UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

MARK SCHEME for the May/June 2012 question paper

for the guidance of teachers

5070 CHEMISTRY

5070/22 Paper 2 (Theory), maximum raw mark 75

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UNIVERSITY of CAMBRIDGE
International Examinations

A1 **(a)** $^{17}_{8}O$ [1]

(b) $^{39}_{19}K^{+}$ / $^{24}_{12}Mg^{2+}$ [1]

(c) $^{14}_{6}C$ [1]

(d) $^{14}_{6}C$ / $^{16}_{8}O^{2-}$ [1]

(e) $^{20}_{10}Ne$ [1]

(f) $^{40}_{20}Ca$ [1]

[Total: 6]

A2 **(a)** **(i)** Zinc hydroxide / $Zn(OH)_2$ [1]

(ii) $Zn^{2+}(aq) + 2OH^{-}(aq) \rightarrow Zn(OH)_2(s)$ (1)
Correct balanced equation (1)
Correct state symbols – dependent on correct formulae (1) [2]

(b) **X** – zinc / Zn (1)
Y – zinc nitrate / $Zn(NO_3)_2$ (1) [2]

(c) **(i)** mass of sample = 4.21 g (1)
M_r = 46 (1) [2]

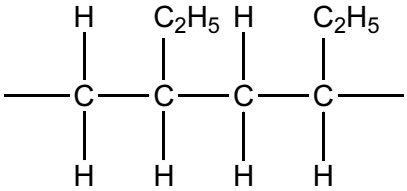
(ii) Mole ratio nitrogen oxygen = 0.0914 : 0.183 (1)
NO_2 (1) [2]

[Total: 9]

A3 **(a)** Any **two** from
- Saves (finite) resources / need to extract metals decrease
- Saves energy / less energy to recycle (than to extract from ore);
- Reduces disposal problems / less landfill
- Reduces mining / less scarring of landscape (due to mining)
- less litter
- fewer toxic gases / fewer harmful gases [2]

Allow: deforestation / less (heavy) metal pollution / less dumped

(b)



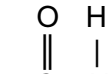
Correct structure (2 marks) [2]
Allow: single repeating unit with continuation bonds with brackets and n
Allow: multiple units e.g. 4 or 6

(c) Any **two** from
- Causes litter / unsightly ;
- Fills up land-fill sites / need land-fill sites
- Incineration produces toxic gases / burning makes carbon monoxide / burning makes (more) carbon dioxide / incineration (of polymer) increases global warming;
- Wastes a finite resource / waste fossil fuels;
- Blocks drains / blocks water flow / harms fishes / sea animals e.g. turtles choke on it [2]

Allow: incineration produces harmful gases

(d) (i) Condensation [1]

(ii) Correct amide linkage [1]

Allow:  between each box

(iii) Fats / lipids: [1]
Allow: oils

(e) (i) SiO_2 [1]

(ii) Many (covalent) bonds / (covalent) giant structure / macromolecule / all atoms joined together (1)

Takes a lot of energy to break bonds / hard to break bonds / high temperature needed to break bonds / bonds are strong (1) [2]

(iii) No free electrons / no delocalised electrons / no sea of electrons / all electrons in covalent bonds / electrons cannot move [1]

[Total: 13]

4 (a) (i) $N_2 + O_2 \rightarrow 2NO$ [1]

(ii) $2NO + O_2 \rightarrow 2NO_2$ (1) [1]

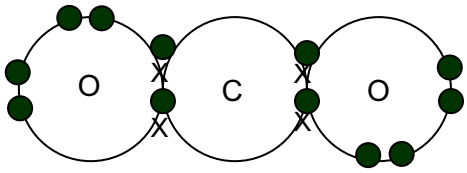
(b) $2NO_2 + H_2O \rightarrow HNO_3 + HNO_2$ [1]

(c) (i) Carbon dioxide / CO_2 (1) [1]

(ii) Calcium nitrate (1) $Ca(NO_3)_2$ (1) [2]
Allow: Calcium nitrite / Calcium nitrate(III) (1) $Ca(NO_2)_2$ (1)

(d) Any **two** from
- Seawater is cheap(er):
- Seawater removes more of the pollutant gases / seawater more effective at removing pollutant gases
- Seawater does not involve landscape destruction / no mining involved
- doesn't produce carbon dioxide / doesn't increase global warming
- seawater is readily available / seawater is abundant [2]

(e)



[1]

[Total: 9]

A5 (a) 1.2 [1]

(b) $2KOH + H_2SO_4 \rightarrow K_2SO_4 + 2H_2O$ [1]
Allow: $KOH + H_2SO_4 \rightarrow KHSO_4 + H_2O$

(c) (i) 30.0 cm^3 / 30 cm^3 [1]

(ii) Moles of acid = 0.00125 (1)
Moles of KOH = 0.00250 (1)
[KOH] = 0.0833 / 0.083 / 0.08 (1)
Allow ecf from wrong moles of KOH and/or wrong volume of KOH from part **(c)(i)** [3]

(d) Any one difference (1)
Correct explanation of that difference (1) e.g.
Graph will start above pH 1.2 / higher starting pH (1)
because ethanoic acid is a weak acid (1)
OR
Neutralisation volume will be 15.0 cm^3 (1) because ethanoic acid reacts in a 1:1 mole ratio (1)
OR
Vertical section of graph will be a smaller (1) because ethanoic acid is a weak acid (1) [2]

[Total: 8]

B6 **(a)** (Reaction that) releases heat / (reaction that) releases energy [1]
Allow: energy given out is greater than energy absorbed / reaction mixture gets hot

(b) Bond breaking takes in energy and bond forming releases energy (1)

More energy is released than taken in (1) [2]
Allow: bond breaking is endothermic and bond making is exothermic / enthalpy change is negative

(c) Implication that volumes of gases are proportional to the number of moles
OR
(Moles of hydrogen = 83.3) moles of oxygen = 41.7 / 41.65 (1)

Volume of oxygen = 1000 dm^3 (1) [2]

(d) First equation involves reduction since electrons are gained / oxygen is reduced because it gains electrons / oxygen is reduced because its oxidation number decreases (1)

Second equation involves oxidation since electrons are lost / hydrogen is oxidised because it loses electrons / hydrogen is oxidised because its oxidation number increases (1) [2]

(e) Water / hydrocarbons (1)
Allow: ethane / propane / alkanes / methane + steam / naphtha [1]
Allow: cracking

(f) Advantage – directly converts chemical energy into electrical energy / more energy efficient / makes no pollutants / doesn't release harmful gases / uses a renewable resource (1)

Disadvantage – storage problems associated with hydrogen or oxygen / hydrogen explosive / pressurised tanks needed / pollution problems on disposal of fuel cell / pollution problems while manufacturing fuel cells (1) [2]

[Total: 10]

B7 **(a)** 0.71 g
Allow: 0.709 / 0.704 g [1]

(b) Copper (carbonate) [1]

(c) Used different amounts in moles [1]
Allow: different atomic masses of the metal / different molecular masses of compound / % of carbon in each compound is different

(d) **(i)** calcium ions with Ca^{2+} and 2.8.8 as drawn or as numbers (1)
oxide ion with O^{2-} and 2.8 as drawn or as numbers (1) [2]

(ii) Reacts with sand to make slag / reacts with silicon dioxide to make calcium silicate / removes silicon dioxide as slag (1) [1]

(e) **(i)** $CO_3^{2-} + H^+ \rightarrow HCO_3^-$
OR
$CO_3^{2-} + 2H^+ \rightarrow CO_2 + H_2O$ (1) [1]

(ii) Add excess copper(II) carbonate to hydrochloric acid (1)
Filter (1)
Evaporate the filtrate partially / evaporate to crystallisation point (1)
Allow: leave to crystallise [3]

[Total: 10]

B8 **(a)** Correct structure showing all atoms and bonds (1)
Contains a (carbon-carbon) double bond (1)
Has carbon and hydrogen only (1) [3]

(b) Isomer (1) [1]

(c) $C_{10}H_{20}$ (1) [1]

(d) Melting point decreases and increases / melting point is irregular down the series
AND
boiling point increases all the time / boiling point increases regularly / shows a trend [1]

(e) Gas because boiling point is lower than room temperature / boiling point is – 6 °C [1]

(f) $C_{16}H_{34} \rightarrow 3C_4H_8 + C_4H_{10}$ (1) [1]

(g) **(i)** $C_4H_8Br_2$ (1) [1]

(ii) Butan-1-ol / butan-2-ol / butanol [1]

[Total: 10]

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

more energetic collisions / more effective collisions / more particles have energy above that of the activation energy / more successful collisions (1) [2]

(b) Position of equilibrium shifts to the left / shift backwards / shifts towards the reactants / back reaction favoured (1)

More moles (of gas) on the left hand side / 4 moles on the left and 2 on the right / greater volume (of gas) on left / more molecules on left (1) [2]

(c) Moles of hydrogen = 250 000 (1)
Energy released = 4 083 333 kJ (1) [2]

(d) $2CH_3OH + 3O_2 \rightarrow 2CO_2 + 4H_2O$ [1]

(e) **(i)** potassium dichromate / potassium manganate(VII) / potassium permanganate / potassium manganate (1)

heat / warm / boil / reflux (1) [2]

(ii) HCO_2H (1)
Allow: HCOOH / displayed formula [1]

[Total: 10]