C7
ORGANIC CHEMISTRY
TEST 2

GCSE
CHEMISTRY
AQA - COMBINED SCIENCE

Materials
For this paper you must have:
• Ruler
• Pencil, Rubber, Protractor and Compass
• Scientific calculator, which you are expected to use when appropriate

Instructions
• Answer all questions
• Answer questions in the space provided
• All working must be shown
• Do all rough work in this book. Cross out any rough work you don’t want to be marked

Information
• The marks for the questions are shown in brackets
A student investigated the viscosity of liquid hydrocarbons.

A viscous liquid is a liquid that flows slowly.

The student used this method.

- Measure 50 cm$^3$ of the liquid hydrocarbon.
- Pour the liquid hydrocarbon into the funnel, as shown in Figure 1.

![Figure 1](image.png)

- Time how long it takes for all of the liquid hydrocarbon to run out of the funnel.
- Repeat the experiment for other liquid hydrocarbons.

(a) (i) Give the name of apparatus A in Figure 1.

__________________________________________________________________________________________________________

(1)

(ii) Name the apparatus that could be used to measure 50 cm$^3$ of liquid hydrocarbon.

__________________________________________________________________________________________________________

(1)
(b) The student’s results for six liquid hydrocarbons are shown in Table 1.

<table>
<thead>
<tr>
<th>Formula of liquid hydrocarbon</th>
<th>Time for liquid hydrocarbon to run out of the funnel in seconds</th>
<th>Mean time in seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Experiment 1</td>
<td>Experiment 2</td>
</tr>
<tr>
<td>C₅H₁₂</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>C₆H₁₄</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>C₇H₁₆</td>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>C₈H₁₈</td>
<td>27</td>
<td>26</td>
</tr>
<tr>
<td>C₁₀H₂₂</td>
<td>46</td>
<td>48</td>
</tr>
<tr>
<td>C₁₂H₂₆</td>
<td>65</td>
<td>67</td>
</tr>
</tbody>
</table>

(i) The student did the experiment three times with each liquid hydrocarbon. Give two reasons why.

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________

(ii) Use the data in Table 1 to calculate the mean time, in seconds, for C₇H₁₆

__________________________________________________________________________
__________________________________________________________________________
__________________________________________________________________________
Mean time = __________________ seconds

(iii) Complete the sentence.

As the number of carbon atoms in a molecule of liquid hydrocarbon increases, the time taken for the liquid hydrocarbon to run out of the funnel

________________________.

(1)
(iv) A ring has been drawn around one result in Table 1. This result has not been used to calculate the mean time for $C_{10}H_{22}$.

Suggest why this result was not used.

________________________________________________________________________________________

________________________________________________________________________________________

(v) Suggest one error the student may have made to get the ringed result.

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

(1)

c) The student investigated the effect of temperature on the viscosity of one of the liquid hydrocarbons.

The liquid hydrocarbon he was using had the hazard symbols shown in Figure 2.

Figure 2

(i) Suggest why the student warmed the liquid hydrocarbon using warm water and not a Bunsen flame.

________________________________________________________________________________________

________________________________________________________________________________________

(ii) The student wore safety glasses.

Give one other safety precaution the student should take, and give a reason for this safety precaution.

Safety precaution __________________________________________________________

Reason __________________________________________________________

________________________________________________________________________________________

(2)
This is the method the student used to investigate the effect of temperature on the viscosity of one of the liquid hydrocarbons.

• Measure 50 cm$^3$ of the liquid hydrocarbon and pour it into a beaker.
• Stand the beaker of liquid hydrocarbon in a heated water bath.
• Leave for a few minutes.
• Measure the temperature of the liquid hydrocarbon.
• Pour the liquid hydrocarbon into the funnel, as shown in Figure 3.

**Figure 3**

![Funnel](image)

• Time how long it takes for all of the liquid hydrocarbon to run out of the funnel.
• Repeat the experiment at different temperatures.

(i) The student’s results are shown in **Table 2**.

<table>
<thead>
<tr>
<th>Temperature of liquid hydrocarbon in °C</th>
<th>Time to run out of the funnel in seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>27</td>
</tr>
<tr>
<td>30</td>
<td>21</td>
</tr>
<tr>
<td>37</td>
<td>17</td>
</tr>
<tr>
<td>46</td>
<td>16</td>
</tr>
<tr>
<td>55</td>
<td>11</td>
</tr>
<tr>
<td>65</td>
<td>9</td>
</tr>
</tbody>
</table>
Plot the results shown in Table 2 on the graph in Figure 4.

Draw a curve of best fit.

(ii) One of the points is anomalous.

Draw a ring around the anomalous point on your graph.

(iii) Predict how long it will take the liquid hydrocarbon to run through the funnel at 70 °C.

Show your working on your graph.

\[
\text{Time} = \underline{\text{_________________________}} \text{ seconds}
\]

(iv) Describe the relationship between the temperature of the liquid hydrocarbon and the viscosity of the liquid hydrocarbon.

\[\text{________________________________________________________} \]
\[\text{________________________________________________________} \]
\[\text{________________________________________________________} \]
\[\text{________________________________________________________} \]
\[\text{________________________________________________________} \]
\[\text{________________________________________________________} \]
Crude oil and natural gas are natural resources in many countries.

The table shows percentages of hydrocarbons in natural gas from three different countries.

<table>
<thead>
<tr>
<th>Hydrocarbon</th>
<th>Percentage (%) of hydrocarbon in natural gas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Country X</td>
</tr>
<tr>
<td>Methane</td>
<td>78.03</td>
</tr>
<tr>
<td>Ethane</td>
<td>9.70</td>
</tr>
<tr>
<td>Propane</td>
<td>4.82</td>
</tr>
<tr>
<td>Butane</td>
<td>1.33</td>
</tr>
<tr>
<td>Pentane</td>
<td>0.30</td>
</tr>
</tbody>
</table>

(a) Calculate the mean percentage of propane from countries X, Y and Z.

Give your answer to 2 decimal places.

Mean percentage of propane = % 

(2)
(b) Suggest why natural gas from different countries has different percentages of hydrocarbons.

___________________________________________________________________
___________________________________________________________________

(1)

(c) Complete the sentence.

Choose the answer from the box.

<table>
<thead>
<tr>
<th>an atom</th>
<th>an electron</th>
<th>an ion</th>
<th>a molecule</th>
</tr>
</thead>
</table>

The formula CH₄ represents _________________ of methane.

(1)

(d) Complete the sentence.

The hydrocarbons in the table belong to the homologous series of ____________________.

(1)

Figure 1 shows how properties vary with the increasing size of molecule in this homologous series.

Figure 1

(e) Which graph shows how boiling points vary?

Tick one box.

A □ B □ C □ D □

(1)
(f) Which graph shows how viscosity varies?

Tick one box.

A  B  C  D

(g) Crude oil is fractionally distilled.

Fractions with larger molecules are cracked.

Describe two differences between fractional distillation and cracking.

1. _________________________________________________________________
   __________________________________________________________________

2. _________________________________________________________________
   __________________________________________________________________

(h) Ethene is a product of crude oil.

Complete the sentence.

Ethene polymerises to produce ____________________ .
The production of plastic bags uses limited resources.

**Figure 2** shows two ways (A and B) of saving limited resources.

![Figure 2](image)

Name A and B.

Choose the answers from the box.

<table>
<thead>
<tr>
<th>recycle</th>
<th>reduce</th>
<th>release</th>
<th>reuse</th>
<th>reverse</th>
</tr>
</thead>
</table>

A ______________________

B ______________________

(Total 12 marks)

A student investigated the substances produced when fuels burn.

The figure below shows the apparatus the student used.

![Apparatus](image)

(a) The complete combustion of a hydrocarbon produces carbon dioxide and one other substance.

Look at the figure above. What would the student see in tube A?

___________________________________________________________________

___________________________________________________________________

(1)
(b) When the student burned the fuel she saw soot in the funnel.

Explain why soot forms.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(c) The student burned another fuel which contained impurities.

The substance in tube B is water containing universal indicator.

The indicator turned red.

Which gas made the indicator turn red?

Tick one box.

- Ammonia
- Carbon monoxide
- Nitrogen
- Sulfur dioxide

(1)
(Total 4 marks)
Supermarkets launch eco-friendly plastic milk bags. Could this be the end of the milk bottle?

Milk bottles are made from glass or from plastic.

Glass milk bottles contain 0.5 litres of milk. When the milk is used up the empty bottles are returned to be re-used. Glass milk bottles are re-used 24 times on average. The glass to make new milk bottles is produced when a mixture of sand, limestone, soda and recycled glass is heated to about 1600 °C in a furnace. There are almost unlimited amounts of the raw materials needed to produce this glass. About 35% of used glass is recycled.

The most common plastic milk bottles contain 2 litres of milk. When the milk is used up the empty bottles are discarded as waste. The plastic used to make these milk bottles is poly(ethene). Poly(ethene) is produced from crude oil by first using fractional distillation, then cracking the naphtha fraction and finally polymerising the ethene. About 5% of used poly(ethene) is recycled.

The new plastic milk bags contain 2 litres of milk. The milk bags are also made from poly(ethene). A milk bag uses 75% less poly(ethene) than is used to make the poly(ethene) milk bottles. When the milk is used up the empty bags are discarded as waste.

(a) Describe what happens in fractional distillation so that fractions, such as naphtha, are separated from crude oil.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
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___________________________________________________________________
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___________________________________________________________________
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___________________________________________________________________
___________________________________________________________________

(3)
Supermarkets claim that using milk bags instead of milk bottles would have less environmental impact.

Do you agree with this claim?

Use the information in the article and your knowledge and understanding to make appropriate comparisons to justify your answer.

___________________________________________________________________
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___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(4) (Total 7 marks)
Barbecues are heated by burning charcoal or burning hydrocarbons.

(a) Use the Chemistry Data Sheet to help you to answer this question.

The chemical equation for charcoal burning is:

\[ \text{C} + \text{O}_2 \rightarrow \text{CO}_2 \]

Complete the word equation for this reaction.

\[ \text{carbon} + \text{________________________} \rightarrow \text{carbon dioxide} \]

(b) Propane is a hydrocarbon.

(i) Complete the displayed structure of propane. Draw in the missing bonds.

(ii) Write the chemical formula of propane.________________________

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

Propane burns in air to produce carbon dioxide and ____________________

hydrogen.
hydroxide.
water.
(c) The table shows information about six hydrocarbons.

<table>
<thead>
<tr>
<th>Hydrocarbon</th>
<th>State at room temperature (20°C)</th>
<th>Boiling point in °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethane (C₂H₆)</td>
<td>gas</td>
<td>−89</td>
</tr>
<tr>
<td>Ethene (C₂H₄)</td>
<td>gas</td>
<td>−104</td>
</tr>
<tr>
<td>Butane (C₄H₁₀)</td>
<td>gas</td>
<td>−1</td>
</tr>
<tr>
<td>Butene (C₄H₈)</td>
<td>gas</td>
<td>−6</td>
</tr>
<tr>
<td>Hexane (C₆H₁₄)</td>
<td>liquid</td>
<td>+69</td>
</tr>
<tr>
<td>Hexene (C₆H₁₂)</td>
<td>liquid</td>
<td>+64</td>
</tr>
</tbody>
</table>

Tick (✓) **two** correct statements about the six hydrocarbons.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Tick (✓)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethane and butane boil at temperatures less than 20°C.</td>
<td></td>
</tr>
<tr>
<td>Hexene and butene are alkanes.</td>
<td></td>
</tr>
<tr>
<td>Butane and hexane are liquid at 0°C.</td>
<td></td>
</tr>
<tr>
<td>Ethene and hexene each have a carbon-carbon double bond.</td>
<td></td>
</tr>
</tbody>
</table>

6

The diagrams represent two compounds, A and 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)

(b) Compounds A and B react to produce compound C and compound D.

\[
\begin{align*}
\text{Compound A} & \quad + \quad \text{Compound B} \\
\text{Compound C} & \quad + \quad \text{Compound D}
\end{align*}
\]

(i) What is the formula of compound D?

______________________________________________________________

(1)

(ii) Compound C is an ester.

Name compound C.

______________________________________________________________

(1)

(iii) State one use of esters.

______________________________________________________________

(1)

(Total 7 marks)
(a) The hydrocarbon \( \text{C}_{16}\text{H}_{34} \) can be cracked.

Balance the equation for cracking \( \text{C}_{16}\text{H}_{34} \)

\[
\text{C}_{16}\text{H}_{34} \rightarrow \underline{\text{______________}} \ \text{C}_2\text{H}_4 \ + \ \text{C}_8\text{H}_{18}
\]

(1)

(b) Describe the differences between cracking and distillation.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)

(c) What type of reaction is cracking?

Tick **one** box.

- Combustion
- Decomposition
- Neutralisation
- Precipitation

(1)
(d) Ethene is used to make poly(ethene).

Poly(ethene) is used to make plastic bags.

The table below shows data from a Life Cycle Assessment (LCA) for a plastic bag and a paper bag.

<table>
<thead>
<tr>
<th></th>
<th>Plastic bag</th>
<th>Paper bag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw materials</td>
<td>Crude oil or natural gas</td>
<td>Wood</td>
</tr>
<tr>
<td>Energy used in MJ</td>
<td>1.5</td>
<td>1.7</td>
</tr>
<tr>
<td>Mass of solid waste in g</td>
<td>14</td>
<td>50</td>
</tr>
<tr>
<td>Mass of CO₂ produced in kg</td>
<td>0.23</td>
<td>0.53</td>
</tr>
<tr>
<td>Volume of fresh water used in dm³</td>
<td>255</td>
<td>4 520</td>
</tr>
</tbody>
</table>

A company stated: ‘A Life Cycle Assessment shows that using plastic bags has less environmental impact than using paper bags’.

Evaluate this statement. Use your knowledge and the information from above the table above.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(6)
(Total 10 marks)