The Telford Langley School

ENSURING EXCELLENCE

# Combined Chemistry Foundation Paper 1

**Name:** _____

**Topic 1:** Atomic Structure & Periodic Table

**Topic 2:** Structure & Bonding

**Topic 3:** Quantitative chemistry

**Topic 4:** Chemical Changes

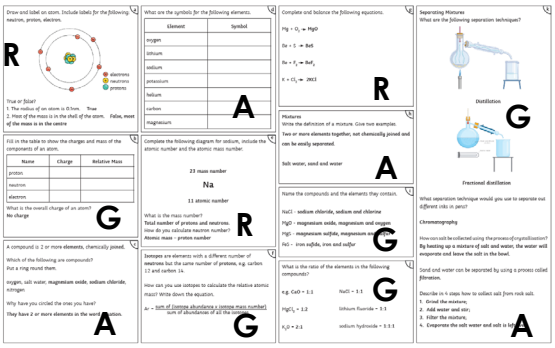
**Topic 5:** Energy Changes

# Exam Date: Monday 19th May 2025

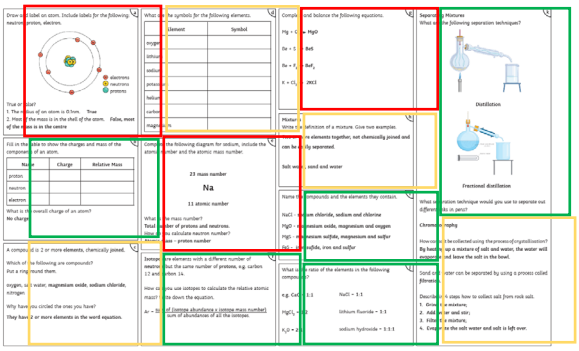
## Instructions

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:**

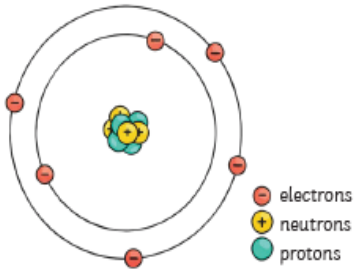
| **Front** | **Back** |
| --- | --- |
| What is the mass number of an atom? | The total number of protons and neutrons found in the nucleus |

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.

# Topic 1: Atomic Structure & Periodic Table

a

Draw and label an atom. Include labels for the following: neutron, proton, electron.




True or false?

1. The radius of an atom is 0.1nm. **True**
2. Most of the mass is in the shell of the atom. **False, most of the mass is in the centre**

b

Fill in the table to show the charges and mass of the components of an atom.

| Name | Charge | Relative Mass |
|---|---|---|
| proton | +1 | 1 |
| neutron | 0 | 1 |
| electron | −1 | 1 |

What is the overall charge of an atom?

**No charge**

c

A compound is 2 or more **elements**, chemically **joined**.

Which of the following are compounds?
Put a ring round them.

oxygen, salt water, **magnesium oxide**, **sodium chloride**, nitrogen

Why have you circled the ones you have?

**They have 2 or more elements in the word equation.**

d

What are the symbols for the following elements.

| Element | Symbol |
|---|---|
| oxygen | O |
| lithium | Li |
| sodium | Na |
| potassium | K |
| helium | He |
| carbon | C |
| magnesium | Mg |

e

Complete the following diagram for sodium, include the atomic number and the atomic mass number.

**23 mass number**

**Na**

**11 atomic number**

What is the mass number?
**Total number of protons and neutrons.**
How do you calculate neutron number?
**Atomic mass – proton number**

f

**Isotopes** are elements with a different number of **neutrons** but the same number of **protons**, e.g. carbon 12 and carbon 14.

How can you use isotopes to calculate the relative atomic mass? Write down the equation.

$$Ar = \frac{\text{sum of (isotope abundance x isotope mass number)}}{\text{sum of abundances of all the isotopes.}}$$

g

Complete and balance the following equations.

$2Mg + O_2 \rightarrow 2MgO$

$Be + S \rightarrow BeS$

$Be + F_2 \rightarrow BeF_2$

$2K + Cl_2 \rightarrow 2KCl$

h

**Mixtures**

Write the definition of a mixture. Give two examples.

**Two or more elements together, not chemically joined and can be easily separated.**

**Salt water, sand and water**

i

Name the compounds and the elements they contain.

NaCl - **sodium chloride, sodium and chlorine**

MgO - **magnesium oxide, magnesium and oxygen**

MgS - **magnesium sulfide, magnesium and sulfur**

FeS - **iron sufide, iron and sulfur**

j

What is the ratio of the elements in the following compounds?

e.g. **CaO – 1:1**

$MgCl_2$ **– 1:2**

$K_2O$ **– 2:1**

NaCl **– 1:1**

lithium fluoride **– 1:1**

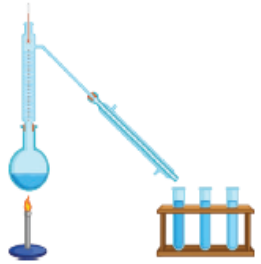
sodium hydroxide **– 1:1:1**

k

**Separating Mixtures**

What are the following separation techniques?

**Distillation**



**Fractional distillation**

What separation technique would you use to separate out different inks in pens?

**Chromatography**

How can salt be collected using the process of crystallisation?
**By heating up a mixture of salt and water, the water will evaporate and leave the salt in the bowl.**

Sand and water can be separated by using a process called **filtration.**

Describe in 4 steps how to collect salt from rock salt.

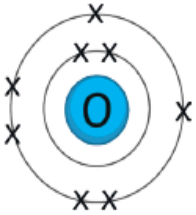
1. **Grind the mixture;**
2. **Add water and stir;**
3. **Filter the mixture;**
4. **Evaporate the salt water and salt is left over.**

# Topic 1: Atomic Structure & Periodic Table

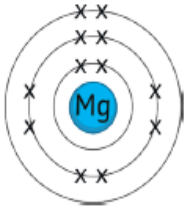
**a**

Complete the electronic structure diagrams for:

**oxygen**




**magnesium**




**b**

What are the following gases?

**argon, neon, xenon, radon**

Describe why the noble gases are so unreactive.

**Their outer shell is full of electrons.**

The boiling points of the noble gases **increase** as you go down the group.

**This is because there are more forces to bond the atoms together, therefore more energy is required to break the bonds.**

**c**

Describe what happens to the reactivity of the alkali metals as you go down the group.

**It increases**

Why?

**The number of electrons increases. They are further away from the nucleus. There is less pull on the outer electrons so the atom is more likely to loose an electron.**

Complete the word and symbol equation for sodium reacting with water:

sodium + water → sodium hydroxide + **hydrogen**

$2Na + 2H_2O \rightarrow 2NaOH + H_2$

**d**

List 3 halogens

**chlorine, fluorine, iodine, astatine**

How many electrons do they have in their outer shell?

**7 electrons**

Describe how the reactivity changes as you go down the group.

**They become less reactive, the atom becomes larger because there are more electron shells, further from the nucleus so the pull of the nucleus is less. So the electron is less likely to be gained as there is less of a positive pull.**

Write balanced symbol equations for the following reactions:

bromine + potassium iodide

$Br_2 + 2KI \rightarrow 2KBr + I_2$

chlorine + sodium iodide

$Cl_2 + 2NaI \rightarrow 2NaCl + I_2$

fluorine + potassium chloride

$F_2 + KCl \rightarrow 2KF + Cl_2$

**e**

Underline the properties of metals and circle the properties of non-metals:

strong, low density, malleable, dull, good conductors of heat and electricity, high melting and boiling point, brittle, not good conductors of electricity

**f**

James Chadwick discovered the...

(underline the correct answer)

proton

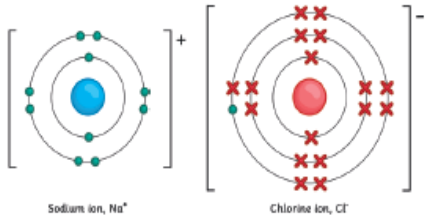
**neutron**

electron

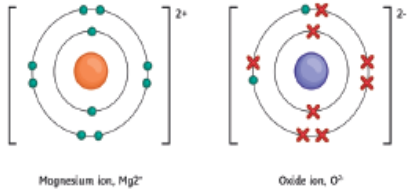
**g**

Complete the following dot and cross diagrams for:

**NaCl**




**MgO**




**h**

Complete word equations for the following reactions:

sodium + chlorine → **sodium chloride**

lithium + iodine → **lithium iodide**

potassium + bromine → **potassium bromide**

**i**

How are the groups arranged in the periodic table?

**According to their properties.**

How can you tell that the alkali metals are very reactive?

**They only have 1 electron in their outer shell.**

How can you tell the noble gases are unreactive?

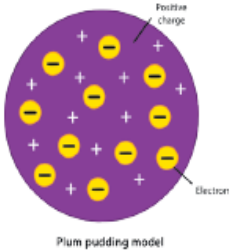
**Full shell of outer electrons.**

**j**

Describe the plum pudding model of the atom.

Draw a diagram.

**A sphere of positive charge with electrons dotted about; looking like a plum pudding.**




Why did scientists believe this model?

**Lack of experimental evidence.**

**k**

Describe what the alpha scattering experiment showed scientists.

**Most alpha particles go straight through, some are scattered, some rebound off the gold foil.**
**This shows that the nucleus of an atom has a very small radius. Most of the mass is concentrated in the nucleus.**

**l**

Niels Bohr discovered that

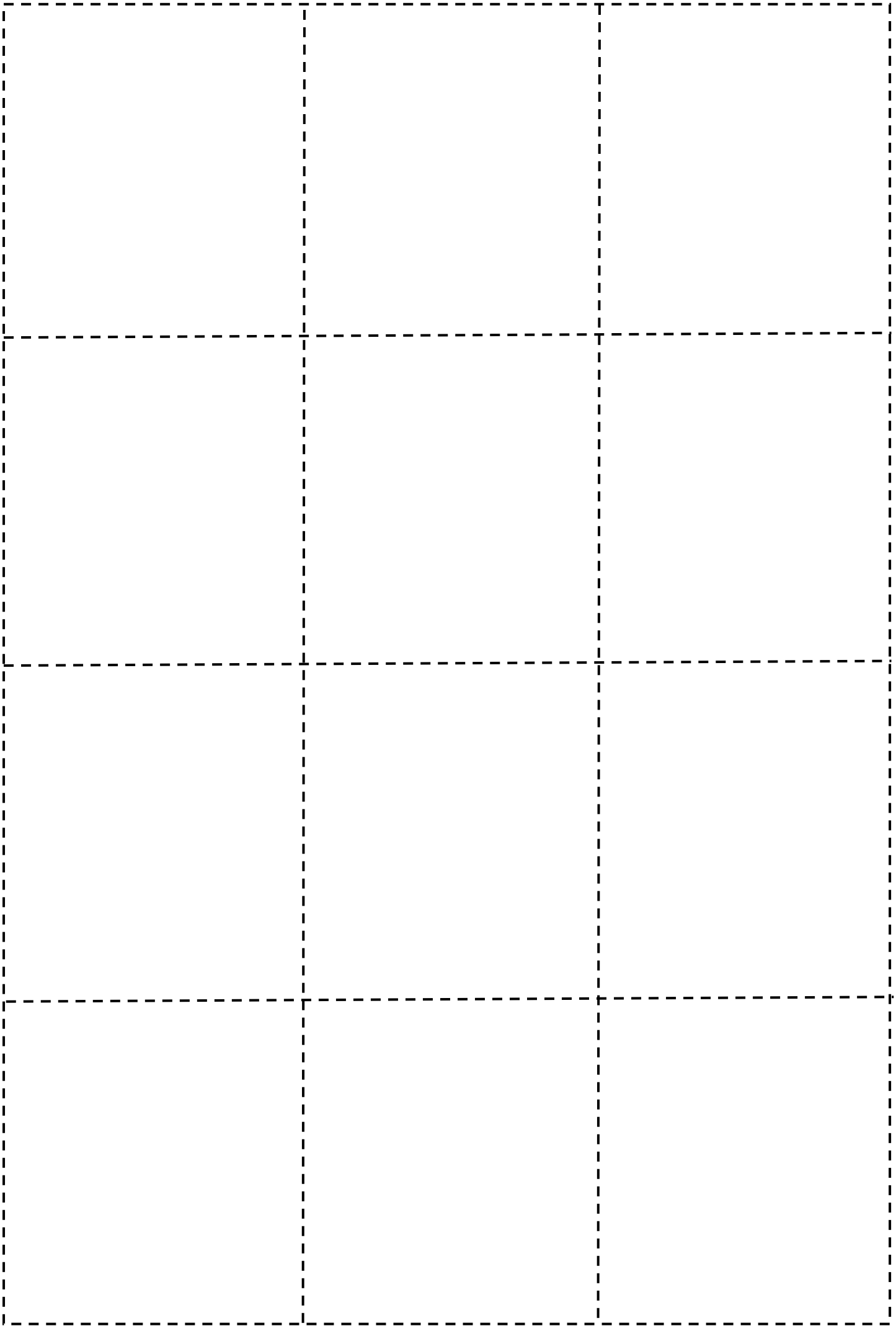
**electrons orbit the nucleus in shells.**

Why did Mendeleev leave gaps in the periodic table?

**He knew that the elements existed but they hadn't been found, based on their mass.**

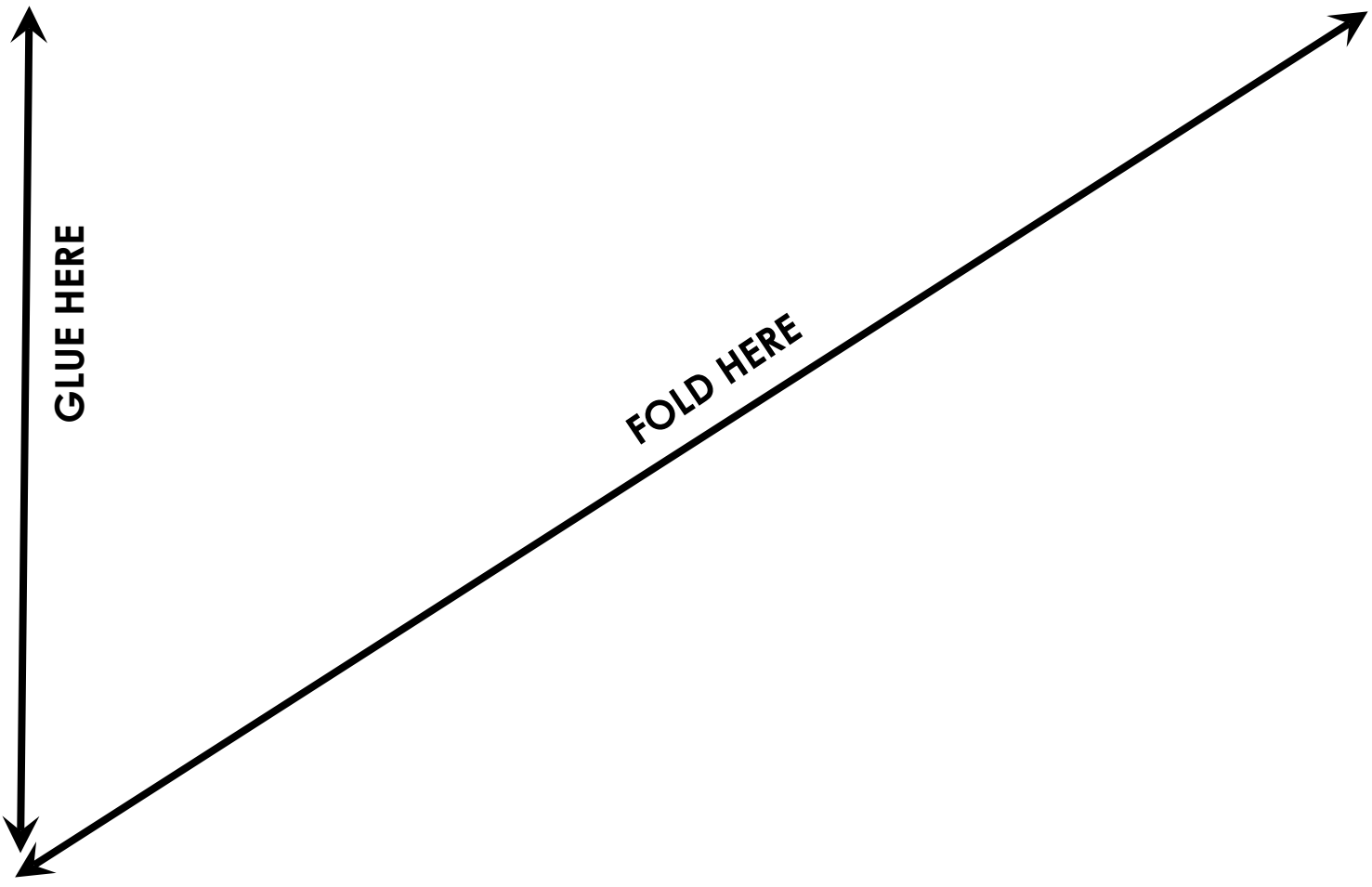
What happened to some of the gaps he left?

**They have been filled. Scientists have found some of the elements.**



# Topic 1: Atomic Structure & Periodic Table

## Question Card Storage



# Topic 2: Structure & Bonding

**a**

The three types of chemical bonding are...

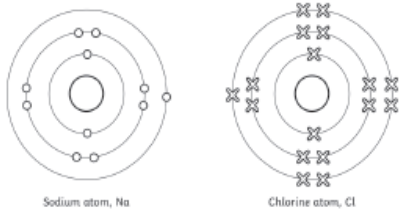
1. **ionic**
2. **covalent**
3. **metallic**

Describe the movement and arrangement of subatomic particles in each of the above.

1. **Electrons are lost and gained to fill the outer shell.**
2. **Electrons are shared to fill the outer shell.**
3. **Positive metal ions are surrounded by free electrons.**

**b**

Draw a dot and cross diagram for the following ionic bonding:
sodium chloride




Which four groups are more likely to make ions?

**1, 2, 6 and 7**

**c**

Describe the bonding in ionic compounds

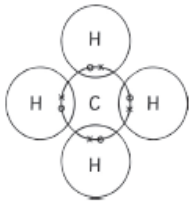
**They are held together by the strong ionic forces of oppositely charged ions. Metal ions have a positive charge and non-metals ions have a negative charge so they are attracted. They have very strong bonds.**

Why can ionic compounds conduct electricity when in solution?

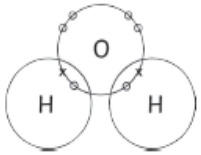
**The ions are free to move about and can conduct electricity.**

**d**

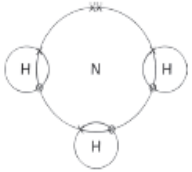
Using this example, draw dot and cross diagrams for $H_2O$, $NH_3$ and $O_2$



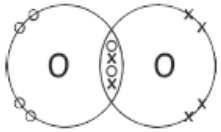

1. $H_2O$




2. $NH_3$

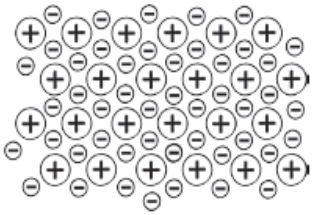



3. $O_2$



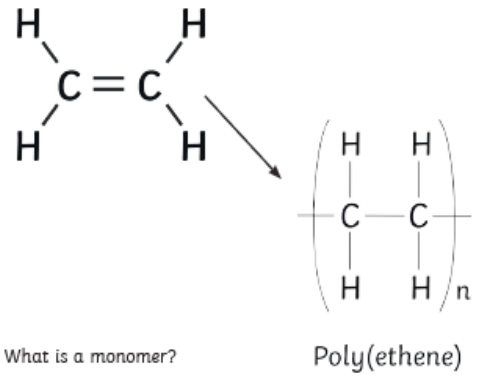

**e**

Describe how metals conduct heat and electricity. Use the diagram to help explain.
**Metals have free Electrons that are able to move around and transfer energy.**



**f**

Complete the polymer diagram for the following monomer.



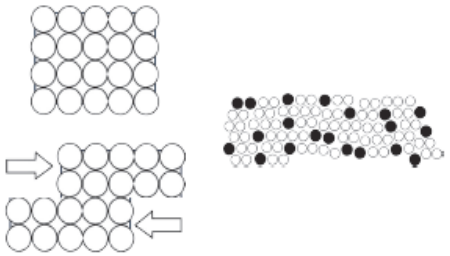

Poly(ethene)

What is a monomer?
**One molecule.**

What is a polymer?
**A long chain of monomers.**

**g**

Properties of metals and alloys.

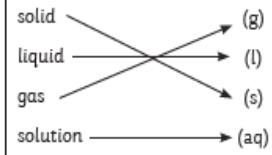


Describe how the 2 pictures are different to each other.
**Alloys have different sized particles. In pure metals, all the atoms are the same.**

Why are some alloys harder than pure metals?
**They have different sized particles so the layers can not slide across each other as easily.**

**h**

Match up the following with the state symbol.




What happens to the intermolecular forces when a liquid turns into a gas?
**Decrease**

**i**

Describe the changes of state during:

evaporation:
**liquid changes to a gas.**

condensation:
**gas changes to a liquid.**

melting:
**solid changes to a liquid.**

**j**

Small molecules form substances with **low** boiling points because they have **weak** intermolecular forces.

They **do not** conduct electricity because they do not have any free electrons.

**k**

My main areas for improvement are:

_____

_____

_____

_____

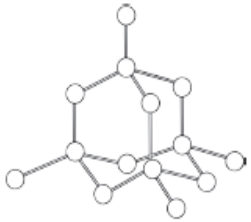
_____

_____

# Topic 2: Structure & Bonding

**a**

Draw a diagram of the structure of diamond.



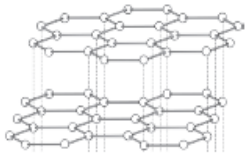
Why is this structure so strong? Choose the correct answer.

2. **Many strong covalent bonds.**

**b**

What is this a diagram of?

**Graphite**



Explain why it can conduct electricity and heat.
**Graphite has free delocalised electrons that can pass between layers; the electrons can carry the charge.**

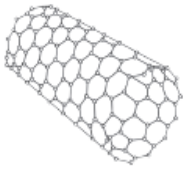
**c**

The topic I understand the most in this unit is

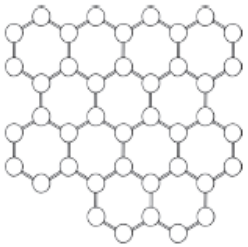
The topic I need to work on is

**d**

This is a carbon **nanotube**.
It has high **tensile** strength, high **heat** and **electrical** conductivity.



**e**



**Graphene** is a single layer of graphite.

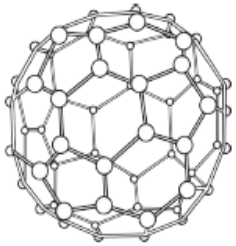
Why is this material so strong?

**It has strong covalent bonds.**

Where is this product used?

**In electronics and composites.**

**f**



What is this structure?

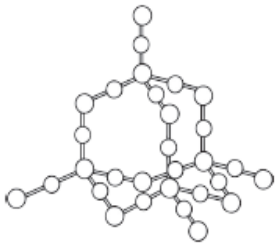
**Buckminsterfullerene**

How many carbon atoms are there?

**e) 60**

**g**

Explain the differences and similarities between silicon dioxide and diamond.
**Silicon dioxide contains silicon and oxygen atoms instead of carbon but has a similar structure to diamond.**



**h**

What are the formulas for the following?
Match up the answers.

Iron (II) oxide → $Fe(OH)_2$
Iron (II) hydroxide → FeO
Iron (lll) oxide → $Fe_2O_3$

**i**

How many:

mm in 1m? **1000mm**

m in 1mm? **0.001m**

What are the abbreviated units for the following:

metre; **m**

centimetre; **cm**

millimetre; **mm**

nanometre; **nm**

micrometre. **µm**

**j**

Compare diamond and graphite.
Describe the structure, hardness and conductivity.

**Both – forms of carbon.**

**Single covalent bonds**

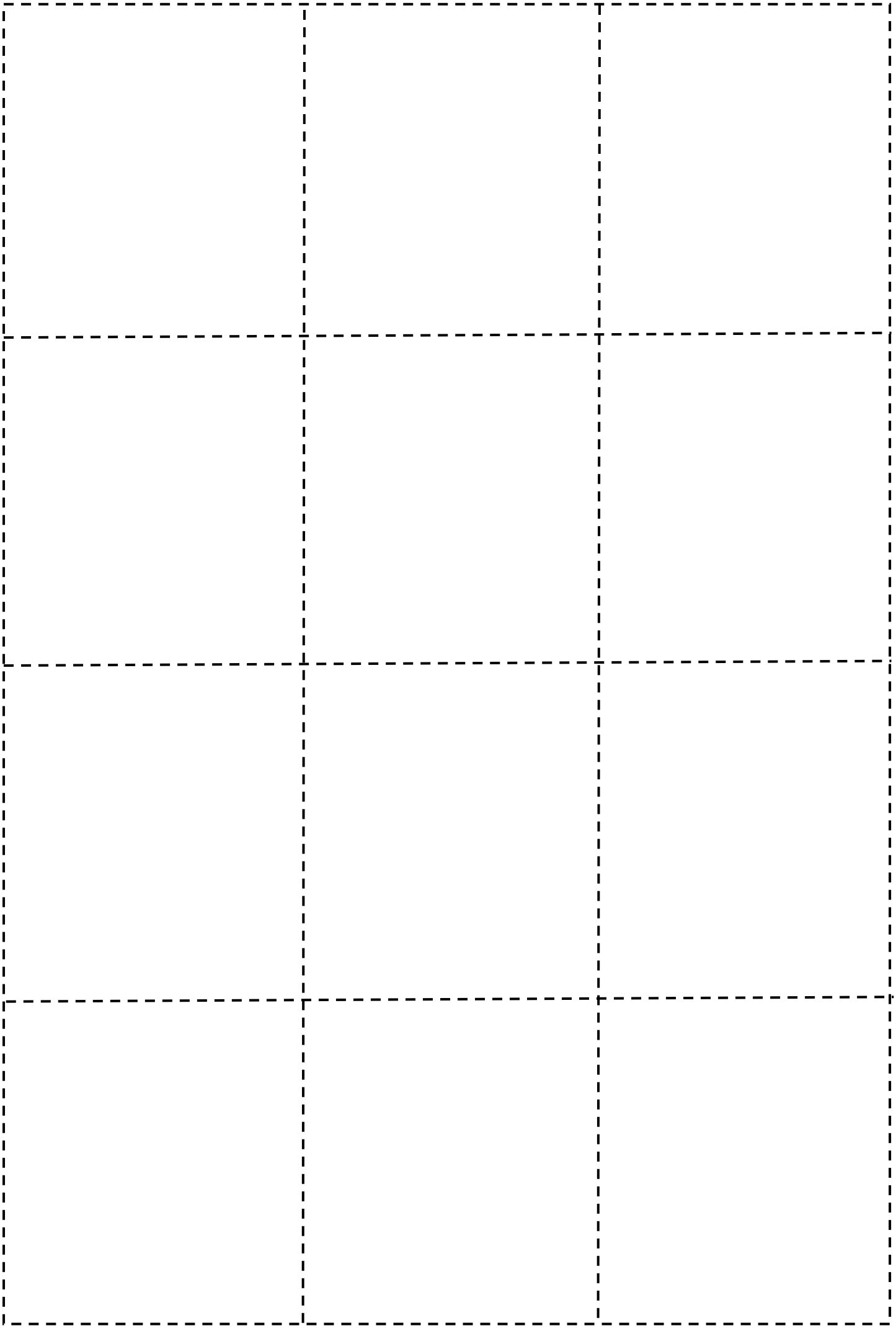
**Have many atoms.**

**Graphite – flat sheets, conducts electricity, each carbon atom forms 3 covalent bonds.**

**Diamond – tetrahedral structure, each carbon atom forms 4 covalent bonds, does not conduct electricity.**

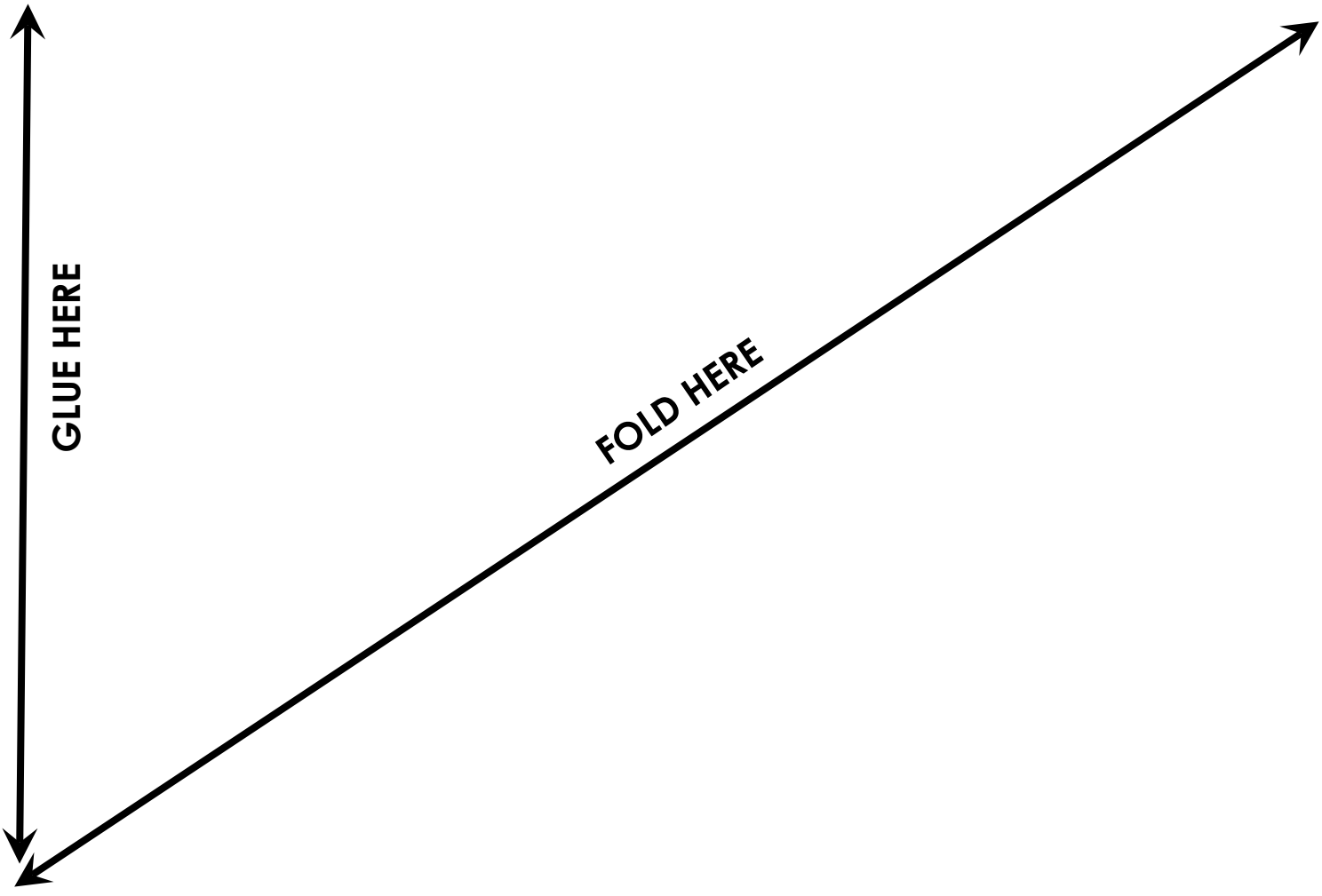
**k**

My main areas for improvement are:



# Topic 2: Structure & Bonding

# Question Card Storage



# Topic 3: Quantitative Chemistry

**a**

Mass of the **product** must always equal the mass of the **reactants**.

Balance the following:

$2H_2 + O_2 \longrightarrow 2H_2O$

$2Na + Cl^2 \longrightarrow 2NaCl$

$Br_2 + 2KI \longrightarrow I_2 + 2KBr$

$N_2 + 3H_2 \longrightarrow 2NH_3$

**b**

Complete the following sentences

The relative formula mass is the ($M_r$) of a compound.

It is the sum of the **relative** atomic masses ($A_r$) of the atoms.

Calculate the relative formula mass for the following. Show your working out.

$A_r$ of C = 12
$A_r$ of H = 1
$A_r$ of O = 16
$A_r$ of N = 14

Example:
$CO_2$
12 + (16 × 2)
12 + 32
= 44

$H_2O$
(1 × 2) + 16
2 + 16
= 18

$CH_4$
12 + (1 × 4)
12 + 4
= 16

$NH_4NO_3$
14 + (1 × 4) + 14 + (16 × 3)
14 + 4 + 14 + 48
= 80

**c**

When a gas is produced during a reaction, why might the mass go down?
(Hint: think about where the gas may go)

**The gas may be released into the environment.**

Write the equation for when magnesium reacts with oxygen.

$2Mg + O_2 \longrightarrow 2MgO$

What happens to the mass of the product from the question above?

**The mass increases because oxygen is added from the environment.**

**d**

$$\% \text{ mass} = \frac{A_r \times \text{number of atoms} \times 100}{M_r \text{ of the compound}}$$

Using the equation above, calculate the % mass of sodium (Na) in NaCl.

$A_r$ of Na = 23

$A_r$ of Cl = 35.5

$$\% \text{ mass} = \frac{23 \times 1 \times 100}{23 + 35.5}$$

$$= \frac{2300}{58.5}$$

= 39.3% (to 1d.p.)

**e**

If 9g of magnesium reacts completely with 6g of oxygen what is the mass of magnesium oxide produced?

1. 5g
2. 10g
3. 15g
4. 20g
5. 25g

**f**

Show that mass is conserved in the following equation.

Use the $A_r$ values to calculate the $M_r$ of both sides of the equation.

$A_r$ of H = 1

$A_r$ of O = 16

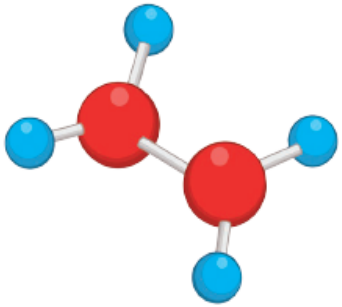
$2H_2 + O_2 \longrightarrow 2H_2O$

$2 \times (1 \times 2) + (16 \times 2) \longrightarrow 2((1 \times 2) + 16)$

$4 + 32 \longrightarrow 2 \times 18$

$36 \longrightarrow 36$

**left-hand side = right-hand side**



**g**

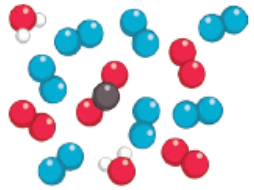
Complete the concentration equation.

$$\text{concentration} = \frac{\text{mass of dissolved substance}}{\text{volume of solvent}}$$

What is the concentration of a solution if there is 40g of dissolved substance and 0.5dm³ of solvent?

$$\text{concentration} = \frac{40}{0.5}$$

**concentration = 80g/dm³**



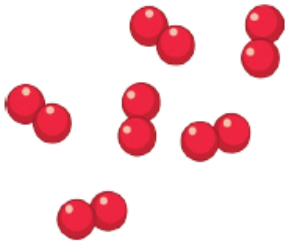
**h**

Rearrange the equation to calculate the mass of the dissolved substance when the concentration is 15g/dm³ and the volume is 0.8dm³.

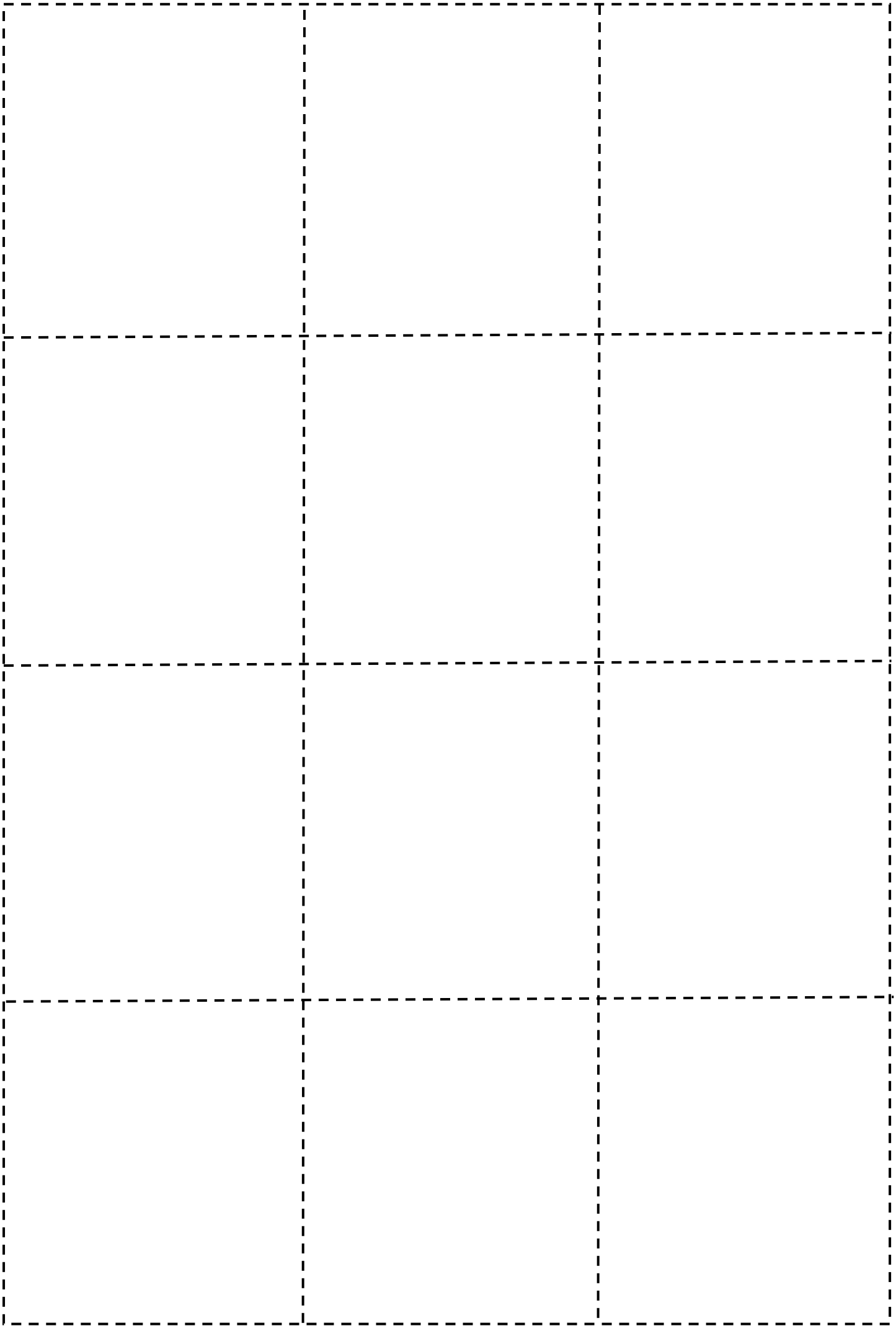
**mass = concentration × volume**

**mass = 15 × 0.8**

**mass = 12g**



Page for extra notes/practice calculations



# Topic 3: Quantitative Chemistry

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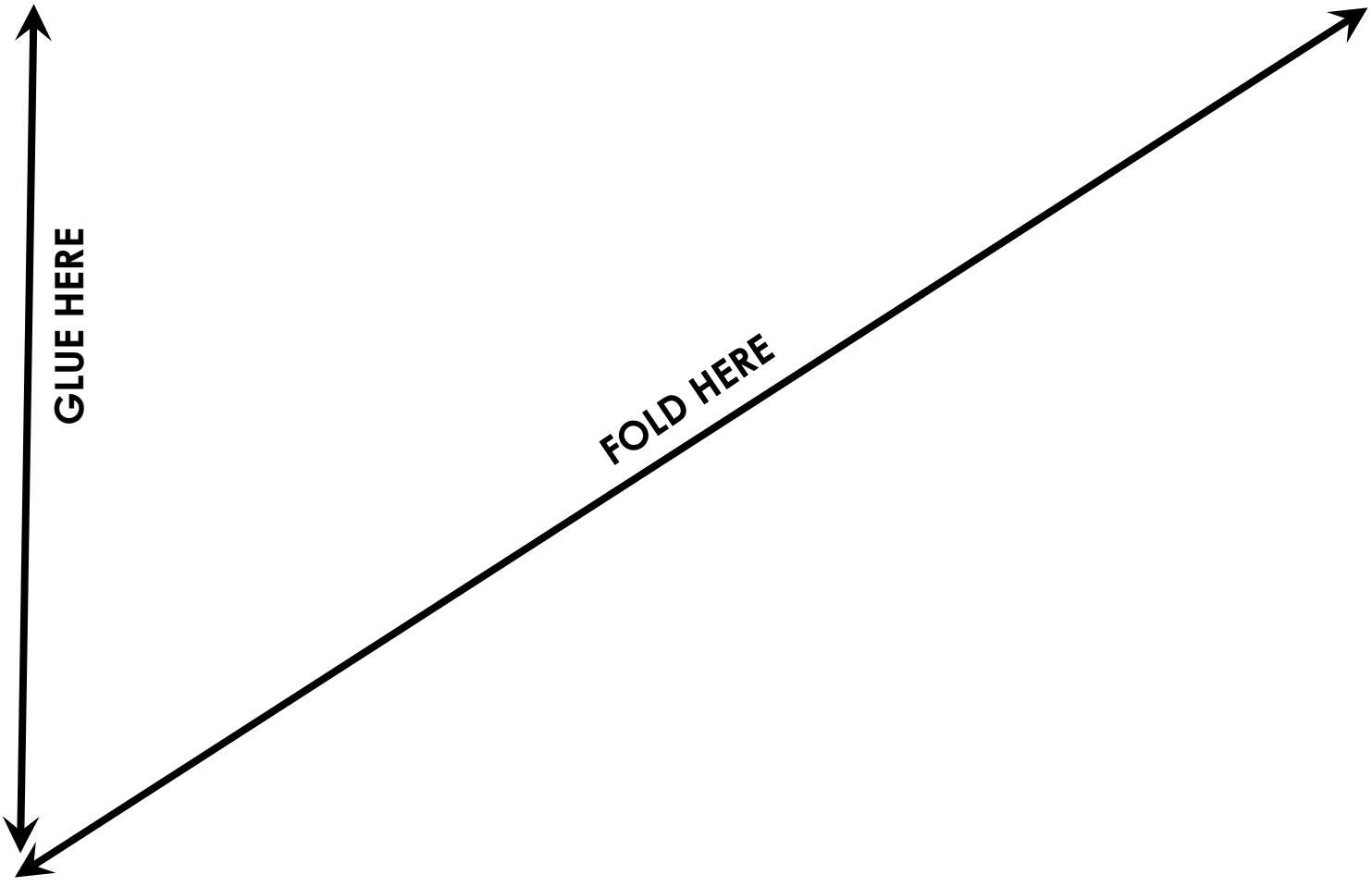


# Topic 4: Chemical Changes

**a**

What is an oxidation reaction?

**The gaining of oxygen in a reaction.**

e.g. copper + oxygen → **copper oxide**

What is a reduction reaction?

**The loss of oxygen in a reaction.**

e.g. copper oxide → **copper + water**

**b**

Place the following metals in order of reactivity – adding the names to the symbols.

Na, Zn, Fe, Cu, Li, K, Mg, Ca

**potassium**

**sodium**

**lithium**

**calcium**

**magnesium**

← carbon

**zinc**

**iron**

← hydrogen

**copper**

Why are hydrogen and carbon sometimes included in the reactivity series?

**They are used in the extraction of the metals.**

Place arrows on the reactivity series where hydrogen and carbon could go.

Why is gold often found in its pure state?

**Gold is a very unreactive metal.**

**c**

Complete the word equations.

zinc carbonate + sulfuric acid → **zinc sulfate + water + carbon dioxide**

magnesium oxide + hydrochloric acid → **magnesium chloride + water**

magnesium carbonate + nitric acid → **magnesium nitrate + water + carbon dioxide**

calcium carbonate + hydrochloric acid → **calcium chloride + water + carbon dioxide**

**d**

Describe why carbon is used to extract some metals from their ores.

**Clue**: Think about the reactivity series.

**Metals below carbon in the reactivity series can be extracted by reduction using carbon. This is because carbon can take the oxygen away.**

**e**

How can the reactions of metals be used to work out the reactivity series?

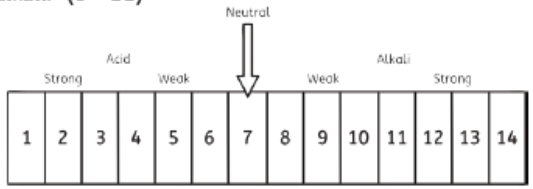
**Clue**: Think about the gas given off and the amount.

**The more bubbles produced, and the faster that they are produced, the more reactive the metal.**

**f**

On the pH scale, label:

strong acid; **(0 - 3)**
strong alkali; **(12 - 14)**
neutral; **(7)**
weak acid; **(4 - 6)**
weak alkali. **(8 - 11)**




**g**

To measure pH you can use...

**universal indicator**
Litmus paper
iodine
methylene blue
Benedict's solution
**pH meter**

**(select two)**

**h**

Describe how to make a soluble salt from an insoluble base.

1. Choose an **acid**.
2. Choose an **insoluble** base.
3. Warm the **acid**.
4. Add the insoluble base to the acid until there is no further **reaction**.
5. **Filter** the mixture.
6. Heat the solution to **evaporate** the water.
7. **Crystals** of salt will start to form.

**i**

Complete the neutralisation reaction.

acid + base → **salt + water**

H+ (aq) + OH- (aq) → **$H_2O$**.

What is the pH of the products of a neutralisation reaction?

a) 1 **b) 7** c) 14

**j**

Complete the sentences by choosing one of the answers:

Some metals react with water to produce...

oxygen and alkali.

salt and hydrogen.

**metal hydroxide and hydrogen.**

Some metals react with acid to produce...

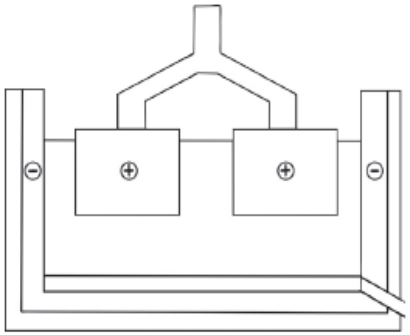
oxygen and alkali.

**salt and hydrogen.**

alkali and carbon dioxide.

a

Describe how the ions move when aluminium is extracted by electrolysis.



**The positive ions are attracted to the negative electrode where they form aluminium atoms. Negative oxygen ions are attracted to the positive electrode where they react to form O2 molecules.**

Why is aluminium oxide mixed with cryolite?

**It lowers the melting point.**

What is the overall equation for the electrolysis of $Al_2O_3$ to make aluminium and oxygen?

**aluminium oxide → aluminium + oxygen**

**$2Al_2O_3 \rightarrow 4Al + 3O2$**

Why can aluminium not be extracted by carbon?

**It is more reactive than carbon so can not be displaced by the carbon.**

b

Circle the equations below if a (displacement) reaction will occur.

**copper oxide + magnesium**

magnesium oxide + iron

potassium oxide + zinc

**zinc oxide + lithium**

Why do some of them not work?

**The metal has to be more reactive than the metal in the compound to take its place.**

c

What is electrolysis?

**Splitting up using electricity**

How are ions able to move in electrolysis?

**Ionic compounds are dissolved/melted sothe ions can move.**

The positive ions go towards the **cathode** where they **gain** electrons.

The negative ions go towards the **anode** where they **lose** electrons.

Why can molten ionic compounds be electrolysed?
Choose an answer.

They can not move

**They can move**

d

In copper sulfate solution what forms at the:

cathode anode

**Copper** **Oxygen and water**

**Copper is less reactive than hydrogen so copper is formed.**

e

In sodium chloride solution what forms at the:

cathode anode

**hydrogen** **chlorine**

**Sodium more reactive than hydrogen so hydrogen is formed.**

f

If the metal is more reactive than hydrogen, what gas will form during electrolysis?

**Hydrogen**

If the metal is less reactive than hydrogen, what will form?

**Pure metal**

If the salt contains halide ions, where will Cl2, Br2 I2 form; anode or cathode?

**Anode**

g

What are the tests for:

chlorine;

**bleaches damp litmus paper**

hydrogen;

**squeaky pop test**

oxygen?

**relight a glowing splint**

h

I understand the following topic

_____

_____

_____

_____

_____

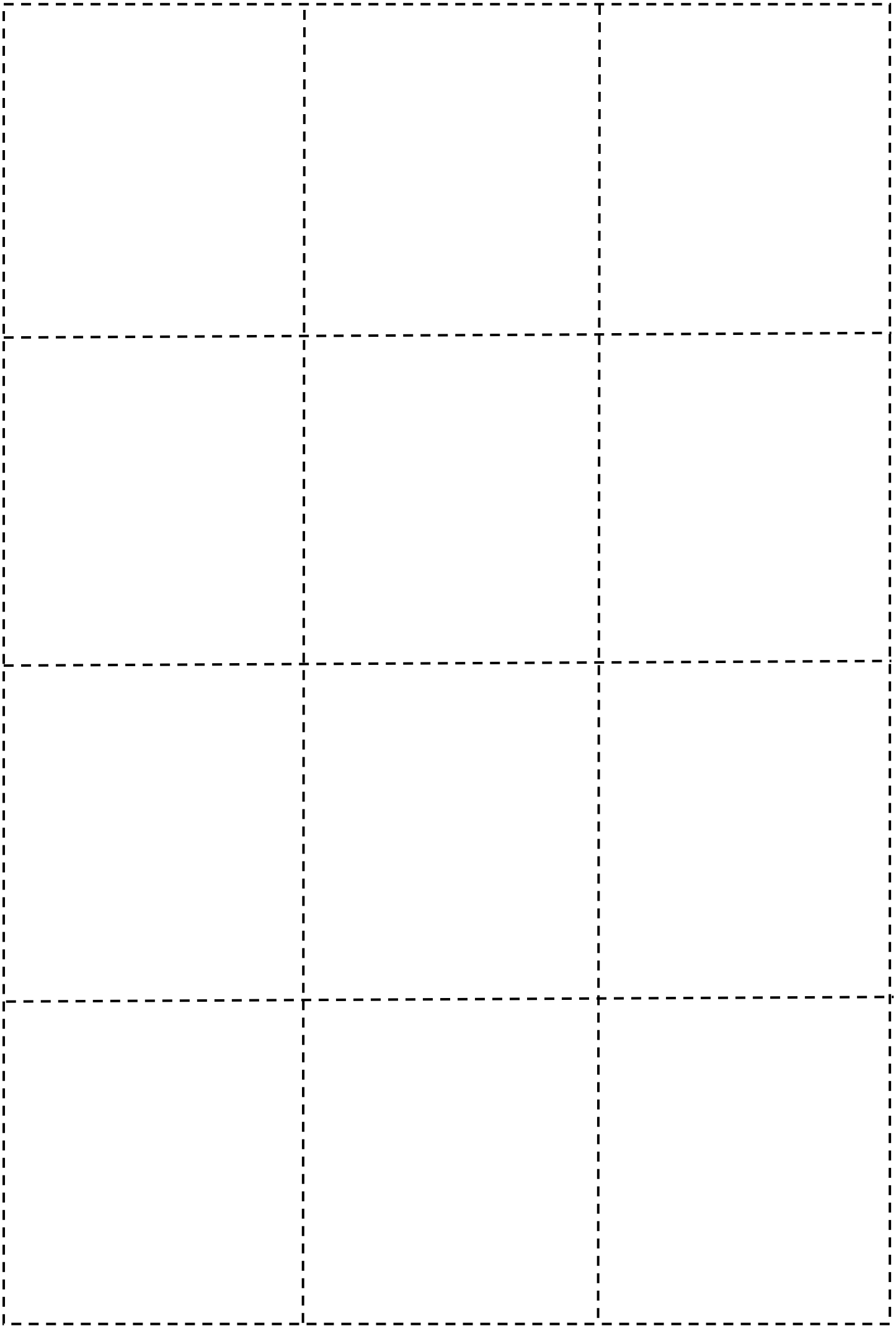
I need to work on the following topic

_____

_____

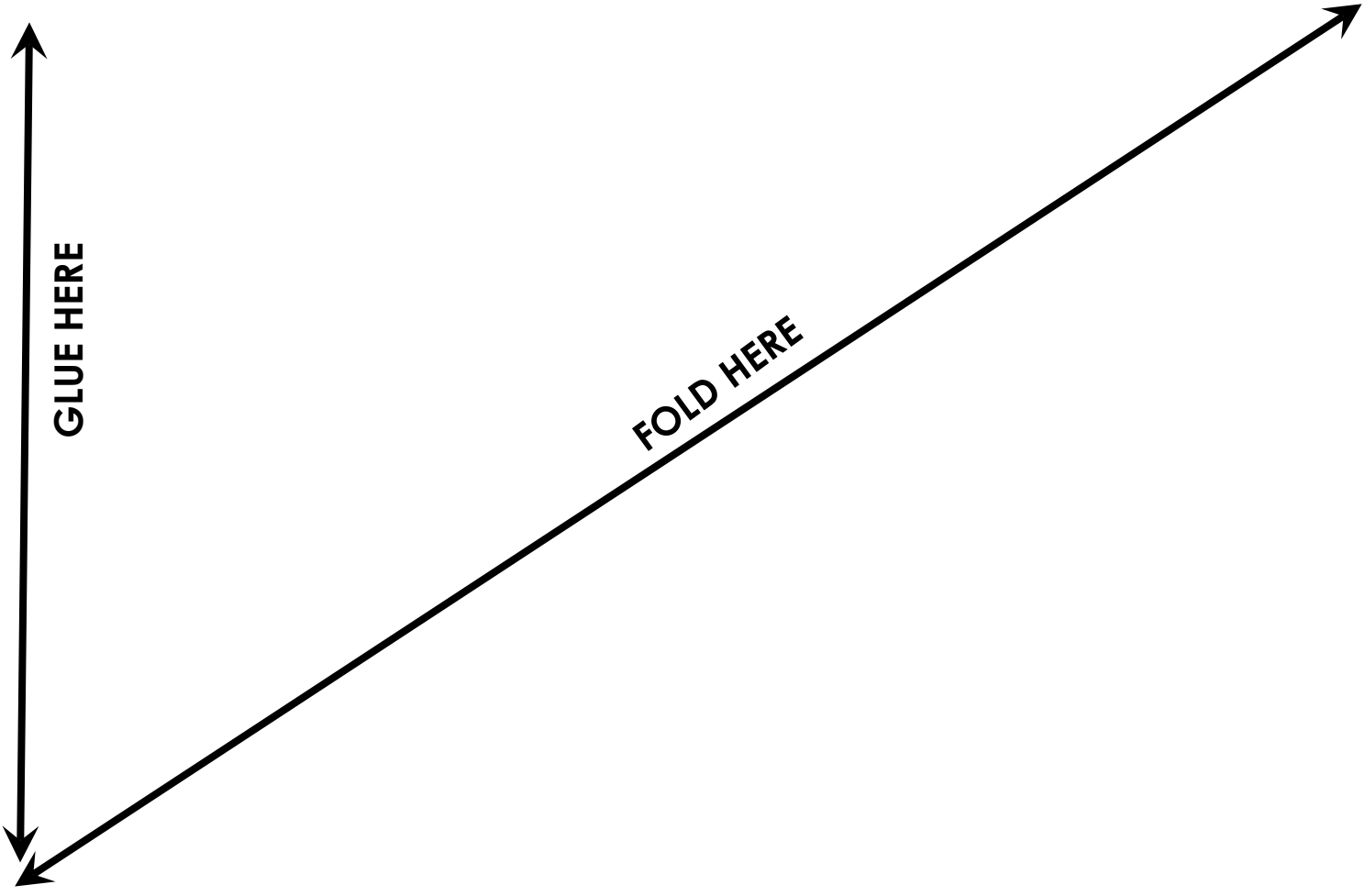
_____

_____



# Topic 4: Chemical Changes

## Question Card Storage



# Topic 5: Energy Changes

a

In an exothermic reaction heat **exits** the reaction to the surrounding environment.

The surrounding temperature **increases**.

In an endothermic reaction heat **enters** the chemical reaction.

The surrounding temperature **deceases**.

b

Circle the exothermic reactions and underline the endothermic reactions:

combustion **exothermic**
photosynthesis **endothermic**
electrolysis **exothermic**
neutralisation **exothermic**
water reacting with calcium oxide **exothermic**
ammonium chloride reacting with water **endothermic**

Name some every day uses of exothermic reactions.
**Hand warmers, self-heating cans, matches, etc.**

Give an example of an every day use of an endothermic reaction.
**sports injury packs, etc.**

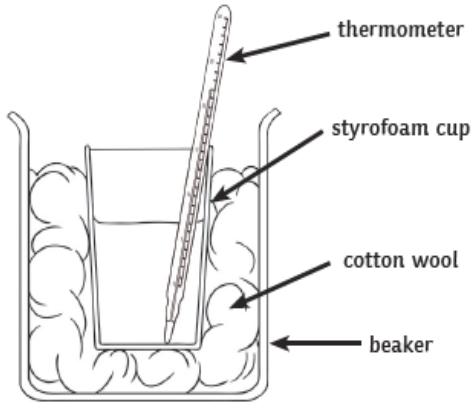
c

What is activation energy?
**The minimum amount of energy needed by the reactants to start the reaction.**

d

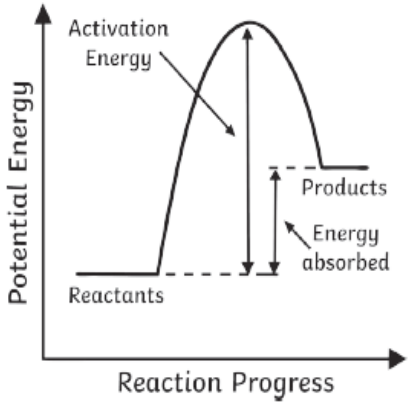
Describe how energy transfer can be measured in a practical. Draw a diagram to show the practical.

1. **Take the start temperature of the reactants.**
2. **Record the highest temperature.**
3. **Record the lowest temperature.**
4. **Take away the temperature from the temperature of the reactants.**



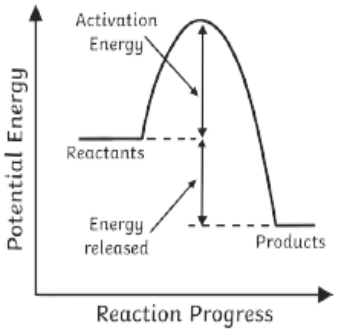

e

Sketch a reaction profile for an endothermic reaction.




f

Sketch a reaction profile for an exothermic reaction.




g

Describe the reaction profile of an endothermic reaction.
**The products are at a higher energy level because energy has come into the chemical reaction.**

Describe the reaction profile of an exothermic reaction.
**The products are at a lower energy level because energy has gone out of the chemical reaction.**

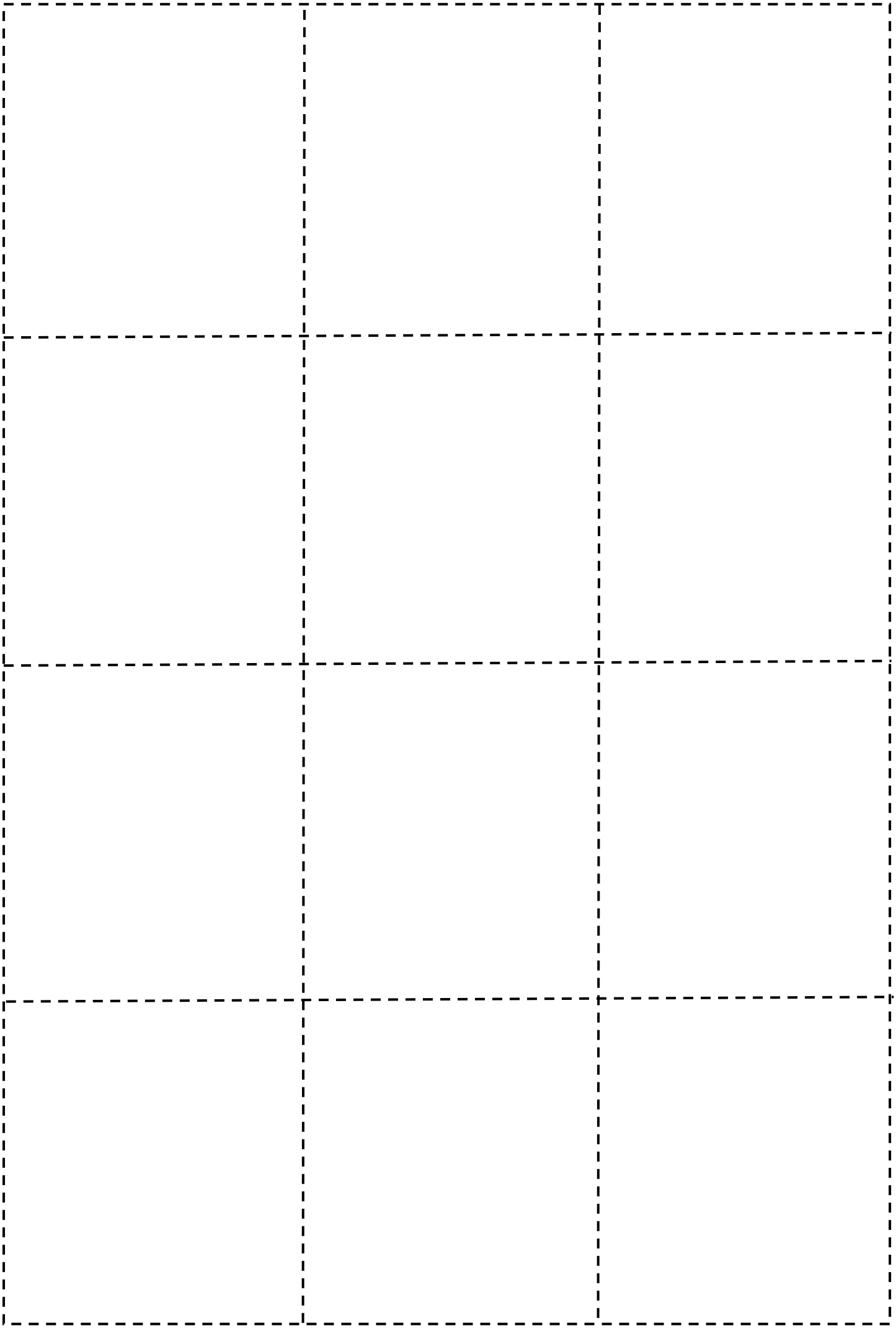
h

What other things can affect the temperature change in a reaction?

**Mass** of the reactants used.
**Concentration** of the reactants used.

Describe how you may test one of the above.
**Concentration**
**Place the same amount of acid and alkali in beakers, place in a water bath to get them to the same temperature. Add to a polystyrene cup. Measure the temperature every 30 seconds and record the highest temperature. Calculate the change in temperature then repeat with different concentrations.**

# Additional Notes Page



# Topic 5: Energy Changes

# Question Card Storage