

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

**MARK SCHEME for the May/June 2012 question paper
for the guidance of teachers**

5070 CHEMISTRY

5070/21

Paper 2 (Theory), maximum raw mark 75

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- A1 (a)** Ammonia (1) [1]
- (b)** Propene / sulfur dioxide (1) [1]
- (c)** Oxygen (1) [1]
- (d)** Neon (1) [1]
- (e)** Nitrogen / sulfur dioxide (1) [1]
- (f)** Chlorine (1) [1]
- (g)** Nitrogen / carbon monoxide (1) [1]

[Total: 7]

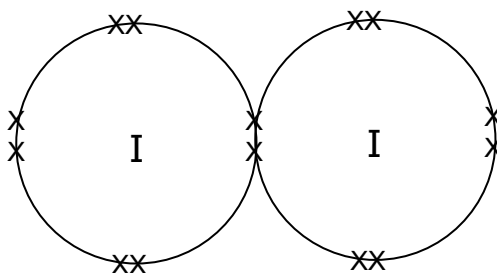
- A2 (a) (i)** SO₂ (1) [1]
- (ii)** Mole ratio sulfur : oxygen is 1.25 : 3.75 (1)
Empirical formula is SO₃ (1) [2]
- (iii)** Water/steam (1) [1]
- (iv)** Iron(III)/Fe³⁺ (1) [1]
- (b) (i)** Iron(II) hydroxide [1]
- (ii)** Fe²⁺(aq) + 2OH⁻(aq) → Fe(OH)₂(s)
Balanced equation (1)
Correct state symbols – dependent on correct formulae (1) [2]

[Total: 8]

- A3 (a)** No free electrons / no delocalised electrons / no sea of electrons / all electrons are in covalent bonds / electrons cannot move (1) [1]
- (b)** Molecules gain (kinetic) energy (1)
Allow particles move faster
Not atoms gain energy
Overcome intermolecular forces / break attraction between molecules (1)
Ignore weak forces between particles
Not break covalent bonds [2]

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- (c) Correct structure – ignore inner shells (1)



Allow all crosses or all dots

[1]

- (d) (i) At^- (1)

[1]

(ii) element	colour	state
Cl_2		gas
Br_2	orange	liquid
I_2	grey / black	

Correct states (1)

Correct colour (1)

Allow red / brown for bromine

[2]

- (iii) Black solid / dark grey solid (1)

[1]

- (e) (i) (colourless to) yellow solution / straw solution / brown solution / dark grey solid (1)

[1]

- (ii) $\text{Cl}_2 + 2\text{I}^- \rightarrow \text{I}_2 + 2\text{Cl}^-$
Ignore state symbols

[1]

- (f) Astatine is less reactive than iodine / astatine is less oxidising than iodine / iodide is a better reducing agent than astatide (1)

Ignore reference to reactivity series

[1]

[Total: 11]

A4 (a) (i) ion	electron configuration	protons	neutrons
$^{24}_{12}\text{Mg}^{2+}$	2.8	12	12
$^{16}_8\text{O}^{2-}$	2.8	8	8

Electron configurations (1)

Numbers of protons (1)

Numbers of neutrons (1)

[3]

- (ii) Magnesium loses two electrons and oxygen gains two electrons / two electrons transferred from magnesium to oxygen (1)

[1]

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- (b) Many (electrostatic) attractions between ions / many (ionic) bonds / giant structure (1)
Not intermolecular forces
Not covalent bonds for the first mark
 large amount of energy to separate the ions / needs lots of energy to break the (ionic) bonds /
 hard to break (ionic) bonds / high temperature needed to break (ionic) bonds / lots of energy to
 break the ionic lattice / bonds are strong (1)
Ignore large amount of energy to break forces
Allow strong forces of attraction between ions [2]

- (c) Use of any aqueous sulfate including dilute sulfuric acid (1)
 Filter reaction mixture (1)
 Wash residue with water (1)
 Air dry residue / put residue into oven (1)
Allow leave the residue to dry [4]

[Total: 10]

- A5 (a) Copper, nickel, iron and magnesium (1) [1]

- (b) Any **two** from:
 Pink solid (1)
 (Blue solution) becomes colourless / becomes pale green (1)
Allow the blue colour becomes paler
 temperature increases (1) [2]

- (c) (i) Exothermic (1) [1]

- (ii) $3\text{Cu}^{2+} + 2\text{Al} \rightarrow 2\text{Al}^{3+} + 3\text{Cu}$
Ignore state symbols [1]

- (d) (Surface) layer of aluminium oxide (1)
 Which does not flake off / acts as a protective barrier / which is impermeable to water / does
 not allow water or air to reach surface of aluminium (1) [2]

- (e) Moles of Mo = 10417 (1)
 Mass of Al = 562500g / 0.5625 tonnes (1)
Allow answer to 2 sig figs up to calculator value [2]

[Total: 9]

- B6 (a) NaCl / Na₂SO₄ / KCl / K₂SO₄ / CaCl₂ / CaSO₄ / MgCl₂ / MgSO₄ (1)
Allow NaHCO₃ / KHCO₃ / Ca(HCO₃)₂ / Mg(HCO₃)₂ [1]

- (b) 0.0276 (1) [1]

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- (c) Moles of Cl^- in $1 \text{ dm}^3 = 0.535$ / mass in $25 \text{ cm}^3 = 0.475 \text{ g}$ (1)
 Moles in $25 \text{ cm}^3 = 0.0134$ (1)
 Mass of $\text{AgCl} = 1.92 \text{ g}$ (1) [3]

- (d) Desalination / reverse osmosis (1)
Allow distillation [1]

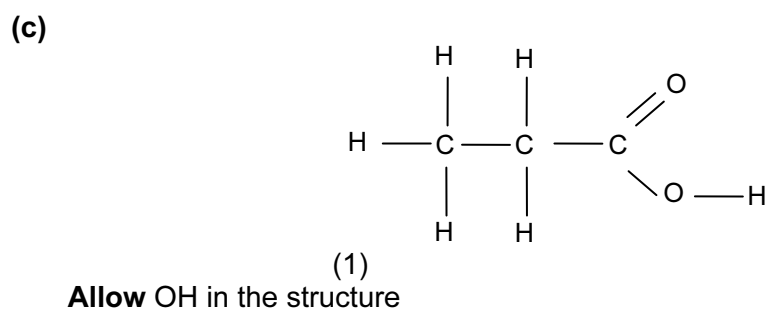
- (e) (i) OH^- (aq) (1)
 $\text{pH} = 7.9$ indicates alkaline / pH above 7 is alkaline / this ion is present in all alkaline solutions (1)
Allow seawater is alkaline / seawater has a pH above 7 [2]

- (ii) Add universal indicator / pH (indicator) paper (1)
Allow use of pH indicator
 Idea of matching colour against a pH chart / idea that the colour indicates the pH (1) [2]

[Total: 10]

- B7 (a) Any **two** from
 Same general formula / members vary by a CH_2 group (1)
 Same functional group / similar chemical properties (1)
Not a group of elements
Allow have same reactions
 gradation of physical properties (1) [1]

- (b) Butanoic acid (1)
Allow methylpropanoic acid [1]

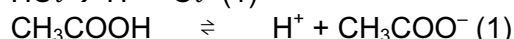
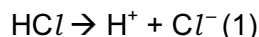


- (d) $\text{C}_7\text{H}_{14}\text{O}_2$ (1)
Allow $\text{C}_6\text{H}_{13}\text{COOH}$ [1]

- (e) Boiling points all increase / boiling points shows a trend
And
 melting point increase and decreases / melting point is irregular down the series / melting point does not show a trend / melting points fluctuate (1) [1]

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- (f) Any **two** from
strong acid fully dissociates **and** weak acid partially dissociates (1)



Ignore state symbols

Ignore incorrect equations

[2]

- (g) $\text{CaCO}_3(\text{s}) + 2\text{CH}_3\text{COOH}(\text{aq}) \rightarrow \text{Ca}(\text{CH}_3\text{COO})_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$

Correct equation (1)

Correct state symbols – dependent on formula (1)

[2]

[Total: 10]

B8 (a) (i) 10 (1)

[1]

- (b) In solid ions cannot move/no free ions (1)

Ignore electrons cannot move

Not electrons can move

In solution ions can move/free ions (1)

Allow particles can move in solution but not in a solid

[2]

- (c) anode equation involves oxidation since electrons are lost/hydroxide ion is oxidised because it loses electrons/oxygen is oxidised because its oxidation increases (1)

Note Must be a clear link between the equation, gain and loss of electrons and oxidation and reduction.

Ignore wrong oxidation numbers

cathode equation involves reduction since electrons are gained/water is reduced because it gains electrons/hydrogen is reduced because its oxidation number reduces (1)

[2]

- (d) (i) Bond breaking takes in energy and bond forming releases energy (1)

Allow bond forming is exothermic and bond breaking is endothermic

less energy is released than taken in (1)

[2]

- (ii) Moles of oxygen = 104.2 (1)

Moles of water = 208.3 (1)

Mass of water = 3750 g (1)

[3]

[Total: 10]

B9 (a) Position of equilibrium moves to the right/shifts forward/shifts towards the products / forward reaction favoured (1)

because the (forward) reaction is endothermic (1)

[2]

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- (b) Speed increases
 because particles are more crowded / more concentrated (particles) / more particles per unit volume / particles are closer together (1)
 more collisions per second / more chance of collision / more frequent collisions (1) [2]
- (c) Any **two** from:
 Increases rate of reaction (1)
Allow reduces the reaction time
 Allows reaction to take place at a lower temperature / saves energy (1)
Allow reduces the activation energy
 so saves energy resources (1) [2]
- (d) Moles of hydrogen = 50 0000 (1)
 Energy = 35 000 000 kJ (1) [2]
- (e) unsaturated fat (1)
 High pressure / nickel catalyst (1)
Allow unsaturated oil / fats with a carbon-carbon double bond [2]

[Total: 10]