**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.

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

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

CIE is publishing the mark schemes for the May/June 2008 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

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]

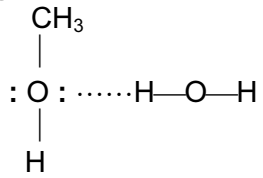
**(c) (i)** hydrogen bonds (1)

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

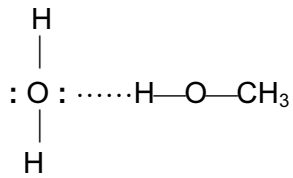
hydrogen bond shown between the lone pair of an O and a H atom in an –OH group (1)

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)

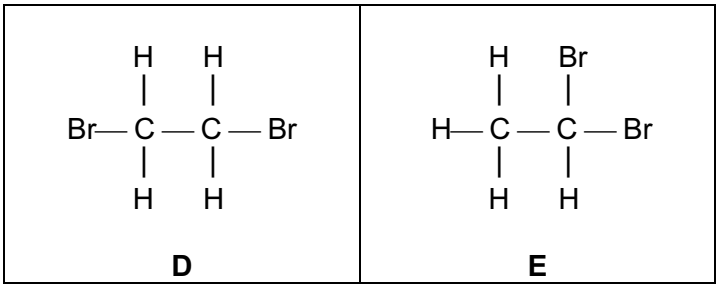
more moles on RHS (1)

**(ii)** no change to equilibrium position (1)

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

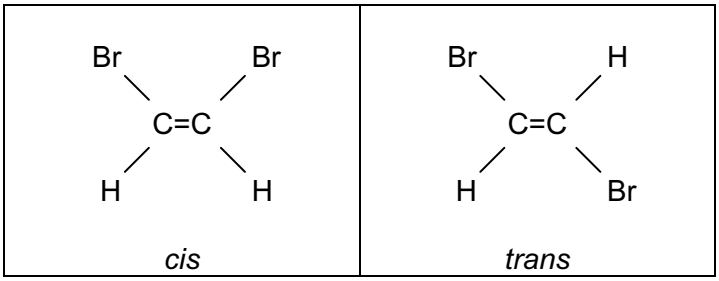
**[Total: 15]**

**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)

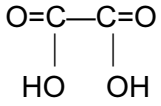
**because**

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

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

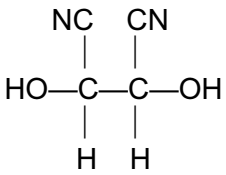
**[Total: 7]**

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

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

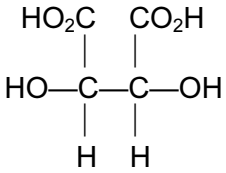
**allow** anion

[2]

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

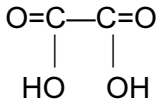
**allow** NCCH(OH)CHO

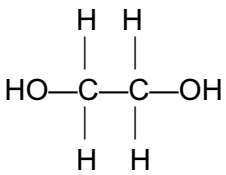
**(ii)** nucleophilic addition (1)

**(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]**