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
An article began:

Ban yellow additives

Quinoline yellow (E104) is suspected of causing hyperactivity, asthma and rashes in children.

(a) A student tested a food to find out if it contained quinoline yellow (E104).

The student’s results are shown below.

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

This method of detecting and identifying colours is called

- chromatography.
- distillation.
- electrolysis.

(ii) Using the student’s results, how many different colours are in the food? ___

(iii) Using the student’s results, how can you tell that the food does not contain quinoline yellow (E104)?

______________________________________________________________________________

______________________________________________________________________________

(1)
(b) Quinoline yellow (E104) is used in foods such as sweets, drinks and ice cream.

(i) Give one reason why quinoline yellow (E104) is added to foods.

________________________________________________________________________

________________________________________________________________________

(1)

(ii) Suggest what should be done to decide if quinoline yellow (E104) should be banned.

________________________________________________________________________

________________________________________________________________________

(1)

(Total 5 marks)

Race horses may be given drugs to improve their performance in races.

This is illegal in the UK.

After races, urine samples are collected from the horses.

These samples are tested for drugs.

Chromatography is one of the tests used to identify drugs in urine.

The diagram shows a chromatogram.

![Chromatogram Diagram]

Key

1. Caffeine
2. Cocaine
3. Ketamine
4. Urine sample from horse

Solvent front
Start line
(a) How do we know that sample 1 was a pure sample of caffeine?

___________________________________________________________________
___________________________________________________________________

(1)

(b) Calculate the $R_f$ value for cocaine.

Give your answer to 2 significant figures.

Use information from the diagram.

Use the equation:

$$R_f = \frac{\text{distance moved by substance}}{\text{distance moved by solvent}}$$

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

$R_f$ value of cocaine = ____________________

(4)

(c) Give three conclusions about the urine sample from the horse.

Use information from the diagram.

1. _________________________________________________________________
___________________________________________________________________

2. _________________________________________________________________
___________________________________________________________________

3. _________________________________________________________________
___________________________________________________________________

(3)

(Total 8 marks)
The result of a process used to detect and identify the colours in two foods, A and B, is shown.

(i) Describe the differences between the colours used in food A and food B.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(ii) Tick (✓) the name of the process used to detect and identify colours in food.

<table>
<thead>
<tr>
<th>Process</th>
<th>(✓)</th>
</tr>
</thead>
<tbody>
<tr>
<td>chromatography</td>
<td></td>
</tr>
<tr>
<td>extraction</td>
<td></td>
</tr>
<tr>
<td>hardening</td>
<td></td>
</tr>
</tbody>
</table>

(Total 3 marks)
A student used paper chromatography to identify the colours in a black ink.

The diagram below shows the student’s results.

(a) What colours are in the black ink?

___________________________________________________________________
___________________________________________________________________

(2)

(b) Suggest which colour is least soluble in the solvent.

Give a reason for your answer.

Colour ______________________

Reason ____________________________________________________________
___________________________________________________________________

(2)
(c) Use the diagram above to complete the table below.

<table>
<thead>
<tr>
<th>Distance in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance moved by green colour</td>
</tr>
<tr>
<td>Distance moved by solvent</td>
</tr>
</tbody>
</table>

Calculate the $R_f$ value for the green colour.

Use the equation:

$$R_f = \frac{\text{distance moved by green colour}}{\text{distance moved by solvent}}$$

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

$R_f$ value = ________________________

(Total 8 marks)

Chromatography can be used to find out what substances a drug contains.

The diagram shows a chromatogram for seven different drugs.
(a) Calculate the $R_f$ value of drug $G$.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

$R_f$ value = ____________________

(4)

(b) Describe what the diagram shows about drug $D$.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(3)

(c) Which substance is most soluble in the solvent used in this chromatogram? Give a reason for your answer.

___________________________________________________________________
___________________________________________________________________

(1)

(d) Explain the result for drug $F$.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)

(Total 10 marks)
Icing on cakes is tested to check that safe colours were used when they were made.

By Megan Chromik [CC-BY-SA-2.0], via Wikimedia Commons

Paper chromatography is one method of testing which colours are in cake icing.

(a) The diagram shows an experiment a student did.

(i) Suggest why there is a lid on the container.

____________________________________________________________________________________
____________________________________________________________________________________

(1)
(ii) The start line should be drawn in pencil not in ink. Suggest why.

________________________________________________________________________
________________________________________________________________________

(1)

(b) The diagram shows the results of the paper chromatography experiment.

![Diagram of paper chromatography results](image)

(i) How many different food colours were used in the colouring from the cake icing?

________________________

(1)

(ii) Is the cake icing safe to eat?

Give a reason for your answer.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

(1)

(c) Gas chromatography linked to mass spectroscopy is an example of an instrumental method. This method was used on a mixture of solvents.

(i) Give two advantages of gas chromatography compared with paper chromatography.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

(2)
(ii) What does gas chromatography do to the mixture of solvents?

________________________________________________________________________

________________________________________________________________________

(1)

(iii) What information does mass spectroscopy give?

________________________________________________________________________

________________________________________________________________________

(1)

(Total 8 marks)