UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

MARK SCHEME for the May/June 2011 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 **Allow** correct name but formula takes precedence

(a) V_2O_5 (1)

(b) $ZnSO_4$ (1) [1]

(c) AgI (1) [1]

(d) CF_3Cl_3 (1) [1]

(e) $(NH_4)_2SO_4$ / $ZnSO_4$ (1) [1]

(f) CH_4 (1) [1]

(g) $(NH_4)_2SO_4$ (1) [1]

[Total: 7]

A2 **(a)** sulfur dioxide (1)
Allow SO_2 [1]

(b) copper(II) sulfate (1)
Allow $CuSO_4$ [1]

(c) $H^+ + OH^- \rightarrow H_2O$ (1)
Ignore state symbols [1]

(d) **(i)** Copper(II) hydroxide (1)
Allow $Cu(OH)_2$ [1]

(ii) $Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s)$
Balanced equation (1)
Correct state symbols (1) [2]

(e) Mol ratio Cu:O = $\frac{79.9}{64} : \frac{20.1}{16}$ / 1.25 : 1.26 (1)
CuO (1) [2]

[Total: 8]

A3 (a) (i) same number of electrons / same number of protons / same electron arrangement of electrons / both have 92 electrons / both have 92 protons (1)

(ii) different number of neutrons / uranium-238 has three more neutrons (1) [2]

(b) (i) $UO_2 + 4HF \rightarrow UF_4 + 2H_2O$ (1) [1]

(ii) $UF_4 + 2Mg \rightarrow U + 2MgF_2$ (1) [1]

(iii) reaction involving gain of electrons / reaction involving decrease in oxidation number (1)
Allow a reaction involving the loss of oxygen / gain of hydrogen [1]

(iv) M_r of UO_2 = 270 (1)
Moles of UO_2 = 3704 (1) **Allow** ecf from wrong M_r
Mass of uranium = 0.881 tonnes (1) **Allow** ecf from wrong moles
Correct answer scores **all three** marks

OR
Alternative approach using percentage composition
M_r of UO_2 = 270 (1)
% of U = 88.1% (1) **Allow** ecf from wrong M_r
Mass of uranium = 0.881 tonnes (1) **Allow** ecf from wrong percentage [3]

(c) between magnesium and copper (1) [1]

[Total: 9]

A4 **(a)** All covalent bond pairs shown (1)
Rest of structure correct (1)
Ignore inner shell electrons of oxygen

(b) Must be a **comparison** in both marking points
Particles in a gas are moving faster than particles in a liquid (1)
Particles in a gas are further apart than those in a liquid (1) [2]

(c) Particles in pure hydrogen peroxide are more crowded / closer together / more particles per unit volume / particles are more concentrated (1)
So more collisions per second / increased collision frequency / collisions more often / more chance of collision / collisions more likely (1) [2]

(d) **(i)** $Fe^{2+} \rightarrow Fe^{3+} + e^{-}$ (1)
Allow $Fe^{2+} - e^{-} \rightarrow Fe^{3+}$
Allow e instead of e^{-} [1]

(ii) Add sodium hydroxide (solution) / (aqueous) Ammonia / add (aqueous) hydroxide ions (1)
Should be a brown-rust ppt (1) [2]

(e) (Colour change of $KMnO_4$ shows) it is a reducing agent / it can be oxidised (1)
(Colour change of KI shows) it is an oxidising agent / it can be reduced (1) [2]

[Total: 11]

A5 **(a)** 78–79 % (1) [1]

(b) Fractional distillation (1)
of liquid air / liquefy air (1)
because (the components of air have) different boiling points (1) [3]

(c) Idea that carbon cycle involves photosynthesis and respiration (1)
Photosynthesis decreases carbon dioxide and increases oxygen / green plants change carbon dioxide into oxygen (1)
And
any two from
Respiration increases carbon dioxide and decreases oxygen (1)
Combustion increases carbon dioxide and decreases oxygen (1)
Decomposition (of living things) increases carbon dioxide (1) [4]

(d) Used in flue-gas desulfurisation / removal of sulfur dioxide from gaseous emissions of power station / absorbs the sulfur dioxide / neutralises (acidic) sulfur dioxide (1)
Added to lakes to neutralise acidic water (1) [2]

[Total: 10]

B6 **(a)** Calcium nitrate solution contains ions / AW (1)
Pentane only contains molecules / pentane is a covalent compound / pentane d contain ions (1)

(b) Sodium and chlorine (1)
Allow Na and Cl_2 [1]

(c) Hydrogen, chlorine (and sodium hydroxide) (1)
Allow H_2, Cl_2 (and NaOH) [1]

(d) Electrolyte is aluminium oxide (dissolved in cryolite) / alumina (1)
Graphite electrodes / Carbon electrodes (1) [2]

(e) **(i)** Gets plated with copper (1)
$Cu^{2+} + 2e^- \rightarrow Cu$ (1) [2]

(ii) 1.21 (g) [1]

(iii) 1.75 (g) [1]

[Total: 10]

B7 **(a)** Propanol / propan-1-ol / propan-2-ol (1) [1]

(b) $CH_3CH_2CH_2CH_2OH$ / $CH_3CH_2CHOHCH_3$ (1)
Only contains (C—C) single bonds (1)
Allow there are no (carbon-carbon) double bonds [2]

(c) $C_7H_{16}O$ (1)
Allow $C_7H_{15}OH$ [1]

(d) **(i)** $CH_3COOC_2H_5$ (1) [1]

(ii) Solvent (1)
Allow flavouring / perfume [1]

(e) $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$ (1)
Use of yeast (1)
Any temperature or range of temperature within 20–40 °C / absence of oxygen / anaerobic conditions / presence of water / Fractional distillation (to separate ethanol) (1)
Ignore incorrect reactants this has been assessed by the equation [3]

(f) Ethene / C_2H_4 (1) [1]

[Total: 10]

B8 (a) (i) Position of equilibrium moves to the right (1)
Allow make more CH_3COOH
Because the reaction is exothermic / to release energy (1) This mark is dependa... the position of equilibrium moves to the right [

(ii) Reaction is faster / activation energy is very high (1) [1]

(b) Labelled products to the right and below reactants (1)
Correct labelled activation energy for the forward reaction (1)
Allow double headed arrow head / arrow without any heads
Not arrow in wrong direction
Correct labelled enthalpy change (1)
Not arrow in wrong direction / double headed arrow
Note – arrows do not have to start exactly at reactant level and finish exactly at product or maximum of curve
Maximum of **two** marks for an error carried forward for a reaction that is endothermic i.e. enthalpy change mark and activation energy [3]

(c) Lowers the activation energy (1)
Allow more effective collisions / more successful collisions [1]

(d) Maximum moles that can be made is 10 / limiting reactant is the carbon monoxide (1)
98% (1) [2]

(e) $CH_3CO_2NH_4$ (1) [1]

[Total: 10]

B9 (a) Only partially dissociates / does not completely ionise (1) [1]

(b) Use universal indicator (1)
Idea that the different colours indicate different pH values / match colour against a colour chart (1)
Allow this mark even for an incorrect indicator [2]

(c) Moles of sulfamic acid = $\frac{0.105}{97}$ / 0.00107 (1)

Moles of KOH = $\frac{10.8}{1000}$ × 0.100 / 0.00108 (1)

so reacts with one mole (1) [3]

(d) (i) $Mg + 2SO_3NH_3 \rightarrow Mg(SO_3NH_2)_2 + H_2$ (1) [1]

(ii) $CaCO_3 + 2SO_3NH_3 \rightarrow Ca(SO_3NH_2)_2 + H_2O + CO_2$ (1)
Forms carbon dioxide / bubbles (1)
Allow carbon dioxide from the equation [2]

(e) Nitrogen (1) [1]

[Total: 10]