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 used paper chromatography to investigate the colours in different inks.

Figure 1 shows the apparatus the student used.

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

Identify the two mistakes.

Describe the problem each mistake would cause.

Mistake 1
Problem

Mistake 2
Problem

(4)
The student then set up the apparatus without making any mistakes.

**Figure 2** shows his results.

![Figure 2](image)

What colours are in the black ink?

___________________________________________________________________
___________________________________________________________________

(1)

(c) Which of the inks is the most soluble in the solvent?

Give a reason for your answer.

Ink ____________________________________________

Reason _________________________________________

___________________________________________________________________

(2)
(d) Use Figure 2 to complete the table below, then calculate the Rf value for red ink.

<table>
<thead>
<tr>
<th>Distance moved by red ink</th>
<th>Distance from start line to solvent front</th>
</tr>
</thead>
<tbody>
<tr>
<td>_________________________</td>
<td>_________________________</td>
</tr>
</tbody>
</table>

The Rf value for red ink is calculated using the equation.

\[
R_f = \frac{\text{distance moved by red ink from the start line}}{\text{distance moved by solvent from the start line}}
\]

Give your answer to two significant figures.

___________________________________________________________________
___________________________________________________________________

\[ R_f \text{ value} = \] ________________

(5)

(e) How can you tell from Figure 2 that the Rf value for the blue ink is greater than the Rf value for the red ink?

___________________________________________________________________
___________________________________________________________________

___________________________________________________________________

(1)

(Total 13 marks)
Figure 1 shows how ethanol is made from plants and from crude oil.

(a) What is the name of the reaction to produce ethanol from sugar?

Tick (✓) one box.

- fermentation
- polymerisation
- reduction

(1)
(b) A student made ethanol from sugar.

**Figure 2** shows the apparatus used.

![Figure 2](image)

(i) What change is seen in the limewater?

Give a reason for your answer.

_________________________________________________________________

_________________________________________________________________

(2)

(ii) The student wanted to separate the solid yeast from the solution.

**Figure 3** shows the apparatus used.

![Figure 3](image)

What is missing from the apparatus in **Figure 3**?

_________________________________________________________________

_________________________________________________________________

(1)

(Total 4 marks)
The label shows the ingredients in a drink called Cola.

Cola

Ingredients:
- Carbonated water
- Sugar
- Colouring
- Phosphoric acid
- Flavouring
- Caffeine

(a)  (i) The pH of carbonated water is 4.5.

The pH of Cola is 2.9.

Name the ingredient on the label that lowers the pH of Cola to 2.9.

__________________________________________________________________________________________  (1)

(ii) Which ion causes the pH to be 2.9?

__________________________________________________________________________________________  (1)
(b) A student investigated the food colouring in Cola and in a fruit drink using paper chromatography.

The chromatogram in the figure below shows the student's results.

(i) Complete the sentence.

The start line should be drawn with a ruler and ___________________.

Give a reason for your answer.

______________________________________________________________

______________________________________________________________

(ii) Suggest three conclusions you can make from the student's results.

______________________________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________

(c) Caffeine can be separated from the other compounds in the drink by gas chromatography.

Why do different compounds separate in a gas chromatography column?

___________________________________________________________________

___________________________________________________________________
(d) Caffeine is a stimulant.

Large amounts of caffeine can be harmful.

(i) Only **one** of the questions in the table **can** be answered by science alone.

Tick (√) one question.

<table>
<thead>
<tr>
<th>Question</th>
<th>Tick (√)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Should caffeine be an ingredient in drinks?</td>
<td></td>
</tr>
<tr>
<td>Is there caffeine in a certain brand of drink?</td>
<td></td>
</tr>
<tr>
<td>How much caffeine should people drink?</td>
<td></td>
</tr>
</tbody>
</table>

(1)

(ii) Give **two** reasons why the other questions **cannot** be answered by science alone.

Reason 1

____________________________________________________________________________________

____________________________________________________________________________________

Reason 2

____________________________________________________________________________________

____________________________________________________________________________________

(2)

(Total 11 marks)
Chromatography can be used to separate components of a mixture.

(a) A student used paper chromatography to analyse a black food colouring.

The student placed spots of known food colours, A, B, C, D and E, and the black food colouring on a sheet of chromatography paper.

The student set up the apparatus as shown in Diagram 1.

Diagram 1

The student made two errors in setting up the apparatus. Identify the two errors and describe the problem each error would cause.

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___________________________________________________________________
___________________________________________________________________
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(4)
(b) A different student set up the apparatus without making any errors. The chromatogram in **Diagram 2** shows the student’s results.

**Diagram 2**

(i) What do the results tell you about the composition of the black food colouring?

______________________________________________________________

______________________________________________________________

______________________________________________________________

(2)

(ii) Use **Diagram 2** to complete **Table 1**.

**Table 1**

<table>
<thead>
<tr>
<th>Distance in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance from start line to solvent front</td>
</tr>
<tr>
<td>Distance moved by food colour C</td>
</tr>
</tbody>
</table>

(2)

(iii) Use your answers in part (b) (ii) to calculate the $R_f$ value for food colour C.

______________________________________________________________

______________________________________________________________

$R_f$ value = ____________________

(1)
(c) **Table 2** gives the results of chromatography experiments that were carried out on some known food colours, using the same solvent as the students.

### Table 2

<table>
<thead>
<tr>
<th>Name of food colour</th>
<th>Distance from start line to solvent front in mm</th>
<th>Distance moved by food colour in mm</th>
<th>R&lt;sub&gt;f&lt;/sub&gt; value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ponceau 4R</td>
<td>62</td>
<td>59</td>
<td>0.95</td>
</tr>
<tr>
<td>Carmoisine</td>
<td>74</td>
<td>45</td>
<td>0.61</td>
</tr>
<tr>
<td>Fast red</td>
<td>67</td>
<td>27</td>
<td>0.40</td>
</tr>
<tr>
<td>Erythrosine</td>
<td>58</td>
<td>17</td>
<td>0.29</td>
</tr>
</tbody>
</table>

Which of the food colours in **Table 2** could be food colour **C** from the chromatogram?

Give the reason for your answer.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)

(d) Two types of chromatography are gas chromatography and paper chromatography.

Give **one** advantage of gas chromatography compared with paper chromatography.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(1)

(Total 12 marks)
This is part of an article about food additives.

THE PERIL OF FOOD ADDITIVES

Some orange drinks contain the additives E102 (Tartrazine), E104 (Quinoline Yellow) and E110 (Sunset Yellow). These three coloured additives are thought to cause hyperactivity in children.

(a) State two reasons that a manufacturer might give to justify the use of these additives.

1. _________________________________________________________________

   ___________________________________________________________________

2. _________________________________________________________________

   ___________________________________________________________________

   (2)

(b) Some scientists asked 4000 twelve-year-old children to help them investigate if there is a link between these three coloured additives and hyperactivity.

How would the scientists use these 4000 children to investigate if there is a link between these three coloured additives and hyperactivity in children?

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(ii) The scientist had samples of E102, E104 and E110 and the orange drink. The scientist used paper chromatography for the test.

Describe how the scientist could use the results to show if the orange drink contained any of these three coloured additives.

You may include a diagram of the paper chromatography results.

(2)
(Total 9 marks)
The figure below shows a paper chromatogram of five different inks.

(a) Explain how paper chromatography separates substances.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(3)

(b) Analyse the chromatogram. Describe and explain the result for black ink.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
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___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(4)
(c) Use the figure above to calculate the $R_f$ value of the blue ink.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

$R_f$ value = ___________________________

(3)
(Total 10 marks)