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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UNIVERSITY of CAMBRIDGE
International Examinations

Section A

A1 **(a)** Vandium(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 <u>between layers</u> / van der Waals forces <u>between layers</u> ; [1]
ALLOW: weak bonds <u>between layers</u>
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

<u>layers</u> 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
- <u>lots of</u> <u>strong</u> (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]

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 chlor***ine*** / chlor***ine*** 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) $^{11}_{5}B$ [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]

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 / $Ca(NO_3)_2$ / $Fe(NO_3)_2$; [1]

(b) acidic because H^+ / hydrogen ions present ; [1]
(both acidic and hydrogen ions needed)
NOT: hydrogen and nitrate ions

(c) moles = 25 × 0.450 = 11.25 / 11.3 / 11 ; [1]
mass = 56 × 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]

A7 **(a)** correct structure of chloroethene ; [1]
ALLOW: CH_2=CHCl
NOT: CH_2CHCl

(b) **(i)** $2 - C_2H_3Cl - + 5O_2 \rightarrow 2HCl + 4CO_2 + 2H_2O$ [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]

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 × 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: $CO + NO \rightarrow CO_2 + \frac{1}{2}N_2$ = 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]

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) $C_6H_{13}OH$ [1]

(c) (i) $C_2H_4 + H_2O \rightarrow C_2H_5OH$ [1]
IGNORE: state symbols

(ii) addition [1]
ALLOW: hydration / additional
NOT: exothermic

(d) use of moles e.g. 180 g glucose $\rightarrow$ 2 × 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 × 46 = 9200 g ethanol ;

% yield calculated e.g. 100 × 0.92/9.2 = 10% ; [1]

[Total: 10]

B10 (a) Correct M_r values: $(NH_4)_2SO_4$ = 132 **AND** KNO_3 = 101 ; [1]

% N in $(NH_4)_2SO_4$ (2 × 14 / 132) = 21.2% / 21.21% ; [1]
OR
mass of N in 500 g = 500 × 28/132 = 106.1 g

% N in KNO_3 (14 / 101) = 13.9% / 13.86% ; [1]
OR
Mass N in 500 g KNO_3 = 500 × 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]

B11 (a) (i) Electrons lost/ oxidation number (of iron) increases / oxidation number goes from 0 to +2 ; [1]
NOT: incorrect oxidation numbers

(ii) $Fe^{2+}(aq) + 2OH^{-}(aq) \rightarrow Fe(OH)_2(s)$ [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]