

MARK SCHEME for the October/November 2008 question paper

5070 CHEMISTRY

5070/02

Paper 2 (Theory), maximum raw mark 75

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Section A

- A1 (a) (i)** P [1]
- (ii) He [1]
- (iii) Cl [1]
- (iv) N/P/As [1]
- (v) Ni [1]
- (vi) S and O (both needed for 1 mark) [1]
ALLOW: N and O (1 mark)

[Total: 6]

A2 (a) any **two** of:

- carbon dioxide disappears or vaporises
ALLOW: carbon dioxide melts/carbon dioxide block decreases in size/hole in block gets deeper
 - black powder/black solid formed/black smuts/black fumes/sooty
ALLOW: black gas/black smoke
 - white powder/white solid formed/white fumes
ALLOW: white gas
 - bright light/flame
IGNORE: flame colour [2]
- NOTE: greyish fumes/solid/powder/gas = 2 marks

(b) to stop Mg reacting with air (or oxygen)/to stop side reactions/to stop air getting in [1]
NOT: to stop oxidation of magnesium/to increase rate of reaction

(c) low temperature/the cold(ness)/it is cold/it is -60°C [1]
NOT: surface area/temperature

(d) $2 \times 24 \text{ g} \rightarrow 810 \text{ kJ}$
 $2 \text{ g} \rightarrow 810 \times 2 / (2 \times 24) =$
 33.75 (kJ)
 OR
 $\text{moles Mg} = 2/24 = 0.083333$
 $810 \times 0.083333/2 = 33.75$ [2]
 correct answer without working scores 2
 1 mark for use of moles i.e. $2/24$ or 2×24
 2 marks for correct answer
 ALLOW: 33.8/34
 $33.7/34.0/33.6$ (from rounding up 0.083333) = 1 mark ONLY
 $67.5 = 1$ mark ONLY

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- (e) magnesium in excess (no marks on its own)
- Mg $6/24 = 0.25$ mol CO₂ $4.4/44 = 0.1$ mol (1 mark)
 - 2 moles Mg needed to 1 of CO₂/recognition of this/division by two or 2:1 ratio shown (1 mark) [2]
- OR 2×24 g magnesium \rightarrow 44 g carbon dioxide (1 mark)
so 6 g magnesium gives $6 \times 44/48 = 5.5$ g carbon dioxide (1 mark)
(or reverse argument for carbon dioxide to calculate mass of magnesium)
- (f) energy taken in to break bonds and energy given out in making bonds/
bond-breaking is endothermic **and** bond-making exothermic
more energy released than absorbed [2]
more energy released in bond-making than absorbed in bond-breaking ORA = 2 marks

[Total: 10]

- A3 (a) methane/CH₄
carbon dioxide/CO₂ [2]
- (b) correct structure of butanoic acid [1]
ALLOW: condensed structural formula or mixture of condensed and displayed formulae
ALL hydrogen atoms must be shown.
- (c) (i) speeds up the reaction [1]
ALLOW: reduces time taken for the reaction (to complete)
ALLOW: reduces activation energy
ALLOW: makes oil quicker
NOT: changes/alters rate of reaction
- (ii) C₂₂H₂₂O₂ + 26½O₂ \rightarrow 22CO₂ + 11H₂O
or multiples [2]
(1 for correct reactants and products, 1 for balance)
REJECT: if additional products/reactants

[Total: 6]

- A4 (a) potassium chlorate is oxidant **and** P is reductant (1 mark)
ALLOW: oxygen/chlorine is oxidant and P is reductant
one of:
potassium chlorate loses oxygen/
phosphorus removes oxygen from potassium chlorate/
phosphorus gains oxygen/
potassium chlorate/chlorine/chlorate gains electrons/
phosphorus loses electrons/
oxidation number of phosphorus increases
oxidation number of chlorine (ALLOW: of potassium chlorate) decreases
ALLOW: increases/decreases in oxidation numbers in correct direction (numbers need not be correct) [2]

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(b) (i) $P_2O_5 + H_2O \rightarrow 2HPO_3$ [1]
ALLOW: multiples
IGNORE: state symbols

(ii) effervescence/bubbling; NOT: carbon dioxide given off
turns red/pink [2]

(c) Sb_2S_3/S_3Sb_2 [1]
NOT: Sb_4S_6

[Total: 6]

A5 (a) (i) (thermal) decomposition [1]
NOT: endothermic

(ii) it is (a) basic (oxide)/it is a base/it is (an) alkaline oxide [1]
ALLOW: it is alkaline/an alkali (in solution)/has a high pH (when it reacts with water)/forms hydroxide ions (when reacts with water)
NOT: it contains hydroxide ions
NOT: answers about effect on plant growth

(b) (i) $CaO + H_2O \rightarrow Ca(OH)_2$ [1]
IGNORE: state symbols

(ii) any three of: [3]

- pH increases inside beam ORA/
- carbon dioxide (in solution) is slightly acidic/
- on the surface CO_2 reacts with neutralises $Ca(OH)_2$ OR implication that pH neutral on the surface/
- reaction of carbon dioxide with calcium hydroxide reduces alkalinity (or lowers pH)/
- further inside (beam), less (or no) CO_2 /little or no reaction (of carbon dioxide) with calcium hydroxide inside (beam)/
- crack allows carbon dioxide to enter the inside of the beam/
- near crack alkalinity less/pH lower OWTTE

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- (iii) moles HCl = $0.04 \times 18/1000 = 7.2 \times 10^{-4}$
 (1 mark for showing $0.04 \times 18/1000$ (or 7.2×10^{-4} without working))

2 moles HCl \equiv 1 mole Ca(OH)₂ (or implication of this i.e. 3.6×10^{-4})
 (1 mark for indication in any way of correct 2:1 ratio i.e. $\frac{1}{2}$ value of answer to 1st part of calculation)

concentration Ca(OH)₂ = $3.6 \times 10^{-4} \times 1000/25 = 0.0144$ (mol/dm³) [3]

correct answer without working = 3 marks
 apply error carried forward between the parts
 ALLOW: 0.014 NOT: 0.015

alternatively:

$$\frac{C_1 \times V_1}{C_2 \times V_2} = \frac{0.04 \times 18}{C_2 \times 25} \quad (1 \text{ mark})$$

$$\frac{C_1 \times V_1}{C_2 \times V_2} = \frac{n_1}{n_2} \quad \frac{0.04 \times 18}{C_2 \times 25} = \frac{2}{1} \quad (2 \text{ marks})$$

Correct answer from this = (3rd mark)

[Total: 9]

- A6 (a) (i)** to kill bacteria/to kill micro-organisms/to kill germs [1]
 ALLOW: to disinfect the water/to sterilise the water
 NOT: to kill viruses/to kill algae/to kill bugs
 NOT: to clean the water/to make the water clear

- (ii) sulphur dioxide/sulphite(s)/named sulphite [1]
 ALLOW: (calcium) hypochlorite//chlorate(I)/hydrogen peroxide
 ALLOW: correct formulae
 NOT: bleaching powder

- (b) two or more units polymerised with continuation bonds [1]
 ALLOW: correct structure with brackets, continuation bonds and 'n' at bottom right

- (c) any **two** of:
 • aluminium oxide dissolves (in sodium hydroxide)/aluminium oxide forms a solution (in sodium hydroxide)/aluminium oxide is soluble (in excess sodium hydroxide)/
 • iron(III) oxide does not dissolve (in excess sodium hydroxide)/iron(III) oxide is insoluble (in excess sodium hydroxide)
 NOT: iron(III) forms a precipitate
 • separate by filtration/allowing iron oxide to settle and drawing off solution/decanting
 ALLOW: separate by centrifugation/use a centrifuge [2]
 FOR ALL 3 points IGNORE: names of solids/solutions formed

- (d) dissolves the aluminium oxide/alumina or [1]
 lowers melting point of the melt/aluminium oxide mixture OWTTE
 ALLOW: lowers the melting point of aluminium oxide
 ALLOW: lowers the temperature at which electrolysis takes place
 NOT: lowers the temperature (unqualified)

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- (e) (aluminium) covered with (aluminium) oxide layer/there is (aluminium) oxide on the surface
ALLOW: protective layer formed by reaction with oxygen
NOT: wrong layer e.g. oxygen layer/layer of nitrogen
layer/aluminium oxide is unreactive/layer stops (chemical) reaction/protective layer formed
NOT: aluminium is unreactive [2]

[Total: 8]

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Section B

- B7 (a)** reactants on left and products on right **and** products at lower level than reactants
catalysed reaction curve lower than that for uncatalysed
ALLOW: two separate diagrams for catalysed and uncatalysed reactions as long as they are
to the same scale
enthalpy change correctly shown in words or as ΔH [3]
- (b) (i)** (fractional) distillation/fractionation/description of this i.e. gradually raising
temperature of liquefied air and collecting fractions
ALLOW: Linde process/double distillation [1]
- (ii)** any **two** of:
- cracking/steam reforming/
 - high temperature/stated temperature ALLOW: 300–1000 °C/
NOT heat (unqualified)
 - use of catalyst
- ALLOW: the following specified substances without the word catalyst aluminium oxide/
zinc oxide/zeolites/copper/silicon dioxide/porous pot/correct symbols of formulae for
these
ALLOW: the word catalyst with incorrect catalyst e.g. catalyst of copper sulphate [2]
- (c) (i)** increase in pressure increases yield/moves the equilibrium to the right/increases
the forward reaction/decreases the back reaction/more products formed/more
ammonia formed OWTTE
number of moles fewer on right (than left)/number of moles greater on left (than right)/
(gas) volume smaller on right/(gas) volume larger on left/increased pressure favours side
with fewer moles or lower volume OWTTE [2]
- (ii)** decreases yield/moves the equilibrium to the left/more reactants/less ammonia formed
OWTTE
(forward) reaction is exothermic/reaction gives out energy/back reaction is endothermic [2]

[Total: 10]

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- B8 (a) (i)** any **two** of:
- chromatography paper (with bottom of paper) in solvent
ALLOW: diagram showing this with solvent clearly labelled and paper dipping into solvent
ALLOW: named solvent
 - spot of mixture put (on line)
ALLOW: diagram showing this
NOT: diagrams showing original spot/base line below solvent level
 - allow solvent to move up paper/pigments are separated as they move (vertically) up the paper
ALLOW: separated pigments on a diagram vertically aligned
NOT: single pigments originating from different spots on the base line [2]
- (ii)** distance spot moves ÷ distance of solvent front from base (starting) line [1]
ALLOW: diagrams
ALLOW: distance moved by substance ÷ distance moved by solvent
ALLOW: the ratio of the distance moved by the spot/substance to that moved by the solvent
NOT: the ratio of the distance moved by the solvent to that moved by the spot/substance
- (b) (i)** it/**X** is a reducing agent **or** it/**X** gets oxidised **or** potassium manganate(VII) oxidises **X**
NOT: reference to colour changes
NOT: potassium manganate(VII) is an oxidising agent (unqualified)
- (ii)** it/**X** does not contain a (C=C) double bond/**X** is saturated
- (iii)** it/**X** is a weak acid
ALLOW: **X** is a weaker acid (than hydrochloric)/**X** is weak/is not strong compared with hydrochloric acid [3]
NOT: **X** is not a strong acid
- (c) (i)** $C = \frac{2.67/12}{0.223}$ $H = \frac{0.220/1}{0.220}$ $O = \frac{7.11/16}{0.444}$ (÷ by correct A_r)
(÷ by lowest figure)
simplest ratio = CHO₂ (any order) [3]
- (ii)** C₂H₂O₄ [1]

[Total: 10]

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- B9 (a)** breaking down/splitting up/decomposition
(of electrolyte/compound/substance)
by electricity/electric current [1]
ALLOW: causing a chemical reaction to occur by an electric current
ALLOW: producing elements (from compounds) by using an electric current
- (b) (i)** sodium, chloride, hydrogen, hydroxide (ALLOW: hydroxyl) (all 4 needed) [1]
ALLOW: Na⁺, Cl⁻, H⁺ and OH⁻
ALLOW: mixture of symbols and words
NOT: chlorine ions
- (ii)** $2Cl^- \rightarrow Cl_2 + 2e^-$ [1]
IGNORE: state symbols
ALLOW 2e instead of $2e^-$
ALLOW: $2Cl^- - 2e^- \rightarrow Cl_2$
- (iii)** hydrogen ions form hydrogen (gas)/hydrogen ions removed [2]
hydroxide/OH⁻ ions (remaining in solution) are alkaline OR hydroxide/OH⁻ ions give high pH/alkalinity caused by OH⁻ ions
NOT: hydroxide ions remain in solution (must be a link to pH)
- (c)** in solution ions can move [2]
NOT: ions are free
ALLOW: ions carry the charge
REJECT: if reference to electrons moving
ions cannot move in solid/ions held together (by strong forces)
IGNORE: electrons can't move for this mark
NOT: ions not present
- (d) (i)** reflux ALLOW: heat/high temperature/boil/warm [2]
ALLOW: temperature range of 30–200 °C
NOT: distil
(sulphuric) acid catalyst/sulphuric acid
ALLOW: other named mineral acids/hydrogen ion catalyst
NOT: acid without qualification (otherwise confusion with the lactic acid)
NOT: catalyst (unqualified)
- (ii)** structure of lactic acid correct i.e. CH₃CHOHCO₂C₂H₅ [1]
ALLOW: RCO₂C₂H₅
REJECT: if OH group altered

[Total: 10]

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- B10(a)** proton number = 53 in both isotopes **AND** electron number 53 in both
I-125 has 72 neutrons and I-131 has 78 neutrons (both needed) [2]
- (b)** suitable reagent e.g. (aqueous) chlorine/(aqueous) bromine/nitric acid/(potassium) manganate(VII)/(potassium) permanganate/(sodium) dichromate/iron(III) ions
ALLOW: correct formulae
solution turns brown
ALLOW: solution turns yellow/orange [2]
IGNORE: colour of reagents at start
ALLOW: grey-black crystals or solid/grey crystals or solid/black crystals or solid
NOT: purple solution/iodine is formed
- (c)** $\text{Zn} + \text{I}_2 \rightarrow \text{Zn}^{2+} + 2\text{I}^-$ [2]
(1 mark for formulae, 1 mark for balance)
IGNORE: state symbols
- (d) (i)** this is a level of response question:
3 of the following points = 2 marks
2 of the following points = 1 mark
1 or 0 of these points = 0 mark
- high melting or boiling points/
 - high density/
 - form coloured compounds/
- ALLOW: form coloured ions
NOT: they are coloured/they form coloured solutions
- form ions with different charges/different valencies/multiple valencies
 - form complex ions/
 - catalysis/they (or their compounds) are good catalysts [2]
- IGNORE: general metallic properties/hard
- (ii)** $\text{Ti}_2\text{O}_3/\text{O}_3\text{Ti}_2$ [1]
NOT: Ti_4O_6
- (iii)** $\text{TiCl}_4 + 2\text{H}_2\text{O} \rightarrow \text{TiO}_2 + 4\text{HCl}$ [1]
ALLOW: multiples
IGNORE: state symbols

[Total: 10]