

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

**MARK SCHEME for the May/June 2010 question paper  
for the guidance of teachers**

**0620 CHEMISTRY**

**0620/31**

Paper 31 (Extended Theory), maximum raw mark 80

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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- 1 (i) sulfur [1]
- (ii) iodine [1]
- (iii) copper **ignore** (II) [1]
- (iv) calcium [1]
- (v) helium [1]  
**not** name of a compound  
**accept** correct symbols
- 2 (i) chloromethane [1]  
**cond** biggest molecular mass / biggest mass of one mole / its molecules  
move slowest / heaviest molecule / highest density [1]  
**accept** atomic mass if correct numerical value given  
**ignore** it is the heaviest (gas) / biggest molecule  
**accept** particles or molecules  
**not** atoms
- (ii) carbon dioxide / calcium carbonate [1]  
**not** methane  
water [1]  
sodium chloride / brine / seawater [1]
- (iii) chlorine [1]  
**not** chlorine water  
**cond** light / UV / heat / high temperature if numerical value given about  
200°C / lead tetraethyl [1]  
**not** warm
- (iv) oxygen and nitrogen (in air) [1]  
**not** from fuel, negates mark 1  
(react) at high temperatures / lightning / in engine [1]  
**not** combustion or exhaust, negates mark 2
- (v)  $2\text{O}_3 \rightarrow 3\text{O}_2$  [2]  
not balanced = [1]
- 3 (a) (i) bubbles / effervescence / hydrogen / gas pushes up / lifts metal [1]
- (ii) does not react with acid / zinc and iron react with acid [1]  
**not** just unreactive
- (b) (i) with copper / first experiment [1]
- (ii) copper acts as a catalyst [1]
- (c) (i) smaller gradient [1]  
**not** rate is slower
- (ii) same final volume of hydrogen / same level (on graph) [1]

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- (d) temperature / heat [1]  
 increase temperature – reaction faster particles have more energy / particles move faster / particles collide more frequently / more particles have enough energy to react  
**not** more excited  
**accept** arguments for a decrease in temperature [1]
- powdered  
 greater surface area  
 greater collision rate / more particles exposed (to acid)  
 any **two** [2]  
**not** concentration / light / catalyst / pressure
- 4 (a) (i) ethanol [1]  
 $\text{CH}_3\text{-CH}_2\text{-OH}$  [1]
- propanoic acid [1]  
 $\text{CH}_3\text{-CH}_2\text{-COOH}$  [1]  
 independent marking, no ecf  
**accept**  $\text{C}_2\text{H}_5$   
**not** – HO
- (ii) type of compound – salt / sodium carboxylate / alkanoate [1]  
**not** soap / sodium stearate etc  
 use – soap / cleaning / detergent [1]
- (iii) terylene / PET / Dacron / diolen / mylar / crimplene [1]
- (b) (i) polyamide / amide / peptide / polypeptide [1]
- (ii) correct amide linkage NHCO then CONH [1]  
**cond** to mark 1, 2 monomers (different shading in box) [1]  
**cond** continuation (to **ONE** correct linkage) [1]
- OR** nylon 6  
 only one linkage – NHCO [1]  
**cond** only one monomer [1]  
**cond** continuation (to correct linkage) [1]
- (iii) use locating agent [1]  
 measure distance travelled by sample / travelled by solvent front [1]  
**cond** this is  $R_f = 0.5$  [1]  
 for mark 3, either mark 1 or mark 2 must be awarded
- accept** run a chromatogram of glycine [1]  
 compare with sample  
 same position [1] max [2]

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- 5 (a) (i) macromolecular / giant covalent / giant atomic [1]  
all atoms held in position / in tetrahedral structure / to four other carbon atoms / all strong bonds [1]
- (ii) jewellery / drilling / cutting / engraving / cutting edges in scalpels [1]  
**mark first use offered**
- (iii) layer structure / sheets [1]  
molecules / ions in layers = [0]  
layers can slide (over each other) [1]
- (iv) lubricant / pencils / electrodes [1]  
**mark first use offered**
- (b) (i) 4e between carbon and oxygens [1]  
2 non-bonding pairs on both oxygens [1]  
**cond** correct coding – only scored if marks 1 and 2 awarded [1]  
**ignore** O<sub>2</sub> in atom
- (ii) 4O around each Si [1]  
2Si around each O [1]  
must refer to diagram **not** valencies **or** electron distributions
- (iii) SiO<sub>2</sub> has higher mp or bp  
SiO<sub>2</sub> is a solid, CO<sub>2</sub> is a gas (at rtp)  
(when both are solids) then SiO<sub>2</sub> is harder  
has higher density  
SiO<sub>2</sub> insoluble, CO<sub>2</sub> soluble [2]  
any **two**, comparison needed
- 6 (a) rates equal [1]  
concentrations do not change / macroscopic properties remain constant [1]  
**accept** amounts do not change
- (b) endothermic [1]  
**cond** favoured by high temperatures [1]
- (c) (i) move to left [1]  
**cond** bigger volume / more moles etc [1]  
do not insist on “gas”
- (ii) less yellow solid / more brown liquid [1]  
**accept** yellow to brown / less solid more liquid / goes brown

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- 7 (a) a transition element has more than one oxidation state or valency [1]  
**accept** different oxidation states
- (b) by removing oxygen concentration of O<sub>2</sub> decreases [1]  
prevents the back reaction / equilibrium shifts to right [1]
- (c) oxidation number reduced (from (+) 4 to 0) [1]  
**accept** accepts electrons **or** accepts four electrons  
if number given must be 4
- (d) low density / lightweight / light [1]  
propellers / fittings on ships / inert anodes in electrolysis / hip replacements /  
ship building / chemical plants / cathodic protection / diving equipment [1]
- (e) (i) percentage of oxygen = 31.6% [1]
- (ii) calculate the number of moles of atoms for each element  
number of moles of Ti = 31.6/48 = 0.66  
number of moles of O = 31.6/16 = 1.98 **accept 2** [1]  
both correct for one mark
- (iii) the simplest whole number ratio for moles of atoms:  
Fe : Ti : O  
1 : 1 : 3 [1]
- (iv) formula is FeTiO<sub>3</sub> **accept** TiFeO<sub>3</sub> [1]  
must be whole numbers from (iii) or cancelled numbers from (iii)  
mark **ecf** throughout

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- 8 (a) same general formula  
 same chemical properties  
 same functional group  
 physical properties vary in predictable way  
 common methods of preparation  
 consecutive members differ by CH<sub>2</sub>  
 any **two** [2]  
**mark first two**  
**ignore** others unless it contradicts a point which has been awarded a mark
- (b) (i)  $2\text{HCOOH} + \text{CaCO}_3 \rightarrow \text{Ca}(\text{HCOO})_2 + \text{CO}_2 + \text{H}_2\text{O}$  [2]  
**not** balanced = [1]
- (ii) zinc + methanoic acid → zinc methanoate + hydrogen [2]  
 [1] for each product
- (iii) protected by oxide layer [1]
- (c) butanoic acid [1]  
 CH<sub>3</sub>-CH<sub>2</sub>-CH<sub>2</sub>-COOH / C<sub>4</sub>H<sub>8</sub>O<sub>2</sub> / C<sub>3</sub>H<sub>7</sub>COOH / C<sub>4</sub>H<sub>7</sub>OOH [1]  
 C<sub>2</sub>H<sub>4</sub>O [1]  
 mark **ecf** to molecular formula