

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

**MARK SCHEME for the October/November 2010 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.

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

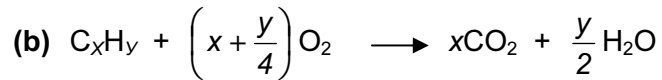
CIE is publishing the mark schemes for the October/November 2010 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2010	9701	22

1 (a) the actual number of atoms of each element present (1)

in one molecule of a compound (1)

[2]



xCO_2 (1)

$\frac{y}{2} H_2O$ (1)

[2]

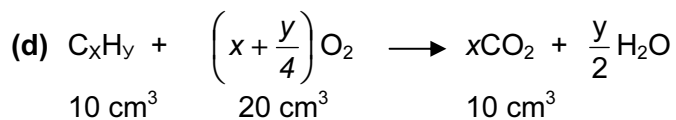
(c) (i) oxygen/ O_2 (1)

(ii) carbon dioxide/ CO_2 (1)

(iii) 10 cm^3 (1)

(iv) 20 cm^3 (1)

[4]



1 mol of C_xH_y gives 1 mol of CO_2

whence $x = 1$ (1)

1 mol of C_xH_y reacts with 2 mol of O_2

whence $\left(x + \frac{y}{4}\right) = 2$

and $y = 4$ (1)

molecular formula is CH_4 (1)

[3]

[Total: 11]

Page 3	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2010	9701	22

2 (a) $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$ (1) [1]

(b) temperature between 300 and 550°C (1)

correct explanation of effect of temperature on
rate of formation of NH_3 **or** on position of equilibrium (1)

catalyst of iron **or** iron oxide (1)

to speed up reaction **or** to reduce E_a (1) [4]

(c) manufacture of HNO_3

or explosives

or nylon

or as a cleaning agent

or as a refrigerant (1)

[1]

(d) fertiliser in rivers causes excessive growth of aquatic plants/algae (1)

when plants and algae die O_2 is used up/fish or aquatic life die (1) [2]

(e) (i) CO by incomplete combustion of the hydrocarbon fuel (1)

NO by reaction between N_2 and O_2 in the engine (1)

(ii) CO toxic/effect on haemoglobin (1)

NO toxic/formation of acid rain (1) [4]

(f) (i) platinum/Pt – allow palladium/Pd **or** rhodium/Rh (1)

(ii) $2\text{CO} + 2\text{NO} \rightarrow 2\text{CO}_2 + \text{N}_2$ (1) [2]

[Total: 14]

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2010	9701	22

3 (a) (i) a compound which contains **only** carbon and hydrogen (1)

(ii) separation of compounds by their boiling points (1) [2]

(b) (i) high temperature **and** high pressure (1)

high temperature **and** catalyst (1)

(ii) $C_{11}H_{24} \rightarrow C_5H_{12} + C_6H_{12}$ **or**

$C_{11}H_{24} \rightarrow C_5H_{12} + 2C_3H_6$ **or**

$C_{11}H_{24} \rightarrow C_5H_{12} + 3C_2H_4$ (1) [3]

(c) (i)

$CH_3CH_2CH_2CH_2CH_3$	$CH_3CH_2CH(CH_3)CH_3$	$ \begin{array}{c} CH_3 \\ \\ CH_3CCH_3 \\ \\ CH_3 \end{array} $
isomer B	isomer C	isomer D
(1)	(1)	(1)

(ii) the straight chain isomer (isomer **B** above) (1)

it has the greatest van der Waals' forces (1)

because unbranched molecules have greater area of contact/
can pack more closely together (1)

[6]

(d) enthalpy change when 1 mol of a substance (1)

is burnt in an excess of oxygen/air under standard conditions
or is completely combusted under standard conditions (1)

[2]

Page 5	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2010	9701	22

(e) (i) heat released = $m c \delta T = 200 \times 4.18 \times 27.5$ (1)

$$= 22990 \text{ J} = 23.0 \text{ kJ (1)}$$

(ii) 23.0 kJ produced from 0.47 g of E

$$2059 \text{ kJ produced from } \frac{0.47 \times 2059}{23.0} \text{ g of E (1)}$$

$$= 42.08 \text{ g of E (1)}$$

allow ecf in (i) or (ii) on candidate's expressions

[4]

(f) $C_3H_6 = 42$

E is C_3H_6

for ecf, E must be unsaturated and be no larger than C_5 (1)

[1]

[Total: 18]

- 4 (a) reaction 1 reagent NaOH/KOH (1)
- solvent H_2O /water/aqueous (1)
- reaction 2 reagent NH_3 /ammonia (1)
- solvent ethanol/ C_2H_5OH /alcohol (1)
- reaction 3 reagent NaOH/KOH (1)
- solvent ethanol/ C_2H_5OH /alcohol (1)

[6]

(b) with $CH_3CH_2CH_2CH_2I$ rate would be faster (1)

C-I bond is weaker than C-Br bond (1)

C-I bond energy is 240 kJ mol^{-1} , C-Br bond energy is 280 kJ mol^{-1}
data **must** be quoted for this mark (1)

[3]

(c) non-toxic non-flammable

volatile/low bp unreactive (any 2)

[2]

Page 6	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – October/November 2010	9701	22

(d) (i) when a covalent bond breaks the two electrons in the bond are shared between the two atoms (1)

(ii) $\text{CCl}_2\text{F}_2 \rightarrow \text{CClF}_2 + \text{Cl}$ (as minimum)

allow $\text{CCl}_2\text{F} + \text{F}$ (1) [2]

(e) they are flammable (1) [1]

[Total: 14]

5 (a) NaBr/sodium bromide [1]

(b) Br_2 /bromine or SO_2 /sulfur dioxide [1]

(c) concentrated sulfuric acid is an oxidising agent
or
phosphoric(V) acid is **not** an oxidising agent [1]

[Total: 3]