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.

- Cambridge will not enter into discussions or correspondence in connection with these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2012 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

1 (a) (i) silicon/Si **or** phosphorus/P

(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]

2 **(a)** $CH_3OH(l) + {}^3/_2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$
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) $\Delta H^{\ominus}_{reaction} = -283 + 2(-286) - (-726)$ (1)
$= -129$ kJ mol^{-1} (1)
correct sign (1) [3]

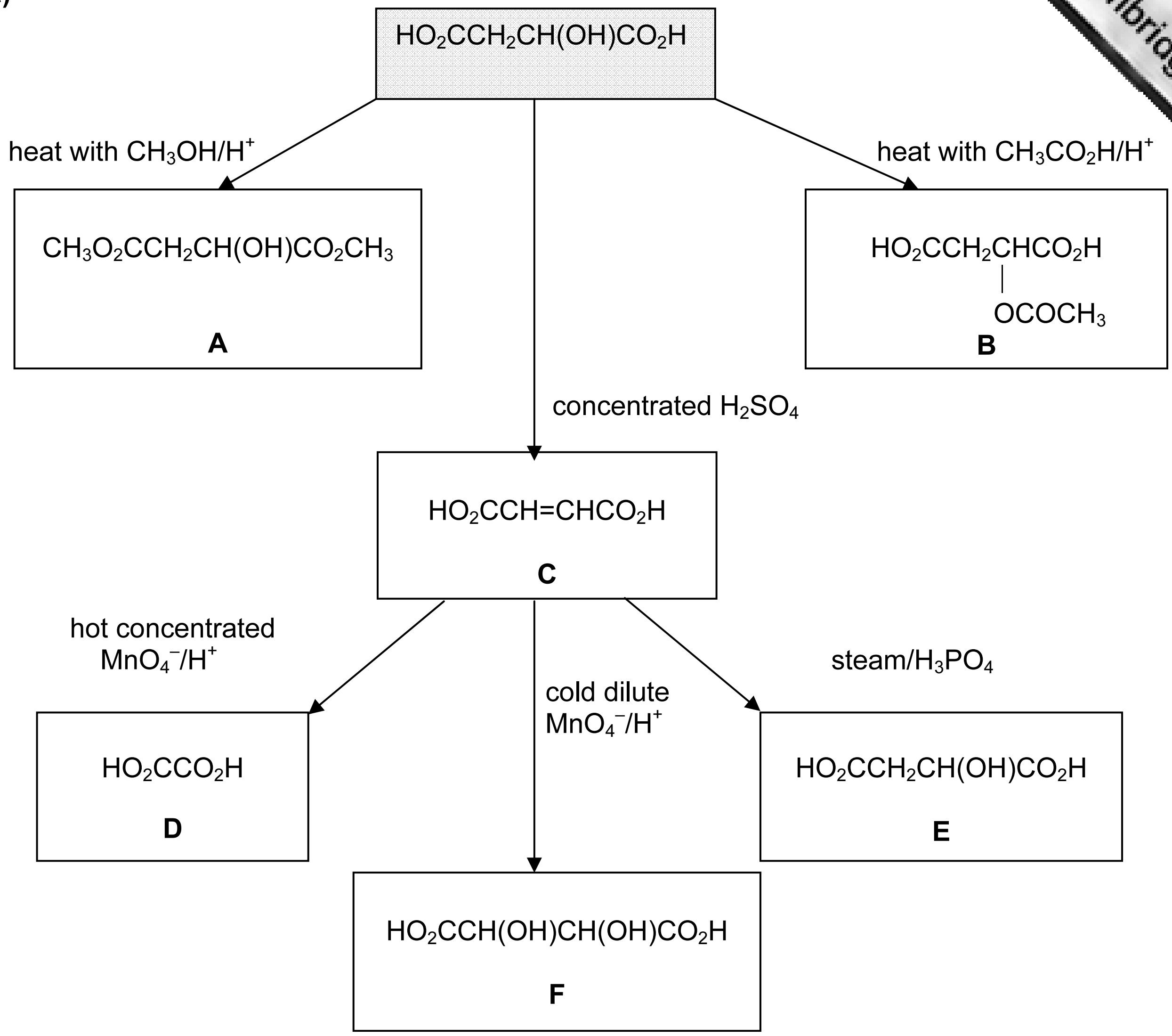
(c) **pressure**
increases rate (1)
by increasing frequency of collisions **or**
by increasing concentration of reactants (1)

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)



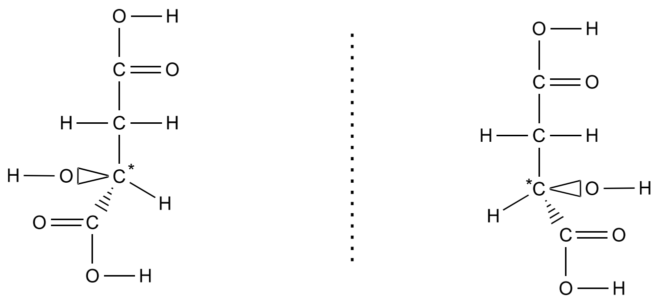
give one mark for each correct compound (6 × 1) [6]

(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]

(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 = $\dfrac{37.5}{12} : \dfrac{4.17}{1} : \dfrac{58.3}{16}$

= 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]

4 **(a)**

reagent	**R_2CHOH**	**RCHO**	**RCO_2H**	**RCO_2R'**	**RCOR'**
$NaHCO_3$			✓		
Na	✓		✓		
$Cr_2O_7^{2-}/H^+$	✓	✓			

give one mark for each correct tick (5 × 1) [5]

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

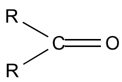
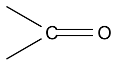
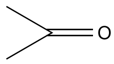
(ii) $n(H_2) = \dfrac{80}{24000} = 3.3 \times 10^{-3}$ mol (1)

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

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

n(**G**) : n(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)**

 **or**  **or**  and **'ketone'** (1)

(ii) **G** is $HOCH_2COCH_2OH$ as the minimum (1)
allow the *gem* diol $CH_3COCH(OH)_2$ [2]

(d) **(i)** **H** is HO_2CCOCO_2H as the minimum (1)

(ii) **J** is $HOCH_2CH(OH)CH_2OH$ as the minimum (1) [2]

[Total: 13]