ADDITIONAL MATERIALS
In addition to this paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
You are reminded of the necessity for good English and orderly presentation in your answers.
Assessment will take into account the quality of written communication (QWC) used in your answer to question 9.
The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.
Answer all questions.

1. The fire triangle is shown below.

(a) Describe what the fire triangle shows. [1]  

(b) Use your understanding of the fire triangle to state how each of the following fire-fighting methods work. [3]

- Placing a heatproof mat over a beaker that contains burning ethanol
- Using water to put out a bonfire
- Cutting down trees to provide a fire break in a forest

(c) A cook notices that a frying pan containing oil has caught fire. He decides to get a fire extinguisher to put the fire out. Choose from the following box the type of fire extinguisher that should **not** be used. [1]

| carbon dioxide | foam | powder | water |

_Type of fire extinguisher not to be used_
2. Ethanol can be used as a fuel. It can be made by the fermentation of sugars using yeast.

The following graph shows the rate of fermentation using different sugars at 25°C.

![Graph showing rate of fermentation for different sugars]

(a) Identify the best sugar for producing ethanol and give a reason for your choice. [1]

Best sugar .................................................................

Reason ..........................................................................................................................

(b) The following table contains some statements relating to the use of ethanol as a fuel.

<table>
<thead>
<tr>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is a renewable resource</td>
</tr>
<tr>
<td>Large areas of land required to grow the crops</td>
</tr>
<tr>
<td>Produces less soot than petrol when burnt</td>
</tr>
<tr>
<td>Engines require modifications to run on ethanol</td>
</tr>
<tr>
<td>Produces less heat per litre than petrol</td>
</tr>
<tr>
<td>Produces only carbon dioxide and water when burnt</td>
</tr>
</tbody>
</table>

(i) In your opinion, should ethanol be used as a fuel? Give reasons to support your answer. [3]

Opinion (Yes/No) .............................................

Reasons ..........................................................................................................................

(ii) Complete the word equation for the complete combustion of ethanol. [1]

ethanol + oxygen → .................................................. + .............................................
3. (a) Draw a line from each gas below to the observation made in identifying it. [3]

<table>
<thead>
<tr>
<th>Gas</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>carbon dioxide</td>
<td>relights a glowing splint</td>
</tr>
<tr>
<td>ammonia</td>
<td>turns flame red</td>
</tr>
<tr>
<td>oxygen</td>
<td>turns limewater milky</td>
</tr>
<tr>
<td></td>
<td>pops with a burning splint</td>
</tr>
<tr>
<td></td>
<td>turns damp red litmus blue</td>
</tr>
</tbody>
</table>

(b) The following box contains observations made when testing for some common metal ions.

<table>
<thead>
<tr>
<th>lilac flame</th>
<th>yellow flame</th>
<th>green flame</th>
</tr>
</thead>
<tbody>
<tr>
<td>blue precipitate</td>
<td>brown precipitate</td>
<td>green precipitate</td>
</tr>
<tr>
<td>white precipitate</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Choose from the box the result you would expect for the following tests. [3]

A flame test is carried out on a sample of sodium chloride

A flame test is carried out on a sample of copper(II) sulfate

Sodium hydroxide solution is added to a solution of iron(III) chloride

........................................................................................................................................
4. (a) The structural formulae of some organic compounds are shown below.

\[ \text{A} \quad \text{B} \quad \text{C} \]

\[ \text{D} \quad \text{E} \quad \text{F} \]

(i) Give the letters, A-F, of two alkanes and two alcohols. [2]

\text{Alkanes} \quad \text{Alcohols} \\
\text{E} \quad \text{F} \\
\text{D} \quad \text{C}

(ii) State which compound, A-F, has the molecular formula C\textsubscript{3}H\textsubscript{6}. [1]

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

(b) Give the molecular formula of decane. [1]

\[ \text{G} \]

........................................................................................................................................
5. (a) Sulfuric acid is produced by the contact process. The main stages in the process are shown below.

Stage 1: Burning sulfur in air to produce gas A
Stage 2: Passing gas A over a catalyst at 450 °C to produce gas B
Stage 3: Dissolving gas B in concentrated sulfuric acid to produce oleum
Stage 4: Diluting oleum to produce sulfuric acid

(i) Give the names of gases A and B. [2]
   Gas A .................................................................
   Gas B .................................................................

(ii) Which stage involves a reversible reaction? ..................... [1]

(iii) Give a reason why gas B is not dissolved directly in water during stage 3. [1]
   ........................................................................................................
   ........................................................................................................
(b) The following pie chart shows the uses of sulfuric acid.

- 5% fibres and paper
- 5% plastics
- 15% detergents
- 30% fertilisers (ammonium sulfate and ammonium phosphate)
- 30% other uses (e.g. explosives, pesticides, dyes, and batteries)
- 5% paints and pigments
- 30% fertilisers (ammonium sulfate and ammonium phosphate)

(i) Calculate the percentage of sulfuric acid used for making paint and pigments. [2]

\[
\text{Percentage used for making paint and pigments} = \frac{\text{Amount used for paints and pigments}}{\text{Total amount used}} \times 100\%
\]

(ii) One important use of sulfuric acid is in the production of fertilisers. Complete the following word equation for the production of ammonium sulfate. [1]

\[
\text{sulfuric acid + } \underline{\text{ammonium hydroxide}} \rightarrow \text{ammonium sulfate}
\]

(iii) This type of fertiliser can be washed into rivers. Explain why this is a cause for concern. [3]
6. The apparatus below can be used to measure the temperature as a neutralisation reaction takes place.

The graphs below show how the temperature changes when acids A and B are added separately to 25 cm$^3$ of sodium hydroxide solution.

Temperature (°C)

Volume of acid added (cm$^3$)
(a) Use the graphs opposite to find the

(i) volume of acid required to neutralise the sodium hydroxide solution in both experiments, [1]

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

(ii) maximum temperature rise for acid B. [1]

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

(b) State which acid, A or B, is stronger and give a reason for your answer. [1]

Stronger acid ..............................

Reason ................................................................................................................

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

(c) Describe how an indicator could be used to find the exact volume of acid needed for neutralisation. [3]

..................................................................................................................
7. Ammonia is produced during the Haber process. The reaction is summarised in the diagram below.

(a) Give the name of gas A. ................................................................. [1]

(b) Name catalyst B and state why it is used. [2]

(c) The yield of ammonia is only 28% therefore 72% of the gases remain unreacted.

   Describe what happens to these unreacted gases and state why this is important. [2]
(d) The following graph shows the effect of temperature and pressure on the yield of ammonia during the Haber process.

![Graph showing the effect of temperature and pressure on ammonia yield.]

Describe how the yield of ammonia varies with temperature and pressure. [2]

**Temperature**

Describe the effect of temperature on the yield of ammonia.

**Pressure**

Describe the effect of pressure on the yield of ammonia.

(e) Write a balanced symbol equation for the production of ammonia. [3]

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.................................................... + .................................................... ⇌ ....................................................
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8. A pupil investigated the effect of temperature on the rate of fermentation using the apparatus shown below.

The experiment was carried out three times at five different temperatures. The volume of gas collected after 10 minutes was recorded each time. The results are shown below.

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Volume of gas collected after 10 minutes (cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>20</td>
<td>9</td>
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<tr>
<td>30</td>
<td>38</td>
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<td>50</td>
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<tr>
<td>60</td>
<td>12</td>
</tr>
</tbody>
</table>

(a) Suggest why the circled value is considered to be anomalous.  

(b) Plot a graph of the mean volume of gas collected against temperature on the grid opposite.
(c) State what conclusions can be drawn from the graph.  

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(d) Write a word equation for the reaction taking place.  

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

(e) Yeast produces a catalyst that allows this reaction to take place. Name the type of catalyst produced by yeast.  

........................................................................................................................................
9. Limestone, CaCO$_3$, is an important raw material. It can be converted into other useful materials as shown in the diagram below.

Describe how these reactions can be carried out in a laboratory. Your answer should include:

- the conditions required for each reaction;
- observations at each stage;
- equations for the reactions taking place.

[6 QWC]
### FORMULAE FOR SOME COMMON IONS

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<th>POSITIVE IONS</th>
<th>NEGATIVE IONS</th>
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</thead>
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<tr>
<td><strong>Name</strong></td>
<td><strong>Formula</strong></td>
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<tr>
<td>Aluminium</td>
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</tr>
<tr>
<td>Ammonium</td>
<td>NH₄⁺</td>
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<td>Barium</td>
<td>Ba²⁺</td>
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<td>H⁺</td>
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## Periodic Table of Elements

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<th>Element Symbol</th>
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**Key:**
- Mass number (A)
- Atomic number (Z)
- Element Symbol
- Name (X)