

# A Level Chemistry

Ribston Hall High School



A Level Preparation Task

Name:

School:

GCSE Grades in

i) Chemistry or Science:

ii) Maths:

The following are a series of questions on topics you have covered at GCSE and that are essential to you getting a good start to A Level Chemistry. If you know these things it will help you with the topics studied in Year 12 Chemistry.

Some of these questions might require GCSE knowledge that has not been covered by your exam board at GCSE.

## Part I: Atomic Structure and Bonding

### Atomic Structure

- 1) Which subatomic particles are found in nucleus?
- 2) What is the charge on an ion formed when an atom loses two electrons?
- 3) What is the charge on an ion formed when an atom gains two electrons?

### Atomic Number, Mass Number and Isotopes

- 1) Use the periodic table to work out how many neutrons are in a neutral phosphorous atom.
- 2) In terms of the number of the subatomic particles, state two similarities and one difference between two isotopes of the same elements.
- 3) Three neutral isotopes of carbon have mass numbers 12,13 and 14.

State the numbers of protons, neutrons and electrons in each.

## Calculating the Relative Atomic Mass

- 1) Find the relative atomic mass of Lithium if its composition is 8%  ${}^6\text{Li}$  and 92%  ${}^7\text{Li}$
- 2) Find the relative atomic mass of Carbon if its composition is 99%  ${}^{12}\text{C}$  and 1%  ${}^{13}\text{C}$
- 3) Find the relative atomic mass of Silver if its composition is 52%  ${}^{107}\text{Ag}$  and 48%  ${}^{109}\text{Ag}$
- 4) Find the relative atomic mass of Sodium fluoride,  $\text{NaF}$
- 5) Find the relative atomic mass of Chloromethane,  $\text{CH}_3\text{Cl}$

## Electronic Structure

- 1) Draw diagrams to show the electron arrangements of the following elements:  
Carbon, Fluorine, Magnesium, sulfur.
- 2) Write the electron arrangements of these elements e.g. Bromine is 2.8.8.7:  
Lithium, Sodium, Potassium, Beryllium, Magnesium, Calcium.
- 3) Write the electron configurations of oxygen and chlorine.
- 4) Give one similarity between the electrons of elements that are in the same group.

## Formation of Ions

- 1) What is the charge on a Sodium ion?
- 2) Which group typically forms  $1-$  ions?
- 3) What is the formula of a sulfite ion? Remember to include the overall charge on the ion.

## Ionic Bonding

- 1) Draw a diagram showing how a magnesium atom reacts with an oxygen atom to form magnesium oxide,  $\text{MgO}$ . Your diagram should show the electron transfer process.
  
  
  
  
  
  
  
  
  
  
- 2) In Potassium oxide, what is the ratio of  $\text{K}^+$  ions and  $\text{O}^{2-}$  ions? What is the ionic formula?

## Ionic Compounds

- 1) Put these ionic compounds in order of melting point, highest to lowest:

Lithium oxide ( $\text{Li}_2\text{O}$ ), Beryllium oxide ( $\text{BeO}$ ), Lithium fluoride ( $\text{LiF}$ ).

Explain why you have put them in the order chosen.

- 2) Explain why the ionic compound, potassium chloride ( $\text{KCl}$ ), can conduct electricity when molten or dissolved, but not when it is solid.

## Covalent Bonding

1) Draw simple dot-and-cross diagrams to show the bonding in the following molecules:

a) Chlorine ( $\text{Cl}_2$ )

b) Water ( $\text{H}_2\text{O}$ )

c) Ethane ( $\text{C}_2\text{H}_6$ )

d) Oxygen ( $\text{O}_2$ )

## Small Covalent Molecules

1) Draw a dot-and-cross diagram to show the bonding in hydrogen fluoride (HF). Label the bonding electrons and lone pairs of electrons.

2) Explain why nitrogen is a gas at room temperature, despite the nitrogen atoms in each molecule being strongly bonded to each other.

## Giant covalent Molecules

1) Why won't diamond dissolve in water when sodium chloride will?

## Metallic Bonding

1) Sodium has a metallic structure, whilst sodium chloride (NaCl) is an ionic compound.

Give one similarity and one difference between the physical properties of these substances.

## Part 2: Inorganic Chemistry

### Trends in Properties across the Periodic Table

The table below shows some of the physical properties of Period 3 Oxides.

The final row has been deduced from these properties.

	Na <sub>2</sub> O	MgO	Al <sub>2</sub> O <sub>3</sub>	SiO <sub>2</sub>	P <sub>4</sub> O <sub>10</sub>	SO <sub>2</sub>
State (at room temperature and standard pressure)	solid	solid	solid	solid	solid	gas
Melting point (°C) (at standard pressure)	1275	2800	2072	1650	570	-73
Electrical conductivity (when molten)	good	good	good	none	none	none
Bonding	ionic lattice	ionic lattice	ionic lattice	Giant covalent structure	Small covalent molecule	Small covalent molecule

1) Explain how the data in the first three rows of the table above supports the idea that the bonding type changes from ionic to covalent as you move across Period 3.

2) Use the information in the table to predict the trend in the melting points of elements as you go across Period 3.

3) Predict the type of bonding you would expect in chlorides of:

- a) Sodium            b) Phosphorous

## Writing and Balancing Equations

1) Write a balanced symbol equation for the combustion of Methane (CH<sub>4</sub>) in oxygen

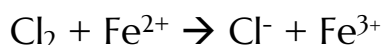


2) Write the balanced symbol equations for the following reactions:

a) The complete combustion of ethanol (C<sub>2</sub>H<sub>5</sub>OH) in oxygen (O<sub>2</sub>) to give carbon dioxide (CO<sub>2</sub>) and Water (H<sub>2</sub>O)

b) The reaction of calcium hydroxide (Ca(OH)<sub>2</sub>) with hydrochloric acid (HCl) to give calcium chloride (CaCl<sub>2</sub>) and Water (H<sub>2</sub>O)

3) Balance the following ionic equation:



Include the state symbols given that Cl<sub>2</sub> is a gas and everything else is aqueous

## Group2

1) The following are descriptions of the reactions of Be and Ca with cold water.

Use them to predict the reactions of Mg and Sr

>Beryllium will not react with cold water at all.

>Calcium reacts steadily with cold water to produce hydrogen gas and calcium hydroxide.

2) Predict with reasoning the trend in boiling points of Group2 Metals.

## Group7

1) Predict with reasoning, what would happen if you mixed the following halogens and halide solutions.

- a)  $\text{Cl}_2$  and  $\text{Br}^-$
- b)  $\text{I}_2$  and  $\text{Cl}^-$
- c)  $\text{I}_2$  and  $\text{Br}^-$
- d)  $\text{Cl}_2$  and  $\text{I}^-$

2) Draw a diagram to show the bonding between atoms in a fluorine molecule.



## Acids and Bases

- 1) Write a balanced equation for the reaction between nitric acid and potassium hydroxide.
  
- 2) Write equations to show what happens when the following substances are mixed with water:
  - a) Sulphuric acid
  
  
  
  - b) Potassium hydroxide
  
  
  
  - c) Nitric acid


## Part 3: Organic Chemistry

### Organic Molecules

*There are different ways of representing a Molecule's Structure*

Chemists have a different ways of representing an organic molecule's **Formula**.

Here are the different types:

FORMULA	WHAT IT SHOWS YOU	FORMULA FOR BUTANOL (an alcohol)
<b>General formula</b>	This describes <b>any member</b> in a homologous series. The number of carbons is represented by 'n' and the number of hydrogens in terms of 'n'.	$C_nH_{2n+1}OH$ (this is true for all alcohols.)
<b>Molecular formula</b>	This shows the number of <b>atoms</b> of each <b>element</b> in a molecule.	$C_4H_{10}O$
<b>Structural formula</b>	This shows the molecule <b>carbon by carbon</b> , with all attached hydrogens and functional groups.	$CH_3CH_2CH_2CH_2OH$
<b>Skeletal formula</b>	The <b>bonds</b> of the carbon skeleton are drawn, with any <b>functional groups</b> . The carbon atoms and attached hydrogens aren't shown.	
<b>Displayed formula</b>	All the <b>atoms</b> and <b>bonds</b> are drawn to show how the molecule is arranged.	$\begin{array}{cccccccc} & H & H & H & H & & & \\ &   &   &   &   & & & \\ H & -C & -C & -C & -C & -O & -H & \\ &   &   &   &   & & & \\ & H & H & H & H & & & \end{array}$

- 1) Draw the skeletal and displayed formulae for the molecule with the structural formula  $\text{CH}_3\text{CHOHCH}_2\text{CH}_3$
- 2) What is the molecular formula of the compound with the structural formula  $\text{CH}_3\text{CH}_2\text{COOH}$ ?

## Alkanes

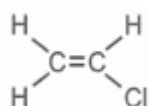
- 1) Draw out the structures of pentane ( $\text{C}_5\text{H}_{12}$ ) and Hexane ( $\text{C}_6\text{H}_{14}$ ).
- 2) a) Write out the molecular formulae of the first four alkanes.  
  
b) What is the general formula of alkanes?
- 3) Write a balanced equation for the complete combustion of propane in oxygen.

## Alkenes

- 1) Draw out a structure for the pentene ( $\text{C}_5\text{H}_{10}$ ).
- 2) Draw out two alternative structures for hexane ( $\text{C}_6\text{H}_{12}$ ).
- 3) Work out the general formula for the alkenes.

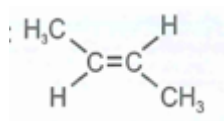
## Polymerisation

- 1) What property of alkenes allows them to form polymers?
- 2) Using the standard way of representing polymers, draw the polymers formed by the following alkenes:



a) Chloroethene

b) Butene



## Alcohols

- 1) Write out the general formula of alcohols.

## Part 4: Physical Chemistry

### Reactions Rates

- 1) Describe how you could measure the rates of the following reactions:
  - a) The endothermic reaction between citric acid and sodium bicarbonate to give carbon dioxide, water and a sodium salt.
  
  
  
  
  
  
  
  
  
  
  - b) The precipitation reaction between sodium thiosulfate and hydrochloric acid to form a sulfur precipitate, sulfur dioxide gas, sodium chloride and water.
  
  
  
  
  
  
  
  
  
  
  - c) The reaction between solid calcium carbonate and hydrochloric acid to produce calcium chloride and carbon dioxide gas.

### Collision Theory

- 1) Two particles in a reaction vessel collide but don't react. Give two reasons why the reaction may not have happened.
  
  
  
  
  
  
  
  
  
  
- 2) What is activation energy of a reaction?
  
  
  
  
  
  
  
  
  
  
- 3) Draw an enthalpy profile diagram for a reaction. On your diagram, label the reactants, products and activation energy.

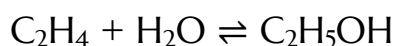
## Reaction Rates and Catalysts

- 1) Describe two things you could do to increase the rate of a reaction between aqueous species.
- 2) Why does increasing the pressure increase the rate of reaction between gases?
- 3) What's a catalyst?
- 4) Give two advantages of using a catalyst in industrial reactions.

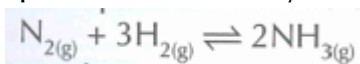
## Reversible Reactions

- 1) Compare the rates of the forward and backward reactions of a reversible reaction at the following points:
  - a) At the start of the reaction.
  - b) At equilibrium.
- 2) What is dynamic equilibrium?

## Le Chatelier's Principle



- 1) You are making ethanol from ethene and steam using the reaction shown above. What will happen to the yield of ethanol if you increase the amount of steam in the reaction mixture?
- 2) Ammonia is produced industrially using the following reversible reaction



The forward reaction is exothermic and the backwards reaction is endothermic. How will the position of equilibrium change if you:

- a) Increase the temperature of the reaction?
  
  
  
  
  
  
  
  
  
  
- b) Remove some ammonia from the reaction?

## The Mole

**One mole** of a substance contains  $6.02 \times 10^{23}$  particles.  $6.02 \times 10^{23} \text{ mol}^{-1}$  is known as **Avogadro's constant**.

$$\text{Number of moles} = \frac{\text{Mass of substance (g)}}{\text{Molar mass (g mol}^{-1}\text{)}}$$

- 1) Find the molar mass of sulphuric acid, given that 0.700 moles weighs 68.6g.
- 2) How many moles of sodium chloride are present in 117 g of NaCl?
- 3) I have 54.0 g of water (H<sub>2</sub>O) and 84.0 g of iron (Fe). Do I have more moles of water or of iron?

# Determination of Formulae from Experiments

## Atom Economy

Lots of reactions make **more than one product**. Some of them will be **useful**, but others will be just **waste**.

The **atom economy** of a reaction tells you how much of the **mass** of the reactants is converted into the **useful products**, and how much is wasted during the reaction.

$$\text{Atom economy} = \frac{\text{Total } M_r \text{ of desired products}}{\text{Total } M_r \text{ of all products}} \times 100$$

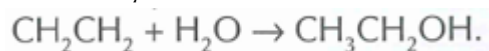
- 1) If a reaction has **100% atom economy** then **all** the atoms in the reactants have been turned into **useful** (desired) **products**. The higher the atom economy, the 'greener' the process.

- a) Ethanol can be made from bromoethane in the following reaction:



What is the atom economy of this reaction?

- b) In industry, ethanol is made from ethene and steam using the following reaction:

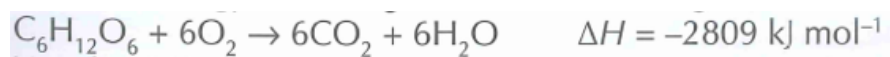


Suggest why this reaction is used, rather than the reaction in part a)

## Endothermic and Exothermic Reactions

- 1) Are the following reactions exothermic or endothermic?
- Burning coal
  - Sodium hydrogen carbonate + hydrochloric acid (temperature drops)
  - Acid + hydroxide (gets hotter)
  - Methane + Steam (cools as they react)

2) a) Draw an energy level diagram for the following reaction:



You should label the products, reactants and enthalpy change on your diagram.

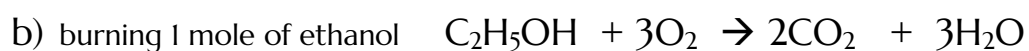
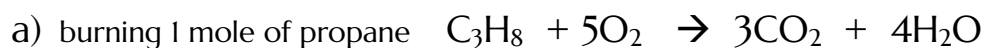
b) is the reaction in part a) endothermic or exothermic?

## Bond Energy

C-H 413	C-O 360	C=C 612	All these values are in kJ mol <sup>-1</sup> .
O=O 498	H-H 436	C=O 743	
C-C 348	O-H 463		

1) calculate the energy change of the following reactions:

(Use the values for the average bond energies given above)





## Part 5: Practical Chemistry

### Planning Experiments

- 1) A student is measuring the effect of temperature on the time taken for a lump of magnesium to react completely in a sample of concentrated hydrochloric acid.
  - a) What is the dependent variable in the student's experiment?
  
  
  
  
  
  
  
  
  
  
  - b) Name two variables that the students should control to make the experiment a fair test.

### Presenting and Interpreting Data

- 1) Kay measured the volume of gas given off in a reaction her results were 22.0 cm<sup>3</sup>, 23.0 cm<sup>3</sup>, 22.0 cm<sup>3</sup>, 19.0 cm<sup>3</sup>, and 24.0 cm<sup>3</sup>. Identify any anomalous results and calculate the mean.