UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

MARK SCHEME for the May/June 2008 question paper

5070 CHEMISTRY

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

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UNIVERSITY of CAMBRIDGE
International Examinations

A1 **(a)** carbon monoxide / CO [1]

(b) ammonia / NH_3 [1]

(c) argon / Ar [1]

(d) carbon monoxide / CO [1]

(e) oxygen / O_2 [1]
NOT: O

[Total: 5]

A2 **(a)** 36.8(%) / 36.8 / 37(%) (answer alone = 2 marks) (NOT 36%) [2]
M_r of iron(II) sulphate = 152 (for 1 mark)

(b) barium nitrate / other soluble barium salt e.g. barium chloride + nitric / hydrochloric acid [1]
NOT: barium hydroxide
white precipitate / solid [1]
IGNORE: incorrect name of precipitate
ALLOW: this mark if nitric acid missing from 1st marking point

(c) $4Fe^{2+} + O_2 + 4H^+ \rightarrow 4Fe^{3+} + 2H_2O$
1 mark for correct reactants and products;
1 mark for correct balance [2]

(d) **(i)** orange to green [1]

(ii) green to yellow [1]
ALLOW: brown / orange / reddish brown

(e) **(i)** 0.00076 / 7.6×10^{-4} (moles) [1]

(ii) mols Fe^{2+} = 0.00456 [1]
ALLOW: 0.0046
mass of iron(II) ions = 0.255 /0.26 / 0.258 (g) [1]
ALLOW: error carried forward [i.e. answer to moles $Fe^{2+} \times 56$]

[Total: 11]

A3 **(a)** 43 protons + 43 electrons [1]
55 neutrons [1]

(b) any reasonable, correct, isotope e.g. $^{97}_{43}Tc$ [1]

ALLOW: mass numbers from between 86 and 110

(c) same number of electrons and protons / same number of + and - charges; [1]
ALLOW: balance between the number of protons and electrons
electrons are - and protons are + [1]
NOT: charge on electron = to that on the proton
NOT: charge on electron and proton is opposite

(d) any TWO from:
- high melting point / boiling point;
- variable valency / oxidation state / (compounds) have ions with different charges;
- form coloured compounds / form coloured ions; [NOT: it is coloured / forms coloured solution]
- high density;
- (compounds) form complex ions
- catalytic activity [2]

[Total: 7]

A4 **(a)** ethane / alkane: (bromine) stays orange / no (colour) change / stays the same; [1]
ALLOW: bromine colours of brown / red / orange
ethene / alkene: (bromine) decolourised / (orange) to colourless [1]
NOT: goes

(b) pair of electrons between the two carbons; [1]
6 correct shared pairs between carbons and 6 hydrogen atoms [1]
[independent marking points]

(c) C_2H_5Cl / $C_2H_4Cl_2$ etc. (up to C_2Cl_6) [1]
ALLOW: any order of atoms
ALLOW: correct graphical / displayed formulae / dot and cross diagrams
ALLOW: HCl

(d) butene / butylene [1]
ALLOW: but-1-ene / but-2-ene / methylpropene
C_4H_8 [1]
NOT: $CH_3CH_2CH_2CH_3$ / graphical formulae
NOT: C_nH_{2n}

[Total: 7]

A5 (a) (i) P_2O_5 / P_4O_{10} [1]

(ii) physical property: [1]
low melting point / low boiling point / electrical insulator or does not conduct
ALLOW: white in colour / solid
chemical property: [1]
acidic oxide / reacts with alkalis / reacts with bases / dissolves in water to form acid
NOT: it is an acid / dissolves in water

(b) $2KClO_3 \rightarrow 2KCl + 3O_2$
1 mark for correct reactant and products;
1 mark for correct balance [2]

(c) $S + O_2 \rightarrow SO_2$ [1]
IGNORE: state symbols

(d) alkane and C_nH_{2n+2} [1]
NOT: it fits a general formula

[Total: 7]

A6 (a) (i) volcanoes / treatment of sulphide ores [1]
ALLOW: bacterial oxidation / burning natural gas
IGNORE: unqualified burning fuels / from car engines / making sulphuric acid / from smoke / from power stations

(ii) lightning / car engines / car exhausts / high temperature furnaces / explosives [1]
ALLOW: burning fuel in car
NOT: from cars unqualified
NOT: bacterial activity / from fertilizers

(b) (i) carbon dioxide / CO_2 [1]

(ii) calcium nitrite / calcium nitrate or correct formulae [1]
IGNORE: incorrect oxidation numbers

(iii) Any one of:
- erodes buildings / reacts with buildings or statues [1]

ALLOW: corrodes buildings / eats away buildings
NOT: destroys buildings / damages buildings
- forest death / kills trees or plants / kills fish in lakes / acidifies lakes

ALLOW: damages / destroys crops
NOT: kills animals (unless in lakes / rivers)
- breathing difficulties in humans OWTTE

NOT: causes pollution / harmful (unless specified) / affects building or animals

(c) • reactant on left and product on right and products above reactants; [1]
• correct arrow and label for activation energy (even if exothermic reaction drawn) [1]
• correct arrow and label for enthalpy change [1]
ALLOW: line in place of arrow
ALLOW: E for activation energy and 43 kJ for ΔH
IGNORE: direction of arrow

[Total: 8]

B7 (a) (solution) goes orange / red / brown [1]
NOT: goes yellow
$Cl_2 + 2Br^- \rightarrow Br_2 + 2Cl^-$ [1]
chlorine has gained electrons / it has gained electrons [1]
ALLOW: oxidation number of chlorine decreases / goes from 0 to -1
NOT: incorrect oxidation numbers
NOT: chloride has gained electrons

(b) dot and cross diagram of magnesium ion (ignore whether dots or crosses) [1]
with 2+ at top right / near top right
NOT: 2+ in nucleus
ALLOW: written as $Mg^{2+} = 2.8$
dot and cross diagram of chloride ion (ignore whether dots or crosses) [1]
with - at top right / near top right
ALLOW: only one chloride ion shown
ALLOW: written as $Cl^- = 2.8.8$
NOT: - in nucleus

(c) • dissolve it / silver nitrate in water; [1]
ALLOW: use / add aqueous solution / from (aq) in equation
• add <u>solution</u> of soluble chloride / named soluble chloride / soluble chloride dissolved in water / hydrochloric acid; [1]
ALLOW: hydrochloric acid alone without the word solution or dissolved in water
ALLOW: this mark if equation given with ALL state symbols correct
• filter; [1]
ALLOW: decant / centrifuge
• wash precipitate with water <u>and</u> leave water to evaporate / wash ppt with water <u>and</u> leave to dry
ALLOW wash ppt with water <u>and</u> dry in an oven [1]

(d) depletion of ozone / destroys ozone (molecules) [1]
ALLOW: thins ozone layer / damages ozone layer / makes hole in ozone layer
ALLOW: increases greenhouse effect / greenhouse gas
NOT: increases risk / causes skin cancer

[Total: 10]

B8 (a) boiling point / volatility [1]
IGNORE: number of carbon atoms

(b) (i) breakdown of long chained hydrocarbons (into shorter / smaller chains); [1]
ALLOW: large for long chained; alkanes / carbon chains for hydrocarbons
ALLOW: converting long chained alkanes to alkenes
NOT: splitting larger fractions
NOT: breaking down larger substances / molecules / particles
by high temperature / stated temperatures in range 400–800°C; [1]
or by high temperature and catalyst / stated temperatures in range 200–800°C + catalyst
NOT: by heating / heat
ALLOW: aluminium oxide / silicon dioxide / zeolites in place of word 'catalyst'

(ii) fractions which are less needed / exceed demand changed to those more needed / in greater demand; [1]
ALLOW: idea of less useful fractions used to make more useful
NOT: larger fractions / alkanes to smaller alkanes
gas oil fraction converted to gasoline [1]
ALLOW: gas oil fraction converted to kerosene / petroleum gases
ALLOW: waxes converted to one of the above 3 fractions / waxes and bitumen converted to one of the above 3 fractions

(c) (i) $CH_3CH=CH_2$ (minimum structure to show double bond) [1]

(ii) $C_{15}H_{32} \rightarrow C_3H_6 + C_{12}H_{26}$ [1]
ALLOW: other possible product apart from propene with correct balance
e.g. 2 C_3H_6 + C_9H_{20} on right

(d) (i) react with steam and catalyst (both required) [1]
ALLOW: phosphoric acid (in place of the word 'catalyst')
ALLOW: water + temperature of above 100°C in place of steam
ALLOW: from correct equation with correct state symbols
NOT: fermentation
$CH_3CH_2CH_2OH$ / $CH_3CH(OH)CH_3$ (as minimum) [1]
ALLOW: full formula showing all atoms and bonds or mixtures of the two

(ii) $-CH(CH_3)-CH_2-CH(CH_3)-CH_2-$ or full structural formula [1]
ALLOW: $-[CH(CH_3)-CH_2]_n-$

[Total: 10]

B9 (a) H^+ / H_3O^+ [1]
NOT: 'hydrogen ions'

(b) (i) moles Mg (0.24 / 24) = 0.01 AND moles acid (2 × 5/1000) = 0.01 ; [1]
Mg in excess since requires 2 moles acid to 1 mole magnesium / because of 1:2 mole ratio in equation [1]

(ii) moles $MgCl_2$ (0.01/2) = 0.005; [1]
0.005 × 95 = 4.75 / 0.48 g [NOT: 0.4 (g)] [1]
ALLOW: error carried forward from directly above and from part **(i)**

(iii) ANY 3 of: [3]
- same number of moles of each acid / same amount of replaceable hydrogen in each acid / same number of hydrogen ions which react in each acid;

ALLOW: same concentration of each acid at the same volume
- hydrochloric acid is a strong acid and ethanoic acid is a weak acid / hydrochloric acid is stronger than ethanoic acid ORA;
- hydrochloric acid fully ionised and ethanoic acid partially ionised

ALLOW: hydrochloric acid more ionised than ethanoic acid ORA
- higher concentration of hydrogen ions in hydrochloric acid / lower concentration of hydrogen ions in ethanoic acid;
- more collisions per unit time / collision rate higher with hydrochloric than with ethanoic acid ORA

(c) (i) $2CH_3COOH + Na_2CO_3 \rightarrow 2CH_3COONa + CO_2 + H_2O$ [1]
ALLOW: correct ionic form for sodium ethanoate

(ii) bubbles/ effervescence [1]
ALLOW: tube gets hot / heat given off
ALLOW: sodium carbonate dissolves / disappears
NOT: gas given off / carbon dioxide given off

[Total: 10]

B10 (a) regular pattern of positive ions; [1]
ALLOW: + / X^+ / X^{2+} etc. for the positive ions
negative sign / e^- / e dispersed amongst the ions [1]
IGNORE: inequality of numbers of electrons and + charges
NOT: electrons in clumps separated from positive ions
NOT: negative sign / e^- / e in circles unless the circles are considerably smaller than the positive ions

(b) electrons move / electrons are delocalised / sea of electrons [1]
NOT: electrons are free (unless qualified)
NOT: reference to free electrons in the outer shells / valency electrons if it implies that they are still associated with particular atoms

(c) (i) reaction is faster [1]
ALLOW: larger surface area for reaction
NOT: reaction is fast (comparison needed)

(ii) moles hydrogen (0.072 / 24) = 0.003 [1]

mass zinc = 0.003 × 65 = 0.195 g [1]
ALLOW: error carried forward

(iii) 16.25% / 16.3% [1]
ALLOW: error carried forward from part **(ii)** to give values below 100%

(d) **three** of: [3]

- (zinc gives) white precipitate (on addition of aqueous ammonia);
- (white) ppt dissolves in excess ammonia/gives colourless solution with excess ammonia;
- copper would give (light) blue ppt (on addition of aqueous ammonia);

ALLOW: ppt is not blue

- (if copper) (light) blue ppt would dissolve in excess ammonia/gives blue solution with excess ammonia;

ALLOW: no blue solution formed with excess ammonia

[Total: 10]