Mark schemes

1

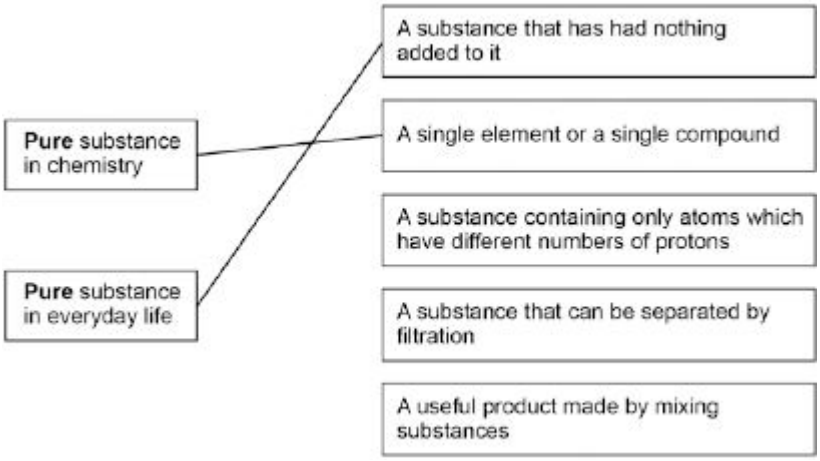
(a) Air

2

Steel

1

(b)



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

1

(c) Damp litmus paper turns white

1

(d) Iron(III)

1

[6]

2

(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

*accept 0.37 with no working shown for **5** marks*

[9]

3 (a) filtration
or
by passing through filter beds to remove solids

1

sterilisation to kill microbes

allow chlorine / ozone allow ultraviolet light

1

(b) water needs more / different processes

1

because it contains any **two** from:

- more organic matter
- more microbes
- toxic chemicals or detergents

2

(c) *(as part of glassware attached to bung)*
salt solution in (conical) flask

allow suitable alternative equipment, eg boiling tube

1

(at end of delivery tube)
pure water in test tube which must not be sealed

allow suitable alternative equipment, eg, beaker, condenser

1

heat source (to heat container holding salt solution)

1

*if no other mark obtained allow for **1** mark suitable equipment drawn as part of glassware attached to bung **and** at end of delivery tube*

(d) determine boiling point

1

should be at a fixed temperature 100°C

allow should be 100°C

allow if impure will boil at a temperature over 100°C

1

(e) high energy requirement

1

[11]

4 (a) water level above the start line
and
start line drawn in ink

allow water level too high

1

water level
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)

allow values in range 2.7 − 2.9 cm and 8.1 − 8.3 cm

1

$$\frac{2.8}{8.2}$$

1

0.34

allow 0.33 or 0.35

*allow ecf from incorrect measurement to final answer for **2** marks if given to 2 significant figures*

*accept 0.34 without working shown for **3** marks*

1

(c) 6.6 cm

allow values between 6.48 and 6.64 cm

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

allow Ca^{2+}

1

sodium ions

allow Na^{+}

1

(f) two different colours

or

Ca^{2+} / one is orange-red and Na^{+} / the other is yellow

allow brick red for Ca^{2+} and / or orange for Na^{+}

*allow incorrect colours if consistent with answer to **7.5***

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]

5

(a) ammonia **and** nitric acid

allow NH_4OH

allow $NH_3(aq)$

1

(b) shows fertilisers are formulations

allow gives percentage / proportion of nitrogen, phosphorus and potassium in the fertiliser

1

(so) farmers can choose fertiliser with required properties

1

(c) as world population increases, ammonia production increases

1

ammonia is used to produce fertilisers

1

so increasing need for fertilisers as more food required for increased population

allow as more food produced less mortality

1

[6]

6

(a) start line drawn in ink

1

so it will run / dissolve in the solvent / split up

allow mixes with the spots

1

spots under solvent **or** solvent above spots / start line

1

so they will mix with solvent **or** wash off paper **or** colour the solvent **or** dissolve in the solvent

1

(b) (i) contains **A** and **E**

1

and one other (unknown substance)

*if no other marks awarded, an answer saying it is made up of three colours gains **1** mark*

1

(ii) 45 or 46

allow any value from 45 to 46

1

18

allow any value from 16 to 20

*award **1** mark if numbers correct but in cm*

1

(iii) 0.40

*allow ecf from **(b)(ii)***

ignore units

1

(c) fast red

*allow ecf from **(b)(iii)***

1

has same R_f value

*allow none of them, as none has the same R_f value for **2** marks*

1

(d) any **one** from:

- more accurate
- more sensitive
- uses small quantities of samples
- quicker / faster / more rapid
- can link to mass spectrometer (MS)

1

[12]

7 (a) (i) (phosphoric) acid

allow phosphoric

1

(ii) H^+ / hydrogen (ion)

if ion symbol given, charge must be correct

1

(b) (i) pencil

1

so it will not run / smudge / *dissolve*

ignore pencil will not interfere with / affect the results

or

because ink would run / smudge / *dissolve*

ignore ink will interfere with / affect the results

1

(ii) any **three** from:

*reference to spots / dots = max **2***

allow colouring for colour

- *3* colours in Cola

*allow more colours in cola **or** fewer colours in fruit drink*

- *2* colours in Fruit drink
- one of the colours is the same
- two of the colours in Cola are different
- one of the colours in Fruit drink is different

allow some of the colours in the drinks are different

- *one of the colours in Cola is the most soluble*

accept one of the colours in Cola has the highest R_f value

3

(c) different substances travel at different speeds **or** have different retention times

accept different attraction to solid

ignore properties of compounds

1

(d) (i) Is there caffeine in a certain brand of drink?

1

(ii) any **two** from:

- cannot be done by experiment
- based on opinion / *lifestyle choice*
- ethical, *social* or economic issue

accept caffeine has different effects on different people

2

[11]

8 (a) additive

1

(b) colour 3 is a mixture of colours 1 and 2

any **two** from:

accept E-number or additive instead of colour

ignore comments about height / level

1

- colour 1 is made up of only one colour / dye
- colour 2 is made up of only one colour / dye
- colour 3 is made up of two colours / dyes
  or
  more colours (than colours 1 and 2)

2

[4]

9

(a) any **two** from:

ignore reference to taste / shelf-life / sales etc

- improve the colour / appearance
- additives are permitted / not banned / listed on the label
- link between additives and hyperactivity not proved
- maintain the low cost of the drink **or** natural colours would make the drink cost more

  allow cheaper if qualified

2

(b) have a control group / placebo **or** test children before any drink given

1

give a drink to at least 3 groups **or** give a drink at least 3 times

1

give each additive to different group / children / at different times

1

observe / monitor / compare behaviour of group / children

1

(c) (i) so that there would be trust / respect / no bias

1

(ii) compare the colours / spots from the orange drink with those of the (three) additives

accept diagram of chromatogram(s) with spots for E102, 104, 110 and sample from the orange drink

1

there should be no matching colours / spots

1

[9]

10 (a) (i) chromatography

1

(ii) 3 / three

1

(iii) the colour / E104 is not on the same level as any of the colours in the food

accept E104 does not match

1

(b) (i) to improve the appearance of the food

ignore adds yellow / colour

ignore taste / flavour

1

(ii) further / or different tests (for harmful effects) **or** obtain more evidence (that it is harmful)

allow do a survey / study

1

[5]

11 (a) (i) prevent evaporation of solvent

allow prevent loss of solvent

allow to support the (chromatography) paper

1

(ii) ink dissolves in the solvent

allow ink 'runs' / spreads ***or*** *pencil does not 'run' / spread*

allow ink would affect the result / mixes with colours

or

carbon / graphite does not dissolve in the solvent

accept pencil for carbon / graphite

1

(b) (i) 4

1

(ii) *no mark for 'no / don't know'* ,

ignore numbers

any **one** from:

- because not all colours match
- not all colours are safe
- some colours could be unsafe
- some colours travelled higher (than safe colours)

1

(c) (i) any **two** from:

ignore reliable / precise

- rapid / quick
- accurate
- sensitive **or** detects very small quantities

accept small sample

2

(ii) separates

1

(iii) identifies solvents / compounds / substances

accept (relative) molecular mass

accept formula mass

accept M_r

accept relative mass

accept molecular ion peak

1

[8]

12 (a) (improve) appearance

allow add colour

allow these food colourings have not been proven to cause hyperactive behaviour in young children

*do **not** accept taste / flavour / preservatives*

ignore reference to E-numbers

1

(b) X

1

(c) any **three** from:

- S contains six / 6 colourings
- P contains five / 5 colourings

  *if neither of first 2 bullet points given allow **1** mark for S contains more colours than P **or** converse*
- both S and P contain the same

  five / 5 colourings
- both contain W **and** Y
- both sweets (may) cause hyperactivity

  ignore unsafe
- neither contain X **and** Z

3

[5]

13

(a) to improve the appearance of the drink

1

because they are permitted colours

1

(b) (i) chromatography

1

(ii) three / 3

1

(iii) because one colour / spot / E102 matched

1

because the other / two colours / spots / E104 and E110 did not match

*if no other mark awarded allow because the drink did not contain E104 and E110 **or** because the drink contained E102 for **1** mark*

*accept only E102 matched for **2** marks*

1

[6]

14 (i) any **two** from:

- **A** has four colours(*)
- **B** has three colours(*)

(*) if first two bullets not stated
*accept **A** has more colours (than **B**) **or B** has less colours (than **A**) for **1** mark only*

- **A** / **B** have two colours the same
- **B** has one different colour

2

(ii) chromatography

1

[3]

15 drinks / colours B **and** C are safe

1

drinks / colours A **and** D are not safe

*accept a pair of one safe colour **and** one not safe colour identified for **1** mark*
*accept A, B, C and D all contain one safe colour for **1** mark*
ignore references to shading

1

[2]

16 use of solvent / solution / water / any named solvent

1

separates / carries colour(s) / dye(s)

allow any idea of movement
eg runs / moves

1

match against Rf value / known chromatogram / similar pattern
or comparison to permitted additive / colour

removal of coloured additive from salmon does not gain any marks

ignore reasons for separation

*maximum **2** if technique clearly doesn't work*

1

[3]

17 (a) check if safe to eat / healthy

or

permitted

accept references to allergies / medical problems

1

(b) any **three** from:

accept dye for colour

- made up of <u>two</u> colours / dots
- contains an unknown colour / dot
- contains a harmful <u>colour</u>
- contains E104 / quinoline yellow
  or does not contain E133 / brilliant blue
- further analysis needed

3

(c) ignore No or Yes but No must be implied

there could be <u>other</u> additives (in the sweets)

*accept any other type of additives but **not** colourings*

1

could still contain / use / add <u>natural</u> colours

accept non-artificial for natural

or

named natural colours

1

[6]