

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International General Certificate of Secondary Education

MARK SCHEME for the October/November 2014 series

0620 CHEMISTRY

0620/33

Paper 3 (Extended Theory), maximum raw mark 80

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.

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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

[1]

(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

[1]

Chemical: reducing agent **or** reduces metal oxides/named metal oxide **or** reacts with/burns in air/oxygen **or** forms an acidic oxide (CO_2) **or** valency/oxidation state of 2 or 4

[1]

(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

[1]

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

[1]

[Total: 6]

2 (a) (i) $\text{X(s)} \leftrightarrow \text{X(l)}$

[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]

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- (b) (i) 14.3
- (ii) $85.7 \div 12$ and $14.3 \div 1$ **or** 7.14 and 14.3
 ratio 1:2
 CH_2 [1]
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 [1]
 6:12 **or** ratio 1:2 [1]
 CH_2 [1]
- (iii) C_6H_{12} [1]

[Total: 9]

- 3 (a) (i) 3 [1]
 (ii) 70 [1]
- (b) Add octane (or other liquid hydrocarbon) (to soot) [1]
 COND(on addition of **any** solvent) filter (to remove insoluble forms of carbon) [1]
 (allow to) evaporate **or** heat **or** warm **or** leave in sun(to get crystals of fullerene) [1]
- (c) (i) graphite [1]
 (ii) delocalised electrons/free electrons/sea of electrons [1]
COND (on electrons) move/mobile/electrons flow [1]
- (iii) Any **two** from: [2]
 potassium oxide
 potassium hydroxide
 potassium carbonate
 potassium hydrogencarbonate (bicarbonate)

[Total: 10]

- 4 (a) carbon dioxide/ CO_2 [1]
- (b) $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$ [1]
- (c) (i) anode/negative electrode **and** electrons lost(by hydrogen/H/ H_2)/electrons move from this electrode [1]
- (ii) $\text{H}_2 \rightarrow 2\text{H}^+ + 2\text{e}^-$ / $\text{H}_2 - 2\text{e}^- \rightarrow 2\text{H}^+$ / $\text{H}_2 + 2\text{OH}^- \rightarrow 2\text{H}_2\text{O} + 2\text{e}^-$ / $\text{H}_2 + 2\text{OH}^- - 2\text{e}^- \rightarrow 2\text{H}_2\text{O}$ [2]
 Species (1) Balancing (1)

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(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:	<u>No or less</u> greenhouse effect <u>No or less</u> acid rain <u>No or less</u> toxic gases <u>No or less</u> smog	
POLLUTANTS:	<u>No or less</u> C/soot <u>No or less</u> CO ₂ <u>No or less</u> CO <u>No or less</u> SO ₂ <u>No or less</u> oxides of nitrogen/NO/NO ₂ /N ₂ O ₄ /NO _x <u>No or less</u> (unburnt) hydrocarbons <u>No or less</u> low level ozone H ₂ O is the only product	[2]

[Total: 7]

- 5 (a) (i) rate decreases [1]
concentration of sodium chlorate ((I))/reactant decreases [1]
- (ii) (initial) gradient greater/steeper (must start at origin) [1]
same final volume of oxygen [1]
- (iii) (to prevent)photochemical reaction/(to prevent)reaction catalysed by light/light breaks down or decomposes sodium chlorate((I)) [1]
- (iv) particles have more energy/particles move faster/ [1]
more collisions [1]
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 [1]
- (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]

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- 6 (a) Rb loses 1 electron/1 electron in outer shell/1 valency or valence electron
Sr loses 2 electrons/2 electrons in outer shell/2 valency or valence electrons
- (b) (i) (mix solutions of) rubidium carbonate/Rb₂CO₃ [1]
strontium chloride/SrCl₂ **or** strontium nitrate/Sr(NO₃)₂ **or** strontium sulfate/SrSO₄ **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) SrCO₃ → SrO + CO₂ [1]
- (c) (i) rubidium nitrite **or** nitrate(III) [1]
(ii) 2Sr(NO₃)₂ → 2SrO + 4NO₂ + O₂ [2]
Species (1) Balancing (1)

[Total: 10]

- 7 (a) (i) butanoic acid/butyric acid [1]
displayed formula below [2]
-

- (ii) any **three** from:
same or similar chemical properties
(same) general (molecular) formula
(consecutive members) differ by CH₂
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⁺/H₃O⁺(as the only positive ion) [1]

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- (b) (i) methyl propanoate
 $\text{CH}_3\text{CH}_2\text{COOCH}_3/\text{CH}_3\text{CH}_2\text{CO}_2\text{CH}_3/\text{C}_2\text{H}_5\text{COOCH}_3/\text{C}_2\text{H}_5\text{CO}_2\text{CH}_3$
- (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 $2.2 \text{ mol/dm}^3 = 0.11$ [1]

maximum number of moles of $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ which could be formed = 0.055 [1]

mass of 1 mole of $\text{CoCl}_2 \cdot 6\text{H}_2\text{O} = 238 \text{ g}$

maximum yield of $\text{CoCl}_2 \cdot 6\text{H}_2\text{O} = 13.09 \text{ g}$ [1]

percentage yield = 48.2% **or** ecf mass of $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ above/ $13.09 \times 100\%$ to 1 dp [1]

[Total: 10]