UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

MARK SCHEME for the October/November 2006 question paper

5070 CHEMISTRY

5070/02 Paper 2 (Theory), maximum raw mark 75

This mark scheme is published as an aid to teachers and students, 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.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

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UNIVERSITY of CAMBRIDGE
International Examinations

Section A

A1(a) **(i)** **A**/sulphur dioxide **[1]**

(ii) **E**/zinc oxide **[1]**

(iii) **C** and **E**/sodium bromide and zinc oxide (<u>both required</u>) **[1]**

(iv) **C**/sodium bromide **[1]**

(b) CH_2Br **[1]**

(c) by (incomplete) combustion of fossil fuels/hydrocarbons/carbon source **[1]**
ALLOW: from car exhausts/engines; gas fires/boilers
NOT: from cars/vehicles (alone)
NOT: combustion (alone)

[Total 6]

A2(a) **(i)** the <u>more</u> reactive the metal the <u>higher</u> the (decomposition) temperature/the less readily the carbonate is decomposed (or reverse argument) **[1]**
NOTE: comparison essential
NOT: the smaller the cation, the lower the decomposition temperature

(ii) $MgCO_3 \rightarrow MgO + CO_2$ (ignore state symbols) **[1]**

(b) **(i)** to produce <u>more</u> petrol/<u>more</u> of the useful fractions/<u>more</u> of the petrol fraction/to produce ethene/alkenes/fractions with higher demand
ALLOW: produce <u>more</u> smaller molecules
ALLOW: to produce plastics **[1]**
NOT: more profitable
NOT: produces smaller molecules/break down petrol fractions.

(ii) <u>high</u> temperature;
ALLOW: 350-550°C
catalyst;
ALLOW: aluminium oxide/alumina **[2]**
IGNORE: pressure

(iii) $2C_2H_4/C_4H_8$ on right **[1]**

[Total 6]

A3(a) 225 seconds ALLOW: 220-230 (s) **[1]**

(b) 90/24000 = 0.0038 moles/3.75×10^{-3} (moles) **[1]**

(c) gradient greater at start;

ends up at the same volume ($90cm^3$) + flattens out **[2]**
NOT: line goes well above 90 cm^3 then drops down again

(d) HC*l* particles/H^+ ions closer together when solution more concentrated
OR more H^+ ions/HC*l* particles for given volume;
NOT: more moles means more particles/more H^+ ions
<u>more frequent</u> collisions (with calcium carbonate); **[2]**
NOT: more successful collisions
NOT: more chance of collisions

[Total 6]

A4(a) light bulbs/fluorescent tubes/lasers/provides inert atmosphere/in arc welding/refining of titanium OR zirconium **[1]**
NOT: lights (alone)/bulbs (alone)

(b) complete/full outer electron shell
ALLOW: atoms cannot gain/lose/share electrons (easily) **[1]**
NOT: 8 electrons in outer shell unless specify He with 2
NOT: reference to stability

(c)

isotope	number of protons	number of electrons	number of neutrons
$^{36}_{18}Ar$	18	18	18
$^{40}_{18}Ar$	18	18	22

6 boxes correct = 2 marks; 5 boxes correct = 1 mark **[2]**

(d) elements in Periodic Table arranged in order of atomic number/ number of protons
NOT: they have different amount of isotopes **[1]**

(e) $Xe + 2F_2 \rightarrow XeF_4$ **[1]**

(f) lower than argon **[1]**
ALLOW: correct position drawn on diagram
NOT: below the bar
NOT: vertically down/facing downwards

[Total 7]

A5(a) **(i)** 20%
ALLOW: 19-21% **[1]**

(ii) add (aqueous) sodium hydroxide/(aqueous) ammonia;
ALLOW: formulae
red-brown precipitate/red-brown solid **[2]**
NOT: red ppt

(b) **(i)** solid particles sediment/fall to bottom **[1]**
ALLOW: filtration
ALLOW: sedimentation
NOT: centrifugation/distillation/decanting

(ii) $Al_2(SO_4)_3$ **[1]**

(c) **(i)** to remove tastes/odours **[1]**
ALLOW: absorbs colours

(ii) to kill bacteria/sterilise water/disinfect water **[1]**
ALLOW: to kill micro-organisms/kills germs
ALLOW: to get rid of bacteria etc

(d) **(i)** $Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$ **[1]**

(ii) $OH^- + H^+ \rightarrow H_2O$ **[1]**

[Total 9]

A6(a) correct structure showing 4 paired dots and crosses **[1]**

(b) **(i)** vibrating/not moving;
regular arrangement/lattice **[2]**
ALLOW: closely packed

(ii) Any two of:
pressure decreases (as ice melts)/
ALLOW: low pressure
temperature increases/
ALLOW: high temperature
the forces between the molecules are weak **[2]**
NOT: methane hydrate is unstable

(iii) methane causes global warming/melting of (polar) ice caps/melting of glaciers/desertification/rise in sea levels/extreme climate changes/change in animal habitats **[1]**

(c) (bacterial) decomposition of vegetable waste/paddy fields/marshes/cow flatulence/landfill sites etc **[1]**
ALLOW: bacterial decomposition

(d) fuel/making synthesis gas/manufacture of ethyne/making carbon black/making hydrogen cyanide/making methanol **[1]**
ALLOW: (for) heating/(for) cooking
NOT: as household gas/natural gas
NOT: from petroleum refining/fossil fuels

(e) reactants on left and products on right;
product level below reactant level and ΔH correctly labelled;
activation energy correctly labelled; **[3]**

[Total 11]

TOTAL PART A = 45

B7(a) nitrogen has gained electrons/oxidation number of nitrogen has decreased; **[1]**
ALLOW: reduction is addition of electrons
ALLOW: N changes from 0 to -3
NOT: removal of oxygen/addition of hydrogen

(b) $2NO_3^- + 12H^+ + 10e^- \rightarrow N_2 + 6H_2O$ **[1]**

(c) **(i)** nitrogen from the air/atmosphere;
hydrogen from methane/natural gas/water/cracking hydrocarbons; **[2]**
IF: (nitrogen and hydrogen) from the air = 1

(ii) Any two of the following specified conditions:
range 380-450°C/
ALLOW: any specific temperature in range 350-480°C;
NOT: high temperature
pressure 200 atm/
ALLOW: any pressure in range between 180-220 atm;
NOT: high pressure
iron catalyst; **[2]**
NOT: catalyst/iron oxide catalyst

(d) correct molar masses i.e. 80 and 132;
ammonium nitrate: (28/80) x 100 = 35%;
ammonium hydrogen phosphate: (28/132) x 100 = 21.2%/21%; **[3]**

(e) eutrophication/increase in algal growth (on surface of water)/algal bloom/reduction of dissolved oxygen in water/water plants die **[1]**

[Total 10]

B8(a) $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$ **[1]**

(b) **(i)** more moles/molecules of gas on left than on right **[1]**
ALLOW: 3 volumes (of gas) on left and 2 on right/more volumes of gas on left than right

(ii) increase in pressure will not have much effect on reaction/not much difference in number of moles on each side of equation
OR
higher pressure means higher concentration of corrosive gases
ALLOW: sulphur dioxide/trioxide is very corrosive
OR
cheaper/more economic to carry out reaction at atmospheric pressure **[1]**

(iii) reaction is exothermic/ΔH is negative;
if heat given out equilibrium shifts to left/reaction shifts in favour of reactants/cooling favours the forward reaction **[2]**

(c) filter solution (to remove excess iron);
concentrate solution by warming/letting solution evaporate/partially evaporate solution (then leave to crystallise) **[2]**
ALLOW: leave to crystallise
NOT: evaporate to dryness

(d) moles NaOH = 0.15 x 20/1000 = 3 x 10^{-3} mol;
moles H_2SO_4 = 3x10^{-3} x ½ = 1.5x10^{-3} mol;
1.5x10^{-3} x 1000/12 = 0.125 (mol/dm^3) **[3]**

[Total 10]

B9(a) correct structure of butanoic acid (all atoms and bonds must be shown) **[1]**
ALLOW: OH in place of O – H

(b) **(i)** not completely ionised in solution/has high proportion of unionised molecules in solution/has small proportion of H^+ ions in solution/not fully dissociated **[1]**

(ii) test with universal indicator/pH meter;
ALLOW: test with pH paper
NOT: test with indicator paper
has pH between greater than 3 and less than 7/stated pH in that range
OR solution of the acid turns universal indicator yellow/orange **[2]**
NOT: has high pH/pH above 3 (alone)

(c) C = 0.18/12 H = 0.03/1 O = 0.08/16;
empirical formula = C_3H_6O; **[2]**
molecular formula = $C_6H_{12}O_2$ (1 mark) **[1]**

(d) **(i)** $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$ **[1]**

(ii) potassium dichromate + (concentrated) sulphuric acid;
ALLOW: other reasonable oxidising agents
heat/reflux/warm **[2]**
ALLOW: bacteria;
room temperature/stated temperature not above 45°C or below 5°C

[Total 10]

B10(a) Any three of:
anode/impure copper electrode: decreases in thickness/solid (impurities) deposits below the anode/anode gets smaller/anode dissolves;
cathode: copper deposited/increases in thickness/gets larger;
ALLOW: goes pink
anode: $Cu \rightarrow Cu^{2+} + 2e^-$;
cathode: $Cu^{2+} + 2e^- \rightarrow Cu$ **[3]**

(b) **(i)** (some of the) electrons in metals are delocalised/electrons are (free to) move/sea of electrons can move **[1]**
NOT: electrons are free

(ii) solid copper sulphate has ions in fixed position/not free to move/ ions which don't move/held in the (crystal) lattice;
REJECT: do not have ions
in solution ions are free to move/ions move **[2]**
NOT: the ions are free
(reference to electrons = 0 for the second mark)

(c) iron object/knife made the cathode/made the negative electrode;
anode is nickel + solution of nickel salt (both points needed); **[2]**
ALLOW: nickel nitrate/nickel sulphate/nickel chloride/other soluble nickel compound
NOT: nickel oxide/nickel hydroxide

(d) in copper metal atoms/ions/particles arranged in layers which can slide/slip over each other; (both 'layers' and 'slide/slip' needed);
NOT: layers move
ACCEPT: diagrams if reasoning clear
in alloy <u>different sized</u> atoms/ions/particles stop layers from slipping/
2nd type of atom/ions/particles disrupts the regular structure of the metal **[2]**
ACCEPT: diagrams if reasoning clear

[Total 10]