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1 (a) (i) E [1]
(ii) A and D [1]
(iii) D [1]
(iv) B [1]
(v) D [1]
(vi) A and D [1]

(b) C₂H₄Br₂ [1]

(c) 4 (H₂O) [1]
5 (O₂) [1]

**note:** mark dependent on 4 (H₂O)

[Total: 9]

2 (a) (i) sodium / Na⁺ [1]
(ii) X is fluoride [1]
Y is nitrate [1]
(iii) 0.244 (mg) [1]
allow: 0.24 [1]
(iv) 4th box down ticked (weakly acidic) [1]

(b) (add nitric acid) add silver nitrate [1]
white precipitate [1]
**note:** mark dependent on correct reagent [1]

(c) polymer [1]
monomer [1]

[Total: 9]
3  (a) ring around the OH group  

(b) bromine (water)  
   allow: bromination  
   decolourised / turns colourless  
   note: mark dependent on correct reagent  
   ignore: goes clear / gets discoloured  
   allow: potassium manganate(VII) / potassium permanganate (1)  
   turns colourless (1)  
   ignore: incorrect colour of reagent  

(c) (i) to break up the cells / to extract the pigment / to separate the pigment from the petals / idea of getting the colour out of the petals, e.g. otherwise the colour won’t come out  
   idea that solvent dissolves the pigment / idea of making a solution  
   ignore: find out how pure the rose petals are / reference to separating colours  

(ii) pigment might be absorbed onto filter paper / pigment sticks to filter paper  

(d) (i) chromatography  

(ii) spot near the bottom and above the solvent level  

(iii) to keep atmosphere in jar saturated (with solvent vapour)  
   allow: to reduce / prevent (solvent) evaporation  

(iv) A and C  

(e) structure of ethanol with ALL atoms and bonds shown  

[Total: 12]
4 (a) thermometer [1]

(b) Any two from: [2]
- same volume of water in can
- same height of burner (from can)
- wick same height
- same rate / amount of stirring of water
- allow: same temperature of water at start
- allow: same amount of fuels burnt / same temperature rise
- allow: same type of can

(c) so same temperature throughout the water / to stop differences in temperature in the different parts of the water / otherwise the temperature will be higher at the bottom (of the water) / so not hotter in one place [1]
ignore: to mix the water / so there are no convection currents

(d) decreases / goes down [1]
idea of liquid or fuel turning to vapour / gas; [1]
allow: gases formed
ignore: fuels evaporate
note: 2nd mark dependent on first

(e) F [1]

(f) (i) mixture of metals / mixture of metal(s) + non-metals [1]
do not allow: compound
(ii) covers surface / idea of protective layer [1]
prevents contact with air / prevents contact with water / so air (or water) does no react with steel [1]
do not allow: reference to tin being more reactive / sacrificial protection (for second marking point)

(g) 1st box down ticked (giant covalent) [1]

[Total: 11]
5 (a) Any four from:

- suitable named metal / metal oxide e.g. reactive metal such as Mg / Zn or
- their oxides
- suitable named acid
- metal + acid gives metal salt / named metal gives named metal salt
- metal + acid gives off hydrogen

**note**: complete word equation for metal + acid → salt + hydrogen (2)

- metal oxide + acid gives metal salt / named metal oxide gives named metal
- salt
- water also product of reaction of metal oxide + acid

**note**: complete word equation for metal oxide + acid → salt + water (2)

(b) exothermic

(c) suitable use of radioactive isotope e.g. detecting leaks in pipes / checking thickness of paper / tracer / cancer treatment / investigating thyroid function

**ignore**: atomic bombs / explosions

(d) protons 92 and 92

- neutrons 143 and 146

- electrons 92 and 92

[Total: 9]

6 (a) (i) (concentration) decreases

- then remains constant

  **allow**: levels out

(ii) 3.8 (hr) / 3 hr 48 min

(iii) 9 (hr)

  **allow**: 8.8–9.2 (hr)

(iv) steeper graph line from same starting point

- levels off lower than 0.10 mol /dm$^3$

(v) increase the temperature / increase concentration of sodium hydroxide

  **allow**: add a catalyst

[Total: 9]
(b) Any four from:

- acid in burette
- use (volumetric) pipette to put sodium hydroxide into flask
- idea of correct setup of apparatus, i.e. flask under burette
- indicator in flask
- run hydrochloric acid into sodium hydroxide
- until indicator changes colour
- any indication of good technique e.g. repeating experiment / add acid
- slowly / shaking flask after each addition of acid

Note: answers must be in the correct context, e.g. do not allow indicator in burette

(c) bonding pair of electrons between H and Cl and no additional electrons on the H atom
six non-bonding electrons around the chlorine atom
ignore: inner shell electrons in Cl.

[Total: 13]

7. (a) for better crop / for better plant growth / to replace elements (or named elements or minerals) lost from soil when crops harvested / for more plant protein
allow: to give more nutrients to plants
ignore: for healthy plant growth / to give plants the compounds they need to grow / to help plants grow

(b) neutralisation acid-base (reaction)

(c) ammonium nitrate

(d) $2 \text{NH}_4^+ \rightarrow 1 \text{SO}_4^{2-} / 2$ ammonium to $1$ sulfate
allow: 2:1 or 1:2 ratio unqualified
allow: $(\text{NH}_4)_2\text{SO}_4$

(e) Any two from:

- slaked lime can form an alkaline solution with water / slaked lime is calcium
- hydroxide / slaked lime is a hydroxide / slaked lime is basic
- slaked lime reacts with ammonium (salts)
allow: slaked lime reacts with fertiliser
- ammonia escapes from soil / gas escapes from soil

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(f) positive: anode and negative cathode
   at + electrode → chlorine
   at – electrode → potassium

[Total: 9]

8  (a) Any four from:

- dissolving
- diffusion
- in iodine solid the particles are close together
- in iodine solid the particles only vibrate  ALLOW: particles do not move
- in solution the iodine molecules are further / far apart
- in solution the particles are randomly arranged/ no particular arrangement
- in solution, particles move (fairly) freely / in solution particles slide over solvent molecules
allow: in solution particles move slowly (from place to place)
- in solution there is bulk movement of particles from higher to lower concentration / particles spread out in solution / move everywhere / mix up
allow: particles move from higher to lower concentration
- ideas of explanation of dissolving in terms of solvent molecules getting between the iodine particles
- ideas about forces between particles of iodine being weakened on dissolving

(b) (i) solid

(ii) heat causes astatine to melt / energy causes astatine to melt  
allow:: the astatine has melted / radioactivity melts the astatine

(iii) $\text{At}_2$ on right

2 (NaAt) on left  
note: 2nd mark dependent on $\text{At}_2$ or 2At on right

[Total: 8]