CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

MARK SCHEME for the May/June 2013 series

5070 CHEMISTRY

5070/21 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, 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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International Examinations

A1 **(a)** Iron(II) hydroxide (1) [1]

(b) Butane (1) [1]

(c) Propene (1) [1]

(d) Calcium carbonate (1) [1]

(e) Sulfur dioxide (1) [1]

(f) Sulfuric acid / sodium chloride (1) [1]

[Total: 6]

A2 **(a)** Any value in range 20–22 (1) [1]

(b) $6H_2O + 6CO_2 \rightarrow C_6H_{12}O_6 + 6O_2$ (1) [1]

(c) **ANY TWO FROM**
Use of enzymes (1)

Chlorophyll / presence of chloroplasts (1)

Sunlight (1) **IGNORE** just light / sun / sunshine

(Ideally) 20–40 ^oC (1) [2]

(d) **(i)** Bond breaking absorbs energy **and** bond making releases energy / bond breaking is endothermic **and** bond making is exothermic (1)

More energy absorbed than released / less energy released than absorbed / endothermic energy change is greater than exothermic energy change / exothermic energy change is less than endothermic energy change (1) [2]

(ii) Products level above and to the right of the reactants level (1)

Correct energy hump drawn and near vertical arrow labelled activation energy (or E_a) from reactant level to energy maximum (1)

Correct labelled enthalpy change with near vertical arrow pointing upwards (1) [3]

[Total: 9]

A3 (a) (i) $2KOH + H_2SO_4 \rightarrow K_2SO_4 + 2H_2O$ (1) [1]

(ii) 24 cm^3 (of potassium hydroxide neutralises acid) (1) [1]

(iii) Moles of KOH = $\frac{24}{1000} \times 0.150 / 0.0036$ (1)

Moles of H_2SO_4 = $\frac{0.0036}{2} / 0.0018$ (1)

Concentration = $\frac{0.0018}{0.025} = 0.072$ (mol dm^{-3}) (1) [3]

(b) Use of nitric acid (1)
Add **excess** base to acid (and warm) (1)

Filter (to remove excess base) (1)

Evaporate to point of crystallisation / leave in warm place / heat then allow solution to cool (1) [4]

[Total: 9]

A4 (a) 40 (1) [1]

(b) Same number of protons and electrons / because it has 12 protons and 12 electrons (1)

Protons are positive and electrons are negative / protons are +1 and electrons are –1 (1) [2]

(c) **C** and **D** [1]

(d) 2– / –2 (1) [1]

(e) **F** and **G** (1) [1]

[Total: 6]

A5 (a)

	N	H	Cr	O
Mole ratio	$\frac{11.1}{14}$ / 0.793	$\frac{3.2}{1}$ / 3.2	$\frac{41.3}{52}$ / 0.794	$\frac{44.4}{16}$ / 2.78
Simplified ratio	$\frac{0.793}{0.793}$ / 1	$\frac{3.2}{0.793}$ / 4	$\frac{0.794}{0.793}$ / 1	$\frac{2.78}{0.793}$ / 3.5
×2	2	8	2	7

Mole ratio line (1) Simplified ratio line (1)
Idea of the × 2 (1) [3]

(b) Chromium (1) [1]

(c) **X** is an oxidising agent (1)

because oxidation number of iodine increases / iodide loses electrons / **X** gains electrons / oxidation number of Cr decreases (1) [2]

(d) **(i)** NH_4^+ (1) [1]

(ii) $Cr_2O_7^{2-}$ (1) [1]

(e) Nitrogen (1) [1]

[Total: 9]

A6 (a) (i) Correct 'dot-and-cross' diagram with one pair of bonding electrons between O and C*l*, four non-bonding electrons on O and six non-bonding electrons on each C*l* (1) [1]

(ii) ANY TWO FROM
Simple molecular structure / small molecule (1)

Weak intermolecular forces have to be broken (1)

Little energy needed to break intermolecular force / intermolecular force is easy to overcome (1) [2]

(b) K^+ 2,8,8 (1)

O^{2-} 2,8 (1)

Alternatively

ALLOW correct charge on ion (1) and correct electronic structure (1) [2]

(c) $H_2O + Cl_2O_7 \rightarrow 2HClO_4$ (1) [1]

[Total: 6]

B7 (a) ANY TWO FROM
Dissolves (1)

Blue / green solution (1)

Fizzes / bubbles / effervescence (1) [2]

(b) $CuCO_3.Cu(OH)_2 + 4HCl \rightarrow 2CuCl_2 + CO_2 + 3H_2O$ (1)

Correct formulae (1)

Balancing (1) [2]

(c) Moles of CO_2 / moles of CO_3^{2-} = 0.004 (1)

M_r of CO_3^{2-} = 60 (1)

Mass of CO_3^{2-} = 0.24 g (1) [3]

(d) (i) $CuCO_3.Cu(OH)_2 + C \rightarrow 2Cu + 2CO_2 + H_2O$

Correct formulae (1)

Balancing (1) [2]

(ii) **ANY ONE FROM:**
less energy used (in recycling than in extracting from the ore) (1)

reduces pollution / reduces waste / reduces trash / less of an eyesore / not an eyesore / less landfill / no landfill (1)

(less mining) saves more land for other uses / (less mining) saves land for more agriculture (1) [1]

[Total: 10]

B8 (a) Group of substances with a general formula / formulae vary by CH_2 (1)

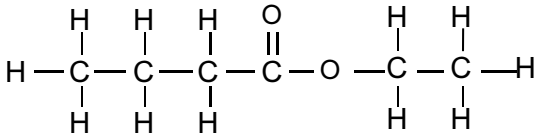
Have similar reactions / have similar chemical properties / have the same functional group (1) [2]

(b) Propanoic acid (1) [1]

(c) $C_nH_{2n+1}CO_2H$ / $C_nH_{2n+1}COOH$ (1) [1]

(d) Melting point does not have a trend but boiling point does / melting point increase and decreases but boiling point only increases (1) [1]

(e) Ethyl butanoate (1)



(1)

[2]

(f) (i) $C_{15}H_{31}COOH \rightleftharpoons C_{15}H_{31}COO^- + H^+$ (1)

Only partially dissociates / forms an equilibrium mixture / does not completely ionise (1) [2]

(ii) $C_{15}H_{31}COONa$ (1) [1]

[Total: 10]

B9 (a) (i) Reaction is faster because particles are moving faster / rate increases because particles have more energy (1)

There are more successful collisions / more particles have energy above the activation energy / more effective collisions / more fruitful collisions / more energetic collisions more chance of successful collisions (1) [2]

(ii) Position of equilibrium shifts to the left (1)

Because the reaction is exothermic (1) [2]

(b) (i) Reaction is slower because the particles are further apart / rate decreases because the particles are less crowded (1)

Fewer collisions per second / particles collide less often / lower collision frequency (1) [2]

(ii) Position of equilibrium shifts to the left (1)

More moles on the reactant side / fewer moles on the product side (1) [2]

(c) 450 kJ (1) [1]

(d) Lowers the activation energy / gives (alternative) route with lower energy (1) [1]

[Total: 10]

B10 (a) (i) $Ag^+ + e^- \rightarrow Ag$ (1) [1]

(ii) Electrons are gained (1) [1]

(b) Temperature does not change the mass (1)

Mass is proportional to the time / doubling time doubles mass (1)

Mass is proportional to the current / doubling current doubles mass (1)

Concentration does not change the mass (1) [4]

(c) Ions cannot move in a solid / ions are in a fixed position in a solid (1)

Ions can move in a solution (1) [2]

(d) $Ag^{+}(aq) + Cl^{-}(aq) \rightarrow AgCl(s)$
Correct formulae and balancing (1)
Correct state symbols – dependent on correct formulae (1) [2]

[Total: 10]