

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 / Al [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<sup>-</sup> 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]**

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**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)**

$$\begin{array}{ccccccc}
 & H & H & H & & & \\
 & | & | & | & & & \\
 H & - C & - C & - C & - O & - H \\
 & | & | & | & & & \\
 & H & H & H & & & 
 \end{array}$$

[1]

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

**[Total: 8]**

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- A3 (a)**  $12.5 \text{ cm}^3 / \text{min}$  [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 ( $40 \text{ cm}^3$ ) [1]
- (ii)** lowers the activation energy / makes the reaction go by a more efficient pathway / [1]  
makes the reaction go by faster pathway;  
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 [1]  
exposed (with larger pieces);  
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 [1]  
collide less often / frequency of collisions decreased / collision rate lower / chance of collisions decreases;  
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]

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- 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 [1]  
ALLOW: goes from green to black or from yellow ( $F_2$ ) to black  
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  $HCl = 0.015 \times 6/1000$  OR  $9 \times 10^{-5}$ ; (1)  
moles  $Ca(OH)_2 = \frac{1}{2}$  those of moles  $HCl$ ; ( $4.5 \times 10^{-5}$ ) (1)  
ALLOW: any indication of correct 1:2 ratio  
molarity of  $Ca(OH)_2 = 4.5 \times 10^{-5} \times 1000/20 = 2.25 \times 10^{-3} \text{ (mol / dm}^3\text{)}$  (1)  
ALLOW: correct answer without working /  $2.3 \times 10^{-3} \text{ (mol / dm}^3\text{)}$   
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  $\frac{1}{2} = V_1M_1 / V_2M_2$  (1 mark)  
correct answer (1 mark) [3]

**[Total: 12]**

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**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: all 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 layers can slide / weak forces between the layers / intermolecular forces between the layers; [1]

in diamond there is continuous 3 dimensional structure of (covalent) bonds / covalent bonds are linked in all directions / (strong) bonding in all directions / all atoms in fixed positions [1]  
ALLOW: all 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

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(c) (i)  $\text{CO}_2 + \text{C} \rightarrow 2\text{CO}$  [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)  $\text{CrC}_6\text{O}_6$  [1]  
ALLOW:  $\text{Cr}(\text{CO})_6$

[Total: 10]

B6 (a) plants absorb  $\text{CO}_2$  from atmosphere / plants take up  $\text{CO}_2$  in photosynthesis; (1)  
ALLOW: plants use carbon dioxide

$\text{CO}_2$  given out in respiration; (1)  
ALLOW: carbon dioxide breathed out in animals

Amount of  $\text{CO}_2$  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 / more forest fires / more droughts /
- melting of glaciers / melting of polar ice caps / melting icebergs  
NOT: increase in temperature / greenhouse effect skin cancers

(ii)  $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$  [1]  
ALLOW: multiples  
IGNORE: state symbols

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

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- (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

white precipitate; (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  $(3.4 \times 204/136) = 5.1$  (g) (1) [2]  
 ALLOW: error carried forward from one incorrect formula mass

[Total: 10]



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- B8 (a) (i)** magnesium oxide and hydrogen (both required) [1]  
ALLOW: correct formula of products  
IGNORE: incorrect equation
- (ii)**  $2\text{CH}_3\text{COOH} + \text{Mg} \rightarrow (\text{CH}_3\text{COO})_2\text{Mg} + \text{H}_2$  [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 OR

**[Total: 10]**

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- 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)**  $\text{CaCO}_3(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{CaSO}_4(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$  [2]  
 1 mark for balanced equation  
 1 mark for correct state symbols (dependent on correct formulae)  
 ALLOW:  $\text{CaSO}_4(\text{s})$
- (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]