

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge Ordinary Level

MARK SCHEME for the October/November 2014 series

5070 CHEMISTRY

5070/22

Paper 22 (Theory), maximum raw mark 75

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Page 2	Mark Scheme	Syllabus	Paper
	Cambridge O Level – October/November 2014	5070	22

- A1 (a) (i)** S/sulfur/P / phosphorus (1) [1]
- (ii) Fe/iron (1) [1]
- (iii) P/phosphorus (1) [1]
- (iv) Zn/zinc/As/arsenic (1) [1]
- (v) Fe/iron (1) [1]
- (vi) H/hydrogen/H₂/N/nitrogen/N₂ (1) [1]
- (b) (i)** $4\text{As} + 3\text{O}_2 \rightarrow 2\text{As}_2\text{O}_3$ (1) [1]
- (ii) (arsenous acid) has a lower concentration of hydrogen ions/hydrochloric acid has higher concentration of hydrogen ions (1)
- less frequent collisions (between ions in arsenous acid)/more frequent collisions (between ions) in hydrochloric acid (1) [2]

[Total: 9]

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge O Level – October/November 2014	5070	22

- A2 (a) (i)** (density generally) increases down the group (1) [1]
- (ii)** allow between 710 – 860 (°C) (1)
(actual value = 760°C) [1]
- (iii)** liquid (no mark on its own)
melting point is below 35 (°C) **AND** boiling point is above 35 (°C) (1) [1]
- (b) (i)** more reactive down the group/less reactive up the group (1) [1]
- (ii)** $2\text{Rb} + 2\text{H}_2\text{O} \rightarrow 2\text{RbOH} + \text{H}_2$ (1) [1]
- (iii)** reaction which releases heat/releases energy/products have lower energy than reactants/reaction in which ΔH is negative/temperature (of surroundings) increases (1) [1]
- (c)** $\text{H}^- + \text{H}_2\text{O} \rightarrow \text{OH}^- + \text{H}_2$ (1) [1]
- (d) (i)** sodium has low density/nickel has high density (1)

sodium has low melting point / nickel has high melting point/sodium has low boiling point/nickel has high boiling point (1) [2]
- (ii)** any suitable use e.g. manufacture of margarine/other stated hydrogenation reactions e.g. cyclohexane from benzene/sorbitol from glucose/amines from nitro-compounds/amines from nitriles/alkanes from alkenes/alkanes from alkynes (1) [1]
- (iii)** nickel ions are different size to copper ions (1)

idea of disruption of layers in metallic structure/layers cannot slide as easily (1)

NOTE: there MUST be some idea of layers/rows or sheets sliding not just atoms sliding [2]

[Total: 12]

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge O Level – October/November 2014	5070	22

A3 (a) water and salts have different boiling points (1)

water evaporates **AND** salts/residues/impurities/solids left in flask (1)

water condenses/turns to liquid in the condenser (1) [3]

(b) (i) Mg^{2+} and Cl^- (1)

IGNORE: state symbols [1]

(ii) 0.0265/0.027/0.03 (mol/dm³) (1) [1]

(iii) white precipitate/white solid formed/white deposit formed (1) [1]

(c) 96 g $\text{SO}_4^{2-} \rightarrow 233 \text{ g BaSO}_4$ (1)

$$1.24 \text{ g SO}_4^{2-} \rightarrow \frac{233}{96} \times 1.24 \text{ OR } 3.0096/3.01 \text{ g BaSO}_4 (1)$$

$$\text{mass in } 50 \text{ cm}^3 = 3.01 \times \frac{50.0}{1000} = 0.151 \text{ g (1)}$$

OR (for 1st two steps)

$$\text{moles SO}_4^{2-} = \frac{1.24}{96} \text{ OR } 0.0129 (1)$$

$$\text{mass of BaSO}_4 = 0.0129 \times 233 \text{ OR } 3.01 \text{ g (1)}$$

OR

$$\text{mass of SO}_4^{2-} \text{ in } 50 \text{ cm}^3 = 1.24 \times \frac{50}{1000} \text{ OR } 0.062 \text{ g (1)}$$

$$\text{moles SO}_4^{2-} = \frac{0.062}{96} \text{ OR } 0.000645833 \text{ mol (1)}$$

$$\text{mass BaSO}_4 = 0.000646 \times 233 = 0.151 \text{ g (1)} [3]$$

[Total: 9]

Page 5	Mark Scheme	Syllabus	Paper
	Cambridge O Level – October/November 2014	5070	22

A4 (a) $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$ (1) [1]

(b) (i) $20(\text{cm}^3)/0.02 \text{ dm}^3$ (1) [1]

(ii) $\text{mol KOH} = 0.15 \times \frac{45}{1000}$ OR $6.75 \times 10^{-3}/0.00675$ (1)

$\text{mol H}_2\text{SO}_4 = 0.003375/0.0034$ (1)

concentration = $0.003375 \times \frac{1000}{20} = 0.17/0.169$ (1) [3]

(c) (i) ethanoic acid has 1 mol of ionisable H per mol of acid/ H_2SO_4 has 2 per mol of acid/ethanoic acid is monobasic/ H_2SO_4 is dibasic/ethanoic acid has one acidic hydrogen (ion)/sulfuric acid has 2 acidic H^+ ions/ethanoic acid has half as much ionisable hydrogen (1) [1]

(ii) any value between 3 and 6.9 inclusive (1) [1]

(d) (i) ANY TWO FROM

- sulfur dioxide/ SO_2 (1)
- (sulfur dioxide) oxidised further/(sulfur dioxide) reacts further to form sulfur trioxide (1)
- oxidation product reacts with water to form sulfuric acid/ SO_3 reacts with water to form sulfuric acid (1) [2]

(ii) irritates skin/irritates eyes/irritates nose/irritates mouth (1) [1]

[Total: 10]

Page 6	Mark Scheme	Syllabus	Paper
	Cambridge O Level – October/November 2014	5070	22

A5 (a) sodium
barium
magnesium
nickel
copper (1) [1]

(b) (i) voltmeter and two wires either side of voltmeter across the electrodes (1) [1]

(ii) iron and silver (1) [1]

(c) ANY TWO FROM

- the zinc corrodes instead of the iron / zinc reacts instead of the iron (1)
- zinc is more reactive (than iron) / zinc is more reactive (than steel) / zinc higher in the reactivity series (than steel / iron) OR reverse argument (1)
- the zinc loses electrons in preference to the iron (1)

IGNORE: sacrificial protection without qualification [2]

[Total: 5]

Page 7	Mark Scheme	Syllabus	Paper
	Cambridge O Level – October/November 2014	5070	22

- B6 (a)** sodium chloride is giant ionic structure / has a continuous structure of ions / ions in lattice (1)
- strong (attractive) forces between the ions / lot of energy needed to break ionic bond (1)
- chlorine is a (simple) molecule / chlorine has simple covalent structure (1)
- chlorine has weak forces between the molecules / small amount of energy required to separate molecules / not much energy needed to break intermolecular forces / chlorine has weak van der Waals' forces (1) [4]
- (b)** in molten sodium chloride ions can move but ions can't move in solid / ions can only move in molten sodium chloride (1) [1]
- (c)** sodium ion 2, 8 and + charge (1)
- chloride ion 2, 8, 8 and – charge (1) [2]
- (d)** at the negative electrode / cathode reduction takes place which is gain of electrons (by sodium) (1)
- at the positive electrode / anode oxidation takes place which is loss of electrons (by chloride) (1)
- OR**
- sodium ions are reduced because they gain electrons (1)
- chloride ions are is oxidised because they lose electrons (1)
- OR**
- sodium is reduced because oxidation number of sodium decreases (1)
- chloride / chlorine is oxidised because the oxidation number of chlorine increases (1) [2]
- (e)** $2\text{NH}_3 + 3\text{Cl}_2 \rightarrow \text{N}_2 + 6\text{HCl}$ (1) [1]

[Total: 10]

Page 8	Mark Scheme	Syllabus	Paper
	Cambridge O Level – October/November 2014	5070	22

B7 (a) alkenes (1) [1]

(b) melting points increase (1)

increase in melting point from even number to odd number of carbon atoms is less than from odd to even number / the increase is less for some atoms than others / any reference to the regular zigzag nature of the increase (1) [2]

(c) C_9H_{20} (1) [1]

(d) (i) $C_{11}H_{24} \rightarrow C_2H_4 + C_3H_6 + C_6H_{14}$ (1) [1]

(ii) ANY TWO FROM

- (hydrocarbons with) longer chains not in high demand / more longer chains produced than used / shorter chains in more demand / fewer short chains produced than used (1)
- so (more) petrol / gasoline is made (1)
- to produce alkenes / to make ethane (1) [2]

(e) (i) 16 g methane $\rightarrow$ 27 g HCN (1)

$$500 \text{ g methane} \rightarrow 500 \times \frac{27}{16} \times \frac{65}{100} = 548 \text{ g (1)}$$

OR

$$\frac{500}{16} = 31.25 \text{ mol methane (1)}$$

$$31.25 \times 27 \times \frac{65}{100} = 548 \text{ g (1)} [2]$$

(ii) $Ca(OH)_2 + 2HCN \rightarrow Ca(CN)_2 + 2H_2O$ (1) [1]

[Total: 10]

Page 9	Mark Scheme	Syllabus	Paper
	Cambridge O Level – October/November 2014	5070	22

- B8 (a) (i)** concentration of ethanoate = 0.45 mol/dm^3 (1)
mass = $0.45 \times 59 \times \frac{200}{1000} = 5.31/5.3 \text{ g}$ (1) [2]
- (ii)** $\frac{0.17}{300} = 5.67 \times 10^{-4} / 5.7 \times 10^{-4} \text{ (mol/dm}^3\text{/s)}$ (1) [1]
- (iii)** rate of reaction decreases with time / reaction slows down (1)
concentration (of H^+ ions) decreases / concentration (of reactants) decreases / concentration (of ethyl ethanoate) decreases (1)
collision frequency reduced (1) [3]
- (b)** $\text{Fe}^{2+}(\text{aq}) + 2\text{OH}^{-}(\text{aq}) \rightarrow \text{Fe}(\text{OH})_2(\text{s})$
correct formulae (1)
correct state symbols (dependent on correct formulae) (1) [2]
- (c)** filter (off iron) (1)
- heat filtrate to crystallisation point then leave to crystallise / evaporate off some of the water from filtrate then leave to crystallise / partially evaporate filtrate and leave to crystallise
AND
dry crystals with filter paper (1) [2]

[Total: 10]

Page 10	Mark Scheme	Syllabus	Paper
	Cambridge O Level – October/November 2014	5070	22

B9 (a) decreases with increase in temperature (1)

reaction is exothermic/increasing temperature favours reaction which absorbs heat (1) [2]

(b) increases with increasing pressure (1)

increasing pressure causes reaction to go in direction of decreasing number of moles/smaller volume (1) [2]

(c) ANY ONE FROM

- low(er) temperature makes reaction rate too slow (1)
- high(er) temperature decreases percentage yield (1)
- low(er) temperature increases percentage yield (1)
- this temperature (i.e. 350–450) gives a (relatively) high rate and low yield (1)

ANY ONE FROM

- low(er) pressure gives poor yield (1)
- high(er) pressure increases yield (1)
- high(er) pressure expends too much energy (1)
- high a pressure too expensive (1)
- high(er) pressure gives a higher rate (1)
- high pressure a safety risk (1)
- this pressure (i.e. 200–300) gives a high yield and high rate (1) [2]

(d) speeds up the reaction/lowers the activation energy (1)

lowers energy costs/less energy used (1) [2]

(e) molar mass of $(\text{NH}_4)_3\text{PO}_4 = 149$ (1)

$$\frac{42}{149} \times 100 = 28.19\%/28.2\% \text{ (1)} \quad [2]$$

[Total: 10]