UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2008 question paper

9701 CHEMISTRY

9701/02 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.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

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UNIVERSITY of CAMBRIDGE
International Examinations

1 (a) (i) 2 (1)

(ii) between 104° and 105° (1) [2]

(b)

ethanal	CH_3CHO	**A** (1)
ethanol	CH_3CH_2OH	**C** (1)
methoxymethane	CH_3OCH_3	**A** (1)
2-methylpropane	$(CH_3)_2CHCH_3$	**B** (1)

[4]

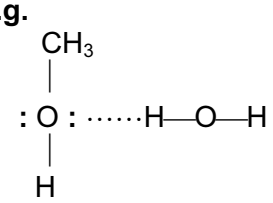
(c) (i) hydrogen bonds (1)

(ii) correct dipole on an -O—H bond (1)

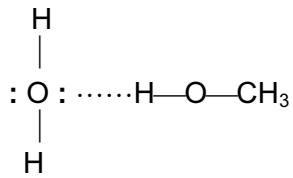
hydrogen bond shown between the lone pair of an O and a H atom in an –OH group (1)

lone pair on O atom of CH_3OH **or** H_2O clearly shown **in the hydrogen bond** (1)

e.g.



or



[4]

(d) hydrogen bonds exist between H_2O molecules (1)

hydrogen bonds cannot form between $C_2H_5OC_2H_5$ molecules (1) [2]

[Total: 12]

2 **(a)** $F(g) \rightarrow F^+(g) + e^-$

correct equation (1)

correct state symbols (1) [2]

(b) from Na to Ar, electrons

are added to the same shell/have same shielding (1)

are subject to increasing nuclear charge/proton number (1)

are closer to the nucleus **or** atom gets smaller (1) [3]

(c) **(i)** **A*l* and Mg**

in A*l* outermost electron is in 3p rather than 3s (1)

3p electron is at higher energy
or is further away/is more shielded from nucleus (1)

(ii) **P and S**

for P 3p sub-shell is singly filled
and for S one 3p orbital has paired electrons (1)

paired electrons repel (1) [4]

(d) **(i)** and **(ii)**

element	Na	Mg	A*l*	Si	P	S
melting point	low	------	high	high	low	low
conductivity	high	------	high	moderate	low	low
	(1)		(1)	(1)	(1)	(1)

one mark for each correct column [5]

(e) because they had not been discovered (1) [1]

[Total: 15]

3 **(a)** high temperature (and/or pressure) provide enough energy (1)

to break N≡N bond
or to provide E_a for N_2/O_2 reaction (1) [2]

(b) **(i)** **two** from C, CO, hydrocarbon, SO_2, H_2S, NO_2/NO_x (1 + 1)

not CO_2, H_2, H_2O, SO_3, NO

(ii) Pt **or** Pd **or** Pt/Rh **or** Pt/Pd/Rh (1)

(iii) $2NO + 2CO \rightarrow 2CO_2 + N_2$
or $2NO + C \rightarrow CO_2 + N_2$ (1) [4]

(c) **(i)** $K_c = \dfrac{[NO]^2[Cl_2]}{[NOCl]^2}$ (1)

units are mol dm^{-3} (1)

(ii) at 230 °C $K_c = \dfrac{(1.46\times10^{-3})^2 \times 1.15\times10^{-2}}{(2.33\times10^{-3})^2}$

$= 4.5 \times 10^{-3}$ mol dm^{-3} (1)

at 465 °C $K_c = \dfrac{(7.63\times10^{-3})^2 \times 2.14\times10^{-4}}{(3.68\times10^{-4})^2}$

$= 9.2 \times 10^{-2}$ mol dm^{-3} (1)

allow ecf on answer to part **(i)**

(iii) endothermic **because** K_c increases with temperature
mark is for explanation
allow ecf on answer to part **(ii)** (1) [5]

(d) **(i)** equilibrium moves to RHS (1)

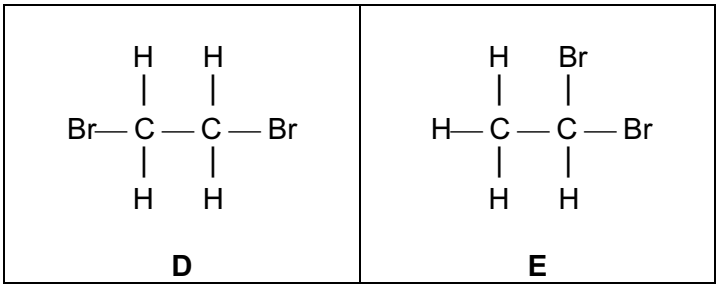
more moles on RHS (1)

(ii) no change to equilibrium position (1)

[NOCl] and [NO] change by same amount (1) [4]

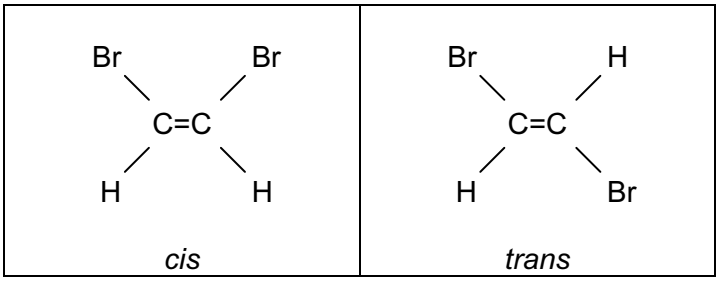
[Total: 15]

4 (a) (i)



(1) (1)

(ii)



(1) (1)

[4]

(b) (i) hydrogen (1)

nickel catalyst – allow platinum or palladium (1)

(ii) isomer formed **must** be 1,2-dibromoethane (**D** above)

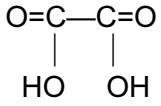
because

cis isomer has one Br atom on **each** carbon atom (1)

mark is for the reason but wrong isomer is penalised [3]

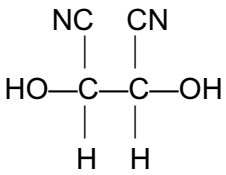
[Total: 7]

5 **(a)** **(i)** silver or black ppt. (1)

(ii)  **or** HO_2CCO_2H (1)

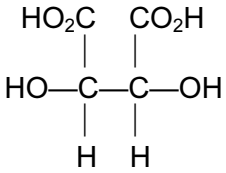
allow anion

[2]

(b) **(i)**  **or** NCCH(OH)CH(OH)CN (1)

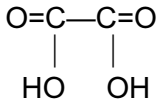
allow NCCH(OH)CHO

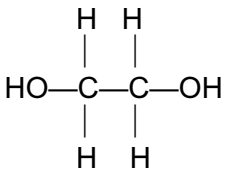
(ii) nucleophilic addition (1)

(iii)  **or** $HO_2CCH(OH)CH(OH)CO_2H$ (1)

allow $HO_2CCH(OH)CHO$ (ecf)

[3]

(c) **(i)**  **or** HO_2CCO_2H (1)

(ii)  **or** HOH_2CCH_2OH (1)

allow HOH_2CCHO

(iii) $NaBH_4$ **or** $LiAlH_4$ **or** H_2/Ni (1) [3]

(d) **both** oxidation **and** reduction **allow** disproportionation (1) [1]

(e) HO—C≡C—OH – candidate's compound must be $C_2H_2O_2$

-OH present (1)

C≡C present (1) [2]

[Total: 11]