UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

MARK SCHEME for the October/November 2010 question paper for the guidance of teachers

5070 CHEMISTRY

5070/22 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) (i) potassium / K [1]

(ii) aluminium / A*l* [1]

(iii) iron / Fe [1]

(iv) magnesium / Mg [1]

(v) silver / Ag [1]
ALLOW: symbols such as Ag, Fe etc.

(b) positive ions regularly arranged; [1]
ALLOW: space between ions as long as the arrangement is regular
ALLOW: ions touching
ALLOW: positively charged atoms for + ions
ALLOW: large empty circles in regular arrangement and labelled as positive ions

electrons shown as negative charges between the ions; [1]
ALLOW: very small empty circles between the ions and labelled electrons
ALLOW: electrons within very small circles / electrons as e^- or e or –
IGNORE: disparity between ionic charges and number of electrons
NOT: electrons as negative charges in large circles
NOTE: mark independently

[Total: 7]

A2 (a) (i) glucose; [1]
ALLOW: other suitable sugars e.g. sucrose
ALLOW: sugar
IGNORE: carbohydrate

(ii) any **two** from: [2]
temperature within range 20–40°C;
IGNORE: temperatures below 20°C
REJECT: high temperature / temperatures above 40°C

lack of oxygen / lack of air / anaerobic
REJECT: oxygen needed

yeast
IGNORE: bacteria / fungi / enzymes / catalyst / zymase

water present / in solution / moisture present / damp
REJECT: dry

pH neutral
REJECT: acid / alkali

IGNORE: pressure
IGNORE: optimum pH / temperature etc.

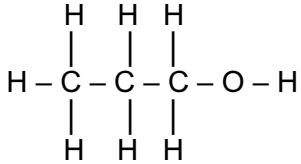
(b) $C_2H_4 + H_2O \rightarrow C_2H_5OH$ [1]
ALLOW: displayed / graphical formulae
ALLOW: C_2H_6O for ethanol
IGNORE: state symbols

(c) (i) ethyl ethanoate / ethyl acetate [1]

(ii) esterification / addition-elimination / condensation / ester formation; [1]
ALLOW: reversible / equilibrium (reaction)
IGNORE: exothermic / endothermic
REJECT: addition alone

(d) (i) propanol; [1]

(ii)



[1]

ALLOW: structure of propan-2-ol
ALLOW: –OH in place of –O–H

[Total: 8]

A3 (a) 12.5 cm^3 / min [1]
both value AND units must be correct for one mark

(b) all the zinc was used up / there was no zinc left / zinc is limiting; [1]
IGNORE: the zinc no longer reacted / zinc finished reacting / all the zinc dissolved

(c) (i) line steeper from the 0-0 point AND ending at the same level (40 cm^3) [1]

(ii) lowers the activation energy / makes the reaction go by a more efficient pathway / makes the reaction go by faster pathway; [1]
ALLOW: makes the reaction go by a different pathway
IGNORE: supplies activation energy / increases speed of reaction

(d) goes slower / speed decreases / smaller surface area (with larger pieces) / less area exposed (with larger pieces); [1]
ALLOW: (reaction) takes more time
IGNORE: goes slowly / small surface area
REJECT: goes slower at the start + larger surface area for larger pieces

fewer collisions per minute / fewer particles exposed to react per minute / particles collide less often / frequency of collisions decreased / collision rate lower / chance of collisions decreases; [1]
Answer must be comparative e.g. NOT: few collisions per minute

(e) any **two** from: [2]

- increases / goes faster
  ALLOW: (reaction) takes less time
  NOT: goes fast

- particles have more energy (at higher temperature) / particles move faster (at higher temperature) / particles collide faster / collision rate increases;
  IGNORE: particles vibrate more
  NOTE: must have reference to particles or named particles

- more particles have activation energy / more chance of successful collisions / more collisions are successful

[Total: 8]

A4 (a) molecule containing two atoms / two atoms joined (by bond) / atoms in A pairs; [1]
ALLOW: has two atoms
IGNORE: two atoms / two atomic / mention of states / mention of same or different elements / made of two elements / elements with two atoms / 2 atoms of itself combined

(b) (i) gets darker / chlorine green bromine red (or brown or red-brown) and iodine grey-black or grey or black
ALLOW: goes from green to black or from yellow (F_2) to black [1]
NOT: iodine dark brown / silver
NOT: colour increases / gets more intense
REJECT: chloride / bromide / iodide (instead of halogens)

(ii) bromine – liquid; (1)
iodine – solid (1) [2]

(c) (i) $Br_2 + 2I^- \rightarrow 2Br^- + I_2$ [1]
IGNORE: state symbols / K^+ ions

(ii) add (aqueous) silver nitrate / (aqueous) lead nitrate; (1)
ACCEPT: formulae
REJECT starch test alone / addition of chlorine alone
REJECT: if incorrect acid added

yellow precipitate; (1) [2]
(both yellow and precipitate needed for mark)
NOTE: second mark dependent on correct reagent.

(iii) chlorine more reactive than bromine (or reverse argument) [1]
NOT: chloride more reactive than bromine

(d) H^+ / H_3O^+ and Cl^- (both needed for the mark) [1]
ALLOW: H^+ / H_3O^+ ,Cl^- and OH^-
ALLOW: correct answer as part of equation e.g. $HCl \rightarrow H^+ + Cl^-$
ALLOW: H^+Cl^-

(e) moles HCl = 0.015 × 6/1000 OR 9×10^{-5} ; (1)
moles $Ca(OH)_2$ = ½ those of moles HCl; (4.5×10^{-5}) (1)
ALLOW: any indication of correct 1:2 ratio
molarity of $Ca(OH)_2 = 4.5 \times 10^{-5} \times 1000/20 = 2.25 \times 10^{-3}$ (mol / dm^3) (1)
ALLOW: correct answer without working / 2.3×10^{-3} (mol / dm^3)
ALLOW: Use of $\frac{V_1M_1}{V_2M_2}$ with correct figures e.g. $\frac{20 \times M_1}{0.015 \times 6}$ (1 mark)
correct use of 1:2 ratio e.g. for the above ½ = V_1M_1 / V_2M_2 (1 mark)
correct answer (1 mark) [3]

[Total: 12]

A5 (a) (i) 1 mark for each pair of matching descriptions up to max of 2 marks [2]

- diamond: atoms closely packed
  graphite: layers / atoms less closely packed /

- diamond: each atom joined to 4 other atoms
  graphite: each atom joined to 3 others
  ALLOW: (atoms in) diamond form more bonds than graphite

- diamond: atoms arranged tetrahedrally / in a pyramid / in bent hexagons /
  ALLOW: in triangles
  graphite: atoms arranged in hexagons / rings / layers

- diamond: <u>all</u> atoms connected (by covalent bonds)/
  graphite: some atoms (i.e. those between layers) not connected (by covalent bonds)

- graphite: had intermolecular forces / van der Waal's forces
  diamond doesn't / has strong forces or bonds throughout

- diamond has no free moving electrons / no delocalised electrons / all electrons involved in bonding
  graphite has (some) delocalised / mobile electrons

(ii) in graphite the <u>layers</u> can slide / weak forces between the <u>layers</u> / intermolecular forces between the <u>layers</u>; [1]

in diamond there is continuous 3 dimensional structure of (covalent) bonds / covalent bonds are linked in all directions / (strong) bonding in all directions / <u>all</u> atoms in fixed positions [1]
ALLOW: <u>all</u> the atoms are bonded together
REJECT: ionic structure

(b) (i) oxygen removed from the tin oxide / it loses oxygen / carbon takes oxygen away; [1]
ALLOW: oxidation number of tin (in tin oxide) decreases / tin (in tin oxide) gains electrons
ALLOW: tin loses oxygen /
NOT: wrong oxidation numbers / electron gain without qualification

(ii) it is poisonous / toxic; [1]
IGNORE: kills red blood cells / stops red blood cells carrying oxygen / combines with haem
IGNORE: harmful / causes pollution / dangerous / hazardous

(c) (i) $CO_2 + C \rightarrow 2CO$ [1]
IGNORE: state symbols

(ii) 6 electrons shared between C and O; (1)

2 non bonding electrons on outer shell of oxygen and 2 non bonding electrons on outer shell of carbon (1) [2]
REJECT: 0 non bonding electrons on outer shell of oxygen and 4 non bonding electrons on outer shell of carbon
IGNORE: dots / crosses
IGNORE: inner shell electrons
NOTE: mark these points independently

(iii) CrC_6O_6 [1]
ALLOW: $Cr(CO)_6$

[Total: 10]

B6 (a) plants absorb CO_2 from atmosphere / plants take up CO_2 in photosynthesis; (1)
ALLOW: plants use carbon dioxide

CO_2 given out in respiration; (1)
ALLOW: carbon dioxide breathed out in animals

Amount of CO_2 given out (in respiration) equal to that absorbed (in photosynthesis) / idea of (roughly) equal uptake and release of carbon dioxide; (1) [3]
ALLOW: carbon dioxide given out in balance with carbon dioxide taken up

(b) (i) any two possible consequences (1 mark for each) e.g. [2]

- sea level rise / flooding of low lying land /
  ALLOW: floods
  NOT: increase in water level
- climate change / extreme weather / increased rainfall /
  NOT: weather unpredictable
- desertification / <u>more</u> forest fires / <u>more</u> droughts /
- melting of glaciers / melting of polar ice caps / melting icebergs
  NOT: increase in temperature / greenhouse effect skin cancers

(ii) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ [1]
ALLOW: multiples
IGNORE: state symbols

(iii) substitution (by chlorine) / reaction with chlorine (in the light) /
ALLOW: suitable word equation or symbol equation [1]
REJECT: addition reaction

(c) (i) larger / longer / heavier / molecules have higher boiling points; [1]
ALLOW: higher boiling point when more carbon atoms (in molecule)
IGNORE: the boiling points increase / they get higher
IGNORE: higher boiling point with more bonds / reference to intermolecular forces / melting points / 'bond' breaking between molecules

(ii) high temperature / heat; [1]
ALLOW: quoted temperatures between 300°C–800°C

EITHER:
Catalyst / named catalyst e.g. aluminium oxide / silicon dioxide / zeolites [1]
ALLOW: porous pot / ceramics
REJECT: incorrect catalyst
OR:
high pressure / quoted pressure between 50-200 atmospheres

[Total: 10]

B7 (a) in solid ions can't move / ions in fixed position / no free ions / ions are in a lattice; [1]
IGNORE: there are no ions / reference to electrons

when molten ions can move / ions are free to move / are mobile; [1]
ALLOW: ions are free
IGNORE: ions moving in solution
REJECT: reference to electrons moving (in addition to ions moving) /

(b) anode: chlorine AND cathode: zinc [1]
ALLOW: Cl_2 / Cl / Zn
ALLOW: correct products from equation (need not be balanced)
REJECT: Cl^- / chloride / Zn^{2+}

(c) $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$ [2]
1 mark for correct reactants and products (OH^-, O_2 and H_2O)
1 mark for correct balance with electrons
ALLOW: multiples in both cases
ALLOW: e for e^-

(d) add (aqueous) sodium hydroxide / other suitable hydroxide / (aqueous) ammonia; (1)
NOT: hydroxide alone

<u>white precipitate</u>; (1)

precipitate soluble in excess (hydroxide or ammonia) / dissolves in excess / gives colourless solution in excess (1) [3]

(e) correct formula masses 136 for $ZnCl_2$ AND 204 for $Zn(NH_3)_4Cl_2$ (1)
correct answer (3.4 × 204/136) = 5.1 (g) (1) [2]
ALLOW: error carried forward from <u>one</u> incorrect formula mass

[Total: 10]

B8 (a) (i) magnesium oxide and hydrogen (both required) [1]
ALLOW: correct formula of products
IGNORE: incorrect equation

(ii) $2CH_3COOH + Mg \rightarrow (CH_3COO)_2Mg + H_2$ [2]
1 mark for correct reactants and products
1 mark for balance (dependent on correct reactant and products)

(b) any **three** from: [3]

- add hydrochloric acid to (excess) magnesium carbonate;
  REJECT: this first mark if titration suggested
- filter (off excess carbonate);
- heat filtrate or solution to crystallisation point / evaporate off (some of) the water from the filtrate / leave in a warm place / leave to crystallise;
  NOT: heat / dry it / put it in the oven / let all water evaporate
- pick out crystals / filter off crystals / dry crystals on filter paper

(c) (thermal) decomposition [1]
ALLOW: endothermic

(d) (i) height or strength of Bunsen flame /
ALLOW: temperature of Bunsen / temperature / amount of energy (applied) / distance of Bunsen flame from tube / amount of carbonate in the tube /
ALLOW: volume of carbonate in tube / mass of carbonate / same amount of limewater in tube [1]
ALLOW: same size of (carbonate) particles
IGNORE: pressure

(ii) order of decomposition is copper (carbonate) > zinc (carbonate) > magnesium (carbonate); (1)
ALLOW: copper carbonate takes shortest time and magnesium carbonate takes longest time / copper carbonate the fastest and magnesium carbonate the slowest

the less reactive (the metal), the faster the rate (of decomposition) /
the more reactive (the metal) the slower the rate (of decomposition) /
the more reactive (the metal) the longer it takes (to decompose) / (1) [2]
ALLOW: the most reactive takes the most time ORA

[Total: 10]

B9 (a) (i) burning fossil fuels / burning named fossil fuel / volcanoes / smelting sulfide ores; [1]
IGNORE: gases from exhausts / factory chimneys / power stations / burning sulfur / decomposition of fossil fuels

(ii) any suitable e.g. [1]
- erosion of buildings / statues (made of carbonate rocks / limestone)/
  IGNORE: erosion of rocks / destroys building / dissolves stones
  ALLOW: corrosion of buildings / damages buildings
- corrosion of metal structures / bridges etc. /
  ALLOW: erosion of metal structures etc.
- forest death / crop loss / reduction in plant growth / do not grow properly
  NOT: kills plants (in stem of question) / destroys trees
- soil acidification / leaching from soil

(b) (i) $CaCO_3(s) + H_2SO_4(aq) \rightarrow CaSO_4(aq) + CO_2(g) + H_2O(l)$ [2]
1 mark for balanced equation
1 mark for correct state symbols (dependent on correct formulae)
ALLOW: $CaSO_4(s)$

(ii) Any suitable use e.g. [1]
(making) paints / (making) dyes / (making) plastics / (making) fertilisers / (making) fibres / (making) soaps / (making) detergents / cleaning metals / oil refining / waste water processing / removing rust
ALLOW: for adjusting pH of the soil / making soil less alkaline / car batteries / catalyst /
IGNORE: general chemical used in the lab / dehydrating agent

(iii) completely ionised / completely dissociated; [1]
ALLOW: the hydrogen ion is fully ionised / completely ionises the hydrogen ions
IGNORE: low pH / has more hydrogen ions

(c) air AND sulfur (both needed) [1]
ALLOW: oxygen and sulfur
ALLOW: sulfide ore in place of sulfur

(d) (i) enthalpy change [1]
ALLOW: heat change / amount of energy released or absorbed / heat of reaction / energy change
IGNORE: exothermic / thermal energy / amount of energy released / amount of energy absorbed / enthalpy

(ii) reaction goes to left / favours the reactants / reverse reaction occurs / amount of product decreases; (1)

(because) the reaction is exothermic; (1) [2]
ALLOW: goes to the side which is endothermic

[Total: 10]