

**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<sup>-</sup> **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<sub>2</sub>) **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]

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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]  
 $\text{CH}_2$  [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]  
 $\text{CH}_2$  [1]
- (iii)  $\text{C}_6\text{H}_{12}$  [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/ $\text{CO}_2$  [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/ $\text{H}_2$ )/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 CO<sub>2</sub>  
No or less CO  
No or less SO<sub>2</sub>  
No or less oxides of nitrogen/NO/NO<sub>2</sub>/N<sub>2</sub>O<sub>4</sub>/NO<sub>x</sub>  
No or less (unburnt) hydrocarbons  
No or less low level ozone  
H<sub>2</sub>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<sup>+</sup> and OH<sup>-</sup> **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/Rb<sub>2</sub>CO<sub>3</sub> [1]  
 strontium chloride/SrCl<sub>2</sub> **or** strontium nitrate/Sr(NO<sub>3</sub>)<sub>2</sub> **or** strontium sulfate/SrSO<sub>4</sub> **or** strontium hydroxide/Sr(OH)<sub>2</sub> [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<sub>3</sub> → SrO + CO<sub>2</sub> [1]
- (c) (i) rubidium nitrite or nitrate(III) [1]  
 (ii) 2Sr(NO<sub>3</sub>)<sub>2</sub> → 2SrO + 4NO<sub>2</sub> + O<sub>2</sub> [2]  
 Species (1) Balancing (1)

[Total: 10]

- 7 (a) (i) butanoic acid/butyric acid [1]  
 displayed formula below [2]
- $$\begin{array}{ccccccc}
 & \text{H} & & \text{H} & & \text{H} & & \text{O} \\
 & | & & | & & | & & // \\
 \text{H} & - \text{C} & - & \text{C} & - & \text{C} & - & \text{C} \\
 & | & & | & & | & & \backslash \\
 & \text{H} & & \text{H} & & \text{H} & & \text{O} - \text{H} \\
 & & & (1) & & & & (1)
 \end{array}$$
- (ii) any **three** from:  
 same or similar chemical properties  
 (same) general (molecular) formula  
 (consecutive members) differ by CH<sub>2</sub>  
 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<sup>+</sup>/H<sub>3</sub>O<sup>+</sup>(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  $50 \text{ cm}^3$  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]