Robert Carre
Multi Academy Trust

KEEP CALM AND STUDY CHEMISTRY

Transition Work
This transition work MUST be completed by the time you start your course and it will be assessed in September. The aims are for you to re-familiarise yourself with work studied during GCSE but largely ignored for the past 10 weeks, but vital for progression at post 16 level.

Chemistry can be a fun subject but requires hard work to succeed with few shortcuts. Please use resources such as the internet, library and your Chemistry GCSE notes to help you complete this work.

To obtain the full A-level you will complete twelve set practical activities which you will be internally assessed on. You must pass these to obtain your Practical Endorsement.

**Exam board:** AQA Chemistry

<table>
<thead>
<tr>
<th>Paper 1</th>
<th>Paper 2</th>
<th>Paper 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>What's assessed:</strong></td>
<td><strong>What's assessed:</strong></td>
<td><strong>What's assessed:</strong></td>
</tr>
<tr>
<td>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)</td>
<td>Relevant physical chemistry topics (sections 3.1.2 to 3.1.6 and 3.1.9)</td>
<td>Any content. Any practical skills.</td>
</tr>
<tr>
<td>Inorganic chemistry (section 3.2) Relevant practical skills</td>
<td>Organic chemistry (section 3.3) Relevant practical skills</td>
<td><strong>Assessed by</strong> written exam: 2 hours 90 marks 30% of A-level</td>
</tr>
<tr>
<td><strong>Assessed by</strong> written exam: 2 hours 105 marks 35% of A-level</td>
<td><strong>Assessed by</strong> written exam: 2 hours 105 marks 35% of A-level</td>
<td><strong>Questions</strong></td>
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<tr>
<td><strong>Questions</strong> 105 marks of short and long answer questions</td>
<td><strong>Questions</strong> 105 marks of short and long answer questions</td>
<td>40 marks of questions on practical techniques and data analysis</td>
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<td></td>
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<td>20 marks of questions testing across the specification</td>
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<td></td>
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<td>30 marks of multiple choice questions</td>
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</tbody>
</table>
**Task 1 - Fundamental Particles**

Atoms are the basic building blocks of matter. It is not the smallest of particles, and within Chemistry, we are interested in electrons, protons and neutrons.

Using a periodic table, draw the *electronic configuration*, as well as identifying *how many sub-atomic particles* there are for the following atoms and its corresponding ions:

<table>
<thead>
<tr>
<th></th>
<th>Hydrogen</th>
<th>Oxygen</th>
<th>Calcium</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hydrogen ion, H⁺</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charge:</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Number of:</td>
<td></td>
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<td></td>
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<tr>
<td>e⁻:</td>
<td></td>
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<td></td>
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<tr>
<td>p:</td>
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<td></td>
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<tr>
<td>n:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Oxygen</th>
<th>Calcium</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Oxygen ion</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charge:</td>
<td></td>
<td></td>
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<tr>
<td>Number of:</td>
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<td>e⁻:</td>
<td></td>
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<td>p:</td>
<td></td>
<td></td>
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<tr>
<td>n:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Calcium</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Calcium ion</strong></td>
<td></td>
</tr>
<tr>
<td>Charge:</td>
<td></td>
</tr>
<tr>
<td>Number of:</td>
<td></td>
</tr>
<tr>
<td>e⁻:</td>
<td></td>
</tr>
<tr>
<td>p:</td>
<td></td>
</tr>
<tr>
<td>n:</td>
<td></td>
</tr>
</tbody>
</table>
Task 2 – Constructing formulae from common ions

Writing chemical formulae is an essential skill for both AS and A2 Chemistry and requires a knowledge of both the common positive and negative ions.

Unlike GCSE these are not given on any data sheet and therefore important to learn and the best way of learning them is using them. You can though use the periodic table and this can be helpful, particular with the metal ions; try to spot the connection between the metals and their position in the Periodic table.

Complete the table for the formula making sure the charges balance;-

<table>
<thead>
<tr>
<th></th>
<th>Na⁺</th>
<th>K⁺</th>
<th>Mg²⁺</th>
<th>Ca²⁺</th>
<th>Al³⁺</th>
<th>Cu²⁺(III)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cl⁻</td>
<td>NaCl</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O²⁻</td>
<td></td>
<td>K₂O</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OH⁻</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mg(OH)₂</td>
</tr>
<tr>
<td>CO₃²⁻</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CaCO₃</td>
</tr>
<tr>
<td>SO₄²⁻</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Al₂(SO₄)₃</td>
</tr>
</tbody>
</table>

Name the five compounds formed in the grey highlighted boxes above.
1.
2.
3.
4.
5.
Using the ion table and your own research give the formulae of the following ionic compounds:

1. Potassium nitrate

2. Lithium hydroxide

3. Barium fluoride

4. Ammonium nitrate

5. Sodium hydrogen carbonate

6. Iron (II) chloride

7. Iron (III) chloride

8. Zinc nitrate

9. Hydrochloric acid

10. Ammonium hydroxide

11. Sodium sulfate

12. Sodium sulphide

13. Sulphuric acid

14. Potassium phosphate

15. Potassium dichromate (VI)
### Task 3 - Dot cross diagrams

You have covered ionic and covalent bonding in your GCSE. Using your knowledge, draw the dot cross diagrams for the following compounds, showing only outer electrons.

You will need to decide what type of bonding is present within these compounds, before you start remembering **ionic compounds** contain ions and must contain **both a metal and a non-metal**; **covalent molecules** share electrons and contain **non-metals**.

<table>
<thead>
<tr>
<th>Chlorine gas</th>
<th>Sodium chloride</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnesium oxide</td>
<td>Water</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>Calcium chloride</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Methane (CH₄)</td>
<td>Nitrogen gas</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Task 4 - Rearranging Formulae

When solving chemistry problems you will often be required to rearrange an equation to solve for an unknown. You would have seen this in Physics when trying to solve speed.

\[
\text{Speed (m/s)} = \frac{\text{distance (m)}}{\text{time (s)}}
\]

We can write this to show distance and time as follows:

\[
\text{Distance (m)} = \text{speed (m/s)} \times \text{time (s)} \quad \text{Time (s)} = \frac{\text{distance (m)}}{\text{speed (m/s)}}
\]

Rearrange the following:

\[a) \quad \text{mass} = \quad \text{mol} = \quad \text{RMM} = \]

\[b) \quad \text{volume} = \quad \text{mol} = 24 \text{ dm}^3 \]

\[c) \quad n = c \cdot v \quad c = \quad v = \]

The units of \(n\) is mol and the unit for \(v\) is dm\(^3\). Write down the units for \(c\).

\[d) \quad \text{There are 1000cm}^3 \text{ in 1dm}^3. \text{ Convert the following:} \]

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>250 cm(^3) is dm(^3)</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>30 cm(^3) is dm(^3)</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>500 cm(^3) is dm(^3)</td>
<td>6</td>
</tr>
</tbody>
</table>
Task 5 - Balancing equations

Look at the following equations – some need balancing, others do not. Balance the equations that need it.

1) C + O₂ → CO
2) Na + O₂ → Na₂O
3) H₂ + O₂ → H₂O
4) Na + I₂ → NaI
5) CH₄ + O₂ → CO₂ + H₂O
6) SO₂ + O₂ → SO₃
7) Fe₂O₃ + C → Fe + CO
8) Fe₂O₃ + CO → Fe + CO₂
9) NH₃ + O₂ → NO + H₂O
10) Fe₃O₄ + H₂ → Fe + H₂O
11) C + CO₂ → CO
12) Fe + S → FeS
13) Ca + H₂O → Ca(OH)₂ + H₂
14) Al + Cl₂ → AlCl₃
15) Fe + HCl → FeCl₂ + H₂
Task 6 – Exam style questions (7 Sections; A-G)

A. **Structure and Bonding**

Q1. Figure 1 shows the structure of five substances.

![Figure 1](image)

(a) Which diagram shows a gas?

Tick (✔) one box.

A [ ] B [ ] C [ ] D [ ] E [ ]

(b) Which diagram shows the structure of diamond?

Tick (✔) one box.

A [ ] B [ ] C [ ] D [ ] E [ ]

(c) Which diagram shows a metallic structure?

Tick (✔) one box.

A [ ] B [ ] C [ ] D [ ] E [ ]

(d) Which diagram shows a polymer?

Tick (✔) one box.

A [ ] B [ ] C [ ] D [ ] E [ ]
(e) A chlorine atom has 7 electrons in the outer shell.

Two chlorine atoms covalently bond to form a chlorine molecule, Cl₂.

**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.

(f) What is the reason for chlorine’s low boiling point?

Tick (✔) one box.

Strong covalent bonds

Strong forces between molecules

Weak covalent bonds

Weak forces between molecules

(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

Electrons move around in the liquid

Ions move around in the liquid

Molecules move around in the liquid

(1)

(Total 8 marks)
Q2.
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.

![Dot and cross diagram](image)

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

___________________________________________________________________
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(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)
(d) Figure 1 shows a model of a Buckminsterfullerene molecule.

A lubricant is a substance that allows materials to move over each other easily. Suggest why Buckminsterfullerene is a good lubricant. Use Figure 1.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
(2)

Silver can form cubic nanocrystals. Figure 2 represents a silver nanocrystal.

(e) A silver nanocrystal is a cube of side 20 nm

Calculate the surface area to volume ratio of the nanocrystal.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Surface area to volume ratio = ____________________

(3)
Silver nanoparticles are sometimes used in socks to prevent foot odour.

Suggest why it is cheaper to use nanoparticles of silver rather than coarse particles of silver.

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(2)
(Total 16 marks)

Q3.

Figure 1 shows the outer electrons in an atom of the Group 1 element potassium and in an atom of the Group 6 element sulfur.

(a) Potassium forms an ionic compound with sulfur.

Describe what happens when two atoms of potassium react with one atom of sulfur.

Give your answer in terms of electron transfer.

Give the formulae of the ions formed.

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(5)
(b) The structure of potassium sulfide can be represented using the ball and stick model in Figure 2.

![Figure 2](image)

The ball and stick model is not a true representation of the structure of potassium sulfide.

Give one reason why.

___________________________________________________________________
___________________________________________________________________
(1)

(c) Sulfur can also form covalent bonds.

Complete the dot and cross diagram to show the covalent bonding in a molecule of hydrogen sulfide.

Show the outer shell electrons only.

![Diagram](image)
(d) Calculate the relative formula mass \((M_r)\) of aluminium sulfate \(\text{Al}_2(\text{SO}_4)_3\)

Relative atomic masses \((A_r)\): oxygen = 16; aluminium = 27; sulfur = 32

Relative formula mass = _______________________________

(e) Covalent compounds such as hydrogen sulfide have low melting points and do **not** conduct electricity when molten.

Draw **one** line from each property to the explanation of the property.

<table>
<thead>
<tr>
<th>Property</th>
<th>Explanation of property</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low melting point</td>
<td>Electrons are free to move</td>
</tr>
<tr>
<td></td>
<td>There are no charged particles free to move</td>
</tr>
<tr>
<td>Does not conduct electricity when molten</td>
<td>Ions are free to move</td>
</tr>
<tr>
<td></td>
<td>Weak intermolecular forces of attraction</td>
</tr>
<tr>
<td></td>
<td>Bonds are weak</td>
</tr>
<tr>
<td></td>
<td>Bonds are strong</td>
</tr>
</tbody>
</table>
(f) Ionic compounds such as potassium sulfide have high boiling points and conduct electricity when dissolved in water.

Draw one line from each property to the explanation of the property.

<table>
<thead>
<tr>
<th>Property</th>
<th>Explanation of property</th>
</tr>
</thead>
<tbody>
<tr>
<td>High boiling point</td>
<td>Electrons are free to move</td>
</tr>
<tr>
<td></td>
<td>There are no charged particles free to move</td>
</tr>
<tr>
<td>Conduct electricity when molten</td>
<td>Ions are free to move</td>
</tr>
<tr>
<td></td>
<td>Weak intermolecular forces of attraction</td>
</tr>
<tr>
<td></td>
<td>Bonds are weak</td>
</tr>
<tr>
<td></td>
<td>Bonds are strong</td>
</tr>
</tbody>
</table>

(Total 14 marks)
B. Calculations

Q1. Titanium is a transition metal.

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

\[
\text{Stage 1} \quad \text{TiO}_2 + 2 \text{C} + 2 \text{Cl}_2 \rightarrow \text{TiCl}_4 + 2 \text{CO}
\]

\[
\text{Stage 2} \quad \text{TiCl}_4 + 4 \text{Na} \rightarrow \text{Ti} + 4 \text{NaCl}
\]

(a) Suggest one hazard associated with Stage 1.

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(1)

(b) Water must be kept away from the reaction in Stage 2.

Give one reason why it would be hazardous if water came into contact with sodium.

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(1)

(c) Suggest why the reaction in Stage 2 is carried out in an atmosphere of argon and not in air.

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(2)

(d) Titanium chloride is a liquid at room temperature.

Explain why you would not expect titanium chloride to be a liquid at room temperature.

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(3)
In **Stage 2**, sodium displaces titanium from titanium chloride.

(e) Sodium atoms are oxidised to sodium ions in this reaction.

Why is this an oxidation reaction?

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

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

\[ \text{Na} \to \underline{\quad} + \underline{\quad} \]

(1)

(g) In **Stage 2**, 40 kg of titanium chloride was added to 20 kg of sodium.

The equation for the reaction is:

\[ \text{TiCl}_4 + 4 \text{ Na} \to \text{ Ti} + 4 \text{ NaCl} \]

Relative atomic masses (A):  \( \text{Na} = 23 \quad \text{Cl} = 35.5 \quad \text{Ti} = 48 \)

Explain why titanium chloride is the limiting reactant. You **must** show your working.

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(4)

(h) For a **Stage 2** reaction the percentage yield was 92.3%

The theoretical maximum mass of titanium produced in this batch was 13.5 kg.

Calculate the actual mass of titanium produced.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Mass of titanium = ______________________ kg

(2)

(Total 15 marks)
Q2.

Sodium hydroxide neutralises sulfuric acid.

The equation for the reaction is:

\[ 2\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O} \]

(a) Sulfuric acid is a strong acid.

What is meant by a strong acid?

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(b) Write the ionic equation for this neutralisation reaction. Include state symbols.

___________________________________________________________________

(2)

(c) A student used a pipette to add 25.0 cm\(^3\) of sodium hydroxide of unknown concentration to a conical flask.

The student carried out a titration to find out the volume of 0.100 mol / dm\(^3\) sulfuric acid needed to neutralise the sodium hydroxide.

Describe how the student would complete the titration.

You should name a suitable indicator and give the colour change that would be seen.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
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___________________________________________________________________
___________________________________________________________________

(4)
(d) The student carried out five titrations. Her results are shown in the table below.

<table>
<thead>
<tr>
<th></th>
<th>Titration 1</th>
<th>Titration 2</th>
<th>Titration 3</th>
<th>Titration 4</th>
<th>Titration 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume of 0.100 mol / dm$^3$ sulfuric acid in cm$^3$</td>
<td>27.40</td>
<td>28.15</td>
<td>27.05</td>
<td>27.15</td>
<td>27.15</td>
</tr>
</tbody>
</table>

Concordant results are within 0.10 cm$^3$ of each other.

Use the student’s concordant results to work out the mean volume of 0.100 mol / dm$^3$ sulfuric acid added.

Mean volume = _____________________________ cm$^3$

(2)

(e) The equation for the reaction is:

$$2\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$$

Calculate the concentration of the sodium hydroxide.

Give your answer to three significant figures.

Concentration = _______________________ mol / dm$^3$

(4)
(f) The student did another experiment using 20 cm$^3$ of sodium hydroxide solution with a concentration of 0.18 mol / dm$^3$.

Relative formula mass ($M$) of NaOH = 40

Calculate the mass of sodium hydroxide in 20 cm$^3$ of this solution.

Mass = ________________ g

(2)

(Total 16 marks)
C. **Electrolysis**

**Q1.** A student investigated the conductivity of different concentrations of sodium chloride solution. The student set the apparatus up as shown in Figure 1.

**Figure 1**

The student measured the conductivity of the pure water with a conductivity meter.

The reading on the conductivity meter was zero.

(a) The student:

- added sodium chloride solution one drop at a time
- stirred the solution
- recorded the reading on the conductivity meter.

The student’s results are shown in the table below.

<table>
<thead>
<tr>
<th>Number of drops of sodium chloride solution added</th>
<th>Relative conductivity of solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>120</td>
</tr>
<tr>
<td>3</td>
<td>310</td>
</tr>
<tr>
<td>4</td>
<td>400</td>
</tr>
<tr>
<td>5</td>
<td>510</td>
</tr>
<tr>
<td>6</td>
<td>590</td>
</tr>
<tr>
<td>7</td>
<td>710</td>
</tr>
<tr>
<td>8</td>
<td>800</td>
</tr>
</tbody>
</table>
(i) The student plotted the results on the grid shown in Figure 2.

Plot the four remaining results.

Draw a line of best fit, ignoring the anomalous result.

Figure 2

(ii) One of the points is anomalous.

Suggest one error that the student may have made to cause the anomalous result.
(iii) The student wanted to compare the conductivity of sodium chloride solution with the conductivity of potassium chloride solution.

State one variable he should keep constant when measuring the conductivity of the two solutions.

__________________________________________________________

(1)

(b) (i) Explain, in terms of bonding, why pure water does not conduct electricity.

__________________________________________________________

__________________________________________________________

__________________________________________________________

__________________________________________________________

(2)

(ii) Explain why sodium chloride solution conducts electricity.

__________________________________________________________

__________________________________________________________

__________________________________________________________

__________________________________________________________

(2)

(iii) After he had added sodium chloride solution, the student noticed bubbles of gas at the negative electrode.

Complete the sentence.

The gas produced at the negative electrode is _________________. (1)

(Total 10 marks)
Q2.

Many everyday substances can be classified as acids, bases or salts. For example, car batteries contain sulphuric acid, oven cleaners contain sodium hydroxide and table salt contains sodium chloride.

(a) A solution of each of these substances was tested with universal indicator.

<table>
<thead>
<tr>
<th>Solution</th>
<th>Colour of universal indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulphuric acid (H₂SO₄)</td>
<td>red</td>
</tr>
<tr>
<td>Sodium hydroxide (NaOH)</td>
<td>purple</td>
</tr>
<tr>
<td>Sodium chloride (NaCl)</td>
<td>green</td>
</tr>
</tbody>
</table>

(i) Explain how these universal indicator colours and the corresponding pH values could be used to identify each of these solutions.

(ii) Name and give the formula of the ion which causes the solution to be acidic.

Name of ion ________________________________
Formula of ion ______________________________

(b) Sodium chloride can be made by reacting sodium hydroxide with hydrochloric acid in the presence of an indicator.

(i) What is the name of this type of reaction?

(ii) Write a balanced chemical equation for this reaction.

_ (aq) + _ (aq) → _ (aq) + _ (l)

(c) The atomic number for sodium is 11 and for chlorine is 17.
(i) Complete the diagrams to show the electron arrangements for a sodium atom and a chlorine atom.

(ii) These atoms form different particles by one electron transferring from the sodium atom to the chlorine atom. What is the name given to the particles formed?

________ ____________________________

(iii) Why do these sodium and chloride particles bond?

________ ____________________________

________ ____________________________

(d) Sodium chloride solution is electrolysed to form three products, hydrogen, chlorine and sodium hydroxide.

Describe how each of these products are formed.

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

(Total 15 marks)
Q3.

The diagram shows one way of producing iron.

Iron oxide reacts with aluminium to produce iron.

The symbol equation for the reaction is:

\[ \text{Fe}_2\text{O}_3 + 2 \text{Al} \rightarrow 2 \text{Fe} + \text{Al}_2\text{O}_3 \]

(a) (i) Complete the word equation for this reaction.

iron oxide + aluminium \(\rightarrow\) iron + _______________________

(ii) The magnesium ribbon is lit to start the reaction.

Why does the burning magnesium ribbon start the reaction?

________________________________________________________________________

________________________________________________________________________

(b) In industry, iron is produced in the blast furnace when iron oxide is heated with carbon.

The iron from the blast furnace is called cast iron.

Cast iron contains carbon.

The diagrams show the structure of pure iron and cast iron.

Use the diagrams to help you answer the questions.

(i) Draw a ring around the correct answer to complete the sentence.

Pure iron is an element because pure iron contains only one sort of atom.

is magnetic.

is a metal.
(ii) Suggest why cast iron is harder than pure iron.

________________________________________________________________________

________________________________________________________________________

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________________________________________________________________________

(2)

(c) Aluminium is extracted by electrolysis using the ionic compound aluminium oxide.

(i) Aluminium cannot be extracted by heating aluminium oxide with carbon. Suggest why.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

(1)

(ii) Why is aluminium oxide dissolved in molten cryolite?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

(1)

(iii) Aluminium metal is produced at the negative electrode (cathode).

Complete the half equation for the process.

\[ \text{Al}^{3+} + \text{_____ e}^- \rightarrow \text{Al} \]  

(1)
(iv) Use the half equation to state why Al\(^{3+}\) ions are reduced.

__________________________________________________________________________

__________________________________________________________________________

(1)

(v) Explain why the positive electrodes (anodes) burn away.
Use your knowledge of the products of electrolysis to help you.

__________________________________________________________________________

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__________________________________________________________________________

__________________________________________________________________________

(4)

(Total 13 marks)
D. **Acids and Bases**

Q1. This question is about metal oxides.

When sodium is heated in oxygen, sodium oxide is produced.

(a) Balance the equation for the reaction.

\[
\text{Na} + \text{O}_2 \rightarrow 2 \text{Na}_2\text{O}
\]

(b) Why is this an oxidation reaction?

(c) Sodium oxide is added to water and shaken.

Universal indicator is added.

The pH of the solution is 14

What is the colour of the universal indicator?

Tick (✔) one box.

- Green
- Purple
- Red
- Yellow
(d) Aluminium oxide reacts with hydrochloric acid to produce a salt.

What is the name of the salt produced?

Tick (✔) one box.

Aluminium chloride

Aluminium nitrate

Aluminium sulfate

Aluminium sulfide

A student investigates the solubility of four metal oxides and four non-metal oxides in water.

The student tests the pH of the solutions formed.

The table shows the student's results.

<table>
<thead>
<tr>
<th>Type of oxide</th>
<th>Oxide</th>
<th>Solubility in water</th>
<th>pH of solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal oxides</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sodium oxide</td>
<td>Soluble</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>Calcium oxide</td>
<td>Soluble</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Magnesium oxide</td>
<td>Slightly soluble</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Zinc oxide</td>
<td>Insoluble</td>
<td></td>
<td>No solution formed</td>
</tr>
<tr>
<td>Non-metal oxides</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>Soluble</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Sulfur dioxide</td>
<td>Soluble</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Phosphorus oxide</td>
<td>Soluble</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Silicon dioxide</td>
<td>Insoluble</td>
<td></td>
<td>No solution formed</td>
</tr>
</tbody>
</table>

The student makes two conclusions.

**Conclusion 1:** ‘All metal oxides produce alkaline solutions.’

**Conclusion 2:** ‘All non-metal oxides produce acidic solutions.’
(e) Explain why the student’s conclusions are only partly correct.

Use information from the table above.

________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________

(4)

(f) Give an improved conclusion for metal oxides.

Use the table above.

________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________

(2)

(Total 9 marks)
Q2.

(a) A student had a colourless solution.

The student thought the solution was dilute hydrochloric acid.

(i) The student added universal indicator to this solution.

What colour would the universal indicator change to if the solution is hydrochloric acid?

_________________________  ________________  ________________________

(1)

(ii) Describe how the student could show that there are chloride ions in this solution.

____________________________

____________________________

____________________________

____________________________

____________________________

(2)

(b) The results of a titration can be used to find the concentration of an acid.
Describe how to use the apparatus to do a titration using 25 cm$^3$ of dilute hydrochloric acid.

In your answer you should include:

• how you will determine the end point of the titration
• how you will make sure the result obtained is accurate.

(4)

(c) Hydrochloric acid is a strong acid. Ethanoic acid is a weak acid.

What is meant by the term weak acid?

(1)

(d) The displayed formula of ethanoic acid is:

(i) On the formula, draw a circle around the functional group in ethanoic acid.

(1)
Ethanoic acid and ethanol react together to make the ester ethyl ethanoate. Draw the displayed formula of ethyl ethanoate.

Q3.

This question is about compounds.

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

<table>
<thead>
<tr>
<th>Soluble compounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>All potassium and sodium salts</td>
</tr>
<tr>
<td>All nitrates</td>
</tr>
<tr>
<td>Chlorides, bromides and iodides, except those of silver and lead</td>
</tr>
</tbody>
</table>

Use information from the table to answer these questions.

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

________________________________________

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

________________________________________

(b) Metal oxides react with acids to make salts.

What type of compound is a metal oxide?

________________________________________

(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.

________________________________________

________________________________________

(2)
(Total 11 marks)
(ii) Balance the equation for the reaction.

\[
PbO + HNO_3 \rightarrow Pb(NO_3)_2 + H_2O
\]

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

\[
\text{Total number of atoms: } \text{Pb} + 2\text{N} + 6\text{O} + 2\text{H} = 1+2+6+2 = 11 \text{ atoms}
\]

(d) An oxide of lead that does not have the formula PbO contains 6.21 g of lead and 0.72 g of oxygen.

Calculate the empirical formula of this lead oxide.

Relative atomic masses (\(A\)): O = 16; Pb = 207

You must show your working to gain full marks.

\[
\text{Mole of Pb: } \frac{6.21 \text{ g}}{207 \text{ g/mol}} = 0.03 \text{ mol}
\]

\[
\text{Mole of O: } \frac{0.72 \text{ g}}{16 \text{ g/mol}} = 0.045 \text{ mol}
\]

\[
\frac{0.03}{0.03} : \frac{0.045}{0.03} = 1 : 1.5 \approx 1 : 1.5
\]

\[
\text{Empirical formula: } \text{PbO}_1.5
\]

(Total 10 marks)
Q4. Ammonium sulfate is an artificial fertiliser.

(a) (i) When this fertiliser is warmed with sodium hydroxide solution, ammonia gas is given off. Describe and give the result of a test for ammonia gas.

Test ______________________________________________________

___________________________________________________________

Result ______________________________________________________

___________________________________________________________(2)

(ii) Describe and give the result of a chemical test to show that this fertiliser contains sulfate ions (SO$_4^{2-}$).

Test ______________________________________________________

___________________________________________________________

Result ______________________________________________________

___________________________________________________________(2)

(b) Ammonium sulfate is made by reacting sulfuric acid (a strong acid) with ammonia solution (a weak alkali).

(i) Explain the meaning of strong in terms of ionisation.

___________________________________________________________(1)

(ii) A student made some ammonium sulfate in a school laboratory.

The student carried out a titration, using a suitable indicator, to find the volumes of sulfuric acid and ammonia solution that should be reacted together.

Name a suitable indicator for strong acid-weak alkali titrations.

___________________________________________________________(1)
(iii) The student found that 25.0 cm$^3$ of ammonia solution reacted completely with 32.0 cm$^3$ of sulfuric acid of concentration 0.050 moles per cubic decimetre.

The equation that represents this reaction is:

$$2\text{H}_2\text{SO}_4(\text{aq}) + 2\text{NH}_3(\text{aq}) \rightarrow (\text{NH}_4)_2\text{SO}_4(\text{aq})$$

Calculate the concentration of this ammonia solution in moles per cubic decimetre.

\[
\text{Concentration} = \quad \text{moles per cubic decimetre}
\]

(3)

(iv) Use your answer to (b)(iii) to calculate the concentration of ammonia in grams per cubic decimetre.

(If you did not answer part (b)(iii), assume that the concentration of the ammonia solution is 0.15 moles per cubic decimetre. This is not the correct answer to part (b)(iii).)

Relative formula mass of ammonia (NH$_3$) = 17.

\[
\text{Concentration} = \quad \text{grams per cubic decimetre}
\]

(2)

(Total 11 marks)
E. **Equilibrium**

Q1.

The Haber process is used to make ammonia NH$_3$. The table shows the percentage yield of ammonia at different temperatures and pressures.

<table>
<thead>
<tr>
<th>PRESSURE (ATMOSPHERES)</th>
<th>PERCENTAGE (%) YIELD OF AMMONIA AT 350°C</th>
<th>PERCENTAGE (%) YIELD OF AMMONIA AT 500°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>100</td>
<td>37</td>
<td>9</td>
</tr>
<tr>
<td>200</td>
<td>52</td>
<td>15</td>
</tr>
<tr>
<td>300</td>
<td>63</td>
<td>20</td>
</tr>
<tr>
<td>400</td>
<td>70</td>
<td>23</td>
</tr>
<tr>
<td>500</td>
<td>74</td>
<td>25</td>
</tr>
</tbody>
</table>

(a) (i) Use the data in the table to draw two graphs on the grid below. Draw one graph for a temperature of 350°C and the second graph for a temperature of 500°C. Label each graph with its temperature.

![Graph](image-url)
(ii) Use your graphs to find the conditions needed to give a yield of 30% ammonia.

________________ °C and _______________ atmospheres

(1)

(iii) On the grid sketch the graph you would expect for a temperature of 450°C.

(1)

(b) (i) This equation represents the reaction in which ammonia is formed.

\[ \text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g}) + \text{heat} \]

What does the symbol \( \rightleftharpoons \) in this equation tell you about the reaction?

_________________________________________________________________________________

(1)

(ii) Use your graphs and your knowledge of the Haber process to explain why a temperature of 450°C and a pressure of 200 atmospheres are used in industry.

_________________________________________________________________________________

_________________________________________________________________________________

_________________________________________________________________________________

_________________________________________________________________________________

_________________________________________________________________________________

_________________________________________________________________________________

(5)

(c) (i) Ammonium nitrate is one type of artificial fertiliser. Calculate the relative formula mass of ammonium nitrate \( \text{NH}_4\text{NO}_3 \).

(Relative atomic masses: H = 1, N = 14, O = 16.)

_________________________________________________________________________________

_________________________________________________________________________________

_________________________________________________________________________________

(1)

(ii) Use your answer to part (c)(i) to help you calculate the percentage by mass of nitrogen present in ammonium nitrate \( \text{NH}_4\text{NO}_3 \).

_________________________________________________________________________________

(2)

(Total 15 marks)
Q2. The equation for a reaction to produce hydrogen is:

\[ \text{CO(g)} + \text{H}_2\text{O(g)} \rightleftharpoons \text{CO}_2\text{(g)} + \text{H}_2\text{(g)} \]

(a) Explain why changing the pressure does not affect the yield of hydrogen at equilibrium.

(b) Suggest why the best yield of hydrogen at equilibrium is obtained at low temperatures.

(c) The temperature used in industry needs to be high enough for the reaction to take place quickly. Explain, in terms of particles, why the rate of reaction increases when the temperature is increased.

(d) Scientists have developed catalysts which allow the reaction to take place quickly at lower temperatures. How could this be good for the manufacturer and for the environment?
Q3.

Ammonia is manufactured by the Haber Process, where nitrogen and hydrogen react together as follows:

\[
N_2 + 3H_2 \rightleftharpoons 2NH_3
\]

The reaction is reversible. A balance is eventually reached when ammonia is being formed at the same rate at which it is decomposing.

This point is called ‘equilibrium’.

<table>
<thead>
<tr>
<th>PRESSURE (ATM)</th>
<th>100°C</th>
<th>300°C</th>
<th>500°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>91.7</td>
<td>27.4</td>
<td>2.9</td>
</tr>
<tr>
<td>100</td>
<td>96.7</td>
<td>52.5</td>
<td>10.6</td>
</tr>
<tr>
<td>400</td>
<td>99.4</td>
<td>79.7</td>
<td>31.9</td>
</tr>
</tbody>
</table>

(a) (i) What is meant by a ‘reversible reaction’?

________________________________________________________________________(1)

(ii) Which substances are present in the mixture at equilibrium?

________________________________________________________________________(1)

(b) (i) Under what conditions shown in the table is the maximum yield of ammonia obtained?

________________________________________________________________________(2)

(ii) The Haber Process is usually carried out at a higher temperature than that which would produce the maximum yield. Suggest why.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________(2)

(c) Ammonia can be converted into nitric acid in three stages:

Stage 1 Ammonia reacts with oxygen from the air to form nitrogen monoxide and water

\[
4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O
\]

Stage 2 On cooling, nitrogen monoxide reacts with oxygen from the air to form nitrogen dioxide.

Stage 3 Nitrogen dioxide reacts with water to form nitric acid and nitrogen monoxide.
(i) Describe the conditions under which the reaction in Stage 1 takes place.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

(ii) Balance the equation for the reaction at Stage 2.

\[ \text{NO} + \text{O}_2 \rightarrow \text{NO}_2 \]  

(1)

(iii) Balance the equation for the reaction at Stage 3.

\[ \text{NO}_2 + \text{H}_2\text{O} \rightarrow \text{HNO}_3 + \text{NO} \]  

(1)

(d) The chemical plant for manufacturing ammonia is often on the same site as plants manufacturing nitric acid and fertilisers.

(i) What advantages will this have for the manufacturing company?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

(ii) Briefly describe two important ways in which it is possible to reduce the environmental impact of such plants on the surrounding area.

1. 

________________________________________________________________________
________________________________________________________________________

2. 

________________________________________________________________________
________________________________________________________________________

(2)

(Total 15 marks)
Q4.
The reaction of methane with steam is used in industry to make hydrogen.

(a) One of the reactions in this process is represented by this equation.

\[
\text{CH}_4 (g) + \text{H}_2\text{O} \rightleftharpoons \text{CO} (g) + 3\text{H}_2 (g)
\]
The forward reaction is endothermic.

State the conditions of temperature and pressure that would give the maximum yield of hydrogen.

Explain your answers.

(i) Temperature

(ii) Pressure

(iii) Which one of the following metals is most likely to be a catalyst for this process? Draw a ring around your answer.

aluminium lead magnesium nickel sodium

Give a reason for your choice.
(b) A second stage in this process is represented by this equation.

\[
\text{C} \equiv \text{O} + \text{O} = \text{C} = \text{O} + \text{H} \equiv \text{H}
\]

(i) Use the bond energies given in the table to help you to calculate the nett energy transfer (energy change) for this reaction.

<table>
<thead>
<tr>
<th>Bond</th>
<th>Bond energy in kJ/mol</th>
</tr>
</thead>
<tbody>
<tr>
<td>C \equiv O</td>
<td>1077</td>
</tr>
<tr>
<td>C = O</td>
<td>805</td>
</tr>
<tr>
<td>H \equiv H</td>
<td>436</td>
</tr>
<tr>
<td>O \equiv H</td>
<td>464</td>
</tr>
</tbody>
</table>

Nett energy transfer = ________________ kJ/mol

(ii) State whether this reaction is exothermic or endothermic.

__________________________

Explain, by reference to your calculation, how you know.

__________________________

__________________________

__________________________

__________________________

__________________________

__________________________

(2)

(Total 10 marks)
**F. Organic Chemistry**

**Q1.** Crude oil is a complex mixture of hydrocarbons, mainly alkanes. The number of carbon atoms in the molecules ranges from 1 to over 100.

(a) How does the boiling point change as the number of carbon atoms in the molecules increases?

(b) Name the method used to separate petroleum into fractions.

(c) The simplest hydrocarbon is methane, CH₄. Its structure can be represented:

\[
\text{\begin{tikzpicture}
\node [draw,shape=circle,fill=white,inner sep=1pt] at (0,0) (gas) {H};
\node [draw,shape=circle,fill=white,inner sep=1pt] at (1,0) (methane) {C};
\node [draw,shape=circle,fill=white,inner sep=1pt] at (2,0) (hydrogen) {H};
\node [draw,shape=circle,fill=white,inner sep=1pt] at (1,-1) (hydrogen2) {H};
\draw (gas) -- (methane);
\draw (methane) -- (hydrogen);
\end{tikzpicture}}
\]

Draw the structure of ethane, C₂H₆.

(Total 3 marks)

**Q2.** Crude oil is separated into fractions by fractional distillation.

The table gives information about some of the fractions.

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Boiling point range in °C</th>
<th>Number of carbon atoms per molecule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas</td>
<td>Below 20</td>
<td>1 – 4</td>
</tr>
<tr>
<td>Petrol</td>
<td>20 – 100</td>
<td>5 – 10</td>
</tr>
<tr>
<td>Paraffin</td>
<td>100 – 250</td>
<td>11 – 15</td>
</tr>
<tr>
<td>Diesel</td>
<td>250 – 350</td>
<td>16 – 20</td>
</tr>
<tr>
<td>Lubricant</td>
<td>350 – 500</td>
<td>21 – 35</td>
</tr>
<tr>
<td>Bitumen</td>
<td>Above 500</td>
<td>Above 35</td>
</tr>
</tbody>
</table>

(a) What is the relationship between the boiling point of a fraction and the number of carbon atoms in its molecules?
(b) Give one further difference, other than boiling point, between diesel and paraffin that also depends on the number of carbon atoms in their molecules.

____________________________________________________________________________________________________________________ (1)

(c) All the fractions contain hydrocarbons.

Name the two elements in a hydrocarbon.

________________ and ________________

(Total 3 marks)

Q3.

Modern window frames are often made from uPVC which contains the plastic poly(chloroethene).

(a) State why plastic window frames need no painting or maintenance.

____________________________________________________________________________________________________________________ (1)

(b) Poly(chloroethene) is a polymer formed by the addition polymerisation of chloroethene.

(i) Chloroethene is an unsaturated molecule. Why is this molecule said to be unsaturated?

____________________________________________________________________________________________________________________ (1)
Q4.
This question is about polymers.

(a) Name the monomer used to form poly(chloroethene).

(b) Figure 1 shows the equation for the formation of poly(chloroethene).

Complete Figure 1.
(c) Poly(chloroethene) is the only product. What type of polymer is poly(chloroethene)?

(1)

Ethanediol reacts with butanedioic acid to produce a polyester and a small molecule.

(d) **Figure 2** shows the structural formula of ethanediol.

![Figure 2](image)

\[ \text{HO–CH}_2\text{–CH}_2\text{–OH} \]

Name the functional group present in ethanediol.

(1)

(e) **Figure 3** shows the structural formula of butanedioic acid.

![Figure 3](image)

\[ \text{HOOC–CH}_2\text{–CH}_2\text{–COOH} \]

Which formula represents the carboxylic acid functional group?

Tick (✔) one box.

- \(-\text{CH}_2\–\)
- \(-\text{CH}_2\text{–CH}_2\–\)
- \(-\text{CH}_2\text{–COOH}\)
- \(-\text{COOH}\)

(1)

(f) **Figure 4** shows part of the structure of the polyester.

Complete the box in **Figure 4**.

![Figure 4](image)

\[ \text{O} \quad \text{O} \]

(2)
(g) Name the small molecule produced when ethanediol reacts with butanedioic acid.

__________________________________________________________

(1)

Starch, proteins and DNA are naturally occurring polymers.

(h) Name the monomers from which starch and proteins are produced.

Starch __________________________
Proteins __________________________

(2)

(i) Describe the structure of DNA.

__________________________________________________________

__________________________________________________________

__________________________________________________________

__________________________________________________________

__________________________________________________________

(2)

(Total 14 marks)

G. Analysis

Q1. This question is about chemicals in fireworks.

Coloured flames are produced because of the metal ions in the fireworks.

(a) What colour flame would sodium ions produce?

__________________________________________________________

(1)

(b) Name a metal ion that would produce a green flame.

__________________________________________________________

(1)

(c) Some fireworks contain a mixture of metal ions.

Why is it difficult to identify the metal ions from the colour of the flame?

__________________________________________________________

__________________________________________________________

__________________________________________________________

(1)
(d) Flame emission spectroscopy is used to identify metal ions in a firework.

The diagram below shows:

- the flame emission spectra of five individual metal ions
- a flame emission spectrum for a mixture of two metal ions.

Which **two** metal ions are in the mixture?

Tick **two** boxes.

- Ca$^{2+}$
- Cu$^{2+}$
- K$^+$
- Li$^+$
- Na$^+$

(2)

The compounds in fireworks also contain non-metal ions.

A scientist tests a solution of the chemicals used in a firework.

(e) Silver nitrate solution and dilute nitric acid are added to the solution.

A cream precipitate forms

Which ion is shown to be present by the cream precipitate?
(f) Describe a test to show the presence of sulfate ions in the solution.

Give the result of the test if there are sulfate ions in the solution.

Test

_______________________________________________________________

________________________________________________________________

________________________________________________________________

________________________________________________________________

Result

_______________________________________________________________

________________________________________________________________

(3) (Total 9 marks)
Q2. A student investigated an egg shell.

![Egg shells](https://via.placeholder.com/150)

Trish Steel [CC-BY-SA-2.0]. via Wikimedia Commons

(a) The student did some tests on the egg shell.

The student’s results are shown in the table below.

<table>
<thead>
<tr>
<th>Test</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dilute hydrochloric acid was added to the egg shell. A gas was produced. The egg shell dissolved, forming a colourless solution.</td>
</tr>
<tr>
<td>2</td>
<td>A flame test was done on the colourless solution from test 1. The flame turned red.</td>
</tr>
<tr>
<td>3</td>
<td>Sodium hydroxide solution was added to the colourless solution from test 1. A white precipitate formed that did not dissolve in excess sodium hydroxide solution.</td>
</tr>
<tr>
<td>4</td>
<td>Silver nitrate solution was added to the colourless solution from test 1. A white precipitate formed.</td>
</tr>
</tbody>
</table>

(i) The student concluded that the egg shell contains carbonate ions.

Describe how the student could identify the gas produced in test 1.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

(2)
(ii) The student concluded that the egg shell contains aluminium ions.

Is the student’s conclusion correct? Use the student’s results to justify your answer.

______________________________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________

(2)

(iii) The student concluded that the egg shell contains chloride ions.

Is the student’s conclusion correct? Use the student’s results to justify your answer.

______________________________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________

(2)

(b) Some scientists wanted to investigate the amount of lead found in egg shells. They used a modern instrumental method which was more sensitive than older methods.

(i) Name one modern instrumental method used to identify elements.

______________________________________________________________

______________________________________________________________

______________________________________________________________

(1)

(ii) What is the meaning of more sensitive?

______________________________________________________________

______________________________________________________________

(1)

(Total 8 marks)
Q3.

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

![Bottles of chemicals](image)

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.

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

Test and result for carbonate ions:

__________________________________________________________

__________________________________________________________

__________________________________________________________
Test and result for chloride ions:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Test and result for nitrate ions:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Test and result for sulfate ions:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

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

________________________________________________________________________

(1)

(b) Instrumental methods of analysis linked to computers can be used to identify chemicals.

Give two advantages of using instrumental methods of analysis.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

(2) (Total 7 marks)
Q4.
A student investigated the colours in three different flowers, A, B and C.

The colours are soluble in ethanol but are insoluble in water.

This is the method used.
1. Crush flower A.
2. Add ethanol to flower A.
3. Filter the mixture.
4. Put spots of the coloured filtrate on to the chromatography paper.
5. Repeat steps 1-4 with flowers B and C.

Figure 1 shows the apparatus used.

(a) The student made two mistakes in setting up the apparatus.

Give one problem caused by each mistake.

Mistake 1______________________________________________________
Problem caused________________________________________________

Mistake 2
____________________________________________________________
Problem caused________________________________________________
(b) Another student set up the apparatus correctly.  
Figure 2 represents the student’s results.

![Figure 2]

Give two conclusions you can make from Figure 2.

1. ______________________________________________________
   ______________________________________________________

2. ______________________________________________________
   ______________________________________________________

(c) Colour A has an Rf value of 0.65

Colour A moves 3.2 cm

Calculate the distance moved by the solvent.

..................................................................................

..................................................................................

Distance moved by the solvent = ________________ cm

(Total 8 marks)
**Task 7 – Research**

Choose one (or more) of the following medicines/drugs and find out:

1. Common brand names
2. Class of drug
3. Brief history of discovery
4. State the chemical functional group found in the compound
5. Uses
6. List any side effects

<table>
<thead>
<tr>
<th>Chloroquine</th>
<th>Thalidomide</th>
<th>Warfarin</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Chloroquine Molecule" /></td>
<td><img src="image2.png" alt="Thalidomide Molecule" /></td>
<td><img src="image3.png" alt="Warfarin Molecule" /></td>
</tr>
</tbody>
</table>
**Book Recommendations**

We recommend the first three texts as interesting texts for Chemistry / Science students, the final text will be of use to those who are not studying A-level maths as it covers the various different types of calculations encountered throughout the A-level course. This book contains many worked through examples. We are hoping to obtain a class set for September 2017.

**Periodic Tales: The Curious Lives of the Elements** (Paperback) Hugh Aldersey-Williams

ISBN-10: 0141041455


This book covers the chemical elements, where they come from and how they are used. There are loads of fascinating insights into uses for chemicals you would have never even thought about.

**The Science of Everyday Life: Why Teapots Dribble, Toast Burns and Light Bulbs Shine** (Hardback) Marty Jopson

ISBN-10: 1782434186


The title says it all really, lots of interesting stuff about the things around you home!

**Bad Science** (Paperback) Ben Goldacre

ISBN-10: 000728487X


Here Ben Goldacre takes apart anyone who published bad / misleading or dodgy science – this book will make you think about everything the advertising industry tries to sell you by making it sound ‘sciency’.

**Calculations in AS/A Level Chemistry** (Paperback) Jim Clark

ISBN-10: 0582411270


If you struggle with the calculations side of chemistry, this is the book for you. Covers all the possible calculations you are ever likely to come across. Brought to you by the same guy who wrote the excellent chemguide.co.uk website.

Note these links are to Waterstones, should you wish to acquire any of these books you may find them cheaper elsewhere.