

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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- 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⁻ 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 cm³ / 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 cm³) [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]

Page 5	Mark Scheme: Teachers' version	Syllabus	Paper
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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 (F₂) to black
NOT: iodine dark brown / silver
NOT: colour increases / gets more intense
REJECT: chloride / bromide / iodide (instead of halogens)
- (ii)** bromine – liquid; (1) [2]
iodine – solid (1)
- (c) (i)** $\text{Br}_2 + 2\text{I}^- \rightarrow 2\text{Br}^- + \text{I}_2$ [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⁺ / H₃O⁺ and Cl⁻ (both needed for the mark) [1]
ALLOW: H⁺ / H₃O⁺, Cl⁻ and OH⁻
ALLOW: correct answer as part of equation e.g. $\text{HCl} \rightarrow \text{H}^+ + \text{Cl}^-$
ALLOW: H⁺Cl⁻
- (e)** moles HCl = $0.015 \times 6/1000$ 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 / dm³) (1)
ALLOW: correct answer without working / 2.3×10^{-3} (mol / dm³)
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

Page 7	Mark Scheme: Teachers' version	Syllabus	Paper
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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) CrC_6O_6 [1]
 ALLOW: $\text{Cr}(\text{CO})_6$

[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 / 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 ORA

[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]