UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Level

MARK SCHEME for the November 2005 question paper

9701 CHEMISTRY

9701/02 **Paper 2** **maximum raw mark 60**

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which Examiners were initially instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

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*.

The minimum marks in these components needed for various grades were previously published with these mark schemes, but are now instead included in the Report on the Examination for this session.

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UNIVERSITY of CAMBRIDGE
International Examinations

1 **(a)** Energy required to remove one electron from each atom (1)

in one mole of (1)

gaseous atoms of an element (1)

('*Energy change when one mole of gaseous atoms loses one mole of electrons*' would score all three marks.) **[3]**

(b) $X^+(g) \rightarrow X^{2+}(g) + e^-$ equation (1)

state symbols (1) **[2]**

(c) Group 5 (1)

sharp rise in successive ionisation energies between 5th and 6th IEs (1)

indicating change to a different shell/energy level **or** outer shell contains 5 electrons (1) **[3]**

(d) down the Group

atomic radii increase/ outer electrons are increasingly further away (1)

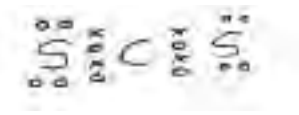
electrons are added to new shells/more shells (1)

more shielding (1)

despite increase in nuclear charge (1) **[4]**

[Total: 12]

2 **(a)**



sulphur atom has 6 /carbon atom has 4 electrons (1)

S=C double bonds (4 electrons) clearly shown (1) **[2]**

(b) linear (1)

180° (1) **[2]**

(c) the enthalpy change when 1 mol of a compound (1)

is formed from its elements in their standard states (1)

under standard conditions (may be quoted) (1) **[3]**

(d) $C + O_2 \rightarrow CO_2$ -395

$S + O_2 \rightarrow SO_2$ -298

$CS_2 + 3O_2 \rightarrow CO_2 + 2SO_2$ -1110

$C + 2S \rightarrow CS_2$ $\Delta H = -395 + 2(-298) - (-1110)$

$= +119 \text{ kJ mol}^{-1}$

cycle (1) use of 2 for S/SO_2 (1) answer (1) **[3]**

(e) CO_2 (1)

N_2 (1)

$CS_2 + 2NO \rightarrow CO_2 + 2S + N_2$ (1)

completely correct equation gets (3)
consequential errors to be decided at co-ordination **[3]**

[Total: 13]

3 **(a)** **(i)** N≡N bond is very strong (1)

large amount of energy required to break it
or E_a is very high (1)

(ii) $N_2 + 3H_2 \rightarrow 2NH_3$

or $N_2 + O_2 \rightarrow 2NO$

or **3**Mg $+ N_2 \rightarrow Mg_3N_2$ (may be others) (1)

N_2/H_2 high pressure, high temperature, catalyst

N_2/O_2 high pressure, high temperature, lightning

Mg/N_2 high temperature, burning Mg

any 2 conditions which correspond
to the eqn given (2)

(iii) E_a overcome/ high energy input/
E_a lowered by catalyst (1) **[6]**

(b) **(i)** fertiliser **or** explosive (1)

(ii) NH_4NO_3 in rivers causes excessive growth of aquatic plants/algae (1)

when plants/algae die O_2 is used up (1)

fish/aquatic life die (1)

'eutrophication' for 2 marks **[4]**

(c) **(i)** NH_3 (1)

(ii) $NH_4NO_3(s) + NaOH(s) \rightarrow NH_3(g) + NaNO_3(s) + H_2O(l)$

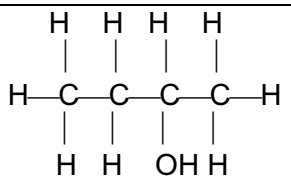
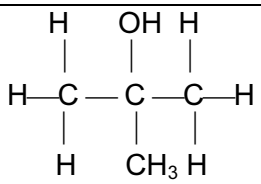
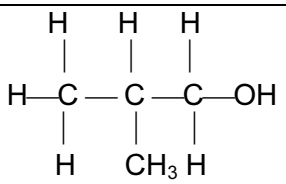
equation (1) state symbols (1) **[3]**

(d) reacts with ammonia (1) **[1]**

[Total: 14]

4 **(a)** a compound which contains the $-CH_2OH$ group (1) **[1]**

(b)

given in qu.			
primary	secondary	tertiary	primary
butan-1-ol	isomer 2	isomer 3	isomer 4

each correct structure (3 x 1)

each correct label (3 x 1) **[6]**

(c) **(i)** from orange (1)

to green (1)

(ii) correct primary alcohol (1) **[3]**

[Total: 10]

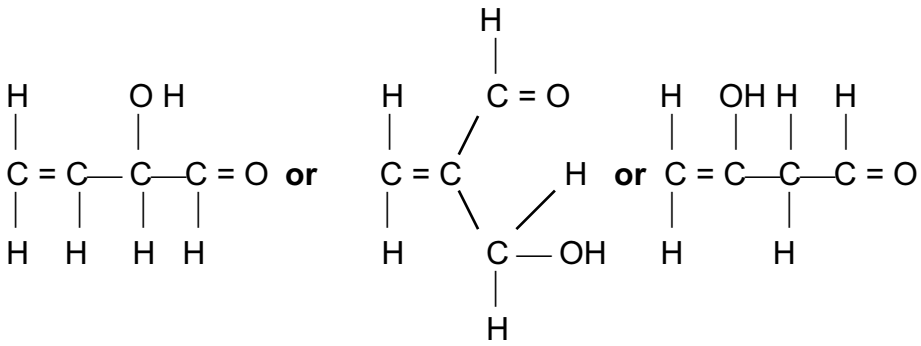
5 **(a)** C=C (1) **[1]**

(b) alcohol (1)

(ignore any reference to primary or secondary) **[1]**

(c) aldehyde (1) **[1]**

(d)



fully correct structure is worth 2 (2)

CH_2 = present in wrong structure gets (1) **[2]**

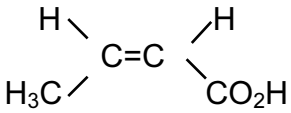
(e) RONa **or** R^+ ONa^- (1)

RO_2CCH_3 (1) **[2]**

(f) RCO_2H (1)

$RCH{=}NNHC_6H_3(NO_2)_2$ as the minimum (1) **[2]**

(g)



correct acid (1)

correctly shown as *cis* (1) **[2]**

[Total: 11]