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

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.

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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)** 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)
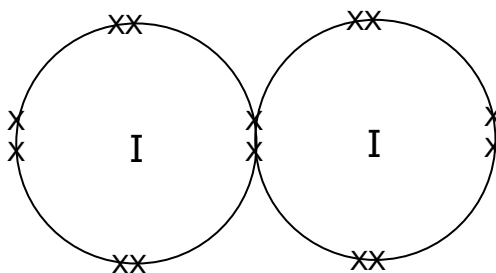
   Allow all crosses or all dots [1]

(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)
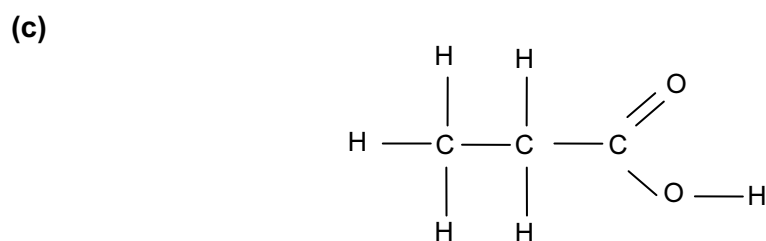
(1)
Allow OH in the structure   [1]

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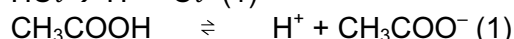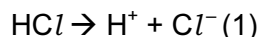
$HCl \rightarrow H^+ + Cl^-$ (1)
$CH_3COOH \rightleftharpoons H^+ + CH_3COO^-$ (1)
Ignore state symbols
Ignore incorrect equations   [2]

(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]