

**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

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.

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- A1 (a)** $^{17}_8\text{O}$ [1]
- (b)** $^{39}_{19}\text{K}^+ / ^{24}_{12}\text{Mg}^{2+}$ [1]
- (c)** $^{14}_6\text{C}$ [1]
- (d)** $^{14}_6\text{C} / ^{16}_8\text{O}^{2-}$ [1]
- (e)** $^{20}_{10}\text{Ne}$ [1]
- (f)** $^{40}_{20}\text{Ca}$ [1]

[Total: 6]

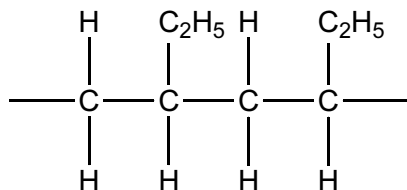
- A2 (a) (i)** Zinc hydroxide / Zn(OH)_2 [1]
- (ii)** $\text{Zn}^{2+}(\text{aq}) + 2\text{OH}^{-}(\text{aq}) \rightarrow \text{Zn(OH)}_2(\text{s})$ (1)
 Correct balanced equation (1)
 Correct state symbols – dependent on correct formulae (1) [2]
- (b) X** – zinc / Zn (1)
Y – zinc nitrate / $\text{Zn(NO}_3)_2$ (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

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(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

Allow: incineration produces harmful gases

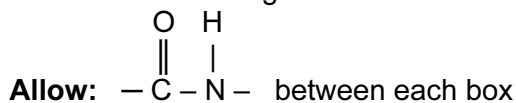
[2]

(d) (i) Condensation

[1]

(ii) Correct amide linkage

[1]



(iii) Fats / lipids:

Allow: oils

[1]

(e) (i) SiO₂

[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) N₂ + O₂ → 2NO

[1]

(ii) 2NO + O₂ → 2NO₂ (1)

[1]

(b) 2NO₂ + H₂O → HNO₃ + HNO₂

[1]

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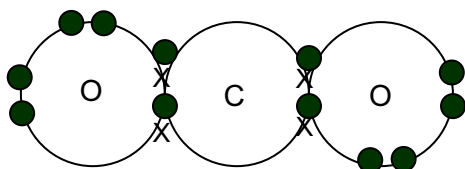
(c) (i) Carbon dioxide / CO₂ (1) [1]

(ii) Calcium nitrate (1) Ca(NO₃)₂ (1) [2]
Allow: Calcium nitrite / Calcium nitrate(III) (1) Ca(NO₂)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) $2\text{KOH} + \text{H}_2\text{SO}_4 \rightarrow \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$ [1]
Allow: $\text{KOH} + \text{H}_2\text{SO}_4 \rightarrow \text{KHSO}_4 + \text{H}_2\text{O}$

(c) (i) 30.0 cm³ / 30 cm³ [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 cm³ (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]

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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 dm³ (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]

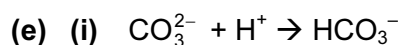
(c) Used different amounts in moles [1]

Allow: different atomic masses of the metal / different molecular masses of compound / % of carbon in each compound is different

(d) (i) calcium ions with Ca²⁺ and 2.8.8 as drawn or as numbers (1)
oxide ion with O²⁻ and 2.8 as drawn or as numbers (1) [2]

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



OR



(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) $\text{C}_{10}\text{H}_{20}$ (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) $\text{C}_{16}\text{H}_{34} \rightarrow 3\text{C}_4\text{H}_8 + \text{C}_4\text{H}_{10}$ (1) [1]

(g) (i) $\text{C}_4\text{H}_8\text{Br}_2$ (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]

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(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) $2\text{CH}_3\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 4\text{H}_2\text{O}$ [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]