

MARK SCHEME for the May/June 2008 question paper

<p>5070/02 5070 CHEMISTRY Paper 2 (Theory), maximum raw mark 75</p>
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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 / NH₃ [1]
- (c)** argon / Ar [1]
- (d)** carbon monoxide / CO [1]
- (e)** oxygen / O₂ [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)** $4\text{Fe}^{2+} + \text{O}_2 + 4\text{H}^+ \rightarrow 4\text{Fe}^{3+} + 2\text{H}_2\text{O}$ [2]
1 mark for correct reactants and products;
1 mark for correct balance
- (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 Fe²⁺ = 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 Fe²⁺ × 56]

[Total: 11]

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- A3 (a)** 43 protons + 43 electrons [1]
55 neutrons [1]
- (b)** any reasonable, correct, isotope e.g. ${}_{43}^{97}\text{Tc}$ [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: [2]
- 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
- [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)** $\text{C}_2\text{H}_5\text{Cl}$ / $\text{C}_2\text{H}_4\text{Cl}_2$ 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: $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$ / graphical formulae
NOT: C_nH_{2n}
- [Total: 7]**

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- 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: [1]
- erodes buildings / reacts with buildings or statues
 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

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- (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 solution 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 and leave water to evaporate / wash ppt with water and leave to dry
 ALLOW wash ppt with water and 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

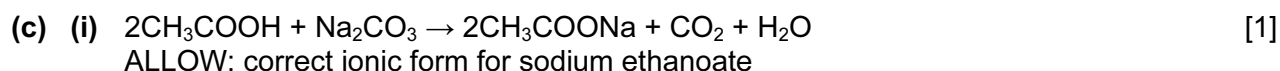
[Total: 10]

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- 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)** $\text{CH}_3\text{CH}=\text{CH}_2$ (minimum structure to show double bond) [1]
- (ii)** $\text{C}_{15}\text{H}_{32} \rightarrow \text{C}_3\text{H}_6 + \text{C}_{12}\text{H}_{26}$ [1]
 ALLOW: other possible product apart from propene with correct balance
 e.g. $2 \text{C}_3\text{H}_6 + \text{C}_9\text{H}_{20}$ 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
 $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ / $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$ (as minimum) [1]
 ALLOW: full formula showing all atoms and bonds or mixtures of the two
- (ii)** $-\text{CH}(\text{CH}_3)-\text{CH}_2-\text{CH}(\text{CH}_3)-\text{CH}_2-$ or full structural formula [1]
 ALLOW: $-\text{[CH}(\text{CH}_3)-\text{CH}_2]_n-$
- [Total: 10]**
- B9 (a)** H^+ / H_3O^+ [1]
 NOT: ‘hydrogen ions’
- (b) (i)** moles Mg ($0.24 / 24$) = 0.01 AND moles acid ($2 \times 5/1000$) = 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]
 $0.005 \times 95 = 4.75 / 0.48 \text{ g}$ [NOT: 0.4 (g)] [1]
 ALLOW: error carried forward from directly above and from part (i)

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- (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



- (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 = $0.003 \times 65 = 0.195 \text{ g}$ [1]
ALLOW: error carried forward

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

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(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]