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.

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

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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 [1]

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) (X(s) ↔) 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 ÷ 12 and 14.3 ÷ 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 × 84 ÷ 100 and 14.3 × 84 ÷ 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) $2H_2 + O_2 \rightarrow 2H_2O$ [1]

(c) (i) anode/negative electrode **and** electrons lost(by hydrogen/H/H_2)/electrons move from this electrode [1]

(ii) $H_2 \rightarrow 2H^+ + 2e(^-)$ / $H_2 - 2e(^-) \rightarrow 2H^+$ / $H_2 + 2OH^- \rightarrow 2H_2O + 2e(^-)$ / $H_2 + 2OH^- - 2e(^-) \rightarrow 2H_2O$ [2]
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 CO_2
	No or less CO
	No or less SO_2
	No or less oxides of nitrogen/NO/NO_2/N_2O_4/NO_x
	No or less (unburnt) hydrocarbons
	No or less low level ozone
	H_2O 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]

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/Rb_2CO_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 <u>with water</u> **and** dry/press between filter paper/put in (low) oven/put on a (sunny) windowsill/put in sun/heat [1]

(ii) $SrCO_3 \rightarrow SrO + CO_2$ [1]

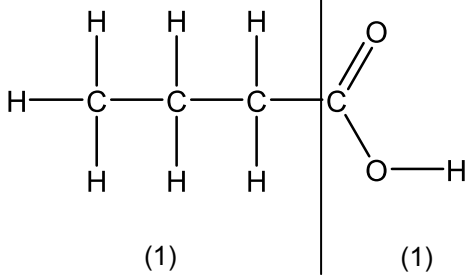
(c) **(i)** rubidium nitr**<u>ite</u>** or nitr**<u>ate(III)</u>** [1]

(ii) $2Sr(NO_3)_2 \rightarrow 2SrO + 4NO_2 + O_2$ [2]
Species (1) Balancing (1)

[Total: 10]

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

displayed formula below [2]



(1) (1)

(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_3O^+(as the only positive ion) [1]

(b) (i) methyl propanoate

$CH_3CH_2COOCH_3/CH_3CH_2CO_2CH_3/C_2H_5COOCH_3/C_2H_5CO_2CH_3$

(ii) methyl ethanoate [1]

(c) (i) $3C_4H_{10} + \mathbf{5\,½}\ O_2 \rightarrow 4C_2H_5COOH + \mathbf{3}\ H_2O$ [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 $CoCl_2.6H_2O$ which could be formed = 0.055 [1]

mass of 1 mole of $CoCl_2.6H_2O$ = 238 g

maximum yield of $CoCl_2.6H_2O$ = 13.09 g [1]

percentage yield = 48.2% **or** ecf mass of $CoCl_2.6H_2O$ above/13.09 × 100% to 1 dp [1]

[Total: 10]