Cambridge
O Level

**Cambridge International Examinations**
Cambridge Ordinary Level

**CHEMISTRY** **5070/22**

Paper 2 Theory **October/November 2016**

MARK SCHEME

Maximum Mark: 75

**Published**

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, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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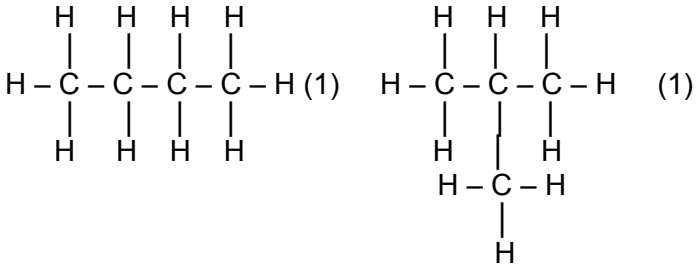
| Question | Answer | Marks |
|---|---|---|
| ***Section A*** | | |
| A1(a) | $SO_2$/sulfur dioxide (1) | **1** |
| A1(b) | $C_3H_8$/propane (1) | **1** |
| A1(c) | $ZnSO_4$/zinc sulfate (1) | **1** |
| A1(d) | CO/carbon monoxide (1) | **1** |
| A1(e) | $Na_3PO_4$/sodium phosphate (1) | **1** |
| | **Total:** | **5** |

| Question | Answer | Marks |
|---|---|---|
| A2(a) | $NH_4^+$ (1)<br>$SO_4^{2-}$ (1) | **2** |
| A2(b) | warm with sodium hydroxide (1)<br><br>(damp red) litmus turns blue/ammonia produced turns red litmus blue (1) | **2** |
| A2(c) | $OH^- + H^+ \rightarrow H_2O$ (1) | **1** |
| | **Total:** | **5** |

| Question | Answer | Marks |
|---|---|---|
| A3(a) | One mark each for any **two** of :<br><br>• same functional group<br>• (same) general formula<br>• similar chemical properties/react similarly<br>• trend in physical properties<br>• each differs by $CH_2$ | **2** |
| A3(b) |  (1)  (1) | **2** |
| A3(c)(i) | One mark each for any **two** of:<br><br>• (generally) increases as number of carbon atoms increases<br>• increases in zigzag way/idea of going up irregularly/idea of going up unevenly<br>• decreases between C2 and C3 compound (or words to that effect) | **2** |
| A3(c)(ii) | any value between –25 (°C) and –45 (°C) (inclusive of these values) (1) | **1** |
| A3(d)(i) | $C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$<br>correct formulae (1)<br>correct balance dependent on correct formulae (1) | **2** |

| Question | Answer | Marks |
|---|---|---|
| A3(d)(ii) | Any **two** of: carbon monoxide/carbon/water (1)<br><br>carbon monoxide is toxic/carbon monoxide is poisonous (1) | **2** |
| | **Total:** | **11** |

| Question | Answer | Marks |
|---|---|---|
| A4(a) | propane: increases (rate)/doubling concentration doubles rate (1)<br>iodine: no effect (on rate) (1)<br>hydrochloric acid: increases (rate)/doubling concentration doubles rate (1) | **3** |
| A4(b) | particles move faster/particles have more energy (1)<br><br>more particles have (energy greater than) the activation energy/more successful collisions (1) | **2** |
| A4(c) | atom(s) with same number of protons and different number of neutrons/atom(s) of the same element with different number of neutrons (1) | **1** |
| A4(d) | $I_2 + 2At^- \rightarrow At_2 + 2I^-$ (1) | **1** |
| A4(e) | they lose electrons/they are oxidised/they give electrons (to hydrogen peroxide)/the oxidation number of iodine increases/the oxidation number of oxygen is decreased (1) | **1** |
| | **Total:** | **8** |

| Question | Answer | Marks |
|---|---|---|
| A5(a) | 34.5% (2)<br>If two marks not scored, 171 (for molar mass of nickel carbonyl) scores 1 mark | **2** |
| A5(b) | mol nickel carbonyl = $\frac{1.71}{171}$ OR 0.01 (mol) (1)<br><br>mol gases = (0.01) × 5/idea of multiplying mol × 5 (1)<br><br>volume of gases = 1.2 $dm^3$/1200 $cm^3$ (units must be correct) (1) | **3** |
| A5(c) | low melting point/low boiling point (1)<br><br>does not conduct electricity (1) | **2** |
| A5(d) | <u>isotopes</u> (1)<br><br>cobalt has greater proportion of heavier isotopes than nickel/nickel has lower proportion of lighter isotopes than nickel (1) | **2** |
| A5(e) | acid that is completely ionised/acid that is completely dissociated/acid that releases all ionisable hydrogen (1) | **1** |
| | **Total:** | **10** |

| Question | Answer | Marks |
|---|---|---|
| A6(a) | electrons move (throughout the structure)/mobile electrons (1) | **1** |
| A6(b) | One mark each for any **two** of:<br>• decrease in melting point down the group, Or Reverse Argument (ORA) /decrease in boiling point down the group ORA (1)<br>• increase in density down the group ORA<br>• increase in reactivity down the group ORA<br>• decrease in hardness down the group ORA | **2** |
| A6(c) | rubidium hydroxide (1)<br>hydrogen (1) | **2** |
| A6(d) | sodium more reactive (than titanium) ORA/sodium higher in reactivity series (than titanium) ORA (1) | **1** |
| | **Total:** | **6** |

| Question | Answer | Marks |
|---|---|---|
| ***Section B*** | | |
| B7(a) | vanadium pentoxide/vanadium(V) oxide/$V_2O_5$ (1) | **1** |
| B7(b) | four bonding electrons between the two oxygen atoms<br>AND<br>four non-bonding electrons on each oxygen atom (1) | **1** |

| Question | Answer | Marks |
|---|---|---|
| B7(c)(i) | little/no change in % yield at low temperature (1)<br><br>yield decreases as temperature increases (1)<br><br>reaction is **exothermic** so equilibrium moves to the left as temperature increases/increasing temperature favours the **endothermic** reaction (1) | **3** |
| B7(c)(ii) | at 250 °C reaction is slow(er)/at 450 °C reaction is fast(er) (1)<br><br>idea of compromise temperature/idea of balance between lower yield and faster rate (1) | **2** |
| B7(d) | (position of) equilibrium moves to the right/(position of) equilibrium moves towards the product side (1)<br><br>more (gas) molecules on left than right of the equation/fewer (gas) molecules on right of equation than left (1) | **2** |
| B7(e) | $SO_3 + 2HBr \rightarrow SO_2 + Br_2 + H_2O$ (1) | **1** |
| | **Total:** | **10** |

| Question | Answer | Marks |
|---|---|---|
| B8(a) | reactants labelled on left and products labelled on the right AND product level below reactant level (1)<br><br>enthalpy change labelled and shown by downward arrow (1)<br><br>activation energy shown as upward arrow from left hand energy level to energy 'hump' above the highest energy levels of both products and reactants (1) | **3** |
| B8(b) | C=C double bond/it is unsaturated (1) | **1** |

| Question | Answer | Marks |
|---|---|---|
| B8(c) | CN<br>\|<br>CH – $CH_2$ (1)<br><br>extension bonds shown (1) | **2** |
| B8(d)(i) | One mark each for any **two** of:<br>• high melting point/high boiling point<br>• high density<br>• hard<br>• good conductor of electricity/good conductor of heat<br>• malleable<br>• ductile<br>• shiny/lustrous | **2** |
| B8(d)(ii) | $Mo(s) + 3Cl_2(g) \rightarrow MoCl_6(s)$<br>correct formulae (1)<br>correct state symbols, dependent on correct formulae (1) | **2** |
| | **Total:** | **10** |

| Question | Answer | Marks |
|---|---|---|
| B9(a) | magnesium loses (outer shell) electrons more easily than copper/copper cannot give (outer shell) electrons to hydrogen ions but magnesium can ORA (1) | **1** |
| B9(b) | the more zinc the greater the strength/the more copper, the lower the strength (1) | **1** |

| Question | Answer | Marks |
|---|---|---|
| B9(c) | layers (of atoms/ions) in copper can slide (when a force is applied) (1)<br><br>atoms/ions of zinc are different size to those of copper/atoms of zinc disrupt the copper lattice (1)<br><br>layers (of atoms/ions) in alloy cannot slide (as easily) (1) | **3** |
| B9(d) | two rods dipping into a liquid and joined to a power supply (1)<br><br>electrolyte labelled as 'aqueous copper ions'/named solution of soluble copper salt e.g. aqueous copper sulfate/solution of copper sulfate (1)<br><br>copper anode/positive electrode AND steel cathode/ negative electrode (1) | **3** |
| B9(e) | $Cu_2O$ (2)<br><br>If two marks not scored, mol Cu = $\frac{9.86}{64}$ AND mol O = $\frac{1.23}{16}$ scores 1 mark | **2** |
| | **Total:** | **10** |

| Question | Answer | Marks |
|---|---|---|
| B10(a) | filter (off excess copper oxide) (1)<br><br>evaporate (filtrate) to crystallisation point/leave in warm place to crystallise/heat (solution) until saturated (1)<br><br>dry with filter paper/dry in a drying oven (1) | **3** |
| B10(b) | mol sulfuric acid = $2.0 \times \frac{15}{1000}$ OR 0.03 (1)<br><br>molar mass of hydrated copper sulfate = 250 (1)<br><br>mass of hydrated copper sulfate = 7.5 g (1) | **3** |
| B10(c) | (light) blue precipitate (1)<br><br>dark blue solution (in excess) (1) | **2** |
| B10(d) | anode: oxygen/$O_2$ (1)<br><br>cathode: copper/Cu (1) | **2** |
| | **Total:** | **10** |