

**MARK SCHEME for the May/June 2009 question paper  
for the guidance of teachers**

<b>5070 CHEMISTRY</b> 5070/02      Paper 2 (Theory), maximum raw mark 75
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Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE O LEVEL – May/June 2009	5070	02

### Section A

- A1 (a)** Vanadium(V) oxide /  $V_2O_5$  / vanadium oxide ; [1]  
 NOT:  $MnO_2$   
 ALLOW: vanadium
- (b)** copper(II) chloride /  $CuCl_2$  / copper chloride / copper ; [1]
- (c)** ethanoic acid / ethanoic / correct formula ; [1]
- (d)** potassium dichromate(VI) / (potassium) dichromate / correct formula ; [1]  
 NOT: potassium
- (e)** chlorine / (potassium) dichromate(VI) / manganese(IV) oxide ; [1]  
 ALLOW: (concentrated) sulfuric acid

[Total: 5]

- A2 (a)** weak forces between layers / van der Waals forces between layers ; [1]  
 ALLOW: weak bonds between layers  
 NOT: the forces are weak / has weak forces between atoms  
 NOT: no forces / bonds between layers  
 NOT: has layers and weak forces  
 NOT: weak forces between molecules  
 NOT: weak electrostatic forces between layers
- layers can slide / slip ; [1]  
 NOT: atoms slide over each other
- (b)** no mobile / no moving electrons / no delocalised electrons / [1]  
 (all) electrons in covalent bonds ;  
 ALLOW: no free electrons / no sea of electrons  
 IGNORE: no ions
- (c)** Any two of: [2]
- hard  
 IGNORE: strong / tough
  - high melting point  
 IGNORE: high boiling point
  - lots of strong (covalent) bonds  
 ALLOW: giant structure of strong bonds  
 ALLOW: has strong bonds throughout  
 ALLOW: all the bonds are difficult to break / takes a lot of energy to break all the bonds  
 ALLOW: ideas of all the atoms held together strongly  
 NOT: has covalent bonds / has strong bonds (without qualification)  
 NOT: rigid arrangement of tetrahedral structure  
 NOT: strong forces of attraction between atoms / strong electrostatic forces

[Total: 5]

Page 3	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE O LEVEL – May/June 2009	5070	02

- A3 (a) (i)** anode: oxygen / O<sub>2</sub> ; [1]  
NOT: O  
cathode: copper / Cu ; [1]  
ions: H<sup>+</sup>, OH<sup>-</sup>, SO<sub>4</sub><sup>2-</sup> ; [1]  
(all three needed for the mark)
- (ii)** hydrogen lower in reactivity series (than sodium) / [1]  
hydrogen lower in discharge series (than sodium) /  
easier to reduce hydrogen ions (than sodium) /  
hydrogen ions gain electrons more easily ;  
ALLOW: it is lower in reactivity series  
NOT: hydrogen is easier to discharge (than sodium)
- (iii)** chloride ions lower in discharge series than hydroxide ions/ [1]  
idea of selective discharge of chloride ions/  
chloride ion concentration greater than hydroxide ion concentration ;  
NOT: reference to chlorine / chlorine ions  
NOT: lower in discharge series than oxygen  
NOT: chloride ions lower in reactivity than hydroxide
- (b) (i)** purification of copper/ [1]  
making high grade copper/  
IGNORE: uses of copper / for coating metals / for electroplating
- (ii)** temperature: no effect / no change [1]  
current: increasing current increases mass (of copper) ORA [1]  
ALLOW: mass proportional to current  
ALLOW: increase of 1 amp doubles the mass  
time: increasing time increases mass (of copper) ORA [1]  
ALLOW: mass proportional to time  
ALLOW: with the passage of time mass increases

[Total: 9]

- A4 (a)** Charges: neutron = 0 / zero / none **AND**  
proton = + / plus 1 / +1 ; [1]
- Relative mass: electron = 0 / negligible / 1/1840 / 1/2000 / 0.0005 **AND**  
neutron = 1 / one [1]
- (b)** <sup>11</sup><sub>5</sub>B [2]  
1 mark for correct nucleon and proton number as shown ;  
1 mark for correct symbol ;
- (c)** 5 electrons in two shells **AND** 5 protons shown ; [1]  
number of neutrons other than 6 ; [1]  
ALLOW: between 3 and 10 neutrons

[Total: 6]

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE O LEVEL – May/June 2009	5070	02

**A5 (a)** each of 4 chlorine atoms bonded to carbon by pair of electrons ; [1]  
rest of structure correct i.e. 6 unbonded electrons on each chlorine ; [1]

**(b)**  $\text{Ca}^{2+}$  as 2,8,8 and  $\text{Cl}^-$  as 2,8,8 in diagram or as numbers ; [1]  
correct charges at top right of each structure ; [1]  
ALLOW: correct ions shown as  $\text{Ca}^{2+}$  and  $\text{Cl}^-$

[Total: 4]

**A6 (a)**  $\text{KNO}_3$  /  $\text{Ca}(\text{NO}_3)_2$  /  $\text{Fe}(\text{NO}_3)_2$  ; [1]

**(b)** acidic because  $\text{H}^+$  / hydrogen ions present ; [1]  
(both acidic and hydrogen ions needed)  
NOT: hydrogen and nitrate ions

**(c)** moles =  $25 \times 0.450 = 11.25$  / 11.3 / 11 ; [1]  
mass =  $56 \times 11.25 = 630$  (g) ; [1]

**(d)** (grey-) green precipitate ; [1]  
of iron(II) hydroxide ; [1]  
NOT: iron(III) hydroxide / ppt of iron / ppt due to iron(II) ions  
white precipitate / ppt of calcium hydroxide formed ; [1]  
ALLOW: idea of calcium hydroxide precipitate masked / cannot be seen  
NOT: white ppt dissolves in excess

**(e)** add (excess) sodium hydroxide (solution) ; [1]  
add aluminium / Dervarda's alloy ; [1]  
heat / warm ; [1]  
gas given off turns (moist) red litmus blue/ [1]  
ALLOW: ammonia gas given off /  
NOT: smelly gas given off  
NOTE: this mark is consequential on both the reagents Al and sodium hydroxide being correct

**OR**

mix solution with (freshly made) iron(II) sulfate (solution) ; (1 mark)  
add concentrated sulfuric acid ; (1 mark)  
idea of making layer of sulfuric acid over the solution / idea of two layers ; (1 mark)  
brown ring (at interface) ; (1 mark)  
NOTE: this mark is consequential on both the reagents being correct but sulfuric acid does not have to be concentrated

[Total: 11]

Page 5	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE O LEVEL – May/June 2009	5070	02

- A7 (a)** correct structure of chloroethene ; [1]  
ALLOW: CH<sub>2</sub>=CHCl  
NOT: CH<sub>2</sub>CHCl
- (b) (i)**  $2 - C_2H_3Cl + 5O_2 \rightarrow 2HCl + 4CO_2 + 2H_2O$  [1]  
ALLOW: multiples / fractions
- (ii)** calcium chloride ; [1]  
ALLOW: CaCl<sub>2</sub>
- (c)** correct name of condensation polymer ; [1]  
correct use of the named polymer ; [1]  
e.g. nylon (1)  
clothing / fishing lines / fishing nets / ropes / stockings / parachutes / toothbrush  
(bristles) / balloons / guitar strings / racquet strings / petrol tanks (1)  
IGNORE: fibres without qualifications  
polyester / terylene / mylar / PET (1)  
terylene: clothing / sheets / pillowcases / furniture coverings / curtains / carpets /  
ropes / sails / machinery belts  
PET: bottles and any of the above  
mylar: balloons  
polyester: any of the above (1)  
IGNORE: fibres without qualifications  
Kevlar (1)  
bullet proof vests / canoes / racquets / car tyres (as composite) (1)  
IGNORE: fabrics / textiles / fibres without qualifications

[Total: 5]

Page 6	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE O LEVEL – May/June 2009	5070	02

### Section B

- B8 (a)** crude oil / petroleum heated in fractionating column / idea of fractional distillation ; [1]  
 NOT: ideas of simple distillation / reference to distillation in the lab  
 Any one of:
- separated according to different boiling point (from other fractions) / fractions have different boiling points / has specific range of boiling points ;  
 NOT: incorrect references to petrol e.g. petrol has the lowest boiling points so comes off at the top
  - separated according to size of molecules (from other fractions) / fractions have different chain lengths ;
  - petrol made by cracking of long chained hydrocarbons / gas oil / kerosene ;
  - equation showing cracking [1]
- (b) (i)** 10 800 g / 10.8 kg [1]
- (ii)** moles carbon dioxide =  $10\,800 / 44 = 245.45$  ; [1]  
 moles octane =  $245.45 / 8 = 30.68$  ; [1]  
 ALLOW: 1 mark for showing division of moles of carbon dioxide by 8 or  $16/2 M_r$  of octane 114 ; [1]  
 Mass of octane =  $114 \times 30.68 = 3497.5$  (g) / 3498 (g) / 3500 (g) [1]  
 ALLOW: 1 mark for multiplying moles of octane by 114 with correct answer for that calculation.
- (c)** CO converted to carbon dioxide ; [1]  
 NO / nitrogen oxide(s) converted to nitrogen ; [1]  
 ALLOW:  $\text{CO} + \text{NO} \rightarrow \text{CO}_2 + \frac{1}{2}\text{N}_2 = 2$  marks (even if not correctly balanced)
- (d)** acid rain / effect of acid rain/ smog ; [1]  
 IGNORE: breathing difficulties / irritation of nose and throat

[Total: 10]

<b>Page 7</b>	<b>Mark Scheme: Teachers' version</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>GCE O LEVEL – May/June 2009</b>	<b>5070</b>	<b>02</b>

- B9 (a)** Any three of: (1 mark each) [3]
- have general formula / each member differs by CH<sub>2</sub> group / by *M<sub>r</sub>* of 14
  - have same functional group
  - have similar chemical properties
  - physical properties show a trend / example of physical property showing trend e.g. boiling points increase with longer carbon chain
- (b) (i)** any value between 105 and 130°C (actual = 117°C) [1]
- (ii)** C<sub>6</sub>H<sub>13</sub>OH [1]
- (c) (i)** C<sub>2</sub>H<sub>4</sub> + H<sub>2</sub>O → C<sub>2</sub>H<sub>5</sub>OH [1]  
 IGNORE: state symbols
- (ii)** addition [1]  
 ALLOW: hydration / additional  
 NOT: exothermic
- (d)** use of moles e.g. 180 g glucose → 2 × 46 or 92 g ethanol [1]  
**OR**  
 100 moles glucose (18000 / 180) → 200 moles ethanol ;
- theoretical yield calculated e.g. 18 kg glucose → 9.2 kg ethanol [1]  
**OR**  
 200 × 46 = 9200 g ethanol ;
- % yield calculated e.g. 100 × 0.92/9.2 = 10% ; [1]

**[Total: 10]**

<b>Page 8</b>	<b>Mark Scheme: Teachers' version</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>GCE O LEVEL – May/June 2009</b>	<b>5070</b>	<b>02</b>

**B10(a)** Correct  $M_r$  values:  $(\text{NH}_4)_2\text{SO}_4 = 132$  **AND**  $\text{KNO}_3 = 101$  ; [1]

% N in  $(\text{NH}_4)_2\text{SO}_4$   $(2 \times 14 / 132) = 21.2\% / 21.21\%$  ; [1]

**OR**

mass of N in 500 g =  $500 \times 28/132 = 106.1$  g

% N in  $\text{KNO}_3$   $(14 / 101) = 13.9\% / 13.86\%$  ; [1]

**OR**

Mass N in 500 g  $\text{KNO}_3 = 500 \times 14/ 101 = 69.3$  g

overall percentage =  $17.6\% / 17.5(5)\%$  ; [1]

ALLOW: 18 %

**(b)** Any **three** from: (one mark each) [3]

- rapid growth of algae / water weeds / algal bloom

ALLOW: rapid growth of (green) plants

NOT: plants grow, unqualified (must be increased/ rapid etc)

- blocks (sun)light so plants die

- bacterial growth increases

- bacteria use up oxygen

NOT: algae / plants use up oxygen

- aquatic life dies / aquatic animals die / fish die because of lack of oxygen

NOT: marine organisms die

**(c)** add potassium carbonate solution / potassium hydroxide (solution) ; [1]

titration / description of titration **AND** repeat titration without indicator ; [1]

ALLOW: titration with indicator then remove indicator with charcoal

crystallise / description of crystallisation **AND** dry with filter paper / [1]

evaporate off some water **AND** dry in oven / put in oven to allow evaporation of water /

allow water to evaporate completely / boil off all the water

**[Total: 10]**



Page 9	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE O LEVEL – May/June 2009	5070	02

- B11(a) (i)** Electrons lost/ oxidation number (of iron) increases / oxidation number goes from 0 to +2 ; [1]  
 NOT: incorrect oxidation numbers
- (ii)**  $\text{Fe}^{2+}(\text{aq}) + 2\text{OH}^{-}(\text{aq}) \rightarrow \text{Fe}(\text{OH})_2(\text{s})$  [2]  
 correct balanced equation = 1 mark  
 correct state symbols = 1 mark  
 (mark for state symbols dependent on correct formulae)
- (b) (i)** stops water from getting to the surface (of the iron) / [1]  
 stops oxygen getting to surface (of the iron) /  
 stops oxygen / water getting to the iron /  
 stops air getting to the iron /  
 ALLOW: acts as a protective barrier / layer  
 NOT: ideas about sacrificial protection  
 NOT: tin does not react with water / air / tin less reactive than iron
- (ii)** with tin: oxygen / water can react with the iron (where it is scratched) ; [1]  
 NOT: iron more reactive than tin  
 with zinc any **two** of: [2]
- zinc more reactive than iron  
 NOT: zinc oxide protective layer
  - zinc is sacrificial metal / idea of sacrificial protection i.e. zinc corrodes more readily than iron / zinc reacts first  
 NOT: zinc rusts more readily than iron
  - zinc loses electrons more readily than iron  
 NOT: zinc displaces iron
- (c)** has layer of (aluminium) oxide that will not flake off / [1]  
 layer of insoluble / unreactive (aluminium) oxide /  
 layer of impermeable (aluminium) oxide / protective oxide layer /  
 NOT: oxide coating without further qualification  
 NOT: forms a protective layer with oxygen
- (d)** correct use ; [1]  
 e.g. drink cans / car bodies / aircraft bodies / high voltage electricity cables /  
 cooking foil / window frames / ladders /  
 ALLOW: cooking utensils / mirrors (as does not corrode)  
 NOT: for cutlery
- correct explanation related to specific use stated ; [1]  
 e.g. drinks cans → will not react with water / acids  
 car bodies → will not corrode  
 aircraft bodies → lightweight / low density  
 electricity cables → lightweight / good conductor of electricity

[Total: 10]