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

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UNIVERSITY of CAMBRIDGE
International Examinations

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.

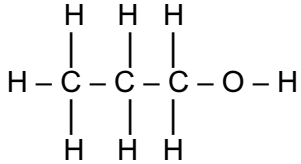
(b) $C_2H_4 + H_2O \rightarrow C_2H_5OH$ [1]
ALLOW: displayed / graphical formulae
ALLOW: C_2H_6O for ethanol
IGNORE: state symbols

(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]