

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
	GCE AS/A LEVEL – May/June 2012	9701	22

- 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]

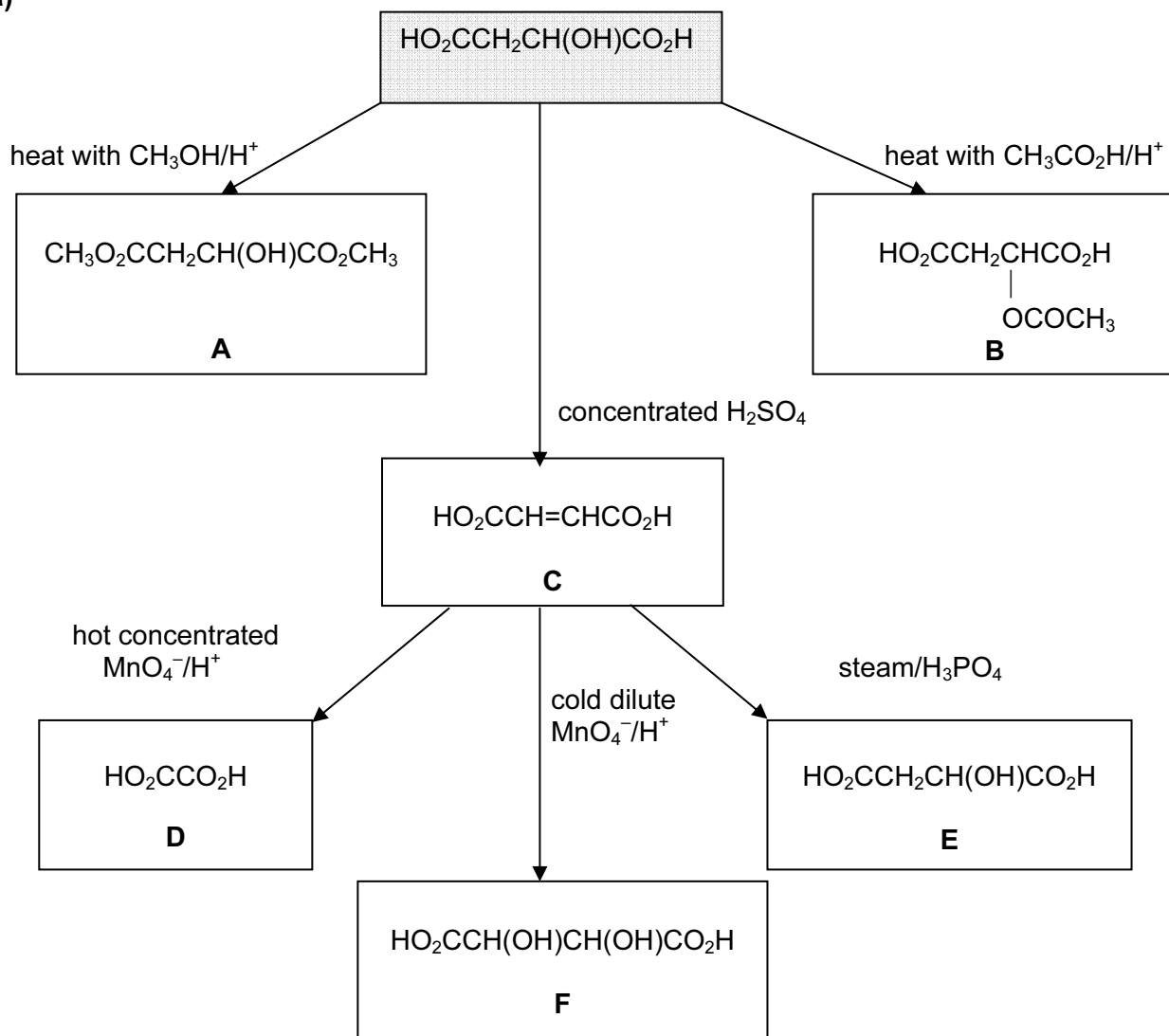
Page 3	Mark Scheme: Teachers' version	Syllabus	Paper
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- 2 (a) $\text{CH}_3\text{OH}(\text{l}) + \frac{3}{2}\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$ (1)
the enthalpy change/heat change/heat evolved when
one mole of CH_3OH (1)
is completely burned **or**
is burned in an excess of air/oxygen (1) [3]
- (b) $\Delta H^\circ_{\text{reaction}} = -283 + 2(-286) - (-726)$ (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]

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
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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

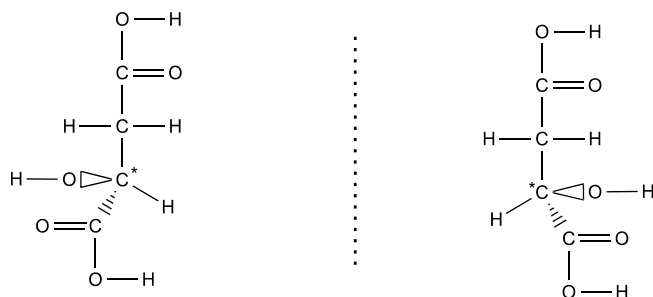
(1) [3]

(c) solvents **or** perfumes **or** flavourings

(1) [1]

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



correct compound (malic acid) shown as a pair of enantiomers in 3D

(1)

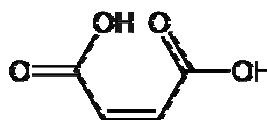
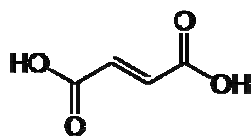
chiral carbon (*) atom correctly identified

(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
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4 (a)

reagent	R ₂ CHOH	RCHO	RCO ₂ H	RCO ₂ R'	RCOR'
NaHCO ₃			✓		
Na	✓		✓		
Cr ₂ O ₇ ²⁻ /H ⁺	✓	✓			

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)

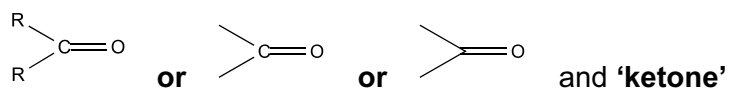
(iii) $n(\text{G}) = \frac{0.30}{90} = 3.3 \times 10^{-3} \text{ mol}$

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

so each –OH group produces one H atom

(1) [4]

(c) (i)



(1)

(ii) **G** is HOCH₂COCH₂OH as the minimum
 allow the *gem* diol CH₃COCH(OH)₂

(1)

[2]

(d) (i) **H** is HO₂CCOCO₂H as the minimum

(1)

(ii) **J** is HOCH₂CH(OH)CH₂OH as the minimum

(1)

[2]

[Total: 13]