



A level Chemistry

Edexcel

Summer Transition Booklet

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## Summer Bridging Work: Chemistry Y11 into Y12

Welcome to A-Level Chemistry at Slough and Eton.

This is a guide to help you get ready for A-Level Chemistry. It is aimed to be used after you complete your GCSE throughout the remainder of the Summer term and over the Summer Holidays to ensure you are ready to start your course in September.

### Assessment

Please bring this completed booklet, textbook and equipment to your FIRST Chemistry lesson (this could be the first day of school). There will also be a transition test w/b 14<sup>th</sup> Sep on all GCSE Chemistry content, including this booklet, which will determine your suitability for the course.

### Introduction

A-level Chemistry is a big step up from GCSE. In order to prepare for Chemistry A-level, it is vital that you have an excellent understanding of key concepts, all of which you covered at GCSE and will study in greater depth over the first year of A-level Chemistry:

1. Atomic structure
2. Amount of substance
3. Bonding
4. Energetics
5. Kinetics
6. Chemical Equilibria, Le Chatelier's Principle and K<sub>c</sub>
7. Oxidation, Reduction and Redox equations
8. Organic Chemistry

To ensure you have an excellent grounding in each of these topics, please continue to review all GCSE Chemistry content so that you have a solid foundation to starting A-level Chemistry.

### Task - ALL students must complete this

1. So, to start you off correctly you **MUST complete** all **GCSE questions** outlined in this booklet and all **3 Transition tasks**. This is to help you recap and retrieve vital knowledge you have learned during your GCSE course that provides the foundation for A-Level Chemistry to build upon. This will allow us to get a good idea of what you need to work on in the early months to make sure you are able to keep up with the demands of one of the most difficult subjects.

Use your normal GCSE revision resources to help you complete them, but here are some suggestions:

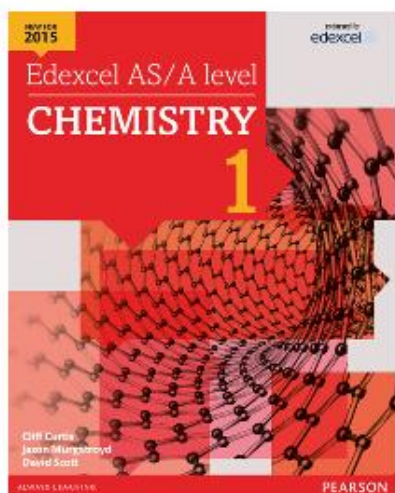
- [www.senecalearning.com](http://www.senecalearning.com)
- [www.gcsepod.com](http://www.gcsepod.com)
- [www.bitesize.com](http://www.bitesize.com)
- [Youtube - Free Science Lessons](#)
- [Youtube - Primrose Kitten](#)

If there is anything you struggle with, write Cornell notes on it using this video for guidance [How to make Cornell Notes](#) (ignore AO1/2/3) and put them in your folder.

2. You MUST also **attempt** the **A-Level Questions**. They are accessible to you with the GCSE content you have – you might just need to think outside the box a bit and stretch yourself! This gives insight into the style of questions at A-Level and shows the jump is not that large if you are fully prepped with all of your GCSE knowledge. Again here are some useful websites:
  - CGP – ‘Head start to Chemistry’ and ‘Essential Maths Skills’ books
  - MaChemGuy – Prepare for A-Level Chemistry
  - ASFC Chemistry – Starting A-Level Chemistry
3. Revise the content, **answer ALL the questions**. You must **print the booklet** and bring it to your first Chemistry lesson.

### Preparing for A-level Chemistry Lessons

1. Purchase **A4 lined paper** and a **A4 folder with dividers** and plastic wallets for use in Chemistry Only. You also should have pens, pencil, highlighters, green pen, calculator, ruler etc. Prepare to be fully equipped every lesson. In September you will be issued with an exercise book. This shall be used to make notes in and complete any classwork in. You shall be given a different book to write up the practical work that the exam boards specify and these must be completed throughout the course.
1. Purchase the following **textbook**:



**Pre-read and make notes on the first few pages from your Edexcel Chemistry Book 1 Topic 1 and 5.**

## Student's Checklist for Being A-level Chemistry-ready

You are expected to know/understand the following:

**Electron configuration** for the first 20 elements

**Naming compounds** from formulae and vice versa

**Bonding**

Three main types – formation and properties

- ☐ ionic
- ☐ covalent
- ☐ and metallic

**Dot and cross diagrams** for covalent molecules and ionic compounds to include:

- ☐ sodium chloride, calcium oxide, calcium fluoride, aluminium oxide
- ☐ chlorine, oxygen, nitrogen, ammonia, carbon dioxide, methane, ethane, ethanol, sulfur dioxide, water

**Writing formulae** for all of the above plus compounds with:

- ☐ carbonate
- ☐ nitrate
- ☐ hydroxide
- ☐ hydrogen carbonate
- ☐ sulfate.

**Balancing equations** for

- ☐ neutralisation
- ☐ metals with acids
- ☐ alkali metals with water
- ☐ redox (displacement of halogens and metals), thermal decomposition

**Calculations**

- ☐ relative atomic mass, relative formula mass and empirical formulae
- ☐ Percentage yield and atom economy
- ☐ Reacting masses and limiting reagent

**Energetics**

- ☐ difference between exothermic and endothermic
- ☐ graphs associated with these
- ☐ energies in bond making and bond breaking

**Organic Chemistry**

- ☐ differences between alkanes and alkenes
- ☐ naming and reactions of alkanes and alkenes
- ☐ fractional distillation
- ☐ cracking
- ☐ characteristics of good fuels
- ☐ balancing combustion equations

## Beyond GCSE: Developing Your Scientific Thinking

Success at A Level Chemistry relies on much more than remembering facts. Chemists are expected to read scientific articles, interpret data, evaluate evidence and apply their knowledge to unfamiliar situations.

Throughout the summer, complete **all of the tasks below**. These activities are designed to introduce you to Chemistry beyond the GCSE specification and help you develop the independent learning skills expected in September.

### Transition Task 1 – Wider Reading (Compulsory)

Choose **at least two** articles from the websites below.

#### Scientific American

<https://www.scientificamerican.com/>

Excellent articles explaining new scientific discoveries and how chemistry impacts everyday life.

#### New Scientist

<https://www.newscientist.com/>

Current research covering chemistry, medicine, climate science and technology.

#### The Mole (Royal Society of Chemistry)

<https://eic.rsc.org/section/the-mole>

Short chemistry articles written specifically for students and teachers.

#### After each article write:

- A 100–150 word summary.
- Three new facts you learnt.
- One question the article made you think about.
- One piece of GCSE chemistry that links to the article.

Complete **two article reviews**.

### Transition Task 2 – Watch and Reflect (Compulsory)

Watch **at least two** of the following videos.

#### 1. How Big is a Mole?

TED-Ed

<https://ed.ted.com/lessons/daniel-dulek-how-big-is-a-mole-not-the-animal-the-other-one>

Learn why chemists use the mole and appreciate the enormous size of Avogadro's number.

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#### 2. The Science Behind a Climate Headline

TED Talk by Rachel Pike

[https://www.ted.com/talks/rachel\\_pike\\_the\\_science\\_behind\\_a\\_climate\\_headline](https://www.ted.com/talks/rachel_pike_the_science_behind_a_climate_headline)

Discover how atmospheric chemists gather evidence used in climate research.

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### 3. Periodic Videos

<http://www.periodicvideos.com/>

Explore videos on every element in the periodic table as well as current developments in chemistry.

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### 4. Elements of the Periodic Table

OpenLearn

<http://www.open.edu/openlearn/science-maths-technology/science/chemistry/elements-the-periodic-table>

Learn about the history, uses and importance of chemical elements.

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### Reflection Questions

For each video answer:

- What was the main scientific idea?
- What surprised you most?
- Which GCSE topic does it relate to?
- What would you like to learn more about at A Level?

### Transition Task 3 – Chemistry in the News (Compulsory)

Find **one recent news story** involving chemistry.

Possible topics include:

- New medicines
- Climate change
- Renewable energy
- Plastics
- Batteries
- Space exploration
- Food science
- Nanotechnology

Write approximately 200 words explaining:

- What happened?
- What chemistry is involved?
- Why is it important?
- What questions does it raise?

Include the source of your article.

## **Magazine/Journal recommendations**

A few more interesting reads for over the summer to explore more about the Chemistry around you and the newest discoveries and developments.

**Scientific American** - <https://www.scientificamerican.com/>

**New Scientist** - <https://www.newscientist.com/>

**The Mole** - <https://eic.rsc.org/section/the-mole>

## **Expectations for A Level Chemistry**

At A Level you will be expected to:

- Read independently about scientific developments.
- Apply your knowledge to unfamiliar contexts.
- Explain your reasoning clearly.
- Interpret graphs, tables and experimental data.
- Use evidence to support scientific arguments.
- Develop resilience when solving challenging problems.

These transition tasks are designed to help you begin developing these skills before September.

## 1. Atomic Structure

### GCSE questions

**Q1.** This question is about the structure of the atom.

(a) Complete the sentences. Choose answers from the box. Each word may be used once, more than once, or not at all.

|          |        |         |
|----------|--------|---------|
| electron | ion    | neutron |
| nucleus  | proton |         |

The centre of the atom is the \_\_\_\_\_.

The two types of particle in the centre of the atom are the proton and the \_\_\_\_\_.

James Chadwick proved the existence of the \_\_\_\_\_.

Niels Bohr suggested particles orbit the centre of the atom. This type of particle is the \_\_\_\_\_.

The two types of particle with the same mass are the neutron and the \_\_\_\_\_. (5)

The table below shows information about two isotopes of element **X**.

|           | Mass number | Percentage (%) abundance |
|-----------|-------------|--------------------------|
| Isotope 1 | 63          | 70                       |
| Isotope 2 | 65          | 30                       |

(b) Calculate the relative atomic mass ( $A_r$ ) of element **X** using the equation:

$$A_r = \frac{(\text{mass number} \times \text{percentage}) \text{ of isotope 1} + (\text{mass number} \times \text{percentage}) \text{ of isotope 2}}{100}$$

Use the table above. Give your answer to 1 decimal place.

$$A_r = \text{_____} \quad (2)$$

(c) Suggest the identity of element **X**. Use the periodic table.

Element **X** is \_\_\_\_\_ (1)

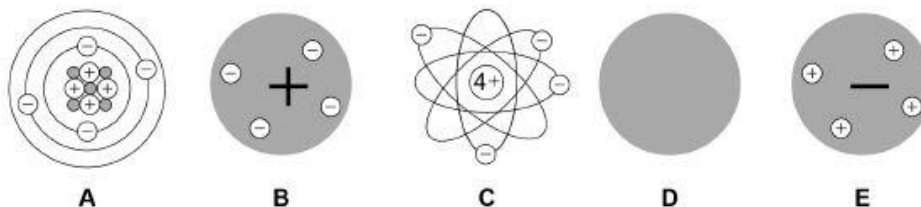
(d) The radius of an atom of element **X** is  $1.2 \times 10^{-10}$  m

The radius of the centre of the atom is  $\frac{1}{10000}$  the radius of the atom.

Calculate the radius of the centre of an atom of element **X**. Give your answer in standard form.

Radius = \_\_\_\_\_ m (2)

**Q2.** The diagram below represents different models of the atom.



(a) Which diagram shows the plum pudding model of the atom? Tick **one** box.

|   |  |   |  |   |  |   |  |   |  |
|---|--|---|--|---|--|---|--|---|--|
| A |  | B |  | C |  | D |  | E |  |
|---|--|---|--|---|--|---|--|---|--|

 (1)

(b) Which diagram shows the model of the atom developed from the alpha particle scattering experiment? Tick **one** box.

|   |  |   |  |   |  |   |  |   |  |
|---|--|---|--|---|--|---|--|---|--|
| A |  | B |  | C |  | D |  | E |  |
|---|--|---|--|---|--|---|--|---|--|

 (1)

(c) Which diagram shows the model of the atom resulting from Bohr's work? Tick **one** box.

|   |  |   |  |   |  |   |  |   |  |
|---|--|---|--|---|--|---|--|---|--|
| A |  | B |  | C |  | D |  | E |  |
|---|--|---|--|---|--|---|--|---|--|

 (1)

(d) Define the mass number of an atom.

(1)

(e) Element **X** has two isotopes. Their mass numbers are 69 and 71

The percentage abundance of each isotope is:

- 60% of  $^{69}\text{X}$
- 40% of  $^{71}\text{X}$

Estimate the relative atomic mass of element **X**. Tick **one** box.

- < 69.5 ☐
- Between 69.5 and 70.0 ☐
- Between 69.5 and 70.0 ☐
- Between 70.0 and 70.5 ☐
- > 70.5 ☐

(1)

**A-Level question to give a go!**

**Q1.** Which of these correctly shows the numbers of sub-atomic particles in a  $^{41}\text{K}^+$  ion?

|          | Number of electrons | Number of protons | Number of neutrons |                       |
|----------|---------------------|-------------------|--------------------|-----------------------|
| <b>A</b> | 19                  | 19                | 20                 | <input type="radio"/> |
| <b>B</b> | 18                  | 20                | 21                 | <input type="radio"/> |
| <b>C</b> | 18                  | 19                | 22                 | <input type="radio"/> |
| <b>D</b> | 19                  | 18                | 23                 | <input type="radio"/> |

(Total 1 mark)

**Q2.** Magnesium exists as three isotopes:  $^{24}\text{Mg}$ ,  $^{25}\text{Mg}$  and  $^{26}\text{Mg}$

(a) In terms of sub-atomic particles, state the difference between the three isotopes of magnesium.

\_\_\_\_\_  
\_\_\_\_\_  
(1)

(b) State how, if at all, the chemical properties of these isotopes differ.

Give a reason for your answer.

Chemical properties \_\_\_\_\_

Reason \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
(2)

**2. Amount of Substance****GCSE questions**

**Q3.** A student investigated the reactions of copper carbonate and copper oxide with dilute hydrochloric acid. In both reactions one of the products is copper chloride.

(a) A student wanted to make 11.0 g of copper chloride.

The equation for the reaction is:



Relative atomic masses,  $A_r$ : H = 1; C = 12; O = 16; Cl = 35.5; Cu = 63.5

Calculate the mass of copper carbonate the student should react with dilute hydrochloric acid to make 11.0 g of copper chloride.

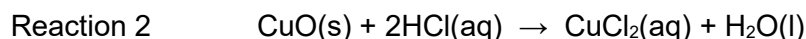
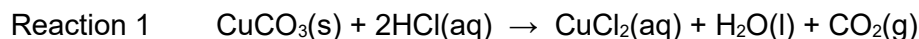
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
Mass of copper carbonate = \_\_\_\_\_ g (4)

(b) The percentage yield of copper chloride was 79.1 %. Calculate the mass of copper chloride the student actually produced.

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Actual mass of copper chloride produced = \_\_\_\_\_ g (2)

(c) Look at the equations for the two reactions:



Reactive formula masses:  $\text{CuO} = 79.5$ ;  $\text{HCl} = 36.5$ ;  $\text{CuCl}_2 = 134.5$ ;  $\text{H}_2\text{O} = 18$

The percentage atom economy for a reaction is calculated using:

$$\frac{\text{Relative formula mass of desired product from equation}}{\text{Sum of relative formula masses of all reactants from equation}} \times 100$$

Calculate the percentage atom economy for Reaction 2.

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Percentage atom economy = \_\_\_\_\_ % (3)

(d) The atom economy for Reaction 1 is 68.45 %. Compare the atom economies of the two reactions for making copper chloride. Give a reason for the difference.

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(1)

### A-Level question to give a go!

**Q3.** Ethanol can be made from glucose by fermentation.



In an experiment, 268 g of ethanol ( $M_r = 46.0$ ) were made from 1.44 kg of glucose ( $M_r = 180.0$ ). What is the percentage yield?

- A** 18.6% ☐
- B** 36.4% ☐
- C** 51.1% ☐
- D** 72.8% ☐

(Total 1 mark)

**Q4.** A gas cylinder contains 5.0 kg of propane.  
How many propane molecules are in the cylinder?  
The Avogadro constant,  $L = 6.022 \times 10^{23} \text{ mol}^{-1}$

**A**  $6.8 \times 10^{22}$

☐

**B**  $7.2 \times 10^{22}$

☐

**C**  $6.8 \times 10^{25}$

☐

**D**  $7.2 \times 10^{25}$

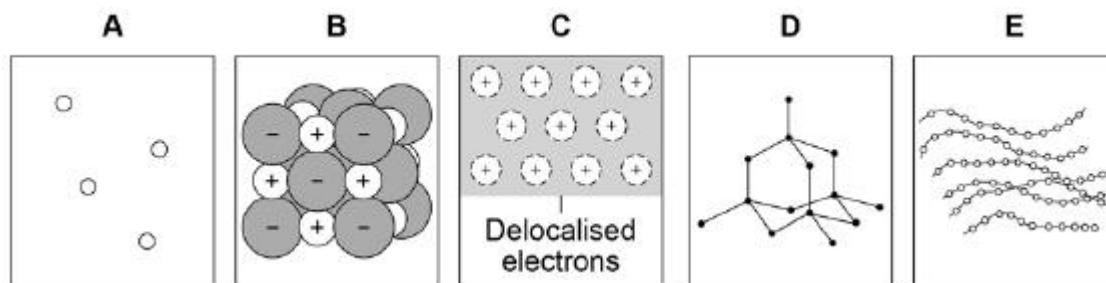
☐

(Total 1 mark)

### 3. Bonding

#### GCSE questions

**Q4.** Figure 1 shows the structure of five substances.



(a) Which diagram shows a gas? Tick (✓) **one** box.

**A** ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

(1)

(b) Which diagram shows the structure of diamond? Tick (✓) **one** box.

**A** ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

(1)

(c) Which diagram shows a metallic structure? Tick (✓) **one** box.

**A** ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

(1)

(d) Which diagram shows a polymer? Tick (✓) **one** box.

**A** ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

(1)

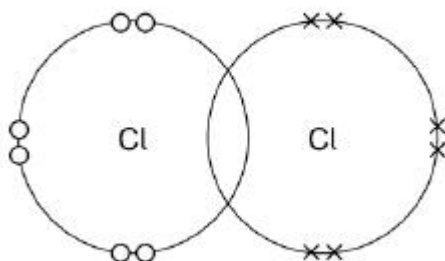
(e) A chlorine atom has 7 electrons in the outer shell.

Two chlorine atoms covalently bond to form a chlorine molecule,  $\text{Cl}_2$

**Figure 2** is a dot and cross diagram showing the outer shells and some electrons in a chlorine molecule.

Complete the dot and cross diagram. Show only the electrons in the outer shell.

**Figure 2**

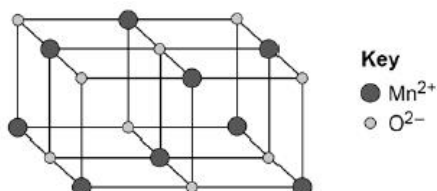


(f) What is the reason for chlorine's low boiling point? Tick (✓) **one** box.

- |                                 |                          |
|---------------------------------|--------------------------|
| Strong covalent bonds           | <input type="checkbox"/> |
| Strong forces between molecules | <input type="checkbox"/> |
| Weak covalent bonds             | <input type="checkbox"/> |
| Weak forces between molecules   | <input type="checkbox"/> |

(1)

**Figure 3** represents the structure of manganese oxide. Manganese oxide is an ionic compound.



(g) Determine the empirical formula of manganese oxide. Use **Figure 3**.

\_\_\_\_\_ Empirical formula = \_\_\_\_\_ (1)

(h) Why does manganese oxide conduct electricity as a liquid? Tick (✓) **one** box.

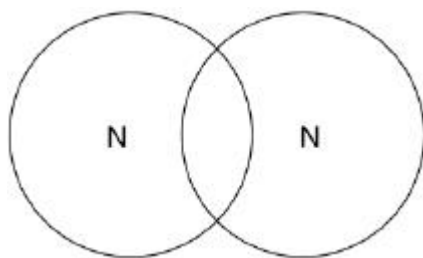
- |                                     |                          |
|-------------------------------------|--------------------------|
| Atoms move around in the liquid     | <input type="checkbox"/> |
| Electrons move around in the liquid | <input type="checkbox"/> |
| Ions move around in the liquid      | <input type="checkbox"/> |
| Molecules move around in the liquid | <input type="checkbox"/> |

(1)

**Q5.** This question is about structure and bonding.

(a) Complete the dot and cross diagram to show the covalent bonding in a nitrogen molecule,  $N_2$

Show only the electrons in the outer shell.



(2)

(b) Explain why nitrogen is a gas at room temperature. Answer in terms of nitrogen's structure.

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(3)

(c) Graphite and fullerenes are forms of carbon. Graphite is soft and is a good conductor of electricity.

Explain why graphite has these properties. Answer in terms of structure and bonding.

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(4)

**A-Level question to give a go!**

**Q5.** Which is the correct crystal structure for the substance named?

|          | Substance       | Structure        |                          |
|----------|-----------------|------------------|--------------------------|
| <b>A</b> | Iodine          | Simple molecular | <input type="checkbox"/> |
| <b>B</b> | Diamond         | Ionic            | <input type="checkbox"/> |
| <b>C</b> | Sodium chloride | Giant covalent   | <input type="checkbox"/> |
| <b>D</b> | Graphite        | Metallic         | <input type="checkbox"/> |

(Total 1 mark)

**Q6.** What is the formula of calcium nitrate(V)?

- |          |                            |                                                                                   |
|----------|----------------------------|-----------------------------------------------------------------------------------|
| <b>A</b> | $\text{CaNO}_3$            |  |
| <b>B</b> | $\text{Ca}(\text{NO}_3)_2$ |  |
| <b>C</b> | $\text{Ca}_2\text{NO}_2$   |  |
| <b>D</b> | $\text{Ca}(\text{NO}_2)_2$ |  |

**(Total 1 mark)**

**Q7.** The table shows some data about the elements bromine and magnesium.

| Element   | Melting point / K | Boiling point / K |
|-----------|-------------------|-------------------|
| Bromine   | 266               | 332               |
| Magnesium | 923               | 1383              |

In terms of structure and bonding explain why the boiling point of bromine is different from that of magnesium. Suggest why magnesium is a liquid over a much greater temperature range compared to bromine.

[illegible]

**(Total 5 marks)**

## 4. Energetics

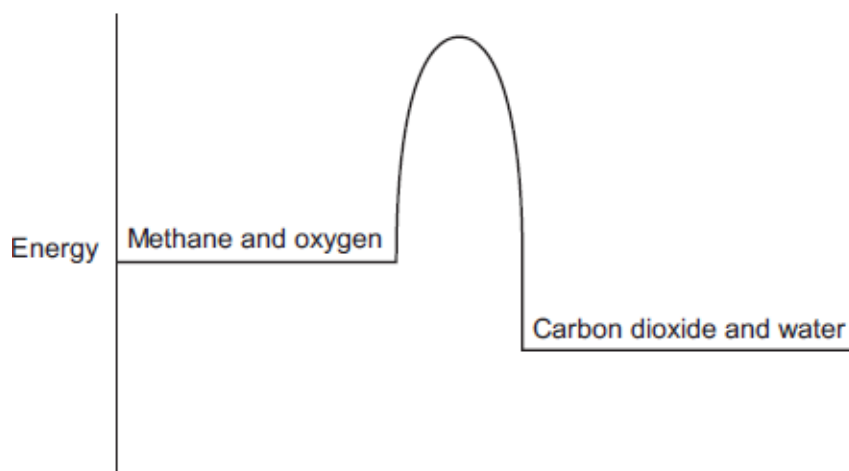
## GCSE questions

**Q6.** Methane ( $\text{CH}_4$ ) is used as a fuel.

- (a) Methane burns in oxygen.
- (i) The diagram below shows the energy level diagram for the complete combustion of methane.

Draw and label arrows on the diagram to show:

- the activation energy
- the enthalpy change,  $\Delta H$ .



(2)

(ii) Complete and balance the symbol equation for the complete combustion of methane.



(2)

(ii) Explain why, in terms of the energy involved in bond breaking and bond making, the combustion of methane is exothermic.

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(3)

(b) Methane reacts with chlorine in the presence of sunlight. The equation for this reaction is:



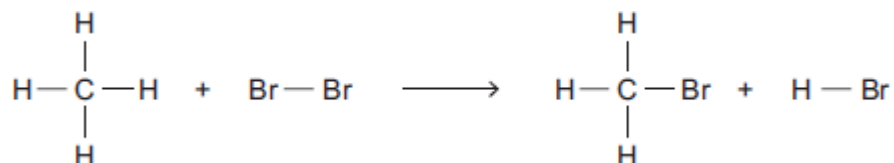
Some bond dissociation energies are given in the table.

| Bond  | Bond dissociation energy<br>in kJ per mole |
|-------|--------------------------------------------|
| C-H   | 413                                        |
| C-Cl  | 327                                        |
| Cl-Cl | 243                                        |
| H-Cl  | 432                                        |

(i) Show that the enthalpy change,  $\Delta H$ , for this reaction is  $-103 \text{ kJ per mole}$ .

(3)

(ii) Methane also reacts with bromine in the presence of sunlight.



This reaction is less exothermic than the reaction between methane and chlorine.

The enthalpy change,  $\Delta H$ , is  $-45 \text{ kJ per mole}$ .

What is a possible reason for this? Tick (✓) **one** box.

$\text{CH}_3\text{Br}$  has a lower boiling point than  $\text{CH}_3\text{Cl}$

☐

The C-Br bond is weaker than the C-Cl bond.

☐

The H-Cl bond is weaker than the H-Br bond.

☐

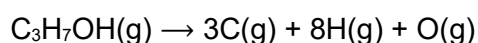
Chlorine is more reactive than bromine.

☐

(1)

**A-Level question to give a go!**

**Q8.** Calculate the enthalpy change, in kJ, for this dissociation of mole of propan-1-ol.



|                                                        | C—H | C—C | C—O | O—H |
|--------------------------------------------------------|-----|-----|-----|-----|
| Mean bond dissociation enthalpy / $\text{kJ mol}^{-1}$ | 412 | 348 | 360 | 463 |

**A**  $-4751$

☐

**B**  $-4403$

☐

**C**  $+4403$

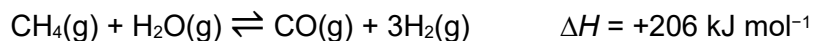
☐

**D**  $+4751$

☐

(Total 1 mark)

**Q9.** Hydrogen is produced by the reaction of methane with steam. The reaction mixture reaches a state of dynamic equilibrium.



Some enthalpy data is given in the table.

| Bond                                 | C–H | O–H | H–H | C≡H              |
|--------------------------------------|-----|-----|-----|------------------|
| Bond enthalpy / $\text{kJ mol}^{-1}$ | 413 | 463 | 436 | To be calculated |

Use the information in the table and the stated enthalpy change to calculate the missing bond enthalpy.

- A** 234 ☐
- B** 1064 ☐
- C** 1476 ☐
- D** 1936 ☐

(Total 1 mark)

## 5. Kinetics

### GCSE questions

**Q7.** When sodium thiosulfate solution reacts with dilute hydrochloric acid, the solution becomes cloudy.

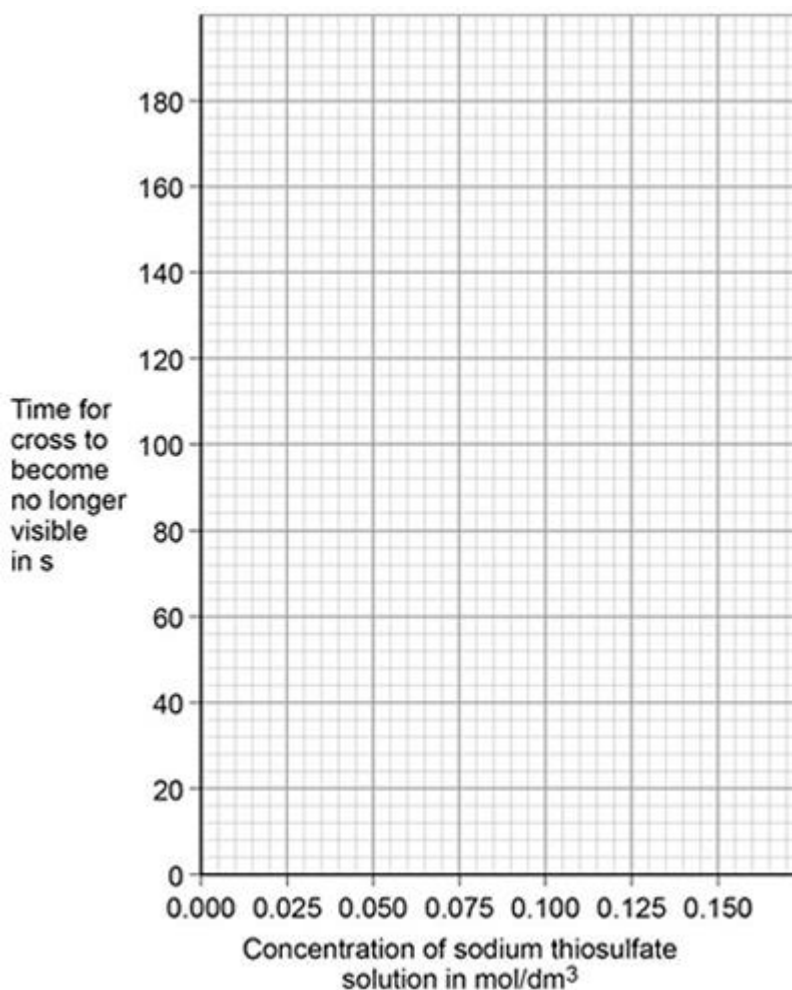
The equation for the reaction is:



Some students used this reaction to investigate the effect of concentration on rate of reaction. The table shows the students' results.

| Concentration of sodium thiosulfate solution in $\text{mol / dm}^3$ | Time for cross to become no longer visible in s |
|---------------------------------------------------------------------|-------------------------------------------------|
| 0.020                                                               | 170                                             |
| 0.040                                                               | 90                                              |
| 0.060                                                               | 82                                              |
| 0.080                                                               | 42                                              |
| 0.100                                                               | 34                                              |
| 0.120                                                               | 30                                              |
| 0.140                                                               | 28                                              |

(a) Plot the data from the table above on the graph below. Draw a line of best fit.



(3)

The students repeated the investigation two more times. They obtained similar results each time.

(b) The students analysed their results to give a conclusion and an explanation for their investigation.

**Conclusion:** 'The higher the concentration, the lower the rate of reaction.'

**Explanation:** 'At higher concentrations, the particles have more energy, so they are moving faster. Therefore the collisions are more energetic.'

The students are not correct.

Give a **correct** conclusion **and** explanation for the results of the investigation.

Conclusion \_\_\_\_\_

Explanation \_\_\_\_\_

(3)

(c) A solution containing 0.18 g of sodium thiosulfate reacts with dilute hydrochloric acid in 2 minutes.

Calculate the mean rate of reaction in g / s. Give your answer in standard form.

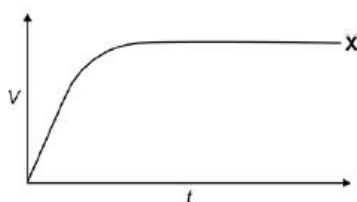
\_\_\_\_\_

\_\_\_\_\_

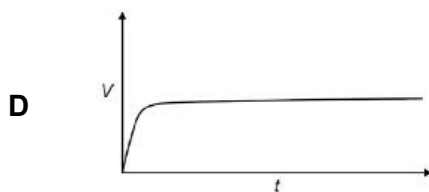
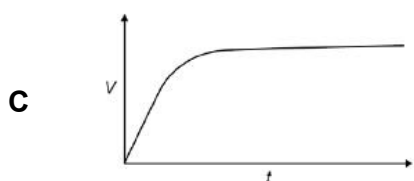
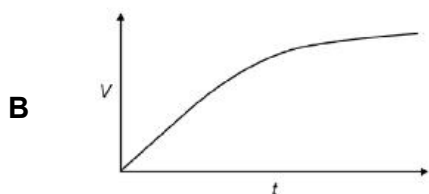
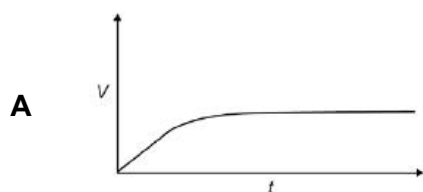
\_\_\_\_\_ Mean rate of reaction = \_\_\_\_\_ g / s (3)

**A-Level question to give a go!**

**Q10.** Line **X** in the diagram represents the volume ( $V$ ) of gas formed with time ( $t$ ) in a reaction between an excess of magnesium and aqueous sulfuric acid.

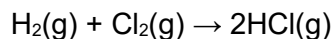


Which line represents the volume of hydrogen formed, at the same temperature and pressure, when the concentration of sulfuric acid has been halved?



(Total 1 mark)

**Q11.** The gas-phase reaction between hydrogen and chlorine is very slow at room temperature.



(a) Define the term *activation energy*.

\_\_\_\_\_  
\_\_\_\_\_. (2)

(b) Give **one** reason why the reaction between hydrogen and chlorine is very slow at room temperature.

\_\_\_\_\_  
\_\_\_\_\_. (1)

(c) Explain why an increase in pressure, at constant temperature, increases the rate of reaction between hydrogen and chlorine.

\_\_\_\_\_  
\_\_\_\_\_. (2)

(d) Explain why a small increase in temperature can lead to a large increase in the rate of reaction between hydrogen and chlorine.

\_\_\_\_\_  
\_\_\_\_\_. (2)

(e) Give the meaning of the term *catalyst*.

\_\_\_\_\_  
\_\_\_\_\_. (1)

(f) Suggest **one** reason why a solid catalyst for a gas-phase reaction is often in the form of a powder.

\_\_\_\_\_. (1)

## 6. Chemical Equilibria, Le Chatelier's Principle and $K_c$

### GCSE questions

**Q8.** In industry ethanol is produced by the reaction of ethene and steam at 300°C and 60 atmospheres pressure using a catalyst.

The equation for the reaction is:  $\text{C}_2\text{H}_4(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightleftharpoons \text{C}_2\text{H}_5\text{OH}(\text{g})$

(a) The forward reaction is exothermic.

Use Le Chatelier's Principle to predict the effect of increasing temperature on the amount of ethanol produced at equilibrium. Give a reason for your prediction.

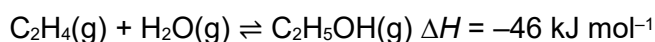
(2)

(b) Explain how increasing the pressure of the reactants will affect the amount of ethanol produced at equilibrium.

(2)

**A-Level question to give a go!**

**Q12.** Which statement is **not** correct about the industrial preparation of ethanol by the hydration of ethene at 300 °C?



- A** The reaction is catalysed by an acid.
- B** The higher the pressure, the higher the equilibrium yield of ethanol.
- C** The higher the temperature, the higher the equilibrium yield of ethanol.
- D** A low equilibrium yield of ethanol is acceptable because unreacted ethene is recycled.

☐☐☐☐

(Total 1 mark)

**Q13.** The forward reaction in this equilibrium is endothermic



Which statement is correct?

- A** If the total pressure is increased at constant temperature, the proportion of  $\text{COCl}_2$  in the equilibrium mixture will decrease
- B** Use of a catalyst will increase the proportion of  $\text{COCl}_2$  in the equilibrium mixture at constant temperature and pressure
- C** Reducing the equilibrium concentration of  $\text{CO}$  will increase the value of the equilibrium constant
- D** Raising the temperature from 373 K to 473 K will increase the value of the equilibrium constant

☐☐☐☐

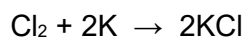
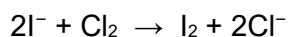
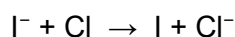
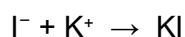
(Total 1 mark)

## 7. Oxidation, Reduction and Redox equations

### GCSE questions

**Q9.** This question is about halogens and their compounds.

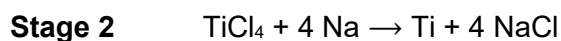
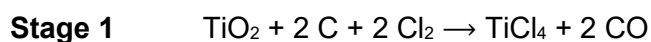
(a) What is the ionic equation for the reaction of chlorine with potassium iodide? Tick **one** box.

☐☐☐☐

(1)

**Q10.** Titanium is a transition metal.

Titanium is extracted from titanium dioxide in a two-stage industrial process.



In **Stage 2**, sodium displaces titanium from titanium chloride.

(a) Sodium atoms are oxidised to sodium ions in this reaction. Why is this an oxidation reaction?

(1)

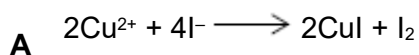
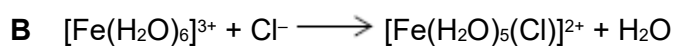
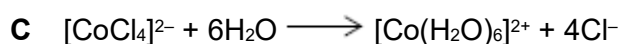
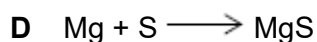
(b) Complete the half equation for the oxidation reaction.



(1)

### A-Level question to give a go!

**Q14.** In which reaction is the metal oxidised?

☐☐☐☐

(Total 1 mark)

## 8. Periodicity

### GCSE questions

**Q11.** This question is about metals.

(a) Which unreactive metal is found in the Earth as the metal itself? Tick (✓) **one** box

aluminium

☐

gold

☐

magnesium

☐

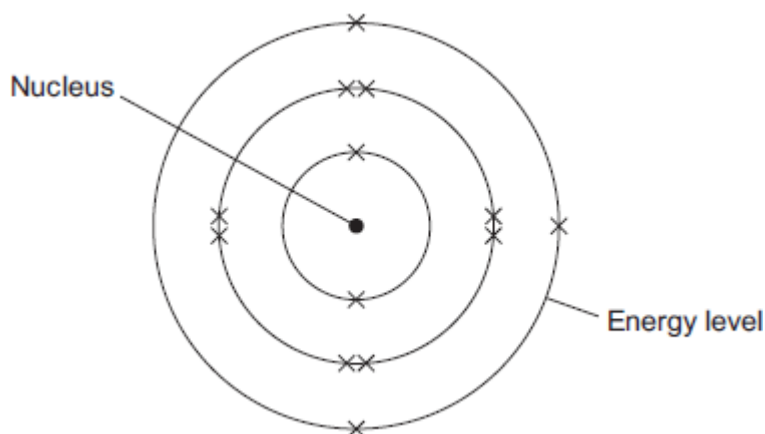
(1)

(b) Complete the sentence.

Aluminium is an element because aluminium is made of only one type of \_\_\_\_\_.

(1)

(c) **Figure 1** shows the electronic structure of an aluminium atom.



(i) Use the correct words from the box to complete the sentence.

electrons

ions

protons

neutrons

shells

The nucleus of an aluminium atom contains \_\_\_\_\_ and \_\_\_\_\_.

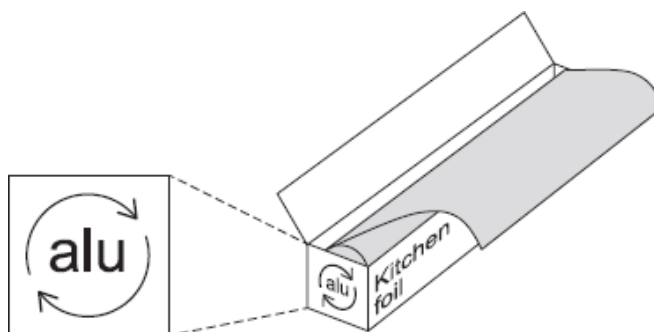
(2)

(ii) Complete the sentence.

In the periodic table, aluminium is in Group \_\_\_\_\_

(1)

- (d) Aluminium is used for kitchen foil. **Figure 2** shows a symbol on a box of kitchen foil.



The symbol means that aluminium can be recycled. It does not show the correct chemical symbol for aluminium.

- (i) What is the correct chemical symbol for aluminium? \_\_\_\_\_ . (1)

- (ii) Give **two** reasons why aluminium should be recycled.

\_\_\_\_\_  
\_\_\_\_\_ (2)

- (e) Aluminium has a low density, conducts electricity and is resistant to corrosion.

Which **one** of these properties makes aluminium suitable to use as kitchen foil? Give a reason for your answer.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2)

**A-Level question to give a go!**

**Q15.** Which of the following is a correct statement about the trend in atomic radius across Period 3 of the Periodic Table?

- |          |                                                          |                       |
|----------|----------------------------------------------------------|-----------------------|
| <b>A</b> | radius increases because the atoms have more electrons   | <input type="radio"/> |
| <b>B</b> | radius decreases because nuclear charge increases        | <input type="radio"/> |
| <b>C</b> | radius increases because shielding (screening) increases | <input type="radio"/> |
| <b>D</b> | radius decreases because shielding (screening) decreases | <input type="radio"/> |

(Total 1 mark)

## 9. Group 2 – The Alkaline Earth Metals

### GCSE questions

**Q12.** This question is about compounds.

- (a) The table gives information about the solubility of some compounds.

| Soluble compounds                                                |
|------------------------------------------------------------------|
| All potassium and sodium salts                                   |
| All nitrates                                                     |
| Chlorides, bromides and iodides, except those of silver and lead |

Use information from the table to answer these questions.

- (i) Name a soluble compound that contains silver ions.

\_\_\_\_\_ (1)

- (ii) Name a soluble compound that contains carbonate ions.

\_\_\_\_\_ (1)

- (b) Metal oxides react with acids to make salts. What type of compound is a metal oxide?

\_\_\_\_\_ (1)

- (c) Lead nitrate solution is produced by reacting lead oxide with nitric acid.

- (i) State how solid lead nitrate can be obtained from lead nitrate solution.

\_\_\_\_\_  
\_\_\_\_\_ (1)

- (ii) Balance the equation for the reaction.



(1)

- (iii) Give the total number of atoms in the formula  $\text{Pb}(\text{NO}_3)_2$

\_\_\_\_\_ (1)

### A-Level question to give a go!

**Q16.** (a) Nickel is a metal with a high melting point.

- (i) Explain, in terms of its structure and bonding, why nickel has a high melting point.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2)

(ii) Draw a labelled diagram to show the arrangement of particles in a crystal of nickel.  
In your answer, include at least six particles of each type.

(2)

(iii) Explain why nickel is ductile (can be stretched into wires).

(1)

### 10. Group 7 – The Halogens

#### GCSE questions

**Q13.** The halogens are elements in Group 7.

(a) Bromine is in Group 7.

Give the number of electrons in the outer shell of a bromine atom. \_\_\_\_\_ (1)

(b) Bromine reacts with hydrogen. The gas hydrogen bromide is produced.

What is the structure of hydrogen bromide? Tick **one** box.

Giant covalent ☐

Ionic lattice ☐

Metallic structure ☐

Small molecule ☐

(1)

(c) What is the formula for fluorine gas? Tick **one** box.

F ☐

F<sub>2</sub> ☐

F<sup>2</sup> ☐

2F ☐

(1)

A student mixes solutions of halogens with solutions of their salts.

The table below shows the student's observations.

|                          | Potassium chloride<br>(colourless) | Potassium bromide<br>(colourless) | Potassium iodide<br>(colourless) |
|--------------------------|------------------------------------|-----------------------------------|----------------------------------|
| Chlorine<br>(colourless) |                                    | Solution turns orange             | Solution turns brown             |
| Bromine (orange)         | No change                          |                                   | Solution turns brown             |
| Iodine (brown)           | No change                          | No change                         |                                  |

(d) Explain how the reactivity of the halogens changes going down Group 7. Use the results in the table above.

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(3)

**A-Level question to give a go!**

**Q17.** An aqueous solution of a white solid gives a yellow precipitate with aqueous silver nitrate. The formula of the white solid could be

- A AgBr
- B AgI
- C NaBr
- D NaI

(Total 1 mark)

**Q18.** What will you see when a solution of silver nitrate is added to a solution containing bromide ions, and concentrated aqueous ammonia is added to the resulting mixture?

- A a white precipitate soluble in concentrated aqueous ammonia
- B a white precipitate insoluble in concentrated aqueous ammonia
- C a cream precipitate soluble in concentrated aqueous ammonia
- D a yellow precipitate insoluble in concentrated aqueous ammonia

(Total 1 mark)

## 11. Introduction to Organic Chemistry

### GCSE questions

**Q14.** Scientists found that a compound contained:

22.8% sodium; 21.8% boron; and 55.4% oxygen.

Use the percentages to calculate the empirical formula of the compound.

Relative atomic masses ( $A_r$ ): B = 11; O = 16; Na = 23

To gain full marks you **must** show all your working.

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Empirical formula = \_\_\_\_\_ (Total 5 marks)

### A-Level question to give a go!

**Q19.** An organic compound is found to contain 40.0% carbon, 6.7% hydrogen and 53.3% oxygen.

Which of the following compounds could this be?

**A** Ethanol

☐

**B** Ethanoic acid

☐

**C** Methanol

☐

**D** Methanoic acid

☐

(Total 1 mark)

## 12. Alkanes

### GCSE questions

**Q15.** This question is about hydrocarbons.

The table gives information about four hydrocarbons. The hydrocarbons are four successive members of a homologous series.

| Hydrocarbon | Formula                        | Boiling point in °C |
|-------------|--------------------------------|---------------------|
| <b>A</b>    | C <sub>4</sub> H <sub>10</sub> | 0                   |
| <b>B</b>    |                                | 36                  |
| <b>C</b>    | C <sub>6</sub> H <sub>14</sub> | 69                  |
| <b>D</b>    | C <sub>7</sub> H <sub>16</sub> | 98                  |

(a) What is the formula of hydrocarbon **B**? Tick (✓) **one** box.

C<sub>4</sub>H<sub>12</sub> ☐

C<sub>5</sub>H<sub>12</sub> ☐

C<sub>5</sub>H<sub>12</sub> ☐

C<sub>6</sub>H<sub>12</sub> ☐

(1)

(b) What is the simplest ratio of carbon : hydrogen atoms in a molecule of hydrocarbon **A**?

Ratio = 2 : \_\_\_\_\_

(1)

(c) Which hydrocarbon is a gas at room temperature (25 °C)? Tick (✓) **one** box.

**A** ☐    **B** ☐    **C** ☐    **D** ☐

(1)

(d) Which hydrocarbon is most flammable? Tick (✓) **one** box.

**A** ☐    **B** ☐    **C** ☐    **D** ☐

(1)

(e) Which **two** substances are produced when a hydrocarbon **completely** combusts in air? Tick (✓) **two** boxes.

Carbon ☐

Carbon dioxide ☐

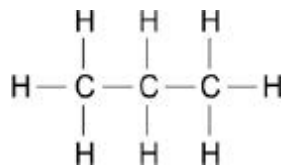
Hydrogen ☐

Sulfur dioxide ☐

Water ☐

(2)

The diagram shows the displayed structure of a hydrocarbon molecule.



- (f) What is the name of the hydrocarbon in the diagram above? Tick (✓) **one** box.

Butane

☐

Ethane

☐

Methane

☐

Propane

☐

(1)

**Q16.** This question is about hydrocarbons.

- (a) The names and formulae of three hydrocarbons in the same homologous series are:

|         |                           |
|---------|---------------------------|
| Ethane  | $\text{C}_2\text{H}_6$    |
| Propane | $\text{C}_3\text{H}_8$    |
| Butane  | $\text{C}_4\text{H}_{10}$ |

The next member in the series is pentane. What is the formula of pentane?

(1)

- (b) Which homologous series contains ethane, propane and butane? Tick **one** box.

Alcohols

☐

Alkanes

☐

Alkenes

☐

Carboxylic acids

☐

(1)

- (c) Propane ( $\text{C}_3\text{H}_8$ ) is used as a fuel. Complete the equation for the complete combustion of propane.



(2)

- (d) Octane ( $\text{C}_8\text{H}_{18}$ ) is a hydrocarbon found in petrol. Explain why octane is a hydrocarbon.

(2)

(e) The table below gives information about the pollutants produced by cars using diesel or petrol as a fuel.

| Fuel   | Relative amounts of pollutants |                    |                |
|--------|--------------------------------|--------------------|----------------|
|        | Oxides of Nitrogen             | Particulate matter | Carbon dioxide |
| Diesel | 31                             | 100                | 85             |
| Petrol | 23                             | 0                  | 100            |

Compare the pollutants from cars using diesel with those from cars using petrol.

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(3)

(f) Pollutants cause environmental impacts. Draw **one** line from each pollutant to the environmental impact caused by the pollutant.

| Pollutant          | Environmental impact caused by the pollutant |
|--------------------|----------------------------------------------|
|                    | Acid rain                                    |
| Oxides of nitrogen | Flooding                                     |
|                    | Global dimming                               |
| Particulate matter | Global warming                               |
|                    | Photosynthesis                               |

(2)

### A-Level question to give a go!

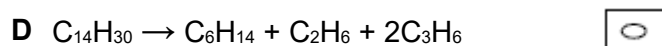
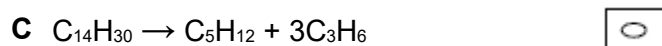
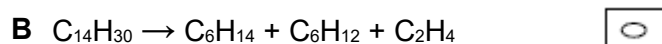
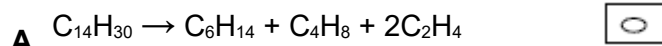
**Q20.** Which correctly represents an incomplete combustion of pentane?

- A**  $\text{C}_5\text{H}_{12} + 8\text{O}_2 \rightarrow 5\text{CO}_2 + 6\text{H}_2\text{O}$  ☐
- B**  $\text{C}_5\text{H}_{12} + 8\text{O}_2 \rightarrow 4\text{CO} + \text{CO}_2 + 6\text{H}_2\text{O}$  ☐
- C**  $\text{C}_5\text{H}_{12} + 6\text{O}_2 \rightarrow 4\text{CO} + \text{CO}_2 + 6\text{H}_2\text{O}$  ☐
- D**  $\text{C}_5\text{H}_{12} + 5\text{O}_2 \rightarrow 4\text{CO} + \text{CO}_2 + 4\text{H}_2\text{O} + 2\text{H}_2$  ☐

(Total 1 mark)

**Q21.** Tetradecane ( $C_{14}H_{30}$ ) is an alkane found in crude oil. When tetradecane is heated to a high temperature, one molecule of tetradecane decomposes to form one molecule of hexane and three more molecules.

Which of the following could represent this reaction?



(Total 1 mark)

**Q22.** Petrol contains saturated hydrocarbons. Some of the molecules in petrol have the molecular formula  $C_8H_{18}$  and are referred to as octanes. These octanes can be obtained from crude oil by fractional distillation and by cracking suitable heavier fractions.

Petrol burns completely in a plentiful supply of air but can undergo incomplete combustion in a car engine.

(a) State the meaning of both the words *saturated* and *hydrocarbon* as applied to the term *saturated hydrocarbon*. Name the homologous series to which  $C_8H_{18}$  belongs.

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(3)

(b) Outline the essential features of the fractional distillation of crude oil that enable the crude oil to be separated into fractions.

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(4)

### 13. Halogenalkanes

#### GCSE questions

**Q17.** During the test for unsaturation – a haloalkane is made. Describe the test for unsaturation

Test \_\_\_\_\_

Result \_\_\_\_\_ (2)

## 14. Alkenes

### GCSE questions

**Q18.** This question is about organic compounds. Hydrocarbons can be cracked to produce smaller molecules.

The equation shows the reaction for a hydrocarbon,  $C_{18}H_{38}$



(a) Which product of the reaction shown is an alkane? Tick **one** box.

$C_2H_4$

☐

$C_3H_6$

☐

$C_4H_8$

☐

$C_6H_{14}$

☐

(1)

(b) The table below shows the boiling point, flammability and viscosity of  $C_{18}H_{38}$  compared with the other hydrocarbons shown in the equation.

|          | Boiling point | Flammability | Viscosity |
|----------|---------------|--------------|-----------|
| <b>A</b> | highest       | lowest       | highest   |
| <b>B</b> | highest       | lowest       | lowest    |
| <b>C</b> | lowest        | highest      | highest   |
| <b>D</b> | lowest        | highest      | lowest    |

Which letter, **A**, **B**, **C** or **D**, shows how the properties of  $C_{18}H_{38}$  compare with the properties of  $C_2H_4$ ,  $C_3H_6$ ,  $C_4H_8$  and  $C_6H_{14}$ ? Tick **one** box.

**A**

☐

**B**

☐

**C**

☐

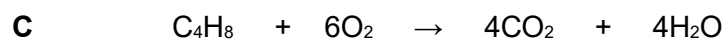
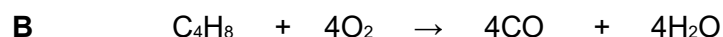
**D**

☐

(1)

(c) The hydrocarbon  $C_4H_8$  was burnt in air. Incomplete combustion occurred.

Which equation, **A**, **B**, **C** or **D**, correctly represents the incomplete combustion reaction?



Tick **one** box.

**A**

☐

**B**

☐

**C**

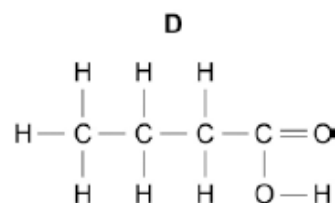
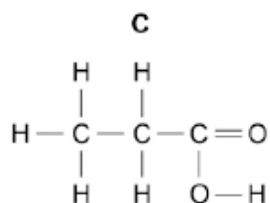
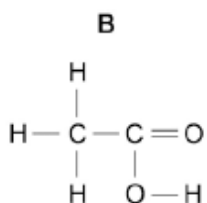
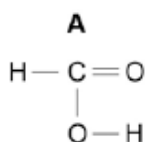
☐

**D**

☐

(1)

(d) Propanoic acid is a carboxylic acid. Which structure, **A**, **B**, **C** or **D**, shows propanoic acid?



Tick **one** box.

**A**

☐

**B**

☐

**C**

☐

**D**

☐

(1)

(e) Propanoic acid is formed by the oxidation of which organic compound? Tick **one** box.

Propane

☐

Propene

☐

Propanol

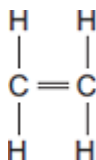
☐

Polyester

☐

(1)

**Q19.** A molecule of ethene ( $\text{C}_2\text{H}_4$ ) is represented as:



(a) A sample of ethene is shaken with bromine water. Complete the sentence.

The bromine water turns from orange to \_\_\_\_\_(1)

(b) Most ethene is produced by the process of cracking.

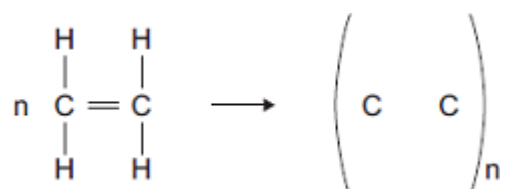
(i) Decane ( $C_{10}H_{22}$ ) can be cracked to produce ethene ( $C_2H_4$ ) and **one** other product.

Complete the equation to show the formula of the other product.



(c) Many molecules of ethene join together to produce poly(ethene).

(i) Complete the structure of the polymer in the equation.



(2)

(ii) Some carrier bags are made from poly(ethene). Some carrier bags are made from cornstarch. Suggest **two** benefits of using cornstarch instead of poly(ethene) to make carrier bags.

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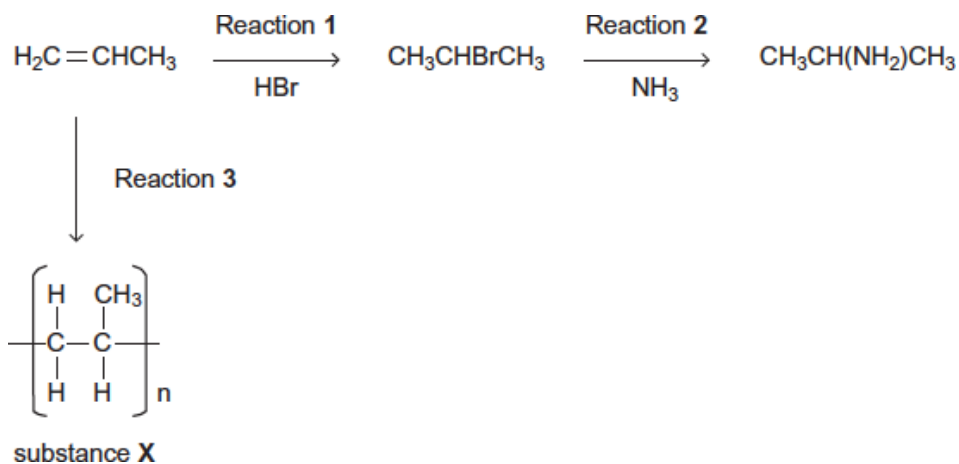
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(2)

### A-Level question to give a go!

**Q23.** Consider the following reactions.



(a) State the type of reaction in Reaction 3. Give the name of substance X.

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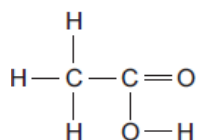
(2)

## 15. Alcohols

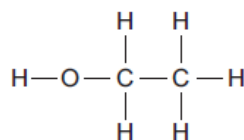
### GCSE questions

**Q20.** The diagrams represent two compounds, **A** and **B**.

Compound A



Compound B



(a) (i) Compound **B** is an alcohol. Name compound **B**.

\_\_\_\_\_ (1)

(ii) Use the correct answer from the box to complete the sentence.

|        |            |          |
|--------|------------|----------|
| burned | decomposed | oxidised |
|--------|------------|----------|

To form compound **A**, compound **B** is \_\_\_\_\_ (1)

(iii) Compounds **A** and **B** are both colourless liquids.

A test tube contains a colourless liquid, which could be either compound **A** or compound **B**. Describe a simple **chemical** test to show which compound, **A** or **B**, is in the test tube.

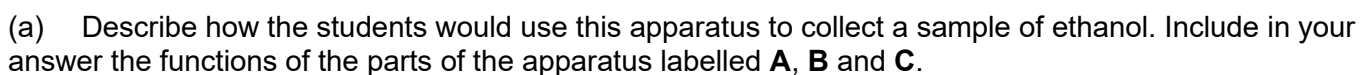
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2)

### A-Level question to give a go!

**Q24.** A group of students wanted to produce a biofuel to power the central heating system in their school. They collected scraps of fruits and vegetables from the kitchens and fermented them with yeast, in the absence of air, in order to produce ethanol.

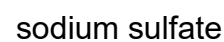
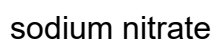
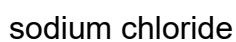
The aqueous mixture was filtered to remove the remaining solids.

The students then set up the apparatus shown in the diagram below and placed the aqueous mixture in the round bottomed flask.



## 16. Organic Analysis

**Q21.** Four bottles of chemicals made in the 1880s were found recently in a cupboard during a Health and Safety inspection at Lovell Laboratories.



The chemical names are shown below each bottle.

(a) You are provided with the following reagents:

- aluminium powder
- barium chloride solution acidified with dilute hydrochloric acid
- dilute hydrochloric acid
- silver nitrate solution acidified with dilute nitric acid
- sodium hydroxide solution.
- limewater
- red litmus paper

(i) Describe tests that you could use to show that these chemicals are correctly named.

(ii)

In each case give the reagent(s) you would use **and** state the result.

Test and result for carbonate ions:

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---

Test and result for chloride ions:

---

---

Test and result for nitrate ions:

---

---

Test and result for sulphate ions:

---

---

(4)

(ii) Suggest why a flame test would **not** distinguish between these four chemicals.

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(1)

(b) Instrumental methods of analysis linked to computers can be used to identify chemicals. Give **two** advantages of using instrumental methods of analysis.

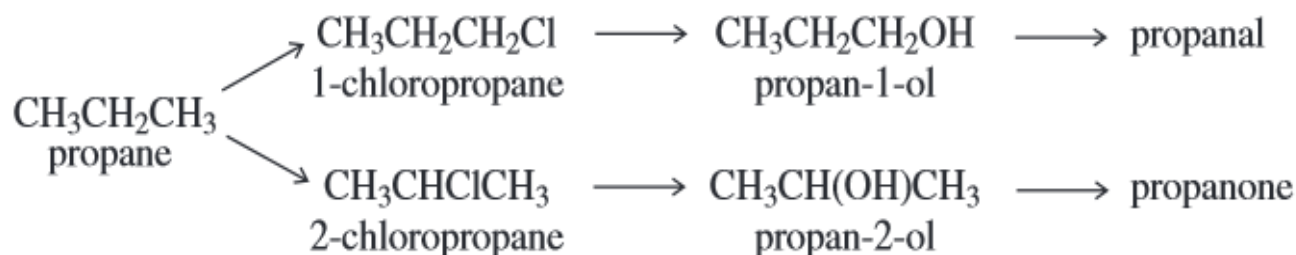
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(2)

**A-Level question to give a go!**

**Q25.** Consider the following scheme of reactions.



(a) High resolution mass spectrometry of a sample of propane indicated that it was contaminated with traces of carbon dioxide.

Use the data in the table to show how precise  $M_r$  values can be used to prove that the sample contains both of these gases.

| Atom            | Precise relative atomic mass |
|-----------------|------------------------------|
| $^{12}\text{C}$ | 12.00000                     |
| $^1\text{H}$    | 1.00794                      |
| $^{16}\text{O}$ | 15.99491                     |

(2)

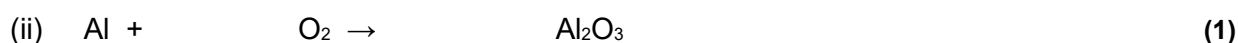
## GCSE to A-Level Chemistry – Skills Transition

### 17. Balancing Equations

Use this method to help you <https://www.youtube.com/watch?v=ab0qYBdHU-k>

#### GCSE questions

**Q1.** (a) Balance these chemical equations.



(b) Briefly explain why an unbalanced chemical equation cannot fully describe a reaction.

(2)

**Q2.** The following passage was taken from a chemistry textbook.

Germanium is a white, shiny, brittle element. It is used in the electronics industry because it is able to conduct

a small amount of electricity.

It is made from germanium oxide obtained from flue dusts of zinc and lead smelters.

The impure germanium oxide from the flue dusts is changed into germanium by the process outlined below.

**STEP 1** The germanium oxide is reacted with hydrochloric acid to make germanium tetrachloride. This is a volatile liquid in which the germanium and chlorine atoms are joined by covalent bonds.

**STEP 2** The germanium tetrachloride is distilled off from the mixture.

**STEP 3** The germanium tetrachloride is added to an excess of water to produce germanium oxide and hydrochloric acid.

**STEPS 1 to 3** are repeated several times.

**STEP 4** The pure germanium oxide is reduced by hydrogen to form germanium.

(a) Balance the equation below which represents the reaction in step 1.



(b) Write a word equation for the reaction in step 3.

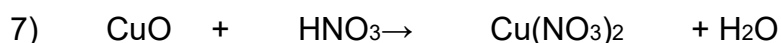
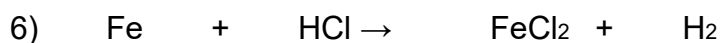
(1)

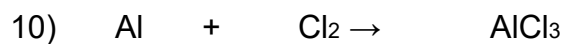
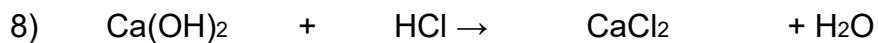
**Q3.** (a) Cola drinks contain phosphoric acid,  $\text{H}_3\text{PO}_4$ . The two equations show how phosphoric acid can be made from phosphorus.

Balance these two equations.



Some more practice



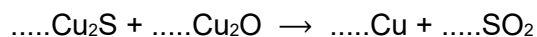


[Even more practice - Balancing Equations Game](#)

### A-Level question to give a go!

**Q11.** Copper can be produced from rock that contains  $\text{CuFeS}_2$

(a) Balance the equations for the two stages in this process.



## 18. Formula Literacy

(2)

For each of the following compounds;

- Identify the number of atoms of each element
- The formula of the ions it consists of
- Name it
- Challenge yourself: calculate its RFM

e.g. the first one is done for you:

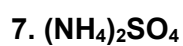
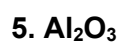
### 1. $\text{NaNO}_3$

1 x sodium atom, 1 x nitrogen atom, 3 x oxygen atoms

$\text{Na}^+$  and  $\text{NO}_3^-$

Sodium nitrate

**Challenge:**  $(1 \times 23) + (1 \times 14) + (3 \times 16) = 85$



## 19. SI units

To reduce confusion and to help with conversion between different units, there is a standard system of units called the SI units which are used for most scientific purposes.

These units have all been defined by experiment so that the size of, say, a metre in the UK is the same as a metre in China. The seven SI base units are:

| Physical quantity   | Usual quantity symbol | Unit     | Abbreviation |
|---------------------|-----------------------|----------|--------------|
| mass                | $m$                   | kilogram | kg           |
| length              | $l$ or $x$            | metre    | m            |
| time                | $t$                   | second   | s            |
| electric current    | $I$                   | ampere   | A            |
| temperature         | $T$                   | kelvin   | K            |
| amount of substance | $N$                   | mole     | mol          |

All other units can be derived from the SI base units.

For example, area is measured in square metres (written as  $\text{m}^2$ ) and speed is measured in metres per second (written as  $\text{ms}^{-1}$ ).

It is not always appropriate to use a full unit. For example, measuring the width of a hair or the distance from Manchester to London in metres would cause the numbers to be difficult to work with.

Prefixes are used to multiply each of the units. You will be familiar with centi (meaning 1/100), kilo (1000) and milli (1/1000) from centimetres, kilometres and millimetres.

There is a wide range of prefixes. The majority of quantities in scientific contexts will be quoted using the prefixes that are multiples of 1000. For example, a distance of 33 000 m would be quoted as 33 km.

| Prefix | Symbol | Multiplication factor |                   |                     |
|--------|--------|-----------------------|-------------------|---------------------|
| Tera   | T      | $10^{12}$             | 1 000 000 000 000 |                     |
| Giga   | G      | $10^9$                | 1 000 000 000     |                     |
| Mega   | M      | $10^6$                | 1 000 000         |                     |
| kilo   | k      | $10^3$                | 1000              |                     |
| deci   | d      | $10^{-1}$             | 0.1               | 1/10                |
| centi  | c      | $10^{-2}$             | 0.01              | 1/100               |
| milli  | m      | $10^{-3}$             | 0.001             | 1/1000              |
| micro  | $\mu$  | $10^{-6}$             | 0.000 001         | 1/1 000 000         |
| nano   | n      | $10^{-9}$             | 0.000 000 001     | 1/1 000 000 000     |
| pico   | p      | $10^{-12}$            | 0.000 000 000 001 | 1/1 000 000 000 000 |

***For the following quantities, which SI unit and most appropriate prefix would you use?***

1. The mass of water in a test tube.
2. The time taken for a solution to change colour.
3. The radius of a gold atom.
4. The volume of water in a burette.
5. The amount of substance in a beaker of sugar.

6. The temperature of the blue flame from a Bunsen burner.

***Rewrite the following quantities.***

7. 0.00122 metres in millimetres

8. 104 micrograms in grams

9. 1.1202 kilometres in metres

10. 70 decilitres in millilitres

11. 70 decilitres in litres

12. 10 cm<sup>3</sup> in litres

**END OF TRANSITION BOOKLET**