

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.

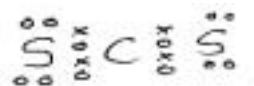
- CIE will not enter into discussion or correspondence in connection with these mark schemes.

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- 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]

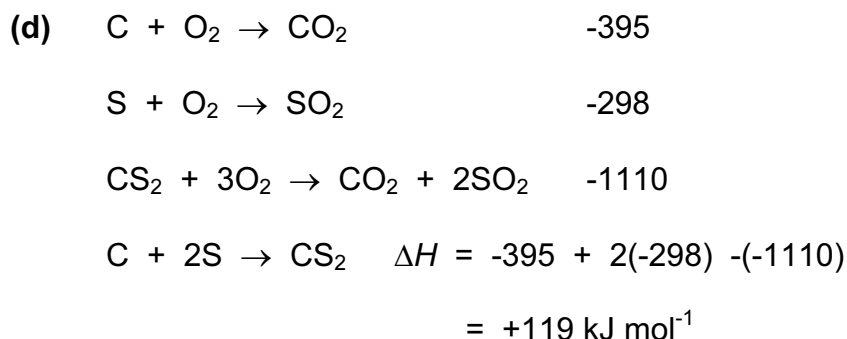
2 (a)



- 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]

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- (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]



cycle (1) use of 2 for S/SO₂ (1) answer (1) [3]

- (e) CO₂ (1)
 N₂ (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 $3Mg + N_2 \rightarrow Mg_3N_2$ (may be others) (1)
 N₂/H₂ high pressure, high temperature, catalyst
 N₂/O₂ high pressure, high temperature, lightning
 Mg/N₂ high temperature, burning Mg
 any 2 conditions which correspond
 to the eqn given (2)

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- (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) $\text{NH}_4\text{NO}_3(\text{s}) + \text{NaOH}(\text{s}) \rightarrow \text{NH}_3(\text{g}) + \text{NaNO}_3(\text{s}) + \text{H}_2\text{O}(\text{l})$
equation (1) state symbols (1) [3]
- (d) reacts with ammonia (1) [1]

[Total: 14]

- 4 (a) a compound which contains the $-\text{CH}_2\text{OH}$ group (1) [1]
- (b)

given in qu.	$ \begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ \text{H}-\text{C} & -\text{C} & -\text{C} & -\text{C}-\text{H} \\ & & & \\ \text{H} & \text{H} & \text{OH} & \text{H} \end{array} $	$ \begin{array}{ccc} \text{H} & \text{OH} & \text{H} \\ & & \\ \text{H}-\text{C} & -\text{C} & -\text{C}-\text{H} \\ & & \\ \text{H} & \text{CH}_3 & \text{H} \end{array} $	$ \begin{array}{ccc} \text{H} & \text{H} & \text{H} \\ & & \\ \text{H}-\text{C} & -\text{C} & -\text{C}-\text{OH} \\ & & \\ \text{H} & \text{CH}_3 & \text{H} \end{array} $
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]

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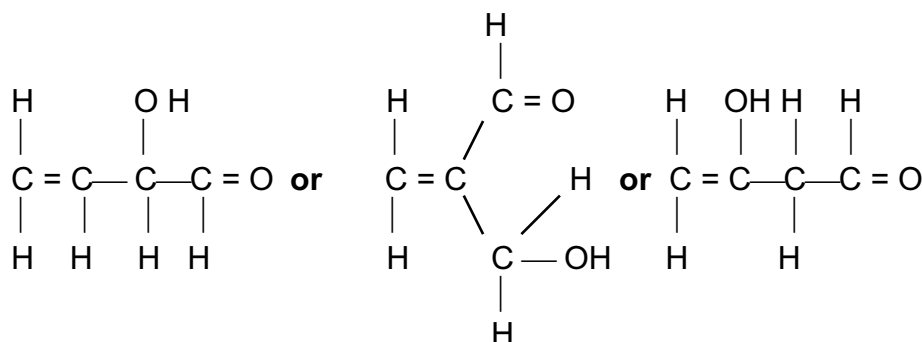
5 (a) $C=C$ (1) [1]

(b) alcohol (1)

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

(c) aldehyde (1) [1]

(d)



fully correct structure is worth 2 (2)

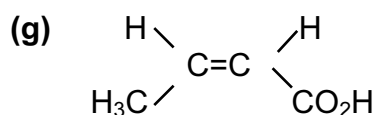
$\text{CH}_2 =$ present in wrong structure gets (1) [2]

(e) RONa or $\text{R}^+ \text{ONa}^-$ (1)

RO_2CCH_3 (1) [2]

(f) RCO_2H (1)

$\text{RCH}=\text{NNHC}_6\text{H}_3(\text{NO}_2)_2$ as the minimum (1) [2]



correct acid (1)

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

[Total: 11]