MARK SCHEME for the May/June 2008 question paper

5070 CHEMISTRY

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

This mark scheme is published as an aid to teachers and candidates, 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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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 <u>compounds</u> / form coloured <u>ions</u>; [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 <u>and</u> C_nH_{2n+2} [1]
NOT: it fits a general formula

[Total: 7]

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

(ii) lightning / car <u>engines</u> / car exhausts / <u>high temperature</u> 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
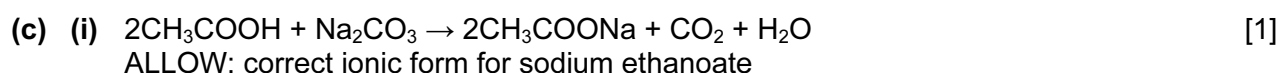   NOT: increases risk / causes skin cancer

[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 <u>high</u> temperature / stated temperatures in range 400–800°C;   [1]
or by <u>high</u> 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 <u>steam</u> and <u>catalyst</u> (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) <u>regular</u> <u>pattern</u> of <u>positive</u> ions; [1]
ALLOW: + / X^+ / X^{2+} etc. for the positive ions
negative sign / e^- / e <u>dispersed amongst the ions</u> [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 fast<u>er</u> [1]
ALLOW: lar<u>ger</u> 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]