UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2008 question paper

9701 CHEMISTRY

9701/02 Paper 2 (Theory 1), 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 October/November 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) substance that speeds up a chemical reaction (1)
by lowering E_a
or by providing an alternative reaction pathway
or without being used up in the process (1)

(ii) $2H_2O_2 \rightarrow 2H_2O + O_2$ (1) [3]

(b) (i) alkanes **or** paraffins (1)

(ii) $2H_2O_2 : O_2$ and $C_{15}H_{32} : 23O_2$ (1)
whence $C_{15}H_{32} : 46H_2O_2$ (1)
allow e.c.f. on **(a)(ii)** [3]

(c) (i) $C_{15}H_{32} = 212$ (1)

$$n(C_{15}H_{32}) = \frac{212 \times 10^6}{212} = 1 \times 10^6 \text{ mol}$$

allow e.c.f. on wrong M_r of $C_{15}H_{32}$ (1)

(ii) $n(H_2O_2)$ required $= 46 \times 10^6$ mol (1)
mass of $H_2O_2 = 34 \times 46 \times 10^6$ g $=$ 1564 tonnes
final answer must be in tonnes (1)
allow e.c.f. on **(b)(ii)** and **(c)(i)** [4]

(d) they would dissolve (1) [1]

[Total: 11]

2 (a) (i) H–C–H 117 to 120° (1)
C=C=O 180° (1)

(ii) molecule contains **both** ketone **and** alkene (1) [3]

(b) (i) $C_2H_2O + 2O_2 \rightarrow 2CO_2 + H_2O$ (1)

(ii) from eqn., 42 g $C_2H_2O \rightarrow 48$ dm^3 of CO_2 (1)

whence 3.5 g $C_2H_2O \rightarrow \frac{48 \times 3.5}{42}$ dm^3 of CO_2 (1)

$= 4.0$ dm^3 of CO_2 (1)

or $n(C_2H_2O) = \frac{42}{3.5} = 0.0833$ (1)

$n(CO_2) = 2 \times 0.083 = 0.0166$ (1)
vol. of $CO_2 = 0.0166 \times 24 = 4.0$ dm^3 (1)
allow e.c.f. on wrong eqn. in **(b)(i)**
penalise significant figure error [4]

© UCLES 2008

(c) (i) enthalpy change when
1 mol of a compound is formed (1)
from its elements (1)
in their standard states under standard conditions (1)

(ii) $C + O_2 \rightarrow CO_2$ $\quad -395$ kJ mol^{-1}
$H_2 + ½O_2 \rightarrow H_2O$ $\quad -286$ kJ mol^{-1}
$C_2H_2O + 2O_2 \rightarrow 2CO_2 + H_2O$ $\quad -1028$ kJ mol^{-1}
$2C + H_2 + ½O_2 \rightarrow C_2H_2O$ $\Delta H = 2(-395) + (-286) - (-1028)$
$= -48$ kJ mol^{-1}
correct cycle (1) use of 2 for C/CO_2 (1) answer (1) [6]

(d) H_2O/water/steam (1) [1]

[Total: 14]

3 (a) anode $Cl^-(aq) \rightarrow ½\,Cl_2(g) + e^-$ (1)
cathode $H^+(aq) + e^- \rightarrow ½H_2(g)$
or $2H_2O(l) + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$ (1)
correct state symbols (1) [2]

(b) because the iron in steel will react with chlorine (1) [1]

(c) (i) sodium hydroxide/NaOH (1)
$2H_2O + 2e^- \rightarrow H_2 + 2OH^-$
or $2H^+ + 2e^- \rightarrow H_2$ (1)
leaving OH^- in solution as NaOH (1) [3]

(d) Na burns with a yellow flame/forms a white solid (1)
$2Na + Cl_2 \rightarrow 2NaCl$ (1)
P burns with a white flame/forms a colourless liquid (PCl_3) **or** a white solid (PCl_5) (1)
$P + 1½Cl_2 \rightarrow PCl_3$ **or** $P_4 + 6Cl_2 \rightarrow 4PCl_3$
or $P + 2½Cl_2 \rightarrow PCl_5$ **or** $P_4 + 10Cl_2 \rightarrow 4PCl_5$ (1) [4]

(e) $MgCl_2$ 6 to 7 (1)
$SiCl_4$ 0 to 3 (1)
$MgCl_2$ dissolves without reaction (1)
$SiCl_4$ reacts with water/hydrolyses (1)
$SiCl_4 + 2H_2O \rightarrow SiO_2 + 4HCl$ **or**
$SiCl_4 + 4H_2O \rightarrow Si(OH)_4 + 4HCl$ **or**
$SiCl_4 + 4H_2O \rightarrow SiO_2.2H_2O + 4HCl$ (1) [5]

[Total: 15 max]

© UCLES 2008

4

organic reaction	type of reaction	reagent(s)
$CH_3CHO \rightarrow$ $CH_3CH(OH)CN$	nucleophilic (1) addition (1)	HCN **or** HCN and CN^- (1)
$CH_3CH_2CH_2CH_3 \rightarrow$ $CH_3CH_2CHBrCH_3$	free radical (1) substitution (1)	Br_2 **or** Br_2 in an organic solvent **not** Br_2(aq) (1)
$CH_3CH(OH)CH_3 \rightarrow$ $CH_3CH=CH_2$	elimination (1)	conc. H_2SO_4 (1)
$CH_3CH=CH_2 \rightarrow$ $CH_3CH(OH)CH_2OH$	addition **or** oxidation (1)	$KMnO_4/MnO_4^-$ (1)

[10]

[Total: 10]

© UCLES 2008

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

(b)

$HCO_2CH(CH_3)_2$	$HCO_2CH_2CH_2CH_3$	$CH_3CO_2CH_2CH_3$ **or** $CH_3CO_2C_2H_5$	$CH_3CH_2CO_2CH_3$ **or** $C_2H_5CO_2CH_3$
W	**X**	**Y**	**Z**

each correct structure is worth (1) [4]

(c) **(i)** presence of >C=O group/carbonyl group (1)

(ii) –CHO group/aldehyde group is absent
or ketone is present (1)

(iii) alcohol **C** is $(CH_3)_2CHOH$
allow e.c.f. on **(c)(i)** and**(ii)** (1)

(iv) correct identification of candidate's ester
(**W** in this case)

allow e.c.f. on **(c)(iii)** (1) [4]

(d) none
no chiral centres are present in any of the four esters
allow e.c.f. on candidate's compounds in **(a)** (1) [1]

[Total: 10]

© UCLES 2008