

Mark schemes

Q1.

- (a) Level 3: The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced. 5-6

Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced. 3-4

Level 1: The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear. 1-2

No relevant content 0

Indicative content

Method

- draw (pencil) start line on (chromatography) paper
- place spot of food colouring on start line
- use of suitable solvent
- place solvent in beaker / container
- place (chromatography) paper in beaker / container so (chromatography) paper is in solvent but solvent is below start line
- use a lid
- wait for solvent to travel up the (chromatography) paper (until near top)
- mark solvent front
- dry the (chromatography) paper

Measurements

- measure distance between start line and centre of spot
- measure distance between start line and solvent front
- use of measurements to determine R_f value

- (b) different solvent used 1

- (c) paper 1

[8]

Q2.

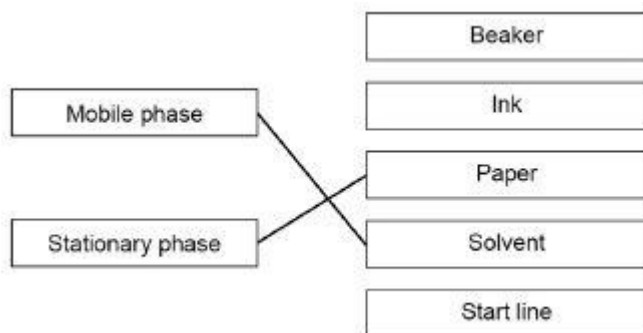
- (a) $\frac{2.7}{9.0}$ 1

= 0.3

ignore units

(b) C and D

(c)



additional line from a box on the left negates the mark for that box

(d) 17 : 3

(e) formulation

(f) the Rf value would stay the same

[8]

Q3.

(a) $0.60 = \frac{5.7}{\text{distance moved by solvent}}$

(distance moved by solvent =) $\frac{5.7}{0.60}$

= 9.5 (cm)

(b) some of the compounds are colourless (in solution)

or

dyes / compounds have the same Rf values

allow there are only two compounds that are coloured (in solution)

- (c) allow the solvent front to travel further 1
use a different solvent 1
- (d) so that the (shade of) green is the same
allow because the green ink is a formulation 1
- (e) the dye is less soluble in the new solvent and more attracted to the new paper 1
- [8]

Q4.

- (a) crush the flower 1
use more flowers 1
- (b) the start line is drawn in ink 1
uses water as the solvent 1
- (c) flower A contains a single pure colour 1
the colour in flower C is a mixture 1
- (d) $\frac{7.2}{9.0}$ 1
= 0.8 1
*an answer of 0.8 scores 2 marks
ignore units* 1
- [8]

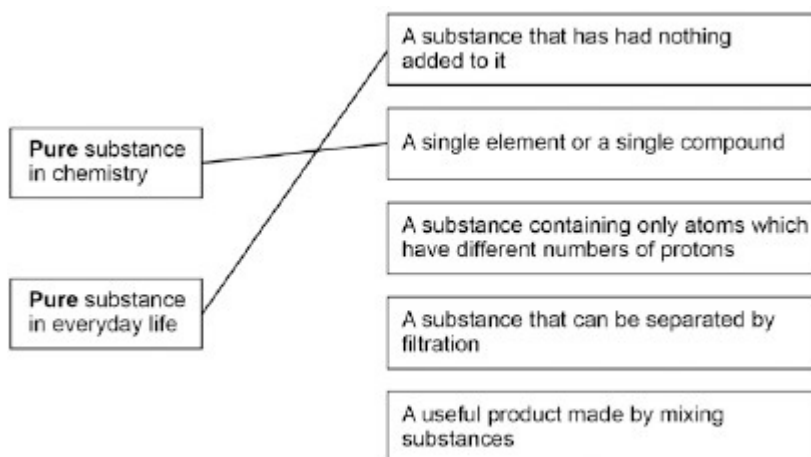
Q5.

- (a) start line drawn in ink
allow start line should have been drawn in pencil 1
- (so) ink dissolves
(as) pencil does not dissolve

- or
ink runs in solvent / water
or
pencil does not run in solvent / water 1
- water used (as solvent)
allow ethanol not used
- or
water in beaker 1
- (so) colours will not dissolve / move 1
- (b) any two from:
- the flowers have no colours in common
allow the flowers are not the same colour
 - A / B contain one colour
 - C contains two colours
allow C is a mixture of colours
 - (the colour in) B is most soluble
allow (the colour in) B has the highest Rf value
allow one of the colours in C is the least soluble 2
- (c) (distance moved) = $\frac{3.2}{0.65}$ 1
- (distance moved) = 4.9 (cm)
allow 4.923076923 (cm) correctly rounded
an answer of 4.9 (cm) scores 2 marks 1
- [8]

Q6.

- (a) Air 2
- Steel 1
- (b)



Allow 1 mark for the correct meanings linked to context but incorrect way around

- (c) Damp litmus paper turns white 1
- (d) Iron(III) 1

[6]

Q7.

- (a) The start line was drawn in ink 1

The water level was above the spots 1

- (b) 3 1

- (c) A 1

- (d) *(distance moved by dye A) 38 (mm)*
allow values in range 36-40 1

(distance from start line to solvent front)
102 (mm)
allow values in range 101-103 1

$\frac{38}{102}$
allow ecf from Table 1 1

0.37254 ...
allow values in range 0.35 – 0.39

| | | |
|-----|--|-----|
| | | 1 |
| | 0.37 | 1 |
| | <i>accept 0.37 with no working shown for 5 marks</i> | [9] |
| Q8. | | |
| (a) | water level above the start line and start line drawn in ink <i>allow water level too high</i> | 1 |
| | <i>water level</i> food colours would dissolve into water or start line the ink would 'run' on the paper | 1 |
| (b) | (distance moved by A) 2.8cm and 8.2 cm (distance moved by solvent) <i>allow values in range 2.7 – 2.9 cm and 8.1 – 8.3 cm</i> | 1 |
| | $\frac{2.8}{8.2}$ | 1 |
| | 0.34 <i>allow 0.33 or 0.35</i> <i>allow ecf from incorrect measurement to final answer for 2 marks if given to 2 significant figures</i> <i>accept 0.34 without working shown for 3 marks</i> | 1 |
| (c) | 6.6 cm <i>allow values between 6.48 and 6.64 cm</i> | 1 |
| (d) | solvent moves through paper | 1 |
| | different dyes have different solubilities in solvent | 1 |
| | and different attractions for the paper | 1 |
| | and so are carried different distances | 1 |
| (e) | calcium ions <i>allow Ca²⁺</i> | |

| | | |
|-----|--|------|
| | | 1 |
| | sodium ions | |
| | <i>allow Na+</i> | 1 |
| (f) | two different colours | |
| | or | |
| | Ca ²⁺ / one is orange-red and Na ⁺ / the other is yellow | |
| | <i>allow brick red for Ca²⁺ and / or orange for Na⁺</i> | |
| | <i>allow incorrect colours if consistent with answer to 7.5</i> | 1 |
| | (so) colours mix | |
| | or | |
| | (so) one colour masks the other | 1 |
| (g) | (Student A was incorrect) | |
| | because sodium compounds are white not green | |
| | or | |
| | because sodium carbonate is soluble | 1 |
| | so can't contain sodium ions | 1 |
| | (Student B was incorrect) | |
| | because adding acid to carbonate produces carbon dioxide | 1 |
| | so must contain carbonate not chloride ions | 1 |
| | | [18] |