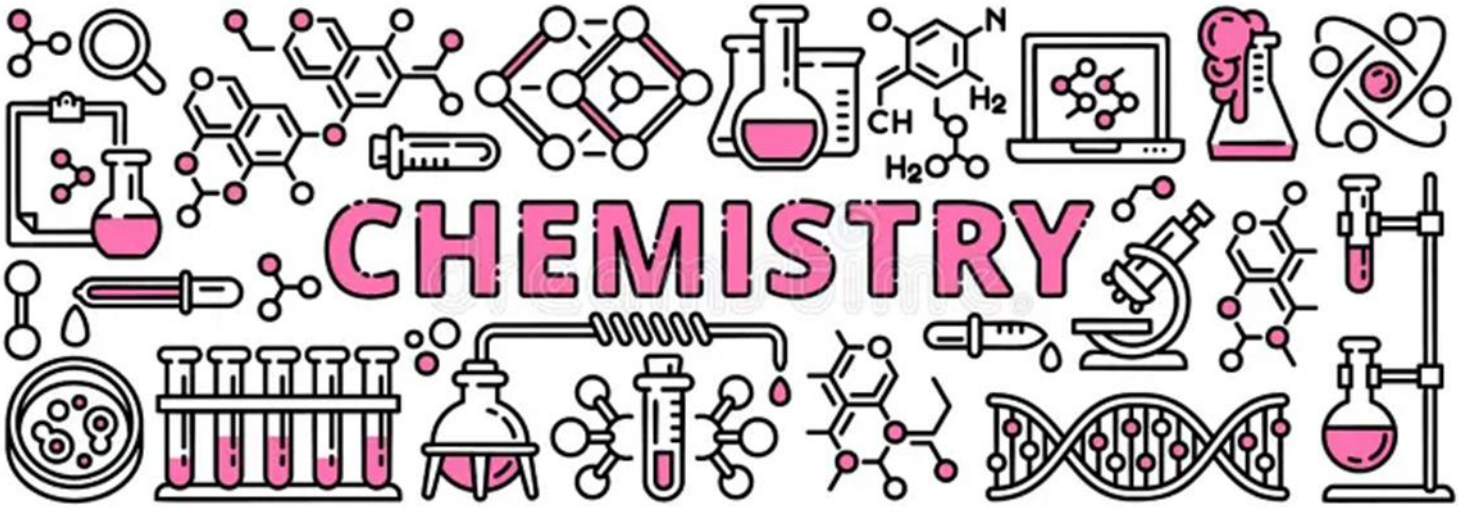


Welcome to A-level Chemistry at Urmston Grammar School!

Introduction

Enclosed is a student booklet with information about:

- the specification and structure of the assessment.
- and key skills activities to support your move from GCSE to A-level Chemistry.

It is the expectation of the department that this work will be fully completed, and assessed using a **green pen**, by you before returning to school for Sixth Form in September. The answers can be found in the second document on the transition work page of the school website.

All of your work should be completed in this booklet, with any spare pieces of paper used attached and referenced next to the question it applies to.

IMPORTANT:

You will sit an induction assessment during your first week of A-level study. It will cover both the content of this transition work and fundamental maths skills.

If you fail to achieve a pass mark, then you will be expected to attend support sessions and sit a re-sit test. This will be a further opportunity to evidence your suitability for the course.

Please complete the below:

Name: _____

I achieved a grade ____ in GCSE Combined Science/Triple Science (delete as appropriate).

I achieved a grade ____ in GCSE Maths.

Aim of the booklet

This booklet will support your transition from GCSE Chemistry to A-level. At first, you may find the jump in demand a little daunting, but if you follow the tips and advice in this guide, you'll soon adapt. As you follow the course you will see how the skills and content you learnt at GCSE will be developed and your knowledge and understanding of all these elements will progress.

We have organised the guide into two sections:

1. Understanding the specification and the assessments
2. Transition activities to bridge the move from GCSE to the start of the A-level course.

Understanding the specification and the assessments

Specification at a glance

The specification is a useful reference document for you. You can download a copy from the AQA website: https://tinyurl.com/23ew2wdp

The most relevant areas of the specification for students are the following:

Section 3: Subject content

Section 6: Maths requirements and examples

Section 7: Practical assessment

In Chemistry the subject content is split into three broad areas:

3.1 Physical chemistry

3.2 Inorganic chemistry

3.3 Organic chemistry

There are several sections within each of these broad areas. The content of each of these three broad areas is then split between AS and A-level.

The split of content between AS and A-level is shown in the tables below.

Content common to AS and A-level (Y12 content)

3.1 Physical chemistry	3.2 Inorganic chemistry	3.3 Organic chemistry
3.1.1 Atomic structure	3.2.1 Periodicity	3.3.1 Introduction to organic chemistry
3.1.2 Amount of substance	3.2.2 Group 2, the alkaline earth metals	3.3.2 Alkanes
3.1.3 Bonding	3.2.3 Group 7(17), the halogens	3.3.3 Halogenoalkanes
3.1.4 Energetics		3.3.4 Alkenes
3.1.5 Kinetics		3.3.5 Alcohols
3.1.6 Chemical equilibrium, Le Chatelier's principle and K_c		3.3.6 Organic analysis
3.1.7 Oxidation, reduction and redox equations		

A-level only content (Y13 content)

3.1 Physical chemistry	3.2 Inorganic chemistry	3.3 Organic chemistry
3.1.8 Thermodynamics	3.2.4 Properties of Period 3 elements and their oxides	3.3.7 Optical isomerism
3.1.9 Rates of equations	3.2.5 Transition metals	3.3.8 Aldehydes and ketones
3.1.10 Equilibrium constant K_p for homogeneous systems	3.2.6 Reactions of ions in aqueous solution	3.3.9 Carboxylic acids and derivatives
3.1.11 Electrode potentials and electrochemical cells		3.3.10 Aromatic chemistry
3.1.12 Acids and bases		3.3.11 Amines
		3.3.12 Polymers
		3.3.13 Amino acids, proteins and DNA
		3.3.14 Organic synthesis
		3.3.15 Nuclear magnetic resonance spectroscopy
		3.3.16 Chromatography

Each section of the content begins with an overview, which describes the broader context and encourages an understanding of the place each section has within the subject. This overview will not be directly assessed.

The specification is presented in a two-column format:

- the left-hand column contains the specification content that you must cover, and that can be assessed in the written papers.
- the right-hand column exemplifies the opportunities for maths and practical skills to be developed throughout the course. These skills can be assessed through any of the content on the written papers, not necessarily in the topics we have signposted.

Assessment structure

A-level

The assessment for the A-level consists of three exams, which you will take at the end of the course.

Paper 1	Paper 2	Paper 3
What's assessed • Relevant physical chemistry topics (sections 3.1.1 to 3.1.4, 3.1.6 to 3.1.8 and 3.1.10 to 3.1.12) • Inorganic chemistry (section 3.2) • Relevant practical skills	**What's assessed** • Relevant physical chemistry topics (sections 3.1.2 to 3.1.6, and 3.1.9) • Organic chemistry (section 3.3) • Relevant practical skills	**What's assessed** • Any content • Any practical skills
Assessed • written exam: 2 hours • 105 marks • 35% of A-level	**Assessed** • written exam: 2 hours • 105 marks • 35% of A-level	**Assessed** • written exam: 2 hours • 90 marks • 30% of A-level
Questions 105 marks of short and long answer questions	**Questions** 105 marks of short and long answer questions	**Questions** 40 marks of questions on practical techniques and data analysis 20 marks of questions testing across the specification 30 marks of multiple-choice questions

Assessment objectives

As you know from GCSE, we have to write exam questions that address the Assessment objectives (AOs). It is important you understand what these AOs are, so you are well prepared. In Chemistry there are three AOs.

- AO1: Demonstrate knowledge and understanding of scientific ideas, processes, techniques, and procedures
  (A-level about 30% of the marks).
- AO2: Apply knowledge and understanding of scientific ideas, processes, techniques, and procedures:
  (A-level about 45% of the marks).
    - in a theoretical context
    - in a practical context
    - when handling qualitative data
    - when handling quantitative data
- AO3: Analyse, interpret, and evaluate scientific information, ideas, and evidence, including in relation to:
  (A-level about 25% of the marks)
    - make judgements and reach conclusions
    - develop and refine practical design and procedures

Other assessment criteria

At least 20% of the marks for AS and A-level Chemistry will assess mathematical skills, which will be equivalent to Level 2 (Higher Tier GCSE Mathematics) or above.

At least 15% of the overall assessment of AS and A-level Chemistry will assess knowledge, skills and understanding in relation to practical work.

Command words

Command words are used in questions to tell you what is required when answering the question. You can find definitions of the command words used in chemistry assessments on the AQA website. They are very similar to the command words used at GCSE.

Subject-specific vocabulary

You can find a list of definitions of key working scientifically terms used in the AS and A-level specification.

You will become familiar with, and gain understanding of, these terms as you work through the course.

Transition activities

The following activities cover some of the key skills from GCSE Chemistry that will be relevant at AS and A-level. They include the vocabulary used when working scientifically and some maths and practical skills.

The booklet has been produced so you can complete it electronically or print it out and do the activities on paper.

The activities are **not a test**. Try the activities first and see what you remember and then use textbooks or other resources to answer the questions. **Don't** just go to Google for the answers, as actively engaging with your notes and resources from GCSE will make this learning experience much more worthwhile.

The answer booklet guides you through each answer. It is not set out like an exam mark scheme but is to help you get the most out of the activities.

Understanding and using scientific vocabulary

Understanding and applying the correct terms are key for practical sciences. Much of the vocabulary you have used at GCSE for practical work will not change but some terms are dealt with in more detail at A-level so are more complex.

Activity 1: Structure and bonding

Use your GCSE notes, and those from any appropriate GCSE revision websites, to complete the table below in as much detail as you can. Continue on a separate page if you need to.

Type of substance	Macromolecular (giant covalent)	Simple molecular (Simple covalent)	Giant ionic lattice	Metallic lattice
Type(s) of element made from				
Description of structure				
Description and strength of bonds				
Does it conduct electricity? Why?				
Does it have low/high melting and boiling points? Why?				
Other important properties				
Common examples				

Use the information in your table to attempt the below questions. They begin at GCSE level, and then increase in difficulty to a challenging A-level question. **Feel free to research some answers if you need to.**

Q1.

This question is about carbon and carbon compounds.

An atom of carbon is represented as:

(Mass number) 13
(Atomic number) 6 C

(a) What is the number of protons in this atom of carbon?

Tick (✓) **one** box.

1 ☐ 6 ☐ 7 ☐ 13 ☐

(1)

(b) What is the number of neutrons in this atom of carbon?

Tick (✓) **one** box.

1 ☐ 6 ☐ 7 ☐ 13 ☐

(1)

(c) What is the number of electrons in this atom of carbon?

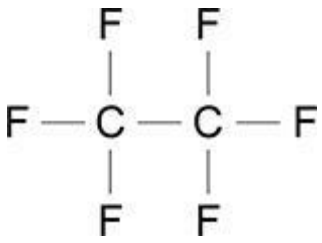
Tick (✓) **one** box.

1 ☐ 6 ☐ 7 ☐ 13 ☐

(1)

(d) **Figure 1** shows the structure of a carbon compound.

Figure 1



Complete the formula of the carbon compound.

C__ F__

(1)

(e) Methane:

- is a carbon compound
- exists as small molecules
- has a low boiling point.

What is the reason for the low boiling point of methane?

Tick (✓) **one** box.

Covalent bonds **and** intermolecular forces are weak. ☐

Only covalent bonds are weak. ☐

Only intermolecular forces are weak. ☐

(1)

(f) Buckminsterfullerene (C_{60}) is a form of carbon.

Buckminsterfullerene was the first fullerene to be discovered.

What is the shape of a buckminsterfullerene molecule?

Tick (✓) **one** box.

Cubic ☐

Cylindrical ☐

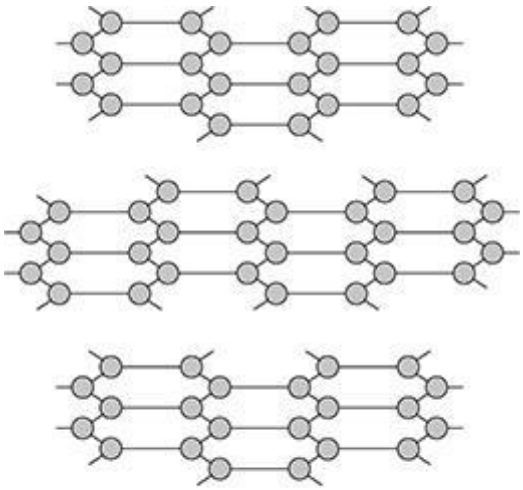
Spherical ☐

(1)

(g) Graphite is a form of carbon.

Figure 2 represents the structure of graphite.

Figure 2



How many covalent bonds does each carbon atom form in graphite?

Tick (✓) **one** box.

1 ☐

2 ☐

3 ☐

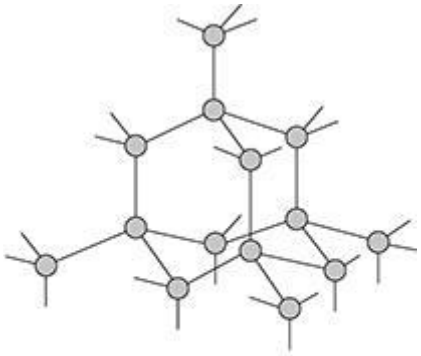
4 ☐

(1)

(h) Diamond is another form of carbon.

Figure 3 represents the structure of diamond.

Figure 3



Key

○ = carbon atom

Describe the structure and bonding in diamond.

_____

_____

_____

_____

_____

_____

(3)

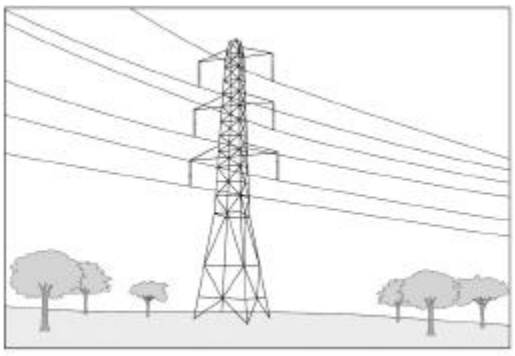
Q2.

This question is about uses of metals in electrical wires.

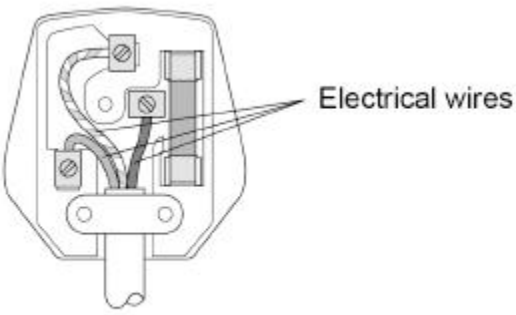
Electrical wires can be made from:

- aluminium
- copper
- silver.

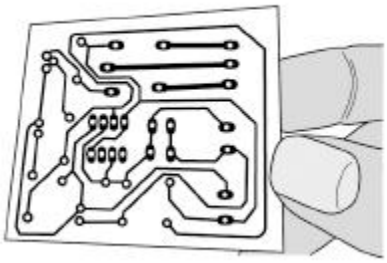
The figure below shows three uses of electrical wires.



Overhead power cables



Wiring in homes



Printed circuit boards

The table below shows information about the metals.

The higher the value for electrical conductivity, the better the metal is at conducting electricity.

	Aluminium	**Copper**	**Silver**
Electrical conductivity in arbitrary units	37.7	59.6	63.0
Density in g/cm^3	2.7	9.0	10.5
Cost of metal per kg in £	1.50	7.00	640.00

(a) Evaluate the use of aluminium, copper and silver for the types of electrical wires shown in the figure above.

Use the table.

(4)

(b) Describe how metals conduct electricity.

(3)

(c) Electrical wires are usually made of pure metals and **not** alloys. This is because pure metals are better electrical conductors.

Suggest why alloys do **not** conduct electricity as well as pure metals.

Answer in terms of structure and bonding.

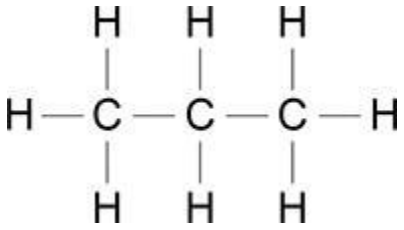
(2)

Q3.

This question is about propane (C_3H_8).

Figure 1 shows the displayed structural formula of propane.

Figure 1



(a) Explain why propane has a low boiling point.

_____

_____

_____

_____

_____

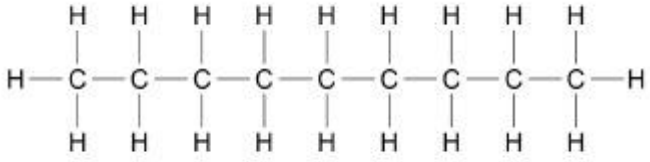
_____

(3)

Q4.

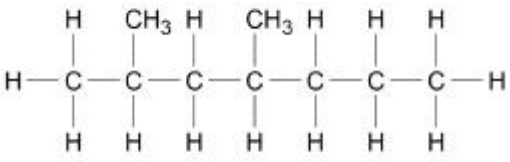
The alkanes nonane and 2,4-dimethylheptane are structural isomers with the molecular formula C_9H_{20}
They are found in crude oil and can be separated by fractional distillation.
Both can be used in fuels or cracked to form other products.

nonane



boiling point 151 °C

2,4-dimethylheptane



boiling point 134 °C

(a) State the general formula of an alkane containing n carbon atoms.
Deduce an expression for the relative molecular mass (M_r) of an alkane in terms of n.

General formula _____

Expression _____

(2)

(b) Explain why nonane has a higher boiling point than 2,4-dimethylheptane.

(2)

Q5. (Challenging!)

This question is about elements in Group 7 of the Periodic Table and their compounds.

(a) Bromine (Br_2), strontium chloride ($SrCl_2$) and iodine monochloride (ICl) all have similar M_r values.

Suggest, with reasons, the order of melting points for these three substances.

(6)

Total for Activity 1	**/32**
What went well?	
What improvements could you make?	

Activity 2: Quantitative chemistry

Use your GCSE notes, and those from any appropriate GCSE revision websites, to complete the questions below in as much detail as you can. Continue on a separate page if you need to.

Question	Answer
What is the equation that links mass, molecular mass and moles?	
What is the equation that links mass, concentration and volume?	
What is the equation that links moles, volume and concentration?	
What is Avogadro's number? What does it mean?	
What is the equation for percentage yield?	
What is the equation for atom economy?	
What is the fundamental difference between atom economy and percentage yield?	
What is the equation used in a bond energy calculation?	

Complete the following unit conversions:

Question	Answer (Show working)
1m into mm	
0.5dm^3 into cm^3	
1.72 tonnes into g	
2034000cm^3 into m^3	
374 K into ^oc	
134mg into g	
-12.3^oc into K	
101kPa into Pa	

Complete the following questions relating to accuracy/resolution:

Question	Answer
Round 2748493 to 3 significant figures	
Round 0.3748596 to 3 significant figures	
Round 0.00003465 to 3 significant figures	
Round 35.65545 to 2 decimal places	
Round 0.000094 to 1 decimal place	
Give ⅜ as a decimal to 2 significant figures	
Give ⅞ as a decimal to 2 decimal places	
Give the following values to the same **appropriate precision:** 0.012, 0.0134, 0.00145	

Use the information in your work to attempt the below questions. They begin at GCSE level, and then increase in difficulty to a challenging A-level question. **Feel free to research some answers if you need to. You will need a calculator.**

Q1.

This question is about energy changes of reactions.

(a) Calculate the percentage (%) by mass of copper in copper sulfate (CuSO4).

Give your answer to 3 significant figures.

Relative atomic mass (*A*r): Cu = 63.5

Relative formula mass (*M*r): $CuSO_4$ = 159.5

Percentage by mass (3 significant figures) = _____ %

(3)

(b) 25 cm^3 of copper sulfate solution contained 6.75 g of copper sulfate.

Calculate the concentration of the solution in g/dm^3.

You should:

- calculate the volume of the solution in dm^3 (1000 cm^3 = 1 dm^3)
- use the equation:

$$\text{concentration of solution in g/dm}^3 = \frac{\text{mass of copper sulfate in grams}}{\text{volume of solution in dm}^3}$$

Volume of solution = _____ dm^3

Concentration of solution = _____ g/dm^3

(3)

Q2.

(a) Titanium can be produced from titanium oxide by electrolysis.

The equation for the reaction is:

$$TiO_2 \rightarrow Ti + O_2$$

Calculate the percentage atom economy for the production of titanium from titanium oxide by electrolysis.

Use the equation:

$$\text{Percentage atom economy} = \frac{\text{Relative atomic mass of desired product}}{\text{Relative formula mass of reactant}} \times 100$$

Relative atomic mass (A_r): Ti = 48

Relative formula mass (M_r): TiO_2 = 80

Percentage atom economy = _____ %

(2)

(b) A solution of potash alum has a concentration of 258 g/dm^3

Calculate the mass of potash alum needed to make 800 cm^3 of a solution of potash alum with a concentration of 258 g/dm^3

Give your answer to 3 significant figures.

Mass (3 significant figures) = _____ g

(4)

(c) The maximum theoretical mass of a salt that could be produced using 50 cm^3 of sulfuric acid is 12.5 g.

The percentage yield of the salt is 92.8%.

Calculate the mass of salt actually produced.

Use the equation:

$$\% \text{ yield} = \frac{\text{mass of salt actually produced}}{\text{maximum theoretical mass of salt that could be produced}} \times 100$$

Mass of salt actually produced = _____ g

(3)

Q3.

This question is about the extraction of metals.

Element **R** is extracted from its oxide by reduction with hydrogen.

The equation for the reaction is:

$$3\ H_2 + \mathbf{R}O_3 \rightarrow \mathbf{R} + 3\ H_2O$$

(a) The sum of the relative formula masses (M_r) of the reactants ($3\ H_2 + \mathbf{R}O_3$) is 150

Calculate the relative atomic mass (A_r) of **R**.

Relative atomic masses (A_r): H = 1 O = 16

Relative atomic mass (A_r) of **R** = _____

(2)

(b) Identify element **R**.

You should use:

- your answer to part (a)
- the periodic table.

Identity of **R** = _____

(1)

(c) Carbon is used to extract tin (Sn) from tin oxide (SnO_2).

The equation for the reaction is:

$$SnO_2 + C \rightarrow Sn + CO_2$$

Calculate the percentage atom economy for extracting tin in this reaction.

Relative atomic masses (A_r): C = 12 O = 16 Sn = 119

_____

_____

_____

_____

_____

_____

Percentage atom economy = _____ %

(3)

Q4.

(a) When iron reacts with chlorine, 0.12 mol of iron reacts with 0.18 mol of chlorine (Cl_2).

Which is the correct equation for the reaction?

Tick (✓) **one** box.

$Fe + Cl_2 \rightarrow FeCl_2$ ☐

$Fe + 3\ Cl_2 \rightarrow FeCl_6$ ☐

$2\ Fe + Cl_2 \rightarrow 2\ FeCl$ ☐

$2\ Fe + 3\ Cl_2 \rightarrow 2\ FeCl_3$ ☐

(1)

The most common oxides of iron are Fe_2O_3 and Fe_3O_4

(b) What is the ratio of the numbers of ions in Fe_3O_4?

Tick (✓) **one** box.

$2\ Fe^{2+} : 1\ Fe^{3+} : 4\ O^{2-}$ ☐

$1\ Fe^{2+} : 2\ Fe^{3+} : 4\ O^{2-}$ ☐

$3\ Fe^{2+} : 4\ O^{2-}$ ☐

$3\ Fe^{3+} : 4\ O^{2-}$ ☐

(1)

(c) Calculate the percentage (%) by mass of iron in Fe_3O_4

Relative atomic masses (A_r): O = 16 Fe = 56

Percentage by mass of iron = _____ %

(3)

(d) Fe_2O_3 reacts with carbon to produce carbon dioxide.

The equation for the reaction is:

$$2\ Fe_2O_3(s) + 3\ C(s) \rightarrow 4\ Fe(s) + 3\ CO_2(g)$$

Calculate the volume of carbon dioxide gas at room temperature and pressure that is produced from 40.0 kg of Fe_2O_3 using excess carbon.

Relative formula mass (M_r): $Fe_2O_3 = 160$

The volume of 1 mole of any gas at room temperature and pressure is 24 dm^3.

Volume of carbon dioxide = _____ dm^3

(5)

Q5.

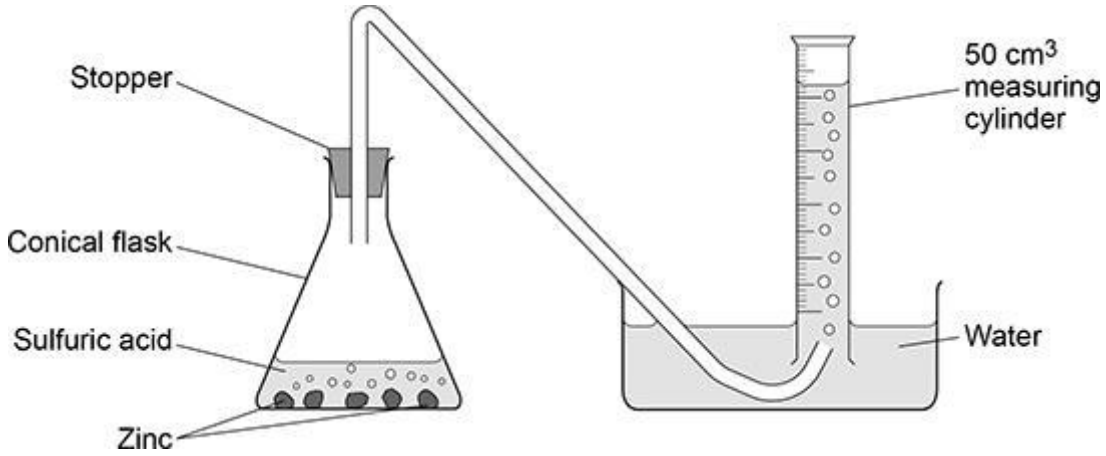
A student investigated the rate of the reaction between zinc and sulfuric acid.

The equation for the reaction is

$$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$$

Figure 1 shows the apparatus.

Figure 1



This is the method used.

1. Pour 50 cm^3 of sulfuric acid into the conical flask.

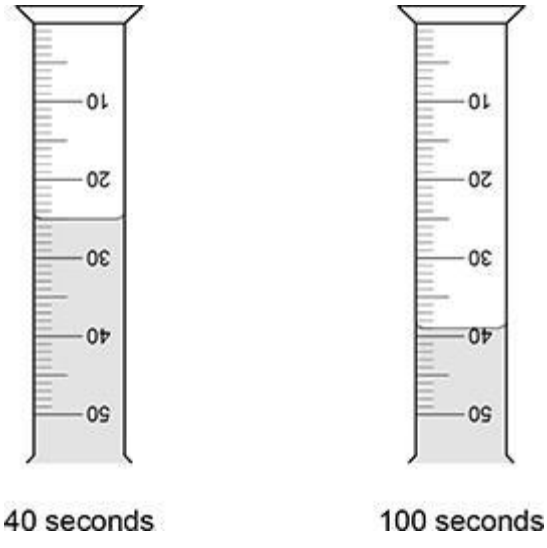
2. Add excess zinc to the conical flask.

3. Insert the stopper and start a timer.

4. Measure the volume of hydrogen collected in the 50 cm^3 measuring cylinder every 20 seconds for 180 seconds.

Figure 2 shows the volumes of hydrogen collected in the 50 cm^3 measuring cylinder after 40 seconds and after 100 seconds.

Figure 2



(a) Determine the number of moles of hydrogen collected between 40 seconds and 100 seconds.

The volume of one mole of any gas at room temperature and pressure is 24 dm^3.

Moles of hydrogen = _____

(4)

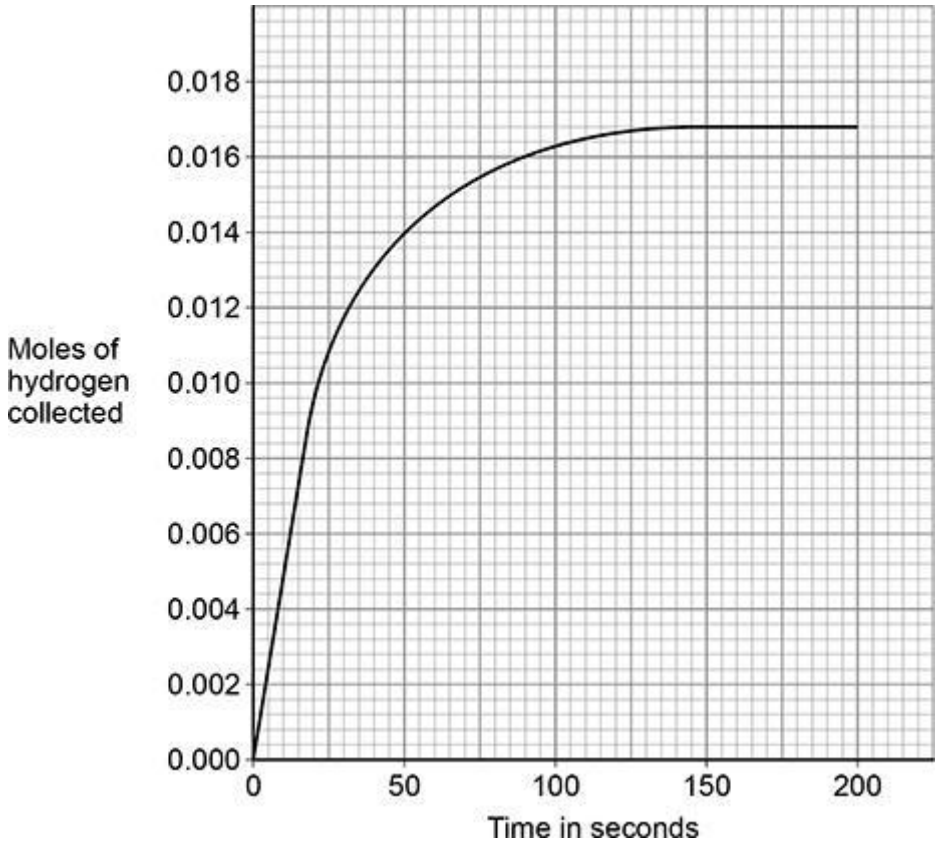
A different student investigated how the concentration of sulfuric acid affected the rate of the reaction.

(b) The student did a different experiment using sulfuric acid of concentration 0.40 mol/dm^3.

The student calculated the number of moles of hydrogen collected after every 20 seconds.

Figure 3 shows the results.

Figure 3



Determine the rate of reaction at 45 seconds.

You should draw a tangent on **Figure 3**.

Give your answer in standard form.

Rate of reaction (in standard form) = _____ mol/s **(5)**

Q6.

(a) A student titrated a solution containing 0.0045 moles of sodium hydroxide with 0.15 mol/dm^3 hydrochloric acid.

The equation for the reaction is:

$$NaOH + HCl \rightarrow NaCl + H_2O$$

Calculate the volume of hydrochloric acid in cm^3 needed in the titration.

Volume of acid = _____ cm^3

(2)

Q7. (Challenging!)

(a) A sample of strontium is made up of only three isotopes: ^{86}Sr, ^{87}Sr and ^{88}Sr
This sample contains 83.00% by mass of ^{88}Sr
This sample of strontium has A_r = 87.73

Calculate the percentage abundance of each of the other two isotopes in this sample.

% abundance ^{87}Sr = _____

% abundance ^{86}Sr = _____

(4)

(b) $Mg(OH)_2$ is used as an antacid to treat indigestion.
A student does an experiment to determine the percentage by mass of $Mg(OH)_2$ in an indigestion tablet.

40.0 cm^3 of 0.200 mol dm^{-3} HCl (an excess) is added to 0.200 g of a powdered tablet.
The mixture is swirled thoroughly.
All of the $Mg(OH)_2$ reacts with HCl as shown.

$$Mg(OH)_2 + 2\ HCl \rightarrow MgCl_2 + 2\ H_2O$$

The amount of HCl remaining after this reaction is determined by titration with 0.100 mol dm^{-3} NaOH

29.25 cm^3 of 0.100 mol dm^{-3} NaOH are needed.

Calculate the percentage by mass of $Mg(OH)_2$ in the indigestion tablet.

Percentage by mass _____

(6)

Total for Activity 1	**/52**
What went well?	
What improvements could you make?	

Activity 3: Symbol equations

Complete the equations below by adding balancing numbers (stoichiometry).

In some cases, there may be chemical substances missing that you would need to identify first. These have been identified with an ‘x’ symbol.

1.

___ H_2 + ___ O_2 → ___ H_2O

2.

___ Na + ___ Cl_2 → ___ NaCl

3.

___ N_2 + ___ H_2 → ___ NH_3

4.

___ Mg + ___ O_2 → ___ MgO

5.

___ Al + ___ Br_2 → ___ $AlBr_3$

6.

___ K + ___ H_2O → ___ KOH + ___ H_2

7.

___ Ca + ___ HCl → ___ $CaCl_2$ + ___ H_2

8.

___ Fe + ___ O_2 → ___ Fe_2O_3

9.

___ C_3H_8 + ___ O_2 → ___ CO_2 + ___ H_2O

10.

___ Zn + ___ HNO_3 → ___ $Zn(NO_3)_2$ + ___ H_2

11.

___ NaOH + ___ H_2SO_4 → ___ Na_2SO_4 + ___ H_2O

12.

___ NH_3 + ___ O_2 → ___ NO + ___ H_2O

13.

___ Al + ___ HCl → ___ $AlCl_3$ + ___ H_2

14.

___ $Pb(NO_3)_2$ + ___ KI → ___ PbI_2 + ___ **x**

x = _____

15.

___ CH_4 + ___ Cl_2 → ___ CCl_4 + ___ HCl

16.

___ Na_2CO_3 + ___ HCl → ___ NaCl + ___ H_2O + ___ CO_2

17.

___ $C_6H_{12}O_6$ + ___ O_2 → ___ CO_2 + ___ H_2O

18.

___ HNO_3 + ___ $Ca(OH)_2$ → ___ $Ca(NO_3)_2$ + ___ H_2O

19.

___ $K_2Cr_2O_7$ + ___ H_2SO_4 + ___ $FeSO_4$ →
___ $Cr_2(SO_4)_3$ + ___ $Fe_2(SO_4)_3$ + ___ K_2SO_4 + ___ **x**

x = _____

20.

___ C_2H_5OH + ___ O_2 → ___ CO_2 + ___ H_2O

21.

___ Cu + ___ HNO_3 → ___ $Cu(NO_3)_2$ + ___ NO_2 + ___ **x**

x = _____

Total for Activity 3	**/21**
What went well?	
What improvements could you make?