

**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**GCE Ordinary Level**

## **MARK SCHEME for the May/June 2013 series**

### **5070 CHEMISTRY**

**5070/22**

Paper 2 (Theory), maximum raw mark 75

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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- A1 (a)** sulfur [1]
- (b)** iron [1]
- (c)** calcium / iron / copper / zinc [1]
- (d)** carbon [1]
- (e)** barium [1]
- (f)** lithium / calcium / barium [1]

**[Total: 6]**

- A2 (a)** carbon dioxide being produced / greenhouse gas emissions / fossil fuels will run out / fossil fuels non-renewable / global warming / acid rain (1) [1]
- (b)**  $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$  (1) [1]  
**ALLOW:** correct multiples  
**IGNORE:** state symbols
- (c) (i)** Bond breaking absorbs energy and bond making releases energy / bond breaking is endothermic and bond making is exothermic (1)
- More energy is released than absorbed / less energy absorbed than released / endothermic energy change is less than the exothermic energy change / exothermic change greater than endothermic change (1) [2]
- (ii)** Product level below and to the right of the reactant level and labelled product or  $(6)\text{H}_2\text{O}$  /  $(6)\text{CO}_2$  (1)
- Correct energy hump drawn and near vertical arrow labelled activation energy (or  $E_a$ ) from reactant level to energy maximum (1)
- Correct labelled enthalpy change with near vertical arrow pointing downwards (1) [3]

**[Total: 7]**

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- A3 (a)** Aluminium has 3 valence electrons and iodine and bromine have 7 / Al has 3 outer electrons and iodine and bromine have 7 (1)

Aluminium loses electrons and iodine / bromine gain electron(s) (1) [2]

- (b)** In a solid, particles are arranged regularly **and** in liquid particles are irregularly arranged (1)

In solid particles are only vibrating **and** in liquid they are moving (or sliding over each other) (1)

**ALLOW:** no movement of particles in solid and moving in liquid [2]

- (c)** Correct dot-and-cross diagram with one pair of bonding electrons between I and Br and six non-bonding electrons on each atom (1) [1]

- (d)** Bromine (water) decolourised / bromine goes colourless bromine goes from orange to colourless (1) [1]

- (e) (i)** Low density [1]

- (ii)** It has an oxide layer / aluminium oxide is on the surface (1)

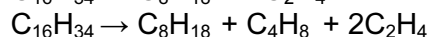
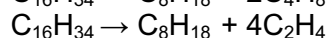
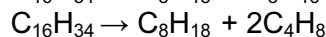
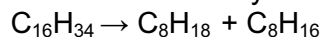
Layer is impermeable to water / layer is impermeable to air / layer is (fairly) resistant to acids / layer is (fairly) resistant to alkalis / layer is unreactive / layer does not flake off / layer adheres to the surface / layer is non-porous (1) [2]

**[Total: 9]**

- A4 (a)** Fractional distillation / fractionation (1)

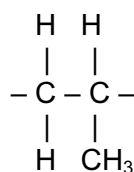
Boiling point (1) [2]

- (b)** TWO marks for any suitable equation correctly balanced showing alkene(s) as product e.g.



(Any equation showing  $\text{C}_8\text{H}_{18}$  as product and  $\text{C}_{16}\text{H}_{34}$  as reactant gains one mark.) [2]

- (c)** Correct section of polymer chain showing 1 or more repeating units and continuation bonds (2 marks) e.g.



1 mark if structure correct but no continuation bonds [2]

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(d) Ethene and steam /  $\text{C}_2\text{H}_4 + \text{H}_2\text{O(g)}$  (1)

High temperature / heat **and** catalyst / correct named catalyst e.g. phosphoric acid / acid (1)  
[2]

[Total:8]

**A5 (a)** Dividing % by mass by atomic mass

$$\text{N} = 12.0/14 \quad \text{H} = 3.4/1 \quad \text{O} = 41.0/16 \quad \text{V} = 43.6/51$$

or correct ratios arising from this

$$\text{N} = 0.857 \quad \text{H} = 3.4 \quad \text{O} = 2.56 \quad \text{V} = 0.855 \text{ (1 mark)}$$

Dividing correctly by smallest to give correct ratio:

$$\begin{array}{cccc} \text{N} = \frac{0.857}{0.855} & \text{H} = \frac{3.4}{0.855} & \text{O} = \frac{2.56}{0.855} & \text{V} = \frac{0.855}{0.855} \\ 1 & 4 & 3 & 1 \end{array} \text{ (1 mark)}$$

**OR**

$$\text{H} = \frac{4}{117} \times 100 \quad \text{O} = \frac{48}{117} \times 100 \quad \text{N} = \frac{14}{117} \times 100 \quad \text{V} = \frac{51}{117} \times 100$$

$$= 3.4\% \quad = 41\% \quad = 12\% \quad = 43.6\%$$

(2 marks)

(IF: 2 marks not obtained, 1 mark for 4, 48, 14 and 51) [2]

(b) (Solution is) coloured / not colourless [1]

(c)  $\text{NH}_4^+$  (1)

$\text{VO}_3^-$  (1) [2]

(d) (**X** is an) oxidising agent / oxidant (1)

the oxidation number of **iodine** increases / **iodide** loses electrons / **X** gains electrons (1) [2]

(e) Ammonia (1)

**ALLOW:**  $\text{NH}_3$

[1]

[Total: 8]

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**A6 (a)** Iron loses electrons (1) [1]

**(b)** Moles Fe =  $0.250 / 56$  **OR**  $0.00446$  mol (1)

Moles  $\text{CuSO}_4$  /  $\text{Cu}^{2+}$  ions / Cu  
 =  $0.100 \times 25 / 1000$  **OR**  $0.0025$  mol (1)

Iron (because there are more moles) (1)

**NOTE:** answer dependent on a calculation showing moles of Fe and moles of  $\text{CuSO}_4$  /  $\text{Cu}^{2+}$  ions / Cu [3]

**(c)** Blue solution becomes (pale) green (1)

(Iron gets coated with) pink solid / pink solid formed (1)

**ALLOW:** brown solid in place of pink solid

**NOTE:** both solid **and** colour required for mark [2]

**(d)** There is a reaction because copper is more reactive than silver / there is a reaction because silver is less reactive than copper

**NOTE:** both reaction **and** reason required [1]

**[Total: 7]**

**B7 (a)** Suitable method of collecting and measuring gas connected to a reaction vessel with correct label for the measuring vessel e.g. gas syringe / upturned burette over water / upturned measuring cylinder over water with tube connected to flask (1)

Apparatus gas tight and workable (1) [2]

**(b) (i)**  $\text{Mg}(\text{OH})_2 + 2\text{HCl} \rightarrow \text{MgCl}_2 + 2\text{H}_2\text{O}$  (1)

$\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$  (1) [2]

**(ii)** Volume of  $\text{CO}_2 = 96$  ( $\text{cm}^3$ ) (1)

Moles  $\text{CO}_2 = 0.004 / 4 \times 10^{-3}$  (mol) (1) [2]

**(iii)**  $M_r \text{CaCO}_3 = 100$  (1)

$(0.004 \times 100) = 0.40$  (g) /  $0.4$  (g) (1) [2]

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- (c) Reaction faster because particles are closer / rate increases because the particles are more crowded / more particles in a given volume (1)

**NOTE:** mark cannot be scored if there is no mention of particles / types of particles e.g. only refer to HCl

More collisions per second / more frequent collisions / particles collide more often / more chances of collisions (1) [2]

**[Total: 10]**

- B8 (a)** OH / hydroxy(l) (1) [1]

- (b) Propanol / propan-1-ol / propan-2-ol (1) [1]

- (c) (ii)  $C_nH_{2n+1}OH$  (1)  
**ALLOW:**  $C_nH_{2n+2}O$  [1]

- (ii)  $C_{10}H_{22}O$  (1)  
**ALLOW:**  $C_{10}H_{21}OH$  [1]

- (d) Melting point does not have a trend (down the series) but density does / melting point increases then decreases but density increases (1)

**NOTE:** there must be reference to both density and melting point [1]

- (e) Butyl ethanoate (1)

Correct structure showing all atoms and bonds (1)



- (f) Potassium dichromate(VI) / potassium dichromate /  $Cr_2O_7^{2-}$  (1)  
**ALLOW:** potassium permanganate / potassium manganate(VII) /  $MnO_4$

Warm / heat / distil / boil / reflux with an acid (1)

**NOTE:** both acid **and** heat required for the mark [2]

- (g) Any **two** of:  
carbon, carbon monoxide, water [1]

**[Total: 10]**

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- B9 (a) (i)** (Reaction is) slower because particles are moving slower / rate decreases because particles have less energy (1)

There are fewer successful collisions / fewer particles have energy greater than activation energy / less chance of successful collisions / less effective collisions / less fruitful collisions / less energy collisions(1) [2]

- (ii)** (Goes to) left (1)

**ALLOW:** reaction goes to the left / greater concentration of reactants / lower concentration of products / more methane and water / reactant side is favoured

(Because) the reaction is endothermic

**ALLOW:** the reaction shifts to the exothermic side / the reaction shifts to the side which releases heat (1) [2]

- (b)** Shifts to left (1)

**ALLOW:** reaction goes to the left / greater concentration of reactants / lower concentration of products / more methane and water / reactant side is favoured

(Because) there are fewer moles on reactant side / more moles on product side / fewer moles of methane and water / more moles of hydrogen and carbon monoxide (1) [2]

- (c) (i)** None / does not change it / nothing / no effect (1) [1]

- (ii)** Lowers the activation energy (1) [1]

- (d)** (Moles of) CO = (560 / 28) = 20 (mol) (1)

Energy = (210 × 20) = 4200 (kJ) (1) [2]

**[Total:10]**

- B10(a) (i)** Mg<sup>2+</sup> and O<sup>2-</sup> (1) [1]

- (ii)** Stronger attraction between the ions / stronger forces between the ions / stronger ionic bonds / higher charges / stronger electrostatic attractions / stronger electrostatic forces / smaller ions (1)

**ALLOW:** its ionic bonding is stronger [1]

- (b) (i)** At 600 °C it is solid so ions cannot move / at 600 °C ions are in fixed position in a solid (1)  
**NOTE:** reference needed to solid as well as lack of movement of ions

At 1000 °C it is molten/ liquid so ions can move / at 1000 °C it is molten/ liquid so ions are mobile / At 1000 °C it is molten/ liquid because the ions are free (1)

**NOTE:** reference needed to temperature, liquid/ solid as well as movement of ions [2]

- (ii)**  $2Cl^- \rightarrow Cl_2 + 2e^-$  /  $2Cl^- - 2e^- \rightarrow Cl_2$   
**ALLOW:** multiples and  $Cl^- \rightarrow \frac{1}{2} Cl_2 + e^-$  [1]

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- (c) (i)  $\text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \rightarrow \text{AgCl}(\text{s})$   
 Correct formulae and balance (1)  
 Correct state symbols for  $\text{Ag}^+$ ,  $\text{Cl}^-$  and  $\text{AgCl}$   
 dependent on the correct formulae (1) [2]

- (ii)  $M_r \text{AgCl} = 143.5$  and  $M_r \text{NaCl} = 58.5$  (1)

Moles  $\text{AgCl} = (0.232 / 143.5) = 0.00162$  (1)

**ALLOW:** ecf from incorrect  $M_r$

Mass of  $\text{NaCl} = (0.00162 \times 58.5) = 0.0948(\text{g})$  (1) [3]

**[Total: 10]**