Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Chromatography and Rf values

Time allowed: 1 hour 30 minutes

Subject code **0620**

Chemistry

Paper 6 (Alternative to practical)

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.

Total marks

/ 60

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.

Information

- This paper has 10 questions worth 60 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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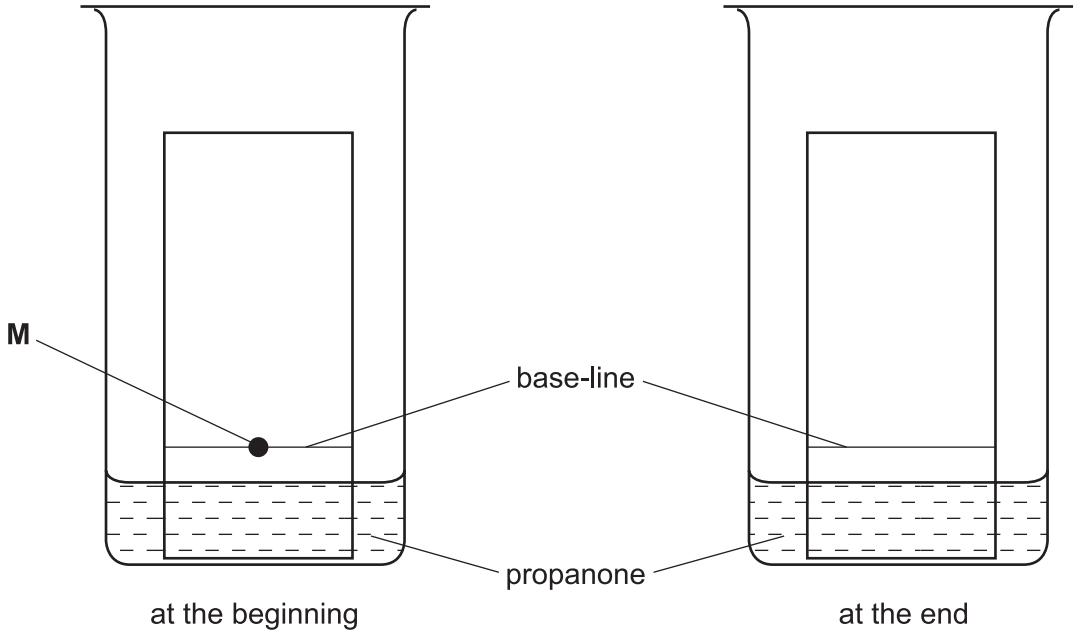
Print at 100% (Actual size) so diagrams keep their real measurements.

1 Substance **M** is a mixture of four dyes. Three of the dyes have different solubilities in propanone. The fourth dye is insoluble in propanone.

(a) Name the process that could be used to separate these dyes.

..... [1]

(b) Sketch on the right hand diagram the results you would expect if **M** was analysed as shown.



[2]

(c) Why is the base-line not drawn in ink?

.....

..... [1]

(d) Why must the level of the propanone be below the base-line?

..... [1]

[Total: 5]

Chromatography Click for more variations

1 **(a)** chromatography (1) [1]

(b) 3 dots above the line and must be vertical (1)
1 dot on base-line (1) [2]
allow: 1 mark for 4 dots above the base-line and must be vertical

(c) interferes with results / ink spreads / ink is soluble / owtte (1) [1]

(d) dyes would wash off / dissolves in propanone (1) [1]

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2 A student uses chromatography to analyse samples of three different dyes. The apparatus the student uses is shown in Fig. 1.1.

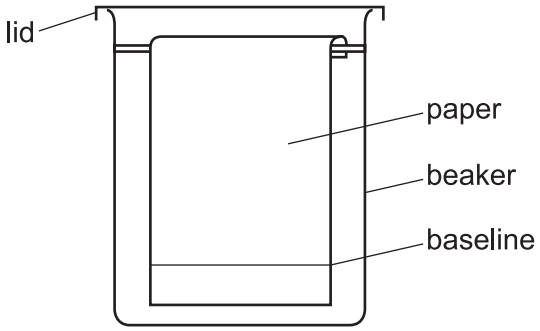


Fig. 1.1

(a) A spot of each dye is placed on the paper and some ethanol is poured into the beaker.

Draw on Fig. 1.1:

- **three** spots (●) to show where the three dyes are placed on the paper at the start of the experiment
- a line to show the level of ethanol in the beaker at the start of the experiment.

[2]

(b) During the experiment the ethanol moves up the paper.

State when the student should remove the chromatography paper from the ethanol in the beaker.

..... [1]

(c) Fig. 1.2 shows the result of the chromatography experiment.

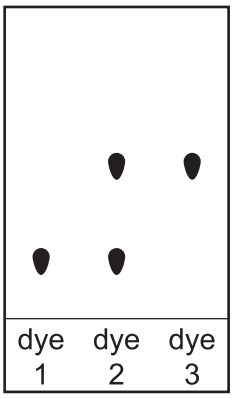


Fig. 1.2

State what conclusions can be made from this result.

.....

.....

..... [2]

[Total: 5]

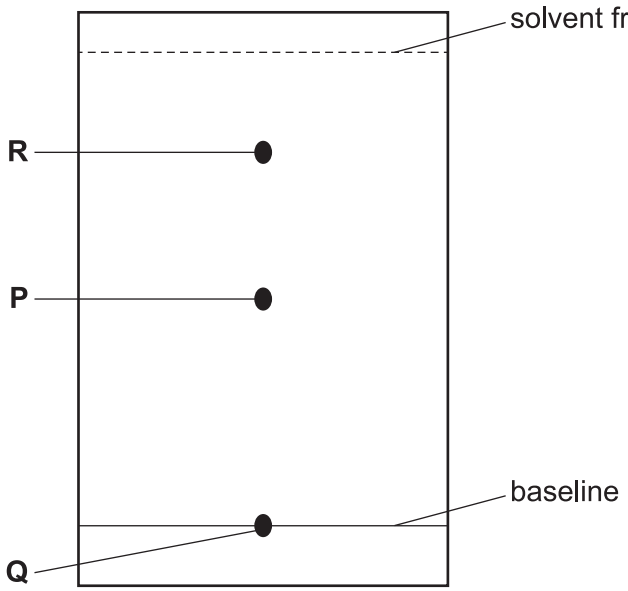
Chromatography Click for more variations

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2(a)	**M1** three spots shown horizontally along the baseline	**1**
	M2 solvent level above / touching the bottom of the paper but below the base line and **not** touching any of the spots	**1**
2(b)	when the ethanol is almost at the top of the paper	**1**
2(c)	**any two from:** **MP1** dye 1 **and** dye 3 are pure substances / contain only 1 colour / substance **MP2** dye 2 contains dye 1 and dye 3 **MP3** all of the dyes were soluble	**2**

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3 A mixture of three compounds, **P**, **Q** and **R**, was separated using a piece of paper.



(a) Name this method of separation.

..... [1]

(b) What could have been used to apply the mixture onto the paper?

..... [1]

(c) Suggest a possible solvent that could be used for this separation.

..... [1]

(d) Suggest why compound **Q** remained on the baseline.

.....

..... [1]

(e) R_f values are used to identify compounds.

$$R_f = \frac{\text{distance travelled by compound}}{\text{distance travelled by the solvent}}$$

Use the diagram to work out the R_f value of compound **R**.

.....

..... [2]

[Total: 6]

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3(a)	chromatography;	1	
3(b)	(teat) pipette / capillary tube;	1	**A:** dropper / glass rod
3(c)	water / organic solvent;	1	
3(d)	compound Q is insoluble;	1	**R:** it reacts with the solvent
3(e)	between (4.7 and 5.1) divided by (6.2 or 6.3); answer: between 0.74 and 0.82;	1 1	correct answer with no working scores 2

4 Inks contain different coloured substances called dyes.
A student used chromatography to investigate the coloured dyes contained in six different inks.

The student drew a baseline on a sheet of chromatography paper.
The student then placed a spot of each ink on the chromatography paper and set up the apparatus as shown in Fig. 1.1.

The student made two errors.

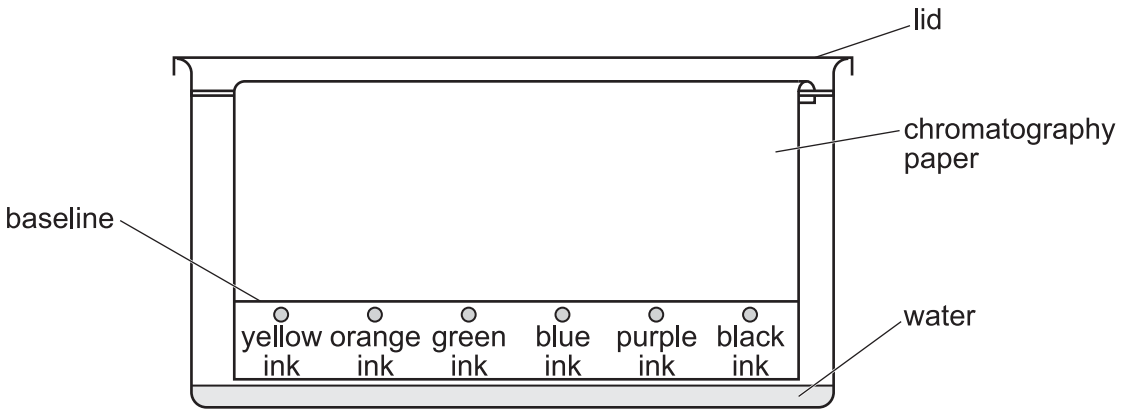


Fig. 1.1

(a) Identify the **two** errors the student made.

1 .....

.....

2 .....

.....
[2]

(b) State the name of the equipment used to draw a baseline on chromatography paper.

..... [1]

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(c) The student corrects the errors and then carries out the chromatography.

The chromatogram in Fig. 1.2 shows the student's results.

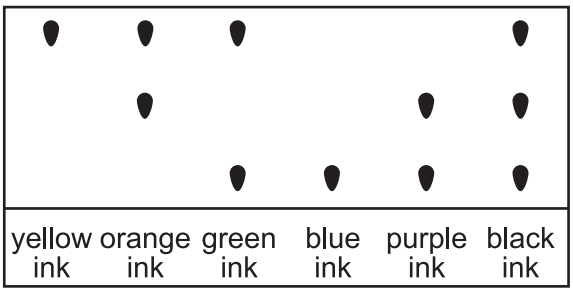


Fig. 1.2

(i) Identify an ink which could contain only **one** coloured dye.

..... [1]

(ii) Deduce which ink could be mixed with the blue ink to make the black ink.

..... [1]

(iii) Deduce the colour of **one** dye that is contained in all three of the orange, green and black inks.

..... [1]

[Total: 6]

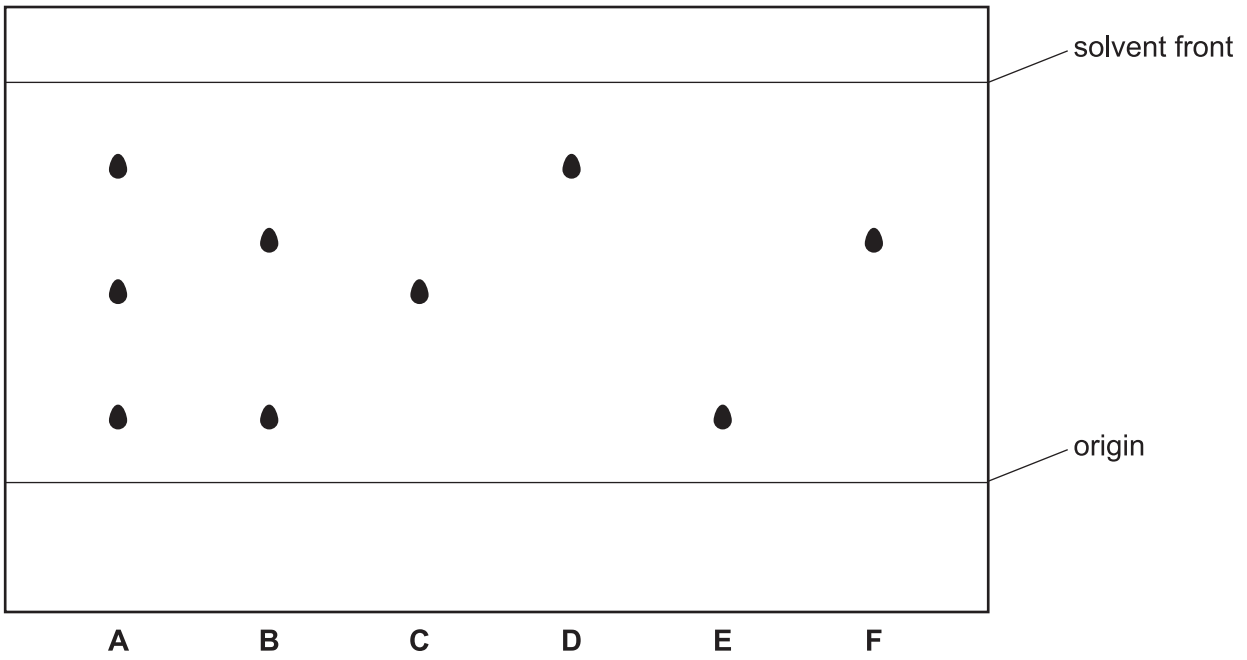
Chromatography Click for more variations

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4(a)	**M1** ink spots should be on baseline	**1**
	M2 water should reach the paper / water should be between bottom of paper and ink spots	**1**
4(b)	pencil / graphite	**1**
4(c)(i)	yellow **OR** blue	**1**
4(c)(ii)	orange	**1**
4(c)(iii)	yellow	**1**

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5 The diagram shows the results of an experiment to separate and identify the colours present in two coloured mixtures, **A** and **B**.
Substances **C**, **D**, **E** and **F** are single colours.



(a) Name this method of separation.

..... [1]

(b) Draw a line **on the diagram** to show the level of the solvent at the beginning of the experiment. [1]

(c) Why should a pencil be used instead of a pen to draw the origin line?

.....

..... [1]

(d) State **one** difference and **one** similarity between the coloured mixtures, **A** and **B**.

difference .....

.....

similarity .....

..... [2]

(e) Which substances are present in mixture **A**?

..... [1]

[Total: 6]

Chromatography Click for more variations

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5 **(a)** chromatography (1) [1]

(b) line drawn on diagram below origin (1) [1]

(c) does not interfere with results/owtte (1) [1]

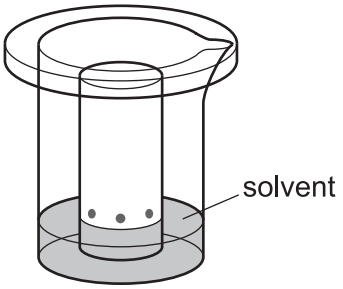
(d) difference
A has more/3 colours/**B** has less/2 colours/**B** contains **F** but **A** doesn't/**A** contains **C**/**D** but **B** does not (1)

similarity
both contain same colour/**E** (1) [2]

(e) **C**, **D** and **E** (1) [1]

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6 The colours present in some fruit sweets can be separated using the apparatus below. The colours are water-soluble dyes.



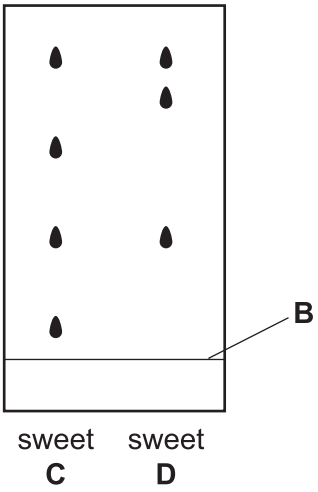
(a) Name the process used to separate the colours.

..... [1]

(b) Name the solvent used.

..... [1]

The results obtained for the colours in two different sweets, **C** and **D**, are shown below.



(c) What is the name for the line at position **B**?

..... [1]

(d) What conclusions can you draw about the colours present in sweets **C** and **D**?

.....

.....

..... [3]

[Total: 6]

Chromatography Click for more variations

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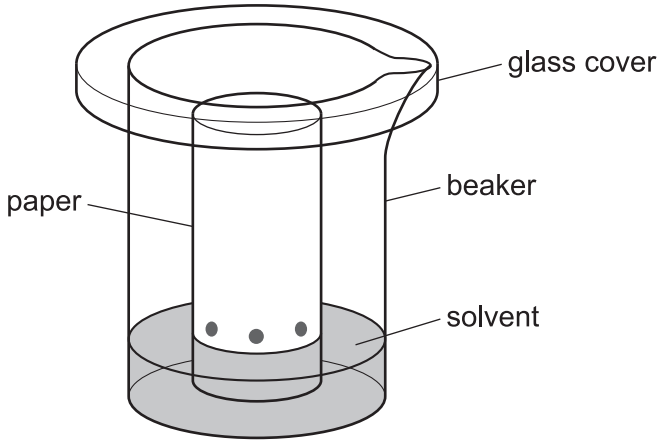
6 **(a)** chromatography (1) [1]

(b) water (1) [1]

(c) origin/base line/datum (1) [1]
ignore references to start/initial/pencil

(d) sweet C has 4 colours (1)
sweet D has 3 colours (1)
allow C has one more colour/more colours than D for one mark
2 colours are the same (1) [3]

7 A student investigated the colours present in a fruit drink. The fruit drink was tested to check that no artificial colours had been added. The apparatus below was used.



(a) **(i)** Name the method used.

..... [1]

(ii) Why is there a glass cover on the beaker?

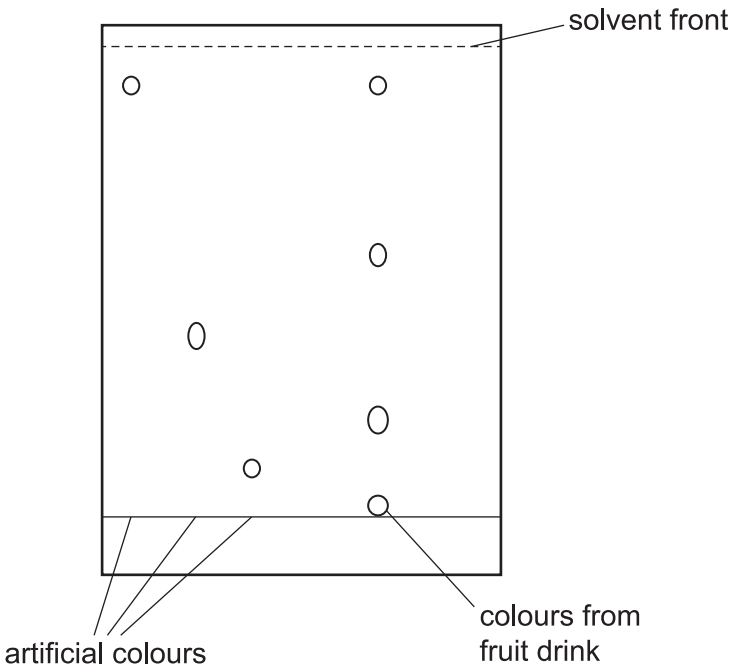
..... [1]

(b) When should the paper be removed from the beaker?

..... [1]

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(c) The diagram shows the results of the experiment.



(i) How many different coloured compounds were present in the fruit drink?

..... [1]

(ii) Are there any of the artificial colours present in the fruit drink? Explain your answer.

.....

.....

..... [2]

[Total: 6]

Chromatography Click for more variations

7 **(a)** **(i)** chromatography (1) [1]

(ii) to prevent loss / evaporation of solvent (1) [1]

(b) when the solvent is near the top of the paper / before the solvent reaches the top of the paper (1) [1]

(c) **(i)** 4 (1) [1]

(ii) yes, one artificial dye (1)
at same height / matches (1) [2]

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8 A black dye can be obtained from some plant roots.

Plan an investigation to determine how many different coloured substances are contained in a black dye obtained from plant roots.

You must include how the results you obtain will tell you how many different coloured substances are contained in the black dye.

You have access to plant roots and all normal laboratory apparatus.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [6]

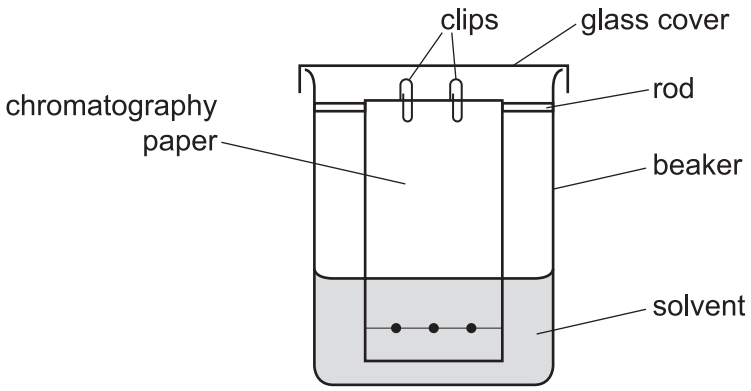
Practical skills: planning, apparatus, measuring and results Click for more variations

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8	Any 6 from: • crush / grind root • with pestle / mortar • with water / solvent • place (drop of) liquid / colour on paper • conduct chromatography • (bottom of) paper placed in a suitable solvent / water • number of coloured substances = number of spots	**6**

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9 A student investigated the colours present in three hair dyes, **P**, **Q** and **R**, using chromatography. **P**, **Q** and **R** are insoluble in water. The student suggested setting up the apparatus for the experiment as shown.



(a) Why is a lid necessary on top of the beaker?

..... [1]

(b) **(i)** Identify **one** mistake in the student's diagram.

..... [1]

(ii) Suggest why this mistake would stop the experiment working.

.....

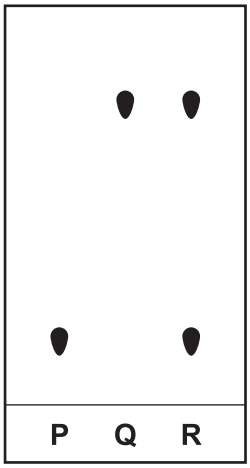
..... [1]

(c) Name a suitable solvent that could be used in this experiment.

..... [1]

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(d) A separate chromatography experiment was done using the hair dyes **P**, **Q** and **R**. The chromatogram obtained is shown.



State **three** conclusions about the hair dyes **P**, **Q** and **R** which can be deduced from the chromatogram.

1 .....

2 .....

3 .....

[3]

[Total: 7]

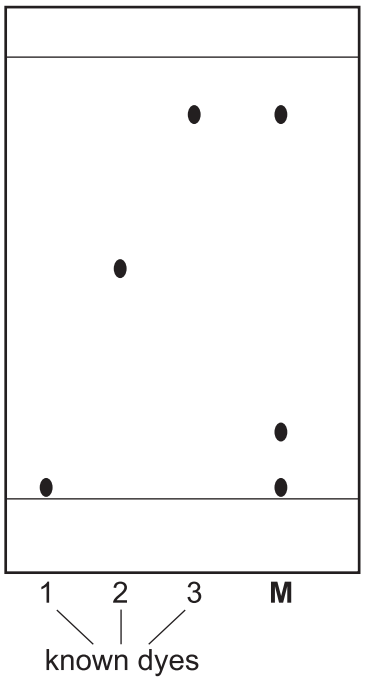
Chromatography Click for more variations

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9(a)	to prevent evaporation / loss of solvent	**1**
9(b)(i)	solvent level above spots / hair dye samples	**1**
9(b)(ii)	dyes would mix / dissolve with solvent / wash off paper	**1**
9(c)	organic solvent / named organic solvent	**1**
9(d)	any **three** from: • R contains P / Q • R is a mixture / contains 2 colours • P is a single colour / pure substance • Q is a single colour / pure substance • P and Q are different colours	**max 3**

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10 A mixture of coloured dyes, **M**, was separated by chromatography. The dyes were insoluble in water.
The chromatogram below shows the result of separating the mixture and the chromatography of three known dyes 1, 2 and 3.



(a) On the diagram, label the base line (origin). [1]

(b) Name a solvent that could be used in this separation.

..... [1]

(c) How many dyes were there in the mixture, **M**?

..... [1]

(d) What are your conclusions about the identity of the dyes in the mixture, **M**?

.....

.....

..... [3]

(e) How could the reliability of the results be checked?

..... [1]

[Total: 7]

Chromatography Click for more variations

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10(a)	base line / origin clearly labelled on diagram;	**1**	
10(b)	any organic solvent / ethanol / alcohol / acetone;	**1**	**R** water / acids
10(c)	3;	**1**	
10(d)	1 and 3 present; 2 not present; unknown dye present;	**3**	**I** reference to properties of dyes 1, 2 and 3
10(e)	repeat the experiment / use a different solvent / measure R_f values;	**1**	

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