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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UNIVERSITY of CAMBRIDGE
International Examinations

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)** SO_2 (1) [1]

(ii) Mole ratio sulfur : oxygen is 1.25 : 3.75 (1)
Empirical formula is SO_3 (1) [2]

(iii) Water / steam (1) [1]

(iv) Iron(III) / Fe^{3+} (1) [1]

(b) **(i)** Iron(II) hydroxide [1]

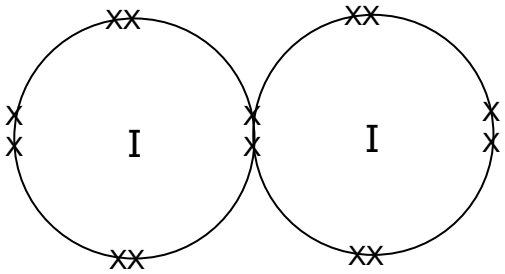
(ii) $Fe^{2+}(aq) + 2OH^-(aq) \rightarrow Fe(OH)_2(s)$
Balanced equation (1)
Correct state symbols – dependent on correct formulae (1) [2]

[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]

(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) $Cl_2 + 2I^- \rightarrow I_2 + 2Cl^-$
Ignore state symbols [1]

(f) Astatine is less reactive than iodine / astatine is less oxidising that 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
$^{24}_{12}Mg^{2+}$	2.8	12	12
$^{16}_{8}O^{2-}$	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]

(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) $3Cu^{2+} + 2Al \rightarrow 2Al^{3+} + 3Cu$
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 = 562500 g / 0.5625 tonnes (1)
Allow answer to 2 sig figs up to calculator value [2]

[Total: 9]

B6 (a) $NaCl / Na_2SO_4 / KCl / K_2SO_4 / CaCl_2 / CaSO_4 / MgCl_2 / MgSO_4$ (1)
Allow $NaHCO_3 / KHCO_3 / Ca(HCO_3)_2 / Mg(HCO_3)_2$ [1]

(b) 0.0276 (1) [1]

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

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

(e) **(i)** OH^- (aq) (1)
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]

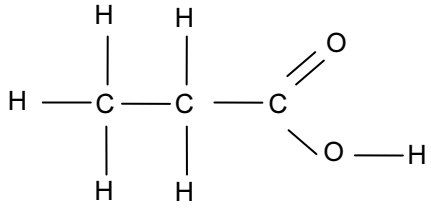
(ii) Add universal indicator / pH (indicator) paper (1)
Allow use of pH indicator
Idea of matching colour against a pH chart / idea that the colour indicates the pH (1) [2]

[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]

(c)



(1)
Allow OH in the structure [1]

(d) $C_7H_{14}O_2$ (1)
Allow $C_6H_{13}COOH$ [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]

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

$HCl \rightarrow H^+ + Cl^-$ (1)
$CH_3COOH \rightleftharpoons H^+ + CH_3COO^-$ (1)
Ignore state symbols
Ignore incorrect equations [2]

(g) $CaCO_3(s) + 2CH_3COOH(aq) \rightarrow Ca(CH_3COO)_2(aq) + H_2O(l) + CO_2(g)$
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]

(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]