Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Date of birth

Day
Month
Year

Scottish candidate number

Number of seat

1. All questions should be attempted.
2. Necessary data will be found in the Data Booklet provided for Chemistry at Standard Grade and Intermediate 2.
3. The questions may be answered in any order but all answers are to be written in this answer book, and must be written clearly and legibly in ink.
4. Rough work, if any should be necessary, as well as the fair copy, is to be written in this book.
   Rough work should be scored through when the fair copy has been written.
5. Additional space for answers and rough work will be found at the end of the book.
6. The size of the space provided for an answer should not be taken as an indication of how much to write. It is not necessary to use all the space.
7. Before leaving the examination room you must give this book to the invigilator. If you do not, you may lose all the marks for this paper.
PART 1

In Questions 1 to 9 of this part of the paper, an answer is given by circling the appropriate letter (or letters) in the answer grid provided.

In some questions, two letters are required for full marks.

If more than the correct number of answers is given, marks will be deducted.

A total of 20 marks is available in this part of the paper.

SAMPLE QUESTION

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CH₄</td>
<td>H₂</td>
<td>CO₂</td>
</tr>
<tr>
<td>D</td>
<td>CO</td>
<td>E</td>
<td>F</td>
</tr>
<tr>
<td>C₂H₅OH</td>
<td></td>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>

(a) Identify the hydrocarbon.

The one correct answer to part (a) is A. This should be circled.

(b) Identify the two elements.

As indicated in this question, there are two correct answers to part (b). These are B and F. Both answers are circled.

If, after you have recorded your answer, you decide that you have made an error and wish to make a change, you should cancel the original answer and circle the answer you now consider to be correct. Thus, in part (a), if you want to change an answer A to an answer D, your answer sheet would look like this:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>E</td>
<td>F</td>
<td></td>
</tr>
</tbody>
</table>

If you want to change back to an answer which has already been scored out, you should enter a tick (✓) in the box of the answer of your choice, thus:

<table>
<thead>
<tr>
<th>✓</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>E</td>
<td>F</td>
<td></td>
</tr>
</tbody>
</table>
1. The Periodic Table shows the names of the elements.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>nitrogen</td>
<td>lithium</td>
<td>aluminium</td>
</tr>
<tr>
<td>D</td>
<td>sodium</td>
<td>oxygen</td>
<td>platinum</td>
</tr>
</tbody>
</table>

(a) Identify the two elements which have similar chemical properties. You may wish to use page 8 of the data booklet to help you.

(b) Identify the element discovered in 1807. You may wish to use page 8 of the data booklet to help you.

(c) Identify the element which is used as the catalyst in the Ostwald Process.

(d) Identify the two elements which form a covalent compound.
2. The grid shows the names of some elements.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>hydrogen</td>
<td>helium</td>
<td>oxygen</td>
<td>silicon</td>
<td>carbon</td>
</tr>
</tbody>
</table>

(a) Identify the two elements which exist as **diatomic** molecules.

(b) Identify the element which has the electron arrangement 2,4.
You may wish to use page 1 of the data booklet to help you.

(c) Identify the element which must be present for iron to rust.
3. Electricity can be produced using electrochemical cells.

![Diagram of electrochemical cell]

<table>
<thead>
<tr>
<th>metal X</th>
<th>metal Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>copper</td>
</tr>
<tr>
<td>B</td>
<td>copper</td>
</tr>
<tr>
<td>C</td>
<td>copper</td>
</tr>
<tr>
<td>D</td>
<td>copper</td>
</tr>
</tbody>
</table>

(a) Identify the arrangement which would **not** produce electricity.

(b) Identify the arrangement which would produce the **largest** voltage.

You may wish to use page 7 of the data booklet to help you.
4. The names of some hydrocarbons are shown in the grid.

(a) Identify the two alkanes.

(b) Identify the hydrocarbon with a boiling point of 36 ºC. You may wish to use page 6 of the data booklet to help you.

(c) Identify the hydrocarbon with molecular formula C₄H₈.
5. Coating iron prevents rusting.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>D</td>
<td>E</td>
<td>F</td>
</tr>
</tbody>
</table>

(a) Identify the coating which is used to galvanise iron.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>D</td>
<td>E</td>
<td>F</td>
</tr>
</tbody>
</table>

1 mark

(b) Identify the coating, which, if scratched, would cause the iron to rust fastest.

You may wish to use page 7 of the data booklet to help you.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>D</td>
<td>E</td>
<td>F</td>
</tr>
</tbody>
</table>

1 mark

(2)
6. A student carried out an experiment to investigate the viscosity of different oils.

He timed how long it took for a marble to fall through 100 cm$^3$ of each oil fraction.

His results are shown in the table.

<table>
<thead>
<tr>
<th>Oil</th>
<th>Time/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>4</td>
<td>23</td>
</tr>
</tbody>
</table>

Identify the correct statement.

A Oil 1 is most viscous.
B Oil 4 is least viscous.
C Oil 2 is more viscous than oil 3.
D Oil 4 is more viscous than oil 1.
7. The grid shows the names of some chlorides.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>calcium chloride</td>
<td>barium chloride</td>
<td>magnesium chloride</td>
</tr>
<tr>
<td>D</td>
<td>sodium chloride</td>
<td>silver chloride</td>
<td>potassium chloride</td>
</tr>
</tbody>
</table>

(a) Identify the chloride which could be produced by a precipitation reaction.

You may wish to use page 5 of the data booklet to help you.

(b) Identify the chloride which could be used as a fertiliser.

[Turn over]
8. Different terms can be used to indicate the number of atoms in a molecule.

<table>
<thead>
<tr>
<th>Term</th>
<th>Number of atoms in a molecule</th>
</tr>
</thead>
<tbody>
<tr>
<td>A tri-atomic</td>
<td>3</td>
</tr>
<tr>
<td>B tetra-atomic</td>
<td>4</td>
</tr>
<tr>
<td>C penta-atomic</td>
<td>5</td>
</tr>
<tr>
<td>D hexa-atomic</td>
<td>6</td>
</tr>
</tbody>
</table>

Identify the term used to describe the following molecule.

![Molecule Diagram]

A B
H H

A B C D

(1)
9. A technician set up an experiment to investigate electrical conductivity.

Identify the two experiments in which the bulb would **not** light.

Identify the **two** experiments in which the bulb would **not** light.

A technician set up an experiment to investigate electrical conductivity.

Identify the two experiments in which the bulb would not light.
PART 2

A total of 40 marks is available in this part of the paper.

10. The diagram shows a tower in which crude oil is separated.

(a) Name the process used to separate crude oil.

(b) Naphtha can be cracked to produce molecules that are more useful. How does the size of these more useful molecules compare to the size of the molecules in naphtha?

(c) In industry the catalyst used to crack naphtha is zeolite. Zeolite is a substance that contains aluminium silicate. Name the elements present in aluminium silicate.
11. A teacher demonstrated the following experiment.

(a) State the test for hydrogen gas.

(b) The universal indicator turned purple.

(c) Why are metals, like lithium, stored under oil?

A solution which turns universal indicator purple is \{ acidic, neutral, alkaline \}.

[Turn over]
12. Manufacture of Titanium

Carbon and titanium oxide are passed through a reactor to produce carbon monoxide and impure titanium chloride. The impurities are removed by distillation. Pure titanium chloride reacts with sodium to produce titanium and sodium chloride.

(a) Use the information to complete the flow diagram.
12. (continued)

(b) Titanium can be mixed with other metals to make a substance that is strong and lightweight.

What term is used to describe a mixture of metals?

______________________________

(c) Medical instruments can be made from a mixture of metals containing 76% titanium, 4% zirconium and the rest is other metals.

Label the pie chart to show the name and percentage for each part of the mixture.

(An additional pie chart, if required, can be found on page 28.)
13. A teacher demonstrated the following experiment.

Her results are shown in the table below.

<table>
<thead>
<tr>
<th>Metal</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>zinc</td>
<td>glowed brightly</td>
</tr>
<tr>
<td>copper</td>
<td>dull red glow</td>
</tr>
<tr>
<td>silver</td>
<td>no reaction</td>
</tr>
</tbody>
</table>

(a) (i) Predict what would be seen if the experiment was repeated using magnesium.

You may wish to use page 7 of the data booklet to help you.

(ii) The experiment was repeated using **powdered** zinc.

How would this affect the speed of the reaction?

(b) Silver is found uncombined in the Earth’s crust.

Name another metal which is found uncombined in the Earth’s crust.

You may wish to use page 7 of the data booklet to help you.
14. Flowers produce a sweet-tasting liquid called nectar. 
Nectar contains a mixture of sugars such as glucose and sucrose. 
(a) To which family of compounds do glucose and sucrose belong?

(b) Glucose can be broken down to produce alcohol. 
   (i) Name this type of chemical reaction.

(ii) What is the chemical name for the alcohol produced?
15. The table below shows the mass of some ions found in a 1 litre sample of water.

<table>
<thead>
<tr>
<th>Ion</th>
<th>Mass/mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>chloride</td>
<td>10</td>
</tr>
<tr>
<td>sulphate</td>
<td>50</td>
</tr>
<tr>
<td>calcium</td>
<td>70</td>
</tr>
<tr>
<td>magnesium</td>
<td>15</td>
</tr>
<tr>
<td>potassium</td>
<td>4</td>
</tr>
</tbody>
</table>

(a) Present the information as a bar chart.  

*Use appropriate scales to fill most of the graph paper.*

(Additional graph paper, if required, can be found on page 28.)
(b) The bicarbonate ion is also present in the sample of water. When heated the bicarbonate ion breaks down to form carbon dioxide gas.

(i) Write the formula for carbon dioxide gas.

__________________________

(ii) Describe what would be seen when carbon dioxide gas is bubbled through lime water.

______________________________

______________________________

1 1 (4)

[Turn over
16. A student investigated the amount of the biological catalyst, catalase, in different vegetables. Catalase breaks down hydrogen peroxide solution to produce water and oxygen.

The results are shown in the table.

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Number of bubbles of oxygen gas in 3 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>leek</td>
<td>40</td>
</tr>
<tr>
<td>potato</td>
<td>10</td>
</tr>
<tr>
<td>parsnip</td>
<td>65</td>
</tr>
<tr>
<td>horseradish</td>
<td>5</td>
</tr>
</tbody>
</table>

(a) Using the information in the table, name the vegetable which contains the largest amount of catalase.

________________________

(b) What term is used to describe a biological catalyst such as catalase?

________________________
16. (continued)

(c) The experiment was repeated to find out if increasing the concentration of hydrogen peroxide solution would speed up the reaction.

Complete the labelling of the diagram to show how she would make her second experiment a fair test.

\[\text{temperature } \underline{\text{°C}}\]
\[\underline{\text{cm}^3}\text{ of } 2 \text{ mol/l hydrogen peroxide solution}\]
\[\underline{\text{g of vegetable}}\]

1 

(Turn over)
17. The plastic poly(chloroethene) has many uses.

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

_______________________________________________

(b) Poly(chloroethene) is non-biodegradable.
State why this may be an **advantage**.

_______________________________________________

_______________________________________________

(c) Poly(chloroethene) can be used as a fibre in clothing.
A student used the apparatus shown to investigate the strength of different fibres.
17. (c) (continued)

His results are shown in the table.

<table>
<thead>
<tr>
<th>Fibre</th>
<th>Mass to break fibres/g</th>
</tr>
</thead>
<tbody>
<tr>
<td>cotton</td>
<td>600</td>
</tr>
<tr>
<td>polyester</td>
<td>1200</td>
</tr>
<tr>
<td>wool</td>
<td>200</td>
</tr>
<tr>
<td>poly(chloroethene)</td>
<td>1000</td>
</tr>
<tr>
<td>poly(propene)</td>
<td>1100</td>
</tr>
</tbody>
</table>

(i) How does the strength of the synthetic fibres compare to the strength of the natural fibres?

(ii) He tested another fibre and found that the mass needed to break it was 300 g.

Predict whether this fibre is natural or synthetic.

[Turn over]
18. Crude oil contains sulphur compounds, such as hydrogen sulphide.

(a) Hydrogen sulphide burns in oxygen to produce sulphur dioxide and water.

Write a **word** equation for this reaction.

(b) The sulphur dioxide produced is used to manufacture sulphuric acid. Part of the manufacture of sulphuric acid is shown.

(i) What is the purpose of a catalyst?

(ii) The table shows the percentage of sulphur trioxide produced at different temperatures.

<table>
<thead>
<tr>
<th>Temperature of catalyst/°C</th>
<th>Percentage of sulphur trioxide produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>442</td>
<td>99.5</td>
</tr>
<tr>
<td>475</td>
<td>95.0</td>
</tr>
<tr>
<td>518</td>
<td>88.0</td>
</tr>
<tr>
<td>600</td>
<td>63.0</td>
</tr>
</tbody>
</table>

What effect does increasing the temperature of the catalyst have on the percentage of sulphur trioxide produced?
19. Rechargeable batteries are used in cars.

(a) Name the electrolyte used in a car battery.

(b) A car battery has six cells joined together. The voltage of the car battery is **12 volts**. What is the voltage of one cell in the car battery?

(c) Some cars use the fuel “LPG” rather than petrol. What is meant by the term **fuel**?

(d) “LPG” is a mixture of hydrocarbons. Name the **two** compounds produced when “LPG” burns in a plentiful supply of air.

**[Turn over]**
20. The chart shows the pH range of soil in which different vegetables can grow successfully.

(a) The soil in a garden has a pH of 6.0.
Name the vegetable which would **not** grow successfully in this garden.

(b) Another garden has soil pH of 4.5.
Name a substance that could be added to the soil in order to grow all the vegetables successfully.

---

(a) broad beans
(b) 1

---

(b) 1

---

(2)
21. Acids have many uses.
   
   (a) Phosphoric acid is found in a fizzy drink.
   Suggest the pH of the fizzy drink.
   
   ________________

   (b) Nitric acid can be used to make fertilisers.
   Explain why there has been a major increase in the use of fertilisers over the last 100 years.
   
   ________________

   ________________

   ________________

   (c) Dilute hydrochloric acid reacts with zinc metal.
   The equation for the reaction is:
   
   hydrochloric acid + zinc $\rightarrow$ compound $\mathbf{X}$ + hydrogen
   
   Name compound $\mathbf{X}$.
   
   ________________

   ________________

   ________________
ADDITIONAL SPACE FOR ANSWERS

ADDITIONAL PIE CHART FOR QUESTION 12(c)

[Pie chart image]

ADDITIONAL GRAPH PAPER FOR QUESTION 15(a)

[Graph paper image]