

**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**GCE Advanced Subsidiary Level and GCE Advanced Level**

**MARK SCHEME for the May/June 2012 question paper  
for the guidance of teachers**

**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 must be read in conjunction with the question papers and the report on the examination.

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Page 2	Mark Scheme: Teachers' version	Syllabus	Paper 1
	GCE AS/A LEVEL – May/June 2012	9701	022Based.com

- 1 (a) (i) silicon/Si **or** phosphorus/P (1)
- (ii) sodium **or** sulfur **name required** (1)
- (iii) white solid formed/white fumes seen  
chlorine gas decolourised  
aluminium glows **or** burns any two (2)
- (iv)  $2Al(s) + 3Cl_2(g) \rightarrow Al_2Cl_6(s)$  **or**  
 $2Al(s) + 3Cl_2(g) \rightarrow 2AlCl_3(s)$   
equation (1)  
state symbols (1)
- (v) outer shell of electrons is full/has a complete octet **or**  
valence shell of electrons is full/has a complete octet **or**  
activation energy is too high **or**  
ionisation energy is too high (1) [7]

(b) (i)

element	Does the chloride dissolve or react?	approximate pH of the resulting solution
Na	dissolve	7
Al	react	1 to 4
Si	react	1 to 4

one mark for each correct answer (6 × 1)

(ii) hydrolysis (1) [7]

(c) (i) around the N atom there is only one lone pair  
around the S atom there are two lone pairs **both** (1)

(ii) angle (a) **or** sulfur – **no mark for this**

**because** two lone pairs repel more than one lone pair **or**  
lone pair-lone pair repulsions are stronger  
than lone pair-bond pair repulsions (1) [2]

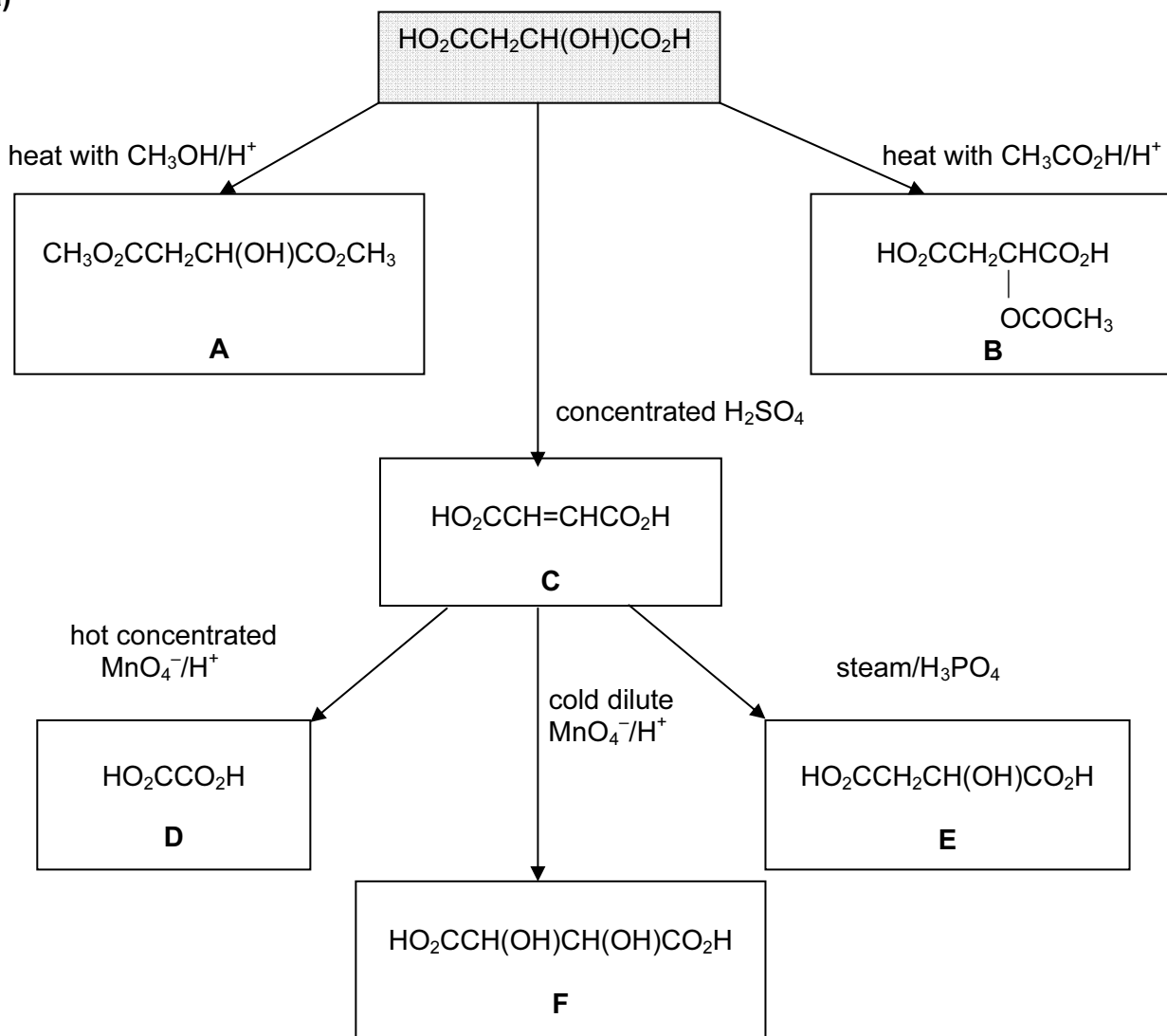
**[Total: 16]**

Page 3	Mark Scheme: Teachers' version	Syllabus	Paper 1
	GCE AS/A LEVEL – May/June 2012	9701	

- 2 (a)  $\text{CH}_3\text{OH}(\text{l}) + \frac{3}{2}\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$  (1)  
the enthalpy change/heat change/heat evolved when  
one mole of  $\text{CH}_3\text{OH}$  (1)  
is completely burned **or** (1)  
is burned in an excess of air/oxygen (1) [3]
- (b)  $\Delta H^\ominus_{\text{reaction}} = -283 + 2(-286) - (-726)$  (1)  
 $= -129 \text{ kJ mol}^{-1}$  (1)  
correct sign (1) [3]
- (c) **pressure**  
increases rate (1)  
by increasing frequency of collisions **or**  
by increasing concentration of reactants (1)
- temperature**  
increases rate (1)  
because more molecules have energy  $>E_a$  (1)
- catalyst**  
increases rate (1)  
by providing an alternative route of lower  $E_a$  (1) [6]

[Total: 12]

3 (a)



give one mark for each correct compound

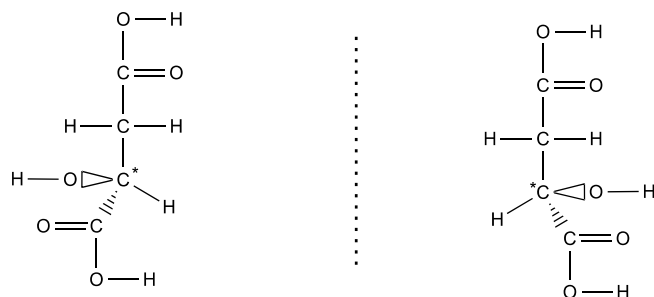
(6 × 1) [6]

- (b) malic acid into C dehydration or elimination (1)  
 C into D oxidation (1)  
 C into E addition or hydration (1) [3]

- (c) solvents or perfumes or flavourings (1) [1]

Page 5	Mark Scheme: Teachers' version	Syllabus	Paper 1
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(d) (i)



correct compound (malic acid) shown as a pair of enantiomers in 3D (1)  
 chiral carbon (\*) atom correctly identified (1)  
 structure **fully** displayed (1)

(ii)



give one for each correct **skeletal formula** (1 + 1)

correct *cis* (or *Z*) **and** *trans* (or *E*) labels (1) [6]

(e)  $C : H : O = \frac{37.5}{12} : \frac{4.17}{1} : \frac{58.3}{16}$

= 3.13 : 4.17 : 3.64 (1)

= 1 : 1.33 : 1.16 (1)

= 6 : 8 : 7

empirical formula is  $C_6H_8O_7$  (1) [3]

[Total: 19]

Page 6	Mark Scheme: Teachers' version	Syllabus	Paper 1
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4 (a)

reagent	R <sub>2</sub> CHOH	RCHO	RCO <sub>2</sub> H	RCO <sub>2</sub> R'	RCOR'
NaHCO <sub>3</sub>			✓		
Na	✓		✓		
Cr <sub>2</sub> O <sub>7</sub> <sup>2-</sup> /H <sup>+</sup>	✓	✓			

give one mark for each correct tick

(5 × 1) [5]

(b) (i) alcohol **or** ROH  
**not** hydroxyl **or** phenol **or** –OH (1)

(ii)  $n(\text{H}_2) = \frac{80}{24000} = 3.3 \times 10^{-3} \text{ mol}$  (1)

$n(\text{H atoms}) = 2 \times 3.3 \times 10^{-3} \text{ mol} = 6.6 \times 10^{-3} \text{ mol}$  (1)

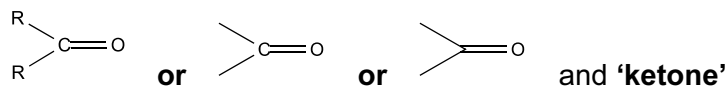
(iii)  $n(\text{G}) = \frac{0.30}{90} = 3.3 \times 10^{-3} \text{ mol}$

$n(\text{G}) : n(\text{H atoms}) = 3.3 \times 10^{-3} : 6.6 \times 10^{-3}$   
 $= 1 : 2$

so each –OH group produces one H atom

(1) [4]

(c) (i)



(ii) **G** is HOCH<sub>2</sub>COCH<sub>2</sub>OH as the minimum  
 allow the *gem* diol CH<sub>3</sub>COCH(OH)<sub>2</sub> (1) [2]

(d) (i) **H** is HO<sub>2</sub>CCOCO<sub>2</sub>H as the minimum (1)

(ii) **J** is HOCH<sub>2</sub>CH(OH)CH<sub>2</sub>OH as the minimum (1) [2]

[Total: 13]