

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

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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 (CO₂) **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) $X(s) \leftrightarrow X(l)$ [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]

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- (b) (i) 14.3 [1]
- (ii) $85.7 \div 12$ and $14.3 \div 1$ **or** 7.14 and 14.3 [1]
 ratio 1:2 [1]
 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:** 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/NO_x
No or less (unburnt) hydrocarbons
No or less low level ozone
H₂O 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 [1]
 Sr loses 2 electrons/2 electrons in outer shell/2 valency or valence electrons [1]
- (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 [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 $2.2 \text{ mol/dm}^3 = 0.11$ [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]