

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

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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) $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ (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 $(6)H_2O$ / $(6)CO_2$ (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.
- $$\text{C}_{16}\text{H}_{34} \rightarrow \text{C}_8\text{H}_{18} + \text{C}_8\text{H}_{16}$$
- $$\text{C}_{16}\text{H}_{34} \rightarrow \text{C}_8\text{H}_{18} + 2\text{C}_4\text{H}_8$$
- $$\text{C}_{16}\text{H}_{34} \rightarrow \text{C}_8\text{H}_{18} + 4\text{C}_2\text{H}_4$$
- $$\text{C}_{16}\text{H}_{34} \rightarrow \text{C}_8\text{H}_{18} + \text{C}_4\text{H}_8 + 2\text{C}_2\text{H}_4$$
- (Any equation showing C_8H_{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.
- $$\begin{array}{c} \text{H} \quad \text{H} \\ | \quad | \\ -\text{C} - \text{C}- \\ | \quad | \\ \text{H} \quad \text{CH}_3 \end{array}$$
- 1 mark if structure correct but no continuation bonds [2]

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(d) Ethene and steam / $C_2H_4 + H_2O(g)$ (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

$N = 12.0/14$ $H = 3.4/1$ $O = 41.0/16$ $V = 43.6/51$

or correct ratios arising from this

$N = 0.857$ $H = 3.4$ $O = 2.56$ $V = 0.855$ (1 mark)

Dividing correctly by smallest to give correct ratio:

$N = \frac{0.857}{0.855}$ $H = \frac{3.4}{0.855}$ $O = \frac{2.56}{0.855}$ $V = \frac{0.855}{0.855}$
 1 4 3 1 (1 mark)

OR

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

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

(2 marks)

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

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

(c) NH_4^+ (1)

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: 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 CuSO₄ / Cu²⁺ ions / Cu
= 0.100 × 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 CuSO₄ / Cu²⁺ 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) Mg(OH)₂ + 2HCl → MgCl₂ + 2H₂O (1)

CaCO₃ + 2HCl → CaCl₂ + CO₂ + H₂O (1) [2]

(ii) Volume of CO₂ = 96 (cm³) (1)

Moles CO₂ = 0.004 / 4 × 10⁻³ (mol) (1) [2]

(iii) M_r CaCO₃ = 100 (1)

(0.004 × 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 $HC\dot{l}$

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)** Mg²⁺ and O²⁻ (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 Ag^+ , Cl^- and 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]