This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners’ meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2014 series for most Cambridge IGCSE®, Cambridge International A and AS Level components and some Cambridge O Level components.
1 (a) **Bromine**

**Physical:** reddish-brown liquid or brown liquid or volatile liquid/low boiling point liquid or poor/non-conductor (of electricity) or soluble in water or soluble in organic/non-polar solvents

**Chemical:** Reacts with water or reacts with iodides (in solution) or displaces iodine or reacts with alkenes/named alkene/unsaturated hydrocarbons or reacts with alkane in UV/named alkane in UV or valency/oxidation state(–)1 or forms Br⁻ or gains or shares 1 electron or combines or reacts with metals/named metal or combines or reacts with non-metals/named non-metal or oxidising agent or bleaches litmus paper/indicator paper or corrosive or forms acidic oxides

(b) **Graphite**

**Physical:** (good) conductor (of electricity) or soft or lubricant or high melting point/high boiling point or grey black or black solid or slippery or greasy (to touch) or brittle/breaks when subjected to stress or insoluble in water

**Chemical:** reducing agent or reduces metal oxides/named metal oxide or reacts with/burns in air/oxygen or forms an acidic oxide (CO₂) or valency/oxidation state of 2 or 4

(c) **Manganese**

**Physical:** (good) conductor (of heat/electricity) or high melting point/high boiling point or forms coloured compounds/coloured ions or hard or strong or high density or malleable or ductile or sonorous or shiny

**Chemical:** Variable or different valency/oxidation state/oxidation number or catalytic activity or forms coloured compounds/coloured ions or forms complex ions/complexes or reacts with acids or reducing agent or reacts with non-metals

[Total: 6]

2 (a) (i) \( X(s) \leftrightarrow X(l) \) [1]

(ii) melting point/freezing point (of X) [1]

(iii) gas/gaseous or vapour [1]

(iv) not horizontal or line slopes or line is lower [1]
(b) (i) 14.3

(ii) \(85.7 \div 12\) and \(14.3 \div 1\) or \(7.14\) and \(14.3\) ratio 1:2

\[\text{CH}_2\]

**note:** Award all 3 marks for correct answer

**allow:** alternative working e.g.

\(85.7 \times 84 \div 100\) and \(14.3 \times 84 \div 100\) or \(71.988/72\) and \(12/12.012\)

\(6:12\) or ratio 1:2

\[\text{CH}_2\]

(iii) \(\text{C}_6\text{H}_{12}\)

[Total: 9]

3 (a) (i) 3

(ii) 70

(b) Add octane (or other liquid hydrocarbon) (to soot)

COND(on addition of any solvent) filter (to remove insoluble forms of carbon)

(allow to) evaporate or heat or warm or leave in sun (to get crystals of fullerene)

(c) (i) graphite

(ii) delocalised electrons/free electrons/sea of electrons

COND (on electrons) move/mobile/electrons flow

(iii) Any two from:

- potassium oxide
- potassium hydroxide
- potassium carbonate
- potassium hydrogen carbonate (bicarbonate)

[Total: 10]

4 (a) carbon dioxide/\(\text{CO}_2\)

(b) \(2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}\)

(c) (i) anode/negative electrode and electrons lost (by hydrogen/H/H\(_2\))/electrons move from this electrode

(ii) \(\text{H}_2 \rightarrow 2\text{H}^+ + 2e^- / \text{H}_2 - 2e^- \rightarrow 2\text{H}^+ / \text{H}_2 + 2\text{OH}^- \rightarrow 2\text{H}_2\text{O} + 2e^- / \text{H}_2 + 2\text{OH}^- - 2e^- \rightarrow 2\text{H}_2\text{O}\)

Species (1) Balancing (1)
(d) Any two from:

**CELL:**
- lightweight
- quieter
- fewer working parts/less maintenance
- more efficient or less energy wasted or more energy produced

**SUSTAINABILITY:**
- conserves a limited resource/petroleum/fossil fuels
- unlimited supplies of renewable resource(of hydrogen from water)

**POLLUTION:**
- No or less greenhouse effect
- No or less acid rain
- No or less toxic gases
- No or less smog

**POLLUTANTS:**
- No or less C/soot
- No or less CO₂
- No or less CO
- No or less SO₂
- No or less oxides of nitrogen/NO/NO₂/N₂O₄/NOₓ
- No or less (unburnt) hydrocarbons
- No or less low level ozone
- H₂O is the only product

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5 (a) (i) rate decreases
concentration of sodium chlorate ((I))/reactant decreases

(ii) (initial) gradient greater/steeper (must start at origin)
same final volume of oxygen

(iii) (to prevent) photochemical reaction/(to prevent) reaction catalysed by light/light breaks down or decomposes sodium chlorate((I))

(iv) particles have more energy/particles move faster/
more collisions
- collisions more frequent or more often/greater chance of collision/collision rate increases/more particles have energy to react/more collisions are successful or effective

(b) (i) \( 2Cl^- \rightarrow Cl_2 + 2e^- / 2Cl^- - 2e^- \rightarrow Cl_2 \) [1]

\[ 2H^+ + 2e^- \rightarrow H_2 / 2H^+ \rightarrow H_2 - 2e^- \] [1]

hydrogen formed at cathode/– and chlorine at anode/+ [1]

**Na⁺ and OH⁻ or sodium ions and hydroxide ions** left in solution/form/become sodium hydroxide [1]

(ii) \( Cl_2 + 2NaOH \rightarrow NaClO/NaOCl + NaCl + H_2O \) [2]
   Species (1) Balancing (1)

[Total: 14]
6 (a) Rb loses 1 electron/1 electron in outer shell/1 valency or valence electron [1]

Sr loses 2 electrons/2 electrons in outer shell/2 valency or valence electrons [1]

(b) (i) (mix solutions of) rubidium carbonate/Rb$_2$CO$_3$ [1]

strontium chloride/SrCl$_2$ or strontium nitrate/Sr(NO$_3$)$_2$ or strontium sulfate/SrSO$_4$ or strontium hydroxide/Sr(OH)$_2$ [1]

COND (on two correct reactants) filter or centrifuge or decant (the residue) [1]

wash with water and dry/press between filter paper/put in (low) oven/put on a (sunny) windowsill/put in sun/heat [1]

(ii) SrCO$_3$ → SrO + CO$_2$ [1]

(c) (i) rubidium nitrite or nitrate(III) [1]

(ii) 2Sr(NO$_3$)$_2$ → 2SrO + 4NO$_2$ + O$_2$ [2]

Species (1) Balancing (1)

[Total: 10]

7 (a) (i) butanoic/butyric acid [1]

displayed formula below [2]

(ii) any three from:

same or similar chemical properties
(same) general (molecular) formula
(consecutive members) differ by CH$_2$

same functional group
common methods of preparation
physical properties vary in predictable manner/show trends/gradually change

or example of a physical property variation i.e. melting point/boiling point/volatility [3]

(iii) dissociates/ionises/splits up (into ions) [1]

partially/incompletely/slightly/not fully [1]

(donates) protons/(forms) H$^+$/H$_3$O$^+$ (as the only positive ion) [1]
### (b) (i) methyl propanoate
\[
\text{CH}_3\text{CH}_2\text{COOCH}_3/\text{CH}_3\text{CH}_2\text{CO}_2\text{CH}_3/\text{C}_2\text{H}_5\text{COOCH}_3/\text{C}_2\text{H}_5\text{CO}_2\text{CH}_3
\]
[1]

(ii) methyl ethanoate
[1]

### (c) (i) \(3\text{C}_4\text{H}_{10} + 5\frac{1}{2}\text{O}_2 \rightarrow 4\text{C}_2\text{H}_5\text{COOH} + 3\text{H}_2\text{O}\)
[1]

(ii) propanol or propan-1-ol or propanal
[1]

[Total: 14]

### 8 (a) (changes from) blue (1) to pink (1)
[2]

(b) no more (solid) dissolves or no more cobalt(II) carbonate dissolves or no more effervescence or bubbling or fizzing
[1]

filter(residue)/centrifuge/decant
[1]

evaporate/heat/warm/boil/leave in sun AND until most of the water has gone/some water is left/until it is concentrated/saturation (point)/crystallisation point/crystals form on glass rod or microscope slide/crystals start to form
[1]

Leave/allow to cool/allow to crystallise/filter (off crystals)/wash(with distilled water)/dry crystals with filter paper/dry crystals in warm place or dry in oven or dry on windowsill
[1]

(c) number of moles of HCl in 50 cm\(^3\) of acid, concentration 2.2 mol/dm\(^3\) = 0.11
[1]

maximum number of moles of CoCl\(_2\).6H\(_2\)O which could be formed = 0.055
[1]

mass of 1 mole of CoCl\(_2\).6H\(_2\)O = 238 g
[1]

maximum yield of CoCl\(_2\).6H\(_2\)O = 13.09 g
[1]

percentage yield = 48.2\% or ecf mass of CoCl\(_2\).6H\(_2\)O above/13.09 \times 100\% to 1 dp
[1]

[Total: 10]