

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
GCE Ordinary Level

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

5070 CHEMISTRY

5070/02

Paper 2 (Theory), maximum raw mark 75

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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]

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- A3 (a) (i)** anode: oxygen / O_2 ; [1]
 NOT: O
 cathode: copper / Cu ; [1]
 ions: H^+ , OH^- , SO_4^{2-} ; [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)** ${}^{11}_5B$ [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]

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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) Ca^{2+} as 2,8,8 and 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 Ca^{2+} and Cl^-

[Total: 4]

A6 (a) KNO_3 / $\text{Ca}(\text{NO}_3)_2$ / $\text{Fe}(\text{NO}_3)_2$; [1]

(b) acidic because 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]

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- A7 (a)** correct structure of chloroethene ; [1]
ALLOW: $\text{CH}_2=\text{CHCl}$
NOT: CH_2CHCl
- (b) (i)** $2 - \text{C}_2\text{H}_3\text{Cl} + 5\text{O}_2 \rightarrow 2\text{HCl} + 4\text{CO}_2 + 2\text{H}_2\text{O}$ [1]
ALLOW: multiples / fractions
- (ii)** calcium chloride ; [1]
ALLOW: CaCl_2
- (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]

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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]

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- B9 (a)** Any three of: (1 mark each) [3]
- have general formula / each member differs by CH_2 group / by M_r 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)** $\text{C}_6\text{H}_{13}\text{OH}$ [1]
- (c) (i)** $\text{C}_2\text{H}_4 + \text{H}_2\text{O} \rightarrow \text{C}_2\text{H}_5\text{OH}$ [1]
IGNORE: state symbols
- (ii)** addition [1]
ALLOW: hydration / additional
NOT: exothermic
- (d)** use of moles e.g. 180 g glucose $\rightarrow 2 \times 46$ or 92 g ethanol [1]
OR
100 moles glucose (18000 / 180) $\rightarrow$ 200 moles ethanol ;
- theoretical yield calculated e.g. 18 kg glucose $\rightarrow$ 9.2 kg ethanol [1]
OR
 $200 \times 46 = 9200$ g ethanol ;
- % yield calculated e.g. $100 \times 0.92/9.2 = 10\%$; [1]

[Total: 10]

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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 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]

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- 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]