WILBERFORCE
sixth form college

A LEVEL CHEMISTRY

SUMMER BRIDGING WORK 2025

Summer Bridging Work is an important part of your transition to Wilberforce Sixth Form College. This piece of work will count towards your effort grade. Please complete your summer bridging work in time for the start of term.

OVERVIEW OF SUBJECT

Chemistry is a central science and impacts on all areas of our lives. All of the materials used by engineers and technologists are made by chemical reactions and we all experience chemical reactions continuously, whether it be doing the washing or cooking, driving a car or listening to an iPod, or even just breathing!

Chemistry is an essential subject if you intend to have a career in medicine, dentistry, pharmacy, physiotherapy, and veterinary science. It also supports other science subjects such as biology and physics. However, chemistry is so important that it is useful for nursing, firefighting, plumbing, hairdressing, truck driving, paint and decorating to name but a few. Chemistry is a facilitating subject which means that the problem solving and analytical skills used in chemistry are valuable and transferrable and can enable you to move onto other seemingly unconnected careers such as accountancy or law.

ENTRY CRITERIA

A minimum of 5 GCSEs (9-4), including English Language and Maths.
Grade 6 in GCSE Chemistry or 6-6 in Combined Science.
Grade 6 in GCSE Maths.
Grade 5 in GCSE English language.

TASK 1

There are billions of molecules that contain carbon, so many that we study the Chemistry of these molecules in their own branch of Chemistry, Organic Chemistry. These molecules have many different shapes and sizes, sometimes because of the shapes that atoms form around a carbon atom when they are bonded to it. These shapes can be **tetrahedral, trigonal planar or linear**.

Research these terms and then write a report on how these shapes can occur in molecules. You should include specific examples of molecules that show these shapes and draw clearly labelled diagrams to illustrate your work.

TASK 2

Complete the questions below. If possible, print them and fill the answers in by hand.
If this is not possible, please complete your answers on lined paper making sure that you have labelled your answers to each question very clearly.

Please bring your completed work to your first Chemistry lesson in September.

Best wishes
Abby Gordge
Teacher of Chemistry

1. An example of a synthetic fertiliser is ammonium nitrate, NH_4NO_3.

Ammonium nitrate is produced when ammonium hydroxide, NH_4OH, reacts with nitric acid, HNO_3.

$NH_4OH(aq) + HNO_3(aq) \rightarrow NH_4NO_3(aq) + H_2O(l)$

The relative formula masses for the reactants and products are shown in the table.

	NH_4OH	**HNO_3**	**NH_4NO_3**	**H_2O**
Relative formula mass	35.0	63.0	80.0	18.0

Calculate the atom economy for the formation of NH_4NO_3.

Use the equation:

$$\text{atom economy} = \frac{\text{mass of atoms in desired product}}{\text{total mass of atoms in reactants}} \times 100\%$$

Give your answer to **1** decimal place.

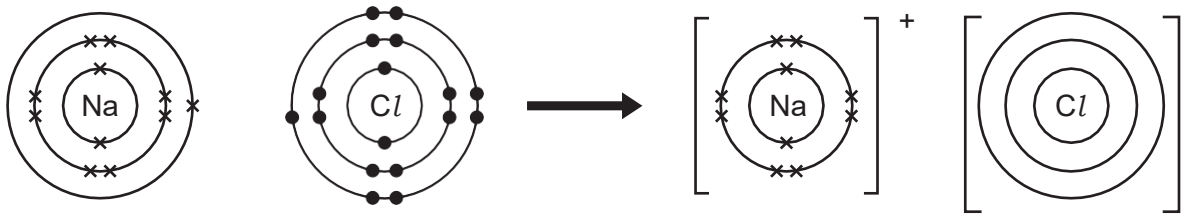
Atom economy = ... % **[4]**

2. Sodium chloride is an ionic compound.

Fig. 2.2 shows the dot and cross diagram for sodium chloride.

Complete Fig. 2.2 to show the structure and charge of the chloride ion.

Fig. 2.2



Sodium atom Chlorine atom Sodium ion Chloride ion

[2]

(b) How does the arrangement of electrons in atoms of sodium and chlorine relate to their group and period in the Periodic Table?

.....

.....

.....

..... **[2]**

(c) An atom of sodium has an atomic number of 11 and a mass number of 23.

State the number of protons, neutrons and electrons in a sodium atom.

Number of protons = ...

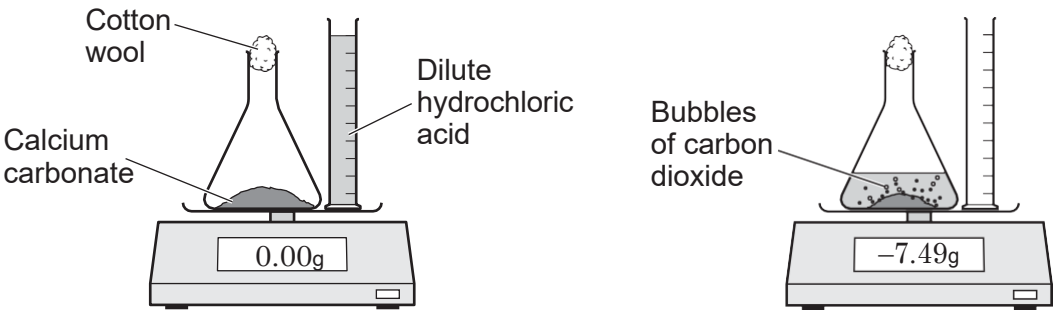
Number of neutrons = ...

Number of electrons = ...

[2]

3. A student adds dilute hydrochloric acid to calcium carbonate to form calcium chloride, water and carbon dioxide.

The diagram shows how the student measures the mass before and during the reaction.



Before reaction **During reaction**

(a) The equation for the reaction of calcium carbonate with dilute hydrochloric acid is:

$CaCO_3(s) + 2HCl(aq) \rightarrow \mathbf{X}(aq) + H_2O(l) + CO_2(g)$

(i) Write the chemical formula for **X**.

..... **[1]**

(ii) The mass decreases during the reaction.

Explain why.

.....

.....

.....

..... **[2]**

(b) 100 cm^3 of dilute hydrochloric acid contains 5.0 g of HCl.

(i) Calculate the number of moles of HCl in 100 cm^3 of dilute hydrochloric acid.

Relative atomic masses (A_r): H = 1.0 Cl = 35.5

Use the equation: number of moles = $\frac{\text{mass of substance}}{\text{relative formula mass}}$

Number of moles = ... **[3]**

(ii) There are 6.0×10^{23} atoms in one mole of atoms.

How many atoms are in 4 moles of HCl?

Put a (ring) around the correct option.

1.2×10^{24} **2.4×10^{24}** **4.8×10^{24}** **8×10^{23}**

[1]

4. Fossil fuels are used as energy sources.

(a) Natural gas contains an alkane with the formula CH_4.

(i) Name this alkane.

..... **[1]**

(ii) Combustion of natural gas increases the temperature of the surroundings.

Name of the type of reaction that increases the temperature of the surroundings.

..... **[1]**

(iii) Incomplete combustion occurs when not enough oxygen is present.

Name **one** pollutant caused by the incomplete combustion of natural gas.

..... **[1]**

(b) Hydrogen can also be used as an energy source in a fuel cell.

The balanced symbol equation for the reaction in the hydrogen fuel cell is:

$2H_2 + O_2 \rightarrow 2H_2O$

The table shows the bond energies involved in the reaction.

Bond	Bond energy (kJ)
O═O	498
H—H	434
O—H	464

Calculate:
- the energy needed to break bonds in the reactants
- the energy given out when bonds form in the products
- the overall energy change of the reaction.

Energy needed to break bonds in the reactants = ...kJ

Energy given out when bonds form in the products =.....kJ

Overall energy change = ...kJ
[3]

5. Black silver oxide powder decomposes when heated to form silver and oxygen gas.

The balanced symbol equation for the reaction is:

$2Ag_2O \rightarrow 4Ag + O_2$

(a) Calculate the theoretical yield of silver made when 250 g of silver oxide completely decomposes.

Relative atomic mass (A_r): O = 16 Ag = 108

Give your answer to **3** significant figures.

Theoretical yield = ... g **[4]**

(b) The actual yield of silver in an experiment is 215 g.

Some black silver oxide powder remains visible after the experiment.

Suggest **two** ways the experiment could be changed to increase the actual yield.

1 .....

.....

2 .....

.....

[2]

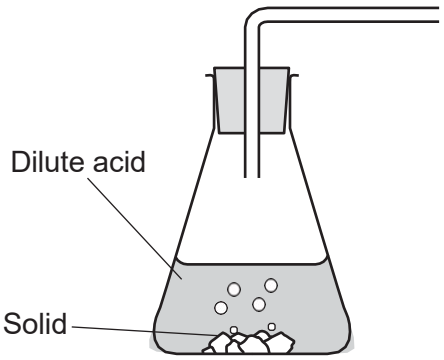
6 A student investigates the rate of reaction when a solid reacts with a dilute acid.

(a) The reaction makes a gas.

The student collects the gas in a measuring cylinder over water.

(i) **Complete** the diagram to show how the student sets up their measuring cylinder to collect the gas over water.

Include labels on your diagram.



[3]

(ii) The student finds it difficult to measure the volume accurately in the measuring cylinder.

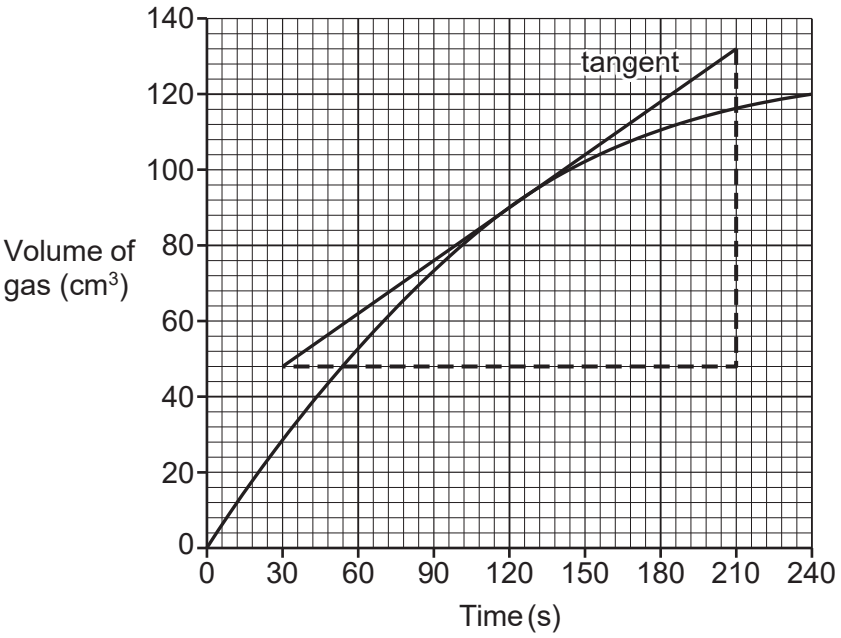
Suggest another method they could use to get more accurate readings.

.....

..... **[1]**

(b) The student plots a graph of their results.

The student draws a tangent to the curve at the point where time = 120 s.



(i) Calculate the gradient of the tangent shown on the graph.

Gradient = ... cm^3/s **[3]**

(ii) What information does your answer to **(i)** give about the reaction?

Tick (✓) **one** box.

The increase in volume and time at 180 s. ☐

The rate of reaction at 120 s. ☐

The time taken to make 90 cm^3 gas. ☐

The volume of gas made in the first minute of the reaction. ☐

[1]

(c) The student repeats their experiment using different conditions.

The rate of the reaction increases each time.

Draw lines to connect each **change in condition** with its correct **explanation** for the increase in rate.

Change in condition	**Explanation**
Increased concentration of acid	Frequency of particle collision increases because surface area increases.
Increased temperature	Frequency of particle collision increases because particles are closer together.
Smaller pieces of solid	More particle collisions are successful because the energy of the particles increases.

[2]

7. Steel is an alloy that contains iron and other elements.

(a) State **one** reason why steel is more useful than pure iron.

.....

..... **[1]**

(b) One type of steel alloy contains 97.8% iron and 0.12% carbon by mass.

The ratio by mass of iron : carbon in this steel is greater than 800 : 1.

(i) Show by calculation that this statement is **true**.

[1]

(ii) The ratio by number of moles of iron : carbon in this steel is approximately 175 : 1.

Explain why the ratio by mass is different to the ratio by number of moles.

.....

.....

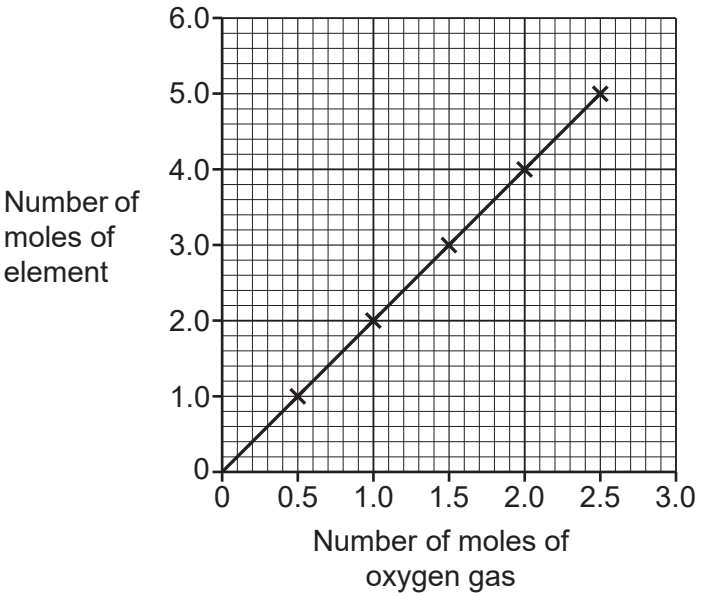
.....

..... **[2]**

8. A student investigates the reaction of an element with oxygen gas, O_2, to make an oxide.

They calculate the number of moles of the element that react with different numbers of moles of oxygen gas.

The graph shows their results.



(a) The student concludes that the graph shows this relationship:

number of moles of element $\propto$ number of moles of oxygen

The student is correct.

Explain why.

.....

.....

.....

..... **[2]**

(b) Calculate the mass of oxygen gas that reacts with 1.5 moles of the element.

Use:
- data from the graph
- the Periodic Table.

Mass of oxygen gas = ... g **[3]**

(c) The student suggests an equation for the reaction. They use X to represent the symbol of the element.

(i) Which equation for the reaction is correct?

Use information from the graph.

Tick (✓) **one** box.

$X + O_2 \rightarrow XO_2$ ☐

$2X + O_2 \rightarrow 2XO$ ☐

$4X + O_2 \rightarrow 2X_2O$ ☐

$4X + 3O_2 \rightarrow X_2O_3$ ☐

[1]

(ii) Explain how you worked out your answer to **(c)(i)**.

.....

..... **[1]**