

**CAMBRIDGE INTERNATIONAL EXAMINATIONS**  
**GCE Advanced Subsidiary Level and GCE Advanced Level**

## **MARK SCHEME for the May/June 2013 series**

### **9701 CHEMISTRY**

**9701/22**

Paper 2 (AS Structured Questions), maximum raw mark 60

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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- 1 (a) a base is a proton acceptor **or**  
a lone pair donor (1)  
a weak base is not fully ionised (1)  
e.g.  $\text{NH}_3 + \text{H}_2\text{O} \rightleftharpoons \text{NH}_4^+ + \text{OH}^-$  **or**  
 $\text{B} + \text{H}^+ \rightleftharpoons \text{BH}^+$  **or** equivalent  
 $\rightleftharpoons$  is necessary (1) [3]
- (b) (i) **stated** pressure greater than 1 atm up to 5 atm (1)  
**stated** temperature 400 to 500 °C (1)  
**named** catalyst  $\text{V}_2\text{O}_5$ /vanadium(V) oxide (1)
- (ii)  $\text{SO}_3$  is dissolved in concentrated  $\text{H}_2\text{SO}_4$   
**and** then diluted with water  
**not** ' $\text{SO}_3$  dissolved in water' as the only statement (1) [4]
- (c) (i) **with concentrated sulfuric acid**  
 $\text{ClCH}_2\text{CH}=\text{CHCl}$  (1)
- with ammonia**  
 $\text{H}_2\text{NCH}_2\text{CH}(\text{OH})\text{CH}_2\text{NH}_2$  (1)
- (ii) nucleophilic (1)  
substitution (1) [4]
- [Total: 11]

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- 2 (a) (i)  $n(\text{H}_2\text{SO}_4) = \frac{25.0 \times 1.00}{1000} = 0.025 \text{ mol}$  (1)
- (ii)  $n(\text{NaOH}) = \frac{16.2 \times 2.00}{1000} = 0.0324 \text{ mol}$  (1)
- (iii)  $n(\text{H}_2\text{SO}_4) \text{ reacting with NaOH} = \frac{0.0324}{2} = 0.0162 \text{ mol}$  (1)
- (iv)  $n(\text{H}_2\text{SO}_4) \text{ reacting with NH}_3 = 0.025 - 0.0162 = 0.0088 \text{ mol}$  (1)
- (v)  $n(\text{NH}_3) \text{ reacting with H}_2\text{SO}_4 = 2 \times 0.0088 = 0.0176 \text{ mol}$  (1)
- (vi)  $n(\text{NaNO}_3) \text{ reacting} = n(\text{NH}_3) \text{ produced} = 0.0176 \text{ mol}$  (1)
- (vii) mass of  $\text{NaNO}_3$  that reacted =  $0.0176 \times 85 = 1.496 \text{ g}$  (1)
- (viii)  $\% \text{ of NaNO}_3 = \frac{1.496 \times 100}{1.64} = 91.2195122 = 91.2$
- give one mark for the correct expression (1)
- give one mark for answer given as 91.2 – i.e to 3 sig. fig. (1)
- allow ecf where appropriate
- [9]
- (b)  $\text{NaNO}_3$  +5 and  $\text{NH}_3$  -3 both required (1) [1]

[Total: 10]

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3 (a) penalise (-1) the use of names of elements or formulae of compounds

- (i) Ca (1)
- (ii) O or N or C (1)
- (iii) C or N or S or F or Cl or Br (1)
- (iv) Si or Ge or B (1)
- (v) Al or Si or P or S or H (1)
- (vi) Al (1) [6]

(b) (i)

element	Na	Mg	Al	Si	P	S
oxide	Na <sub>2</sub> O	MgO	Al <sub>2</sub> O <sub>3</sub>	SiO <sub>2</sub>	P <sub>2</sub> O <sub>5</sub> /P <sub>4</sub> O <sub>10</sub> or P <sub>2</sub> O <sub>3</sub> /P <sub>4</sub> O <sub>6</sub>	SO <sub>2</sub>
flame	yellow or orange	white	white	white	white or yellow	blue

formula of oxide (1)  
colour of flame (1)

(ii)

chloride	NaCl	MgCl <sub>2</sub>	AlCl <sub>3</sub> or Al <sub>2</sub> Cl <sub>6</sub>	SiCl <sub>4</sub>	PCl <sub>3</sub> or PCl <sub>5</sub>	SCl <sub>2</sub> or S <sub>2</sub> Cl <sub>2</sub>
pH	7	6.5 to 6.9	1 to 4			

formula of chloride (1)  
pH of solution formed (1) [4]

(c) (i)



(1)

- (ii) intermolecular forces/van der Waals' forces are stronger or greater in ICl (1)  
ICl has most electrons or has the largest permanent dipole (1)

- (iii) ICl (1)  
greatest difference in electronegativity is between I and Cl (1) [5]

**[Total: 15]**

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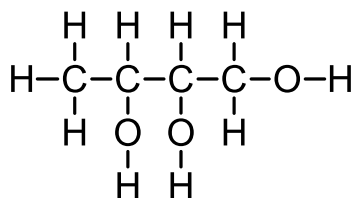
4 (a)

A	Br <sub>2</sub> in an inert organic solvent	CH <sub>3</sub> CHBrCHBrCH <sub>2</sub> OH
B	PCl <sub>5</sub>	CH <sub>3</sub> CH=CHCH <sub>2</sub> Cl
C	H <sub>2</sub> and Ni catalyst	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> OH
D	NaBH <sub>4</sub>	NO REACTION
E	K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> /H <sup>+</sup> , heat under reflux	CH <sub>3</sub> CH=CHCO <sub>2</sub> H

give one mark for each correct answer

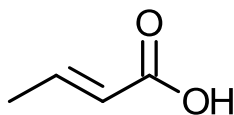
(5 × 1) [5]

(b)



(1) [1]

(c)



correct C<sub>4</sub> with C=C in position 2

accept *cis* form

correctly shown -CO<sub>2</sub>H

allow ecf on candidate's answer to E in (a)

(1)

(1)

[2]

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<b>(d) (i) reagent</b>	<b>observation</b>	
2,4-dinitrophenylhydrazine Tollens' reagent	red/orange ppt. silver mirror <b>or</b> grey ppt. <b>or</b> black ppt.	
Fehling's reagent	brick red ppt.	
correct reagent		(1)
observation		(1)
<b>(ii) reduction <b>or</b> nucleophilic addition</b>		(1) [3]
<b>(e)</b>	$\text{C} : \text{H} : \text{O} = \frac{73.7}{12} : \frac{12.3}{1} : \frac{14.0}{16}$ $= 6.14 : 12.3 : 0.875$ $= 7.01 : 14.1 : 1$	(1)
gives C <sub>7</sub> H <sub>14</sub> O formula must be given		(1) [2]

**[Total: 13]**

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5 (a)  $C_4H_8O_2$  (1) [1]

(b)

HCO <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>3</sub> <b>W</b>	HCO <sub>2</sub> CH(CH <sub>3</sub> ) <sub>2</sub> <b>X</b>
CH <sub>3</sub> CO <sub>2</sub> CH <sub>2</sub> CH <sub>3</sub> <b>Y</b>	CH <sub>3</sub> CH <sub>2</sub> CO <sub>2</sub> CH <sub>3</sub> <b>Z</b>

give one mark for each correct answer (4 × 1) [4]

(c) (i) —CHO **or** aldehyde absent (1)  
(ii) >CO **or** carbonyl absent (1)  
(iii) —CO<sub>2</sub>H **or** carboxylic acid present (1) [3]

(d) (i) CH<sub>3</sub>CO<sub>2</sub>H **or** ethanoic acid (1)  
(ii) Y above (1) [2]

(e) none – no chiral carbon atoms present (1) [1]

**[Total: 11]**