CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2013 series

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 should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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1 (a) a base is a proton acceptor **or**
a lone pair donor (1)
a weak base is not fully ionised (1)
e.g. $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$ **or**
$B + H^+ \rightleftharpoons BH^+$ **or** equivalent
$\rightleftharpoons$ is necessary (1) [3]

(b) (i) **stated** pressure greater than 1 atm up to 5 atm (1)
stated temperature 400 to 500 ^oC (1)
named catalyst V_2O_5/vanadium(V) oxide (1)

(ii) SO_3 is dissolved in concentrated H_2SO_4
and then diluted with water
not 'SO_3 dissolved in water' as the only statement (1) [4]

(c) (i) **with concentrated sulfuric acid**
$ClCH_2CH=CHCl$ (1)

with ammonia
$H_2NCH_2CH(OH)CH_2NH_2$ (1)

(ii) nucleophilic (1)
substitution (1) [4]

[Total: 11]

2 **(a)** **(i)** $n(H_2SO_4) = \frac{25.0 \times 1.00}{1000} = 0.025$ mol (1)

(ii) $n(NaOH) = \frac{16.2 \times 2.00}{1000} = 0.0324$ mol (1)

(iii) $n(H_2SO_4)$ reacting with NaOH $= \frac{0.0324}{2} = 0.0162$ mol (1)

(iv) $n(H_2SO_4)$ reacting with NH_3 = 0.025 - 0.0162 = 0.0088 mol (1)

(v) $n(NH_3)$ reacting with H_2SO_4 = 2 x 0.0088 = 0.0176 mol (1)

(vi) $n(NaNO_3)$ reacting = $n(NH_3)$ produced = 0.0176 mol (1)

(vii) mass of $NaNO_3$ that reacted = 0.0176 x 85 = 1.496 g (1)

(viii) % of $NaNO_3$ $= \frac{1.496 \times 100}{1.64} = 91.2195122 = 91.2$

give one mark for the correct expression (1)
give one mark for answer given as 91.2 – i.e to 3 sig. fig. (1)
allow ecf where appropriate

[9]

(b) $NaNO_3$ +5 **and** NH_3 -3 **both** required (1) [1]

[Total: 10]

3 (a) penalise (-1) the use of names of elements or formulae of compounds

(i) Ca (1)
(ii) O **or** N **or** C (1)
(iii) C **or** N **or** S **or** F **or** Cl **or** Br (1)
(iv) Si **or** Ge **or** B (1)
(v) Al **or** Si **or** P **or** S **or** H (1)
(vi) Al (1) [6]

(b) (i)

element	Na	Mg	Al	Si	P	S
oxide	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5/P_4O_{10} **or** P_2O_3/P_4O_6	SO_2
flame	yellow **or** orange	white	white	white	white **or** yellow	blue

formula of oxide (1)
colour of flame (1)

(ii)

chloride	NaCl	$MgCl_2$	$AlCl_3$ **or** Al_2Cl_6	$SiCl_4$	PCl_3 **or** PCl_5	SCl_2 **or** S_2Cl_2
pH	7	6.5 to 6.9	1 to 4			

formula of chloride (1)
pH of solution formed (1) [4]

(c) (i)

(1)

(ii) intermolecular forces/van der Waals' forces
are stronger or greater in ICl (1)
ICl has most electrons **or**
has the largest permanent dipole (1)

(iii) ICl (1)
greatest difference in electronegativity is between I and Cl (1) [5]

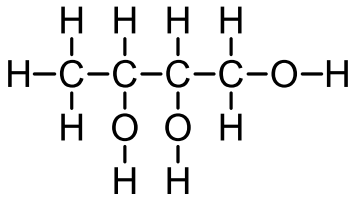
[Total: 15]

4 (a)

A	Br_2 in an inert organic solvent	$CH_3CHBrCHBrCH_2OH$
B	PCl_5	$CH_3CH{=}CHCH_2Cl$
C	H_2 and Ni catalyst	$CH_3CH_2CH_2CH_2OH$
D	$NaBH_4$	NO REACTION
E	$K_2Cr_2O_7/H^+$, heat under reflux	$CH_3CH{=}CHCO_2H$

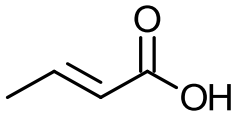
give one mark for each correct answer (5 × 1) [5]

(b)



(1) [1]

(c)



correct C_4 with C=C in position 2
accept *cis* form (1)
correctly shown $–CO_2H$ (1)
allow ecf on candidate's answer to E in **(a)** [2]

(d) (i)

reagent	**observation**
2,4-dinitrophenylhydrazine	red/orange ppt.
Tollens' reagent	silver mirror **or** grey ppt. **or** black ppt.
Fehling's reagent	brick red ppt.

correct reagent (1)
observation (1)

(ii) reduction **or** nucleophilic addiction (1) [3]

(e) $C : H : O = \frac{73.7}{12} : \frac{12.3}{1} : \frac{14.0}{16}$

$= 6.14 : 12.3 : 0.875$ (1)
$= 7.01 : 14.1 : 1$

gives $C_7H_{14}O$
formula must be given (1) [2]

[Total: 13]

5 (a) $C_4H_8O_2$ (1) [1]

(b)

$HCO_2CH_2CH_2CH_3$ **W**	$HCO_2CH(CH_3)_2$ **X**
$CH_3CO_2CH_2CH_3$ **Y**	$CH_3CH_2CO_2CH_3$ **Z**

give one mark for each correct answer (4 × 1) [4]

(c) (i) —CHO **or** aldehyde absent (1)
(ii) >CO **or** carbonyl absent (1)
(iii) —CO_2H **or** carboxylic acid present (1) [3]

(d) (i) CH_3CO_2H **or** ethanoic acid (1)
(ii) **Y** above (1) [2]

(e) none – no chiral carbon atoms present (1) [1]

[Total: 11]