Mark schemes

(a) Air

Steel

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

(c) Damp litmus paper turns white

(d) Iron(II)

2

(a) The start line was drawn in ink

The water level was above the spots

(b) 3

(c) A

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

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

0.37254 …

allow values in range 0.35 – 0.39

0.37

accept 0.37 with no working shown for 5 marks

(a) filtration

or

by passing through filter beds to remove solids

sterilisation to kill microbes

allow chlorine / ozone allow ultraviolet light

(b) water needs more / different processes

because it contains any two from:

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

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

allow suitable alternative equipment, eg boiling tube

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

allow suitable alternative equipment, eg, beaker, condenser

heat source (to heat container holding salt solution)

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

should be at a fixed temperature 100°C

allow should be 100°C

allow if impure will boil at a temperature over 100°C
(e) high energy requirement

(a) water level above the start line
and
start line drawn in ink
allow water level too high

water level
food colours would dissolve into water
or
start line
the ink would ‘run’ on the paper

(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

\[
\begin{array}{c}
2.8 \\
8.2 \\
0.34
\end{array}
\]
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

(c) 6.6 cm
allow values between 6.48 and 6.64 cm

(d) solvent moves through paper

different dyes have different solubilities in solvent
and different attractions for the paper
and so are carried different distances

(e) calcium ions
allow Ca\(^{2+}\)
sodium ions
allow Na\(^+\)
(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

(so) colours mix
or
(so) one colour masks the other

(g) (Student A was incorrect)
because sodium compounds are white not green
or
because sodium carbonate is soluble
so can’t contain sodium ions

(Student B was incorrect)
because adding acid to carbonate produces carbon dioxide
so must contain carbonate not chloride ions

(a) ammonia and nitric acid
allow NH$_4$OH
allow NH$_3$(aq)

(b) shows fertilisers are formulations
allow gives percentage/proportion of nitrogen, phosphorus and potassium in the fertiliser

(so) farmers can choose fertiliser with required properties

(c) as world population increases, ammonia production increases
ammonia is used to produce fertilisers
so increasing need for fertilisers as more food required for increased population
allow as more food produced less mortality

6 (a) fermentation
(b)  (i)  turns cloudy / milky / white
    
    ignore bubbles

    because carbon dioxide is produced
    
    allow CO$_2$ produced

    1

    (ii)  filter paper

    1

    (a)  (i)  fizz / effervescence / bubbles

    allow calcium carbonate decreases in size or dissolves

    because carbon dioxide produced / released

    allow because gas produced / released

    1

    limewater turns cloudy / milky / white

    1

    because (a precipitate of or solid) calcium carbonate forms

    allow because of carbon dioxide if not already credited

    1

    (ii)

    \[
    \begin{array}{c}
    \text{H} \\
    \text{H} - \text{C} - \text{C} = \text{O} \\
    \text{H} \quad \text{O} - \text{H}
    \end{array}
    \]

    allow -OH

    do not allow lower case ‘h’

    1

    (iii)  acid

    must be in this order

    ignore any name of an acid

    1

    ester(s)

    1

(b)  white (precipitate)  no change

    no change  no change

    all four correct 2 marks

    any two correct 1 mark

2
(c) (i) lilac
   
   allow purple

   red

   must be in this order

   (ii) colours are masked / changed by each flame colour

(a) (i) Filtration

(ii) Chlorine

(b) (i) nanoparticles are small / smaller / much smaller / tiny

   allow any in range 1−100 nm or $1 \times 10^{-9} m - 1 \times 10^{-7} m$ or a few hundred atoms in size

   ignore numbers if stated smaller

   (ii) they have a high surface area to volume ratio

   reference to surface area without volume ratio is insufficient

   allow nanoparticles are very reactive or nanoparticles are more reactive than normal particles.

(c) (sodium hydroxide) produces a white precipitate

   accept solid / suspension or ppt or ppte for precipitate.

   ignore cloudy / milky

   which (then) dissolves / disappears (in excess sodium hydroxide)

   M2 cannot be awarded unless a solid of some sort has been made

   ignore names or formulae of compounds

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(a) (i) Proton

(ii) Neutron

(b) In order of increasing atomic number

(c) (i) 9

(ii) Gas
(d) (i) gains (one) electron

(to gain a) full outer energy level \textbf{or} noble gas configuration

\textit{allow because it has seven outer electrons}

(ii) add sodium hydroxide (solution)

\textit{allow ammonia (solution) or ammonium hydroxide or any other soluble hydroxide or flame test}

(forms a) blue precipitate

\textit{second mark dependent on suitable reagent being added}

\textit{allow blue−green / blue / green if flame test given}

(a) copper (II) → blue

iron (III) → brown

more than one line from any box negates the mark

(b) aluminium

\textit{allow correct answer shown in box if answer line blank}

(c) (i) yellow

\textit{allow orange}

(ii) lilac

\textit{allow purple}

(iii) one colour masks the other

\textit{allow colours mixed}

X: Fe\textsuperscript{2+} / iron(II), SO\textsubscript{4}\textsuperscript{2−} / sulfate

\textit{allow iron(II) sulfate}

\textit{or FeSO\textsubscript{4}}

Y: Na\textsuperscript{+} / sodium, I\textsuperscript{−} / iodide

\textit{allow sodium iodide}

\textit{or NaI}
Z: Fe$^{3+}$ / iron(III), Br$^-$ / bromide

- allow iron(III) bromide
- or FeBr$_3$

Correct identification of any two ions = one mark
Correct identification of any four ions = two marks

(b) any five from:

- allow converse arguments

method 1

- weighing is accurate
- not all barium sulfate may be precipitated
- precipitate may be lost
- precipitate may not be dry
- takes longer
- requires energy

- allow not all the barium hydroxide has reacted

method 2

- accurate
- works for low concentrations

- allow reliable / precise

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