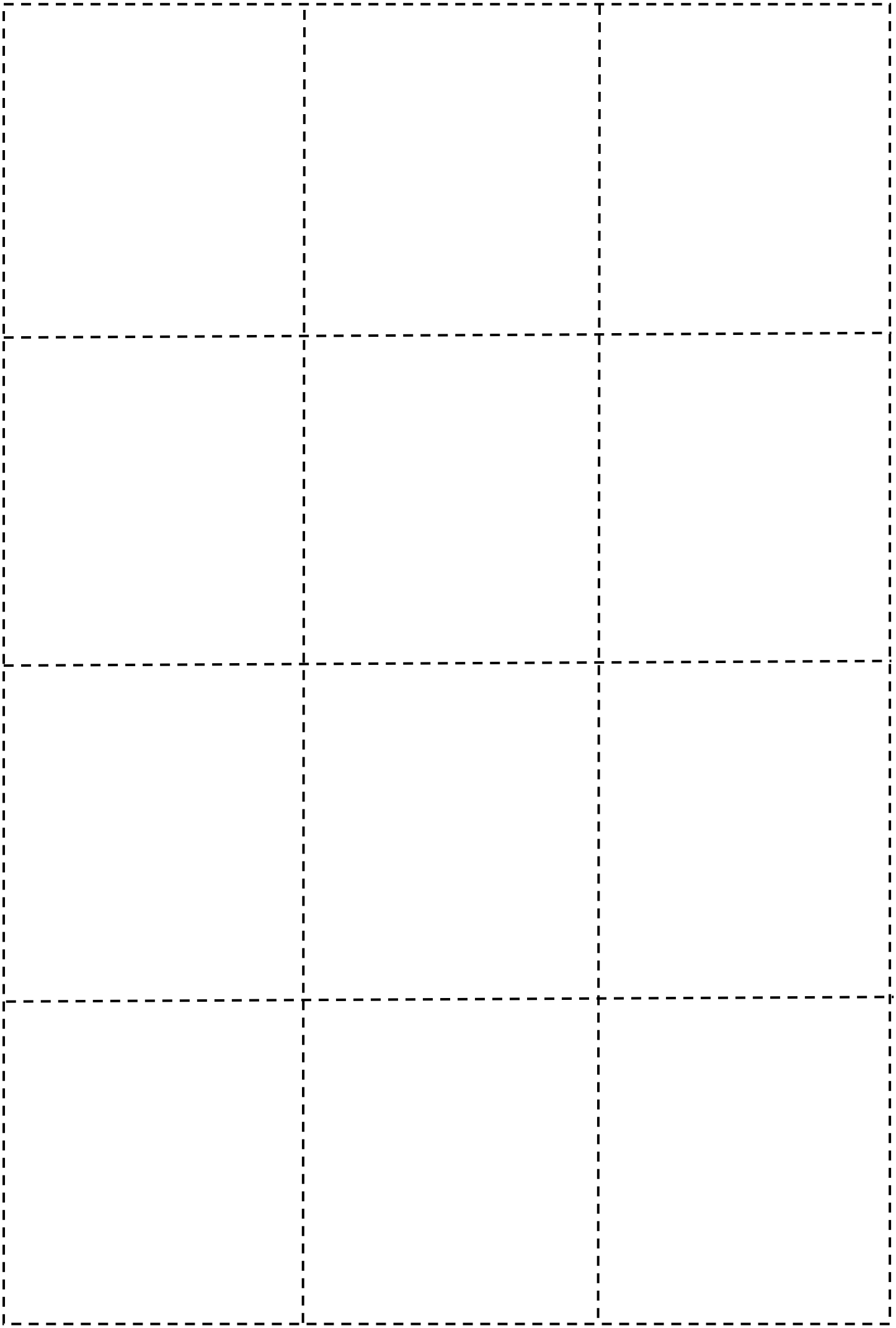
_____

_____

_____

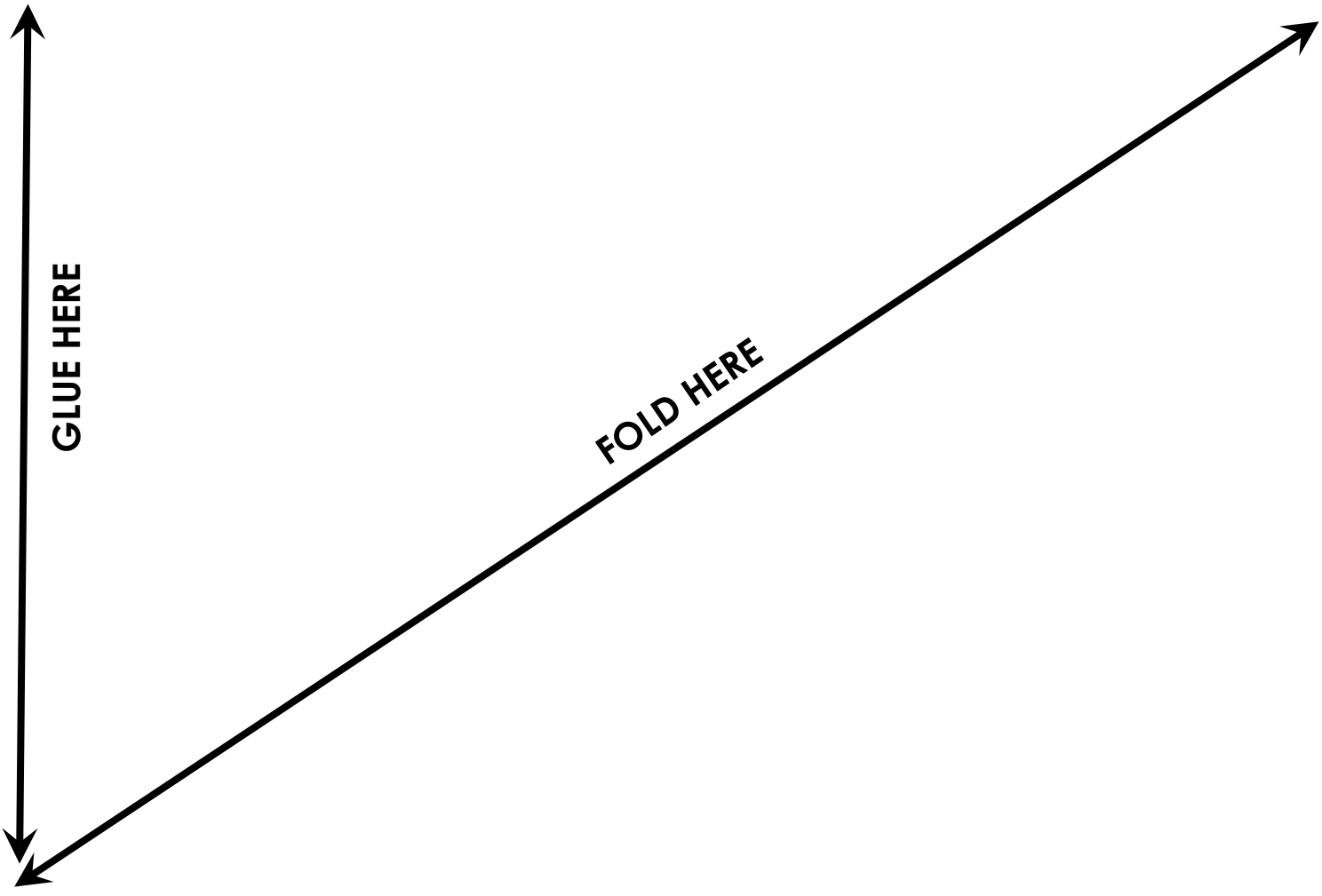
_____

_____



# Topic 2: Particle Model

# Question Card Storage



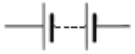
**a**

Draw the symbol diagrams for:

cell

resistor

battery



variable resistor

lamp (bulb)

ammeter


fuse

voltmeter


LED

diode

LDR

thermistor

**b**

What is electric current?

**The flow of electrical charge.**

State the equation that links charge, current and time.

**charge = current × time**

Write the symbols and units for the following:

charge: **(Q) coulombs, C**

current: **(I) amperes, A**

time: **(t) seconds, s**

**c**

A charge of 12A flows through an electric cooker for 1 hour. How much charge has been used?

**Convert hours to seconds: 60 mins = 3600 secs**

**12 × 3600 = 43200 C**

State the equation that links current, potential difference and resistance. Remember to include units.

**potential difference (V) = current (A) × resistance (Ω)**

A voltmeter reading is 3V and the resistance is 2Ω. What is the current?

**current = potential difference ÷ resistance**

**3 ÷ 2 = 1.5A**

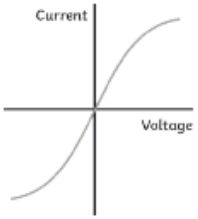
**d**

Use the components stated below to identify the potential difference/current graphs:

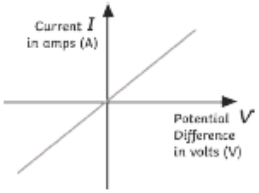
filament lamp, diode, ohmic conductor

**diode**


**filament lamp**




**ohmic conductor**



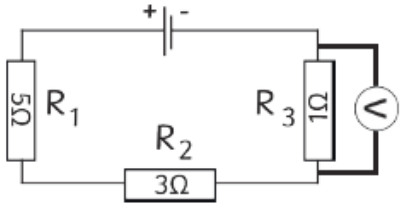

**e**

Complete the table.

| Type of Circuit | Potential Difference Shared or the Same? | Current Same or Split? |
|---|---|---|
| Series | **shared** | **same** |
| Parallel | **same** | **split between branches** |

For the circuit below, calculate the total resistance.

**9Ω**




On the diagram, draw where a voltmeter could be positioned to measure the voltage through one of the components. The voltmeter should be drawing using a V within a circle as the correct symbol and can be drawn across any of the components within the circuit.

**f**

Complete the following sentences.

For a thermistor: as the temperature increases, the resistance **decreases**

Used in: **thermostats**

For an LDR: as the light intensity increases, the resistance **decreases**

Used in: **street lights**

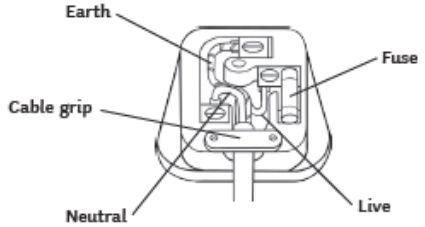
**g**

State the 2 different types of electricity supply.

1. **alternating current**
2. **direct current**

**h**

Label the diagram of the 3 pin plug.




What is the purpose of:

the neutral wire?

**It completes the circuit and carries away the current.**

the live wire?

**It provides alternating potential difference.**

the earth wire?

**It is a safety feature to prevent the application from becoming live.**

a

Complete the energy transfers for the following electrical appliances.

**mains-powered kettle:**

electrical → thermal + sound

**hairdryer:**

electrical → kinetic + thermal + sound

**toaster**

electrical → thermal + light

b

What is the equation linking energy transferred, power and time?
**energy transferred = power × time**

what are the units for:

energy? **joules**

power? **watts**

time? **seconds**

c

Most devices have a power rating. Describe the relationship between the power rating and the changes in stored energy when a device is used.
**A device with a higher power rating will transfer stored energy to other types of energy at a faster rate.**

d

State the equation that links power, current and potential difference.
**power (W) = potential difference (V) × current (A)**

A 2.4kW kettle is connected to the mains power supply (230V). Calculate the current through the kettle.

**Remember 1000W = 1kW**

You will need to rearrange your equation above.

**2.4 × 1000 = 2400**

**Current = power ÷ potential difference**
**= 2400 ÷ 230**
**= 10.43A**

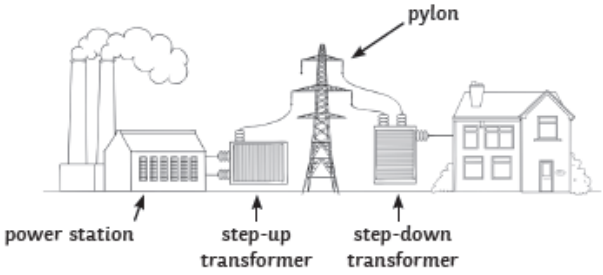
e

True or false:

- The current in a circuit can be altered by a variable resistor. **True**
- A voltmeter is connected in parallel with a component. **True**
- An ammeter is connected in parallel with a component. **False**

f

Label the national grid diagram.




Give two examples of when the demand for electricity is likely to be high.

1. **At half-time or the end of large sporting events.**
2. **First thing in the morning when people are getting up, or later when arriving home.**

g

Why is energy transferred at such high voltage in cables?
**High voltage means that the energy is transferred at low currents. This results in less resistance, therefore less energy is lost as heat, so the transmission is more efficient.**

Describe how the following work:

step-up transformer.

**Potential difference is increased.**

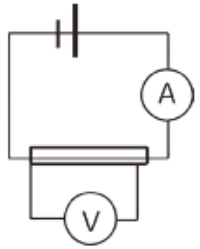
step-down transformer.

**Potential difference is decreased.**

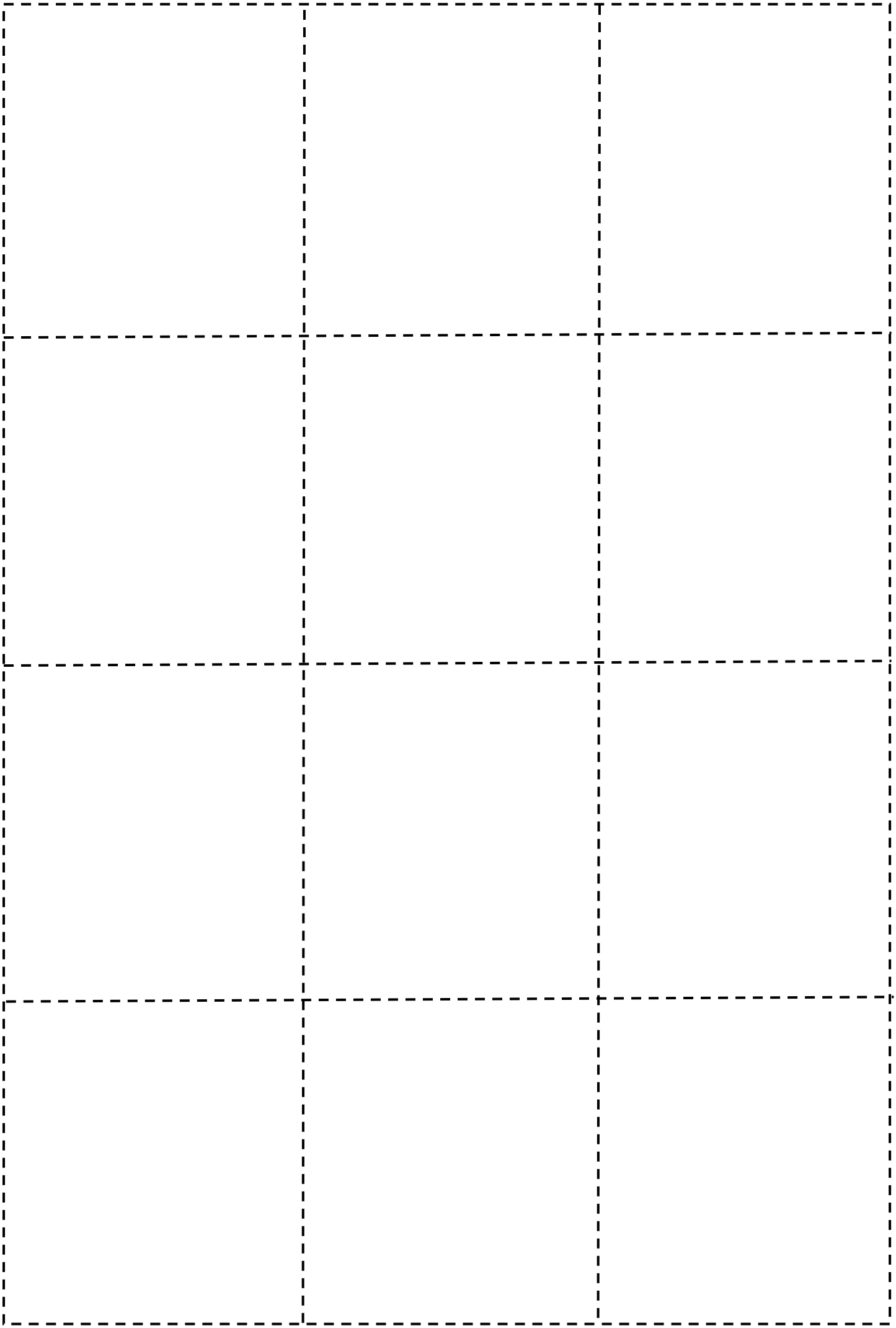
h

Describe an experiment to show how the length of a wire affects its resistance.
**Equipment:** metre ruler, ammeter, voltmeter, cell, switch.

**Hint:** it may help to draw a diagram of how to set up the apparatus.

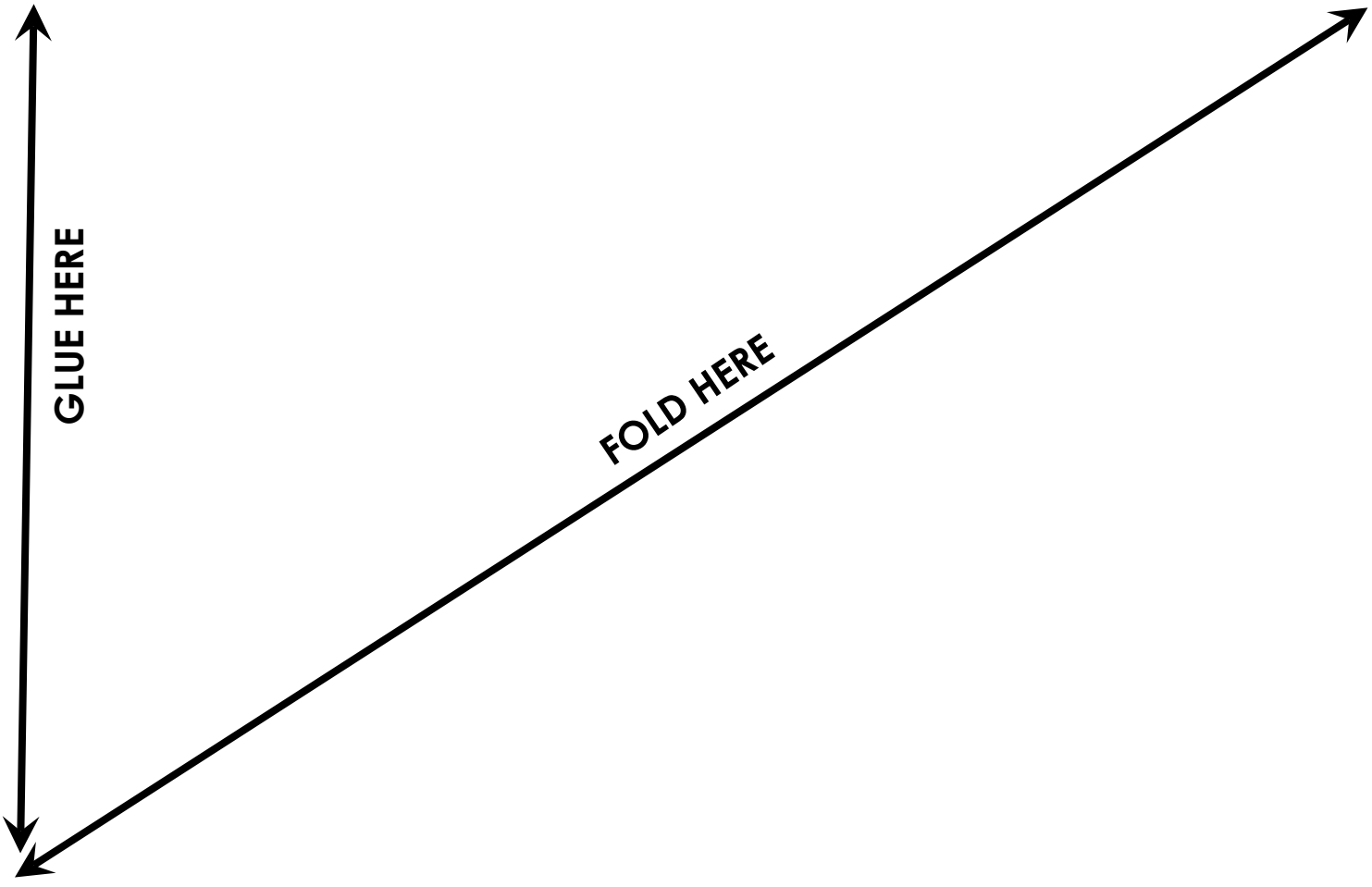



**Set up the apparatus as shown.**
**Attach the first crocodile clip at 0cm.**
**Attach the second crocodile clip at 10cm.**
**Record the potential difference and the current.**
**Connect the second crocodile clip at different lengths (20cm, 30cm) and repeat the process.**
**Use the results to calculate resistance at different lengths, using the formula:**
**resistance = potential difference ÷ current**

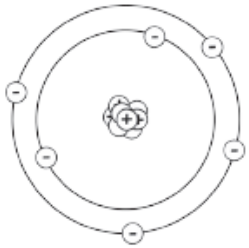


# Topic 3: Electricity

# Question Card Storage



**a** **Complete the diagram below to show where in an atom you would find the protons, neutrons and electrons.**



⊖ electrons

⊕ protons

◯ neutrons

**Explain why atoms have no overall charge.**
Atoms have no overall charge because the number of protons equals the number of electrons.

**b** **Complete the sentences by deleting the incorrect answers.**
**Most of the mass of an atom is concentrated in the nucleus/ ~~electron shells.~~**

**The element sodium is shown below.**

11
**Na**
23

**Sodium has the following number of...**

**protons:** 11

**neutrons:** 12

**electrons:** 11

**c** **Two isotopes of carbon are shown below:**

$^{12}_{6}C$ $^{14}_{6}C$

**Complete the sentences by choosing the correct words from the box below:**

| electrons, neutron, elements, beta compounds, gamma protons, radiation |
|---|

**Isotopes are the same element. They have the same number of** protons **but a different number of** neutrons. **Most unstable elements tend to decay into other** elements **and give out** radiation. **There are 3 types of ionising radiation: alpha,** beta **and** gamma.

**d** **Describe the plum pudding model of the atom.**
Atoms are spheres of positive charge with electrons stuck in them.

**e** **Radioactive decay is the process of the nucleus emitting ionising radiation.**
**The unit for radioactivity is** Bq (becquerels)

**Explain the term count rate.**
The number of radiation counts per second.

**Name the piece of equipment used to determine count rate.**
Geiger-Müller counter.

**Name three safety precautions to be taken when handling a radioactive source.**

1. Wear gloves.
2. Use tongs to hold the source.
3. Wear protective clothing.

**f** **State the difference between irradiation and contamination.**
**keywords: exposed, radioactive, contaminated, harmful**
Irradiation means an object has been exposed to a radioactive source but is not radioactive.
Contamination involves radioactive particles getting onto an object. It is contaminated and is harmful.

**g**

| Type of Radiation | Description | Penetration | Range in Air | Ionising Power |
|---|---|---|---|---|
| Alpha | helium nucleus | stopped by paper | a few cms | strong |
| Beta | high-speed electron | stopped by aluminium | several metres | medium |
| Gamma | EM radiation | stopped by lead | at least a km | weak |

**h** **Cobalt-60 has an activity rate of 1000Bq and a half-life of 5 years. What will be the activity after 10 years?**
**Hint: what would be its activity after 5 years? Repeat this for the next 5 years.**

250

**i** **The equation below shows the beta decay of carbon-14.**

$$^{14}_{6}\text{carbon} \longrightarrow {}^{14}_{7}\text{nitrogen} + {}^{0}_{-1}e$$

**Complete the sentence by deleting the incorrect answers:**

**Beta decay ~~does~~/does not cause a change in mass of the nucleus but does~~/does not~~ cause the charge of the nucleus to change.**

a

**The equation below shows the alpha decay of radon.**

$$^{219}_{86}\text{radon} \longrightarrow {}^{215}_{84}\text{polonium} + {}^{4}_{2}\text{He}$$

**Complete the sentence by deleting the incorrect answers:**

**Alpha decay causes a ~~increase~~/decrease in the mass of the nucleus.**

**Complete the following equation for the alpha decay of uranium-234:**

$$^{234}_{92}\text{U} \longrightarrow {}^{230}_{90}\text{Th} + {}^{4}_{2}\text{He}$$

b

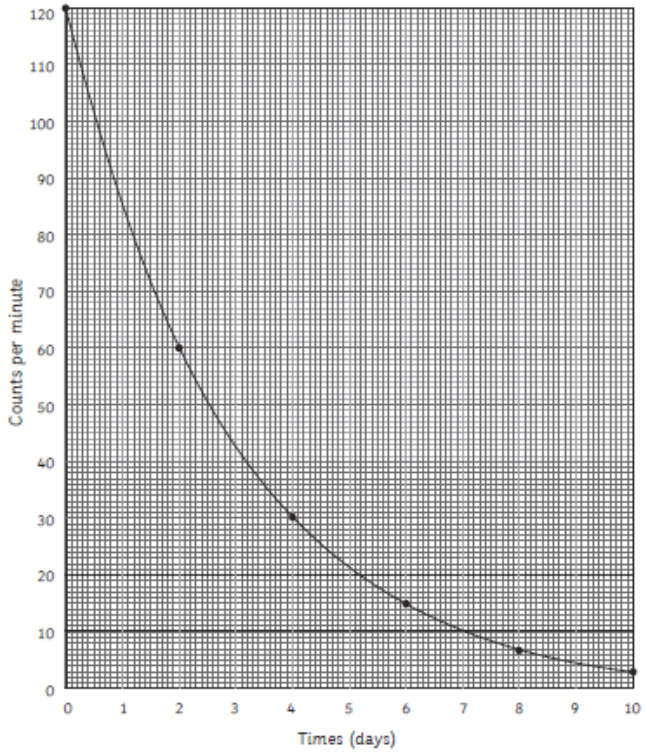
**Define the term half-life**

The time taken for the radioactivity of a specified isotope to fall to half its original value.

**Substance A is a radioactive material that will change with time. The data below shows the radioactivity of substance A.**

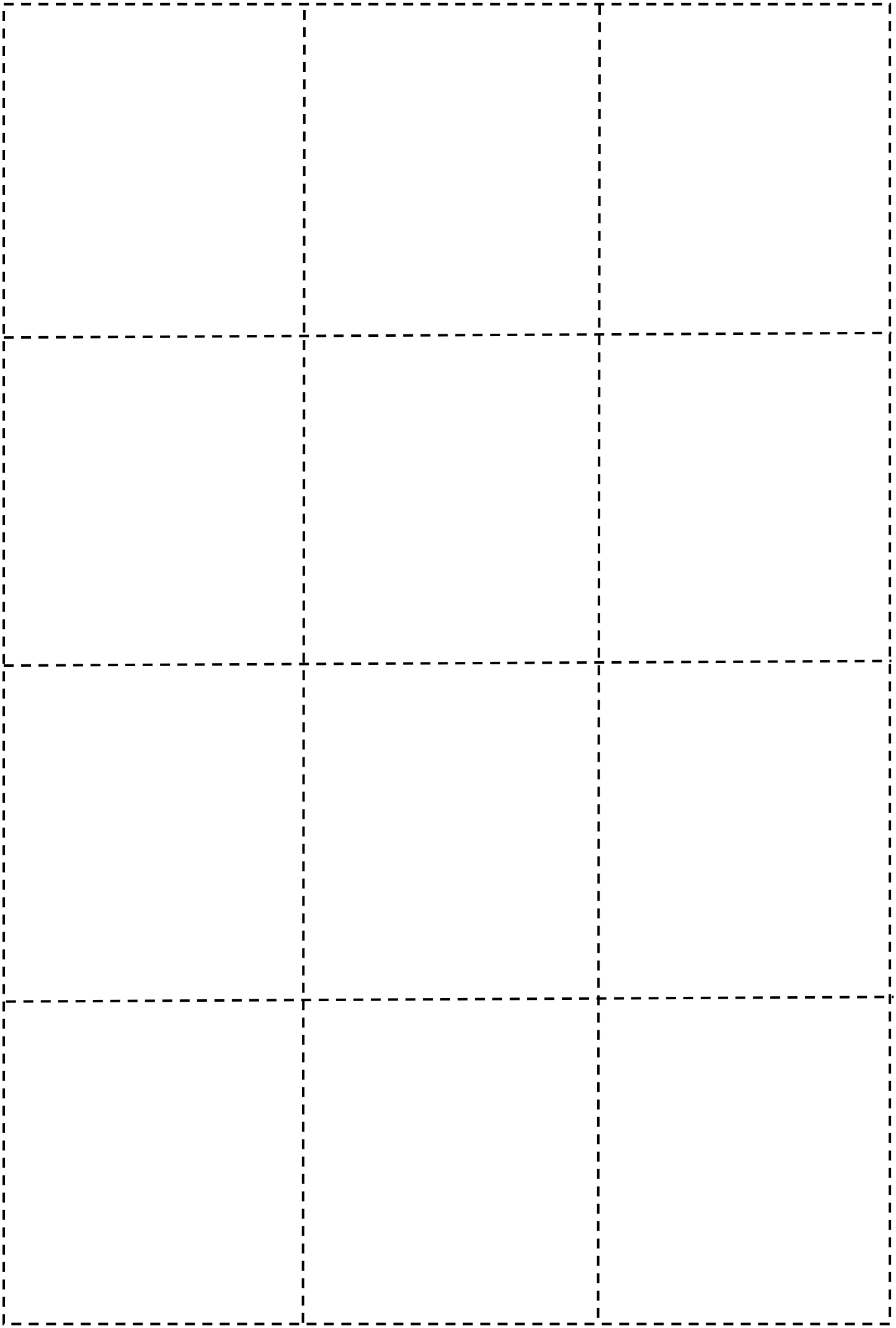
| Time (days) | 0 | 2 | 4 | 6 | 8 | 10 |
|---|---|---|---|---|---|---|
| Count rate (counts/second) | 120 | 60 | 30 | 15 | 7.5 | 3.75 |

**Plot a half-life graph on the graph paper below.**




**Use your graph to calculate the half life.**

2 days



# Topic 4: Atomic Structure

# Question Card Storage