

**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

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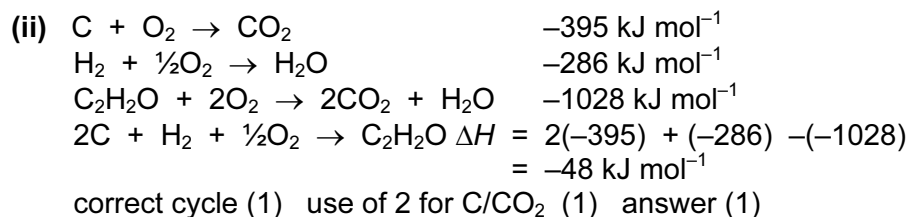
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- 1 (a) (i) substance that speeds up a chemical reaction (1)  
by lowering  $E_a$   
or by providing an alternative reaction pathway  
or without being used up in the process (1)
- (ii)  $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$  (1) [3]
- (b) (i) alkanes or paraffins (1)
- (ii)  $2\text{H}_2\text{O}_2 : \text{O}_2$  and  $\text{C}_{15}\text{H}_{32} : 23\text{O}_2$  (1)  
whence  $\text{C}_{15}\text{H}_{32} : 46\text{H}_2\text{O}_2$  (1)  
allow e.c.f. on (a)(ii) [3]
- (c) (i)  $\text{C}_{15}\text{H}_{32} = 212$  (1)  
 $n(\text{C}_{15}\text{H}_{32}) = \frac{212 \times 10^6}{212} = 1 \times 10^6 \text{ mol}$   
allow e.c.f. on wrong  $M_r$  of  $\text{C}_{15}\text{H}_{32}$  (1)
- (ii)  $n(\text{H}_2\text{O}_2)$  required =  $46 \times 10^6 \text{ mol}$  (1)  
mass of  $\text{H}_2\text{O}_2 = 34 \times 46 \times 10^6 \text{ g} = 1564 \text{ tonnes}$   
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)  $\text{H}-\text{C}-\text{H}$  117 to 120° (1)  
 $\text{C}=\text{C}=\text{O}$  180° (1)
- (ii) molecule contains **both** ketone **and** alkene (1) [3]
- (b) (i)  $\text{C}_2\text{H}_2\text{O} + 2\text{O}_2 \rightarrow 2\text{CO}_2 + \text{H}_2\text{O}$  (1)
- (ii) from eqn.,  $42 \text{ g C}_2\text{H}_2\text{O} \rightarrow 48 \text{ dm}^3 \text{ of CO}_2$  (1)  
whence  $3.5 \text{ g C}_2\text{H}_2\text{O} \rightarrow \frac{48 \times 3.5}{42} \text{ dm}^3 \text{ of CO}_2$  (1)  
=  $4.0 \text{ dm}^3 \text{ of CO}_2$  (1)
- or  $n(\text{C}_2\text{H}_2\text{O}) = \frac{42}{3.5} = 0.0833$  (1)  
 $n(\text{CO}_2) = 2 \times 0.083 = 0.0166$  (1)  
vol. of  $\text{CO}_2 = 0.0166 \times 24 = 4.0 \text{ dm}^3$  (1)  
allow e.c.f. on wrong eqn. in (b)(i)  
penalise significant figure error [4]

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(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)



(d) H<sub>2</sub>O/water/steam (1) [1]

[Total: 14]

3 (a) anode  $Cl^-(aq) \rightarrow \frac{1}{2}Cl_2(g) + e^-$  (1)  
 cathode  $H^+(aq) + e^- \rightarrow \frac{1}{2}H_2(g)$   
 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<sup>-</sup> 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<sub>3</sub>) or a white solid (PCl<sub>5</sub>) (1)  
 $P + 1\frac{1}{2}Cl_2 \rightarrow PCl_3$  or  $P_4 + 6Cl_2 \rightarrow 4PCl_3$   
 or  $P + 2\frac{1}{2}Cl_2 \rightarrow PCl_5$  or  $P_4 + 10Cl_2 \rightarrow 4PCl_5$  (1) [4]

(e) MgCl<sub>2</sub> 6 to 7 (1)  
 SiCl<sub>4</sub> 0 to 3 (1)  
 MgCl<sub>2</sub> dissolves without reaction (1)  
 SiCl<sub>4</sub> reacts with water/hydrolyses (1)  
 $SiCl_4 + 2H_2O \rightarrow SiO_2 + 4HCl$  or  
 $SiCl_4 + 4H_2O \rightarrow Si(OH)_4 + 4HCl$  or  
 $SiCl_4 + 4H_2O \rightarrow SiO_2 \cdot 2H_2O + 4HCl$  (1) [5]

[Total: 15 max]

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4

organic reaction	type of reaction	reagent(s)
$\text{CH}_3\text{CHO} \rightarrow$  $\text{CH}_3\text{CH}(\text{OH})\text{CN}$	nucleophilic (1)  addition (1)	HCN  <b>or</b> HCN and $\text{CN}^-$ (1)
$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3 \rightarrow$  $\text{CH}_3\text{CH}_2\text{CHBrCH}_3$	free radical (1)  substitution (1)	$\text{Br}_2$  <b>or</b> $\text{Br}_2$ in an organic solvent  <b>not</b> $\text{Br}_2(\text{aq})$ (1)
$\text{CH}_3\text{CH}(\text{OH})\text{CH}_3 \rightarrow$  $\text{CH}_3\text{CH}=\text{CH}_2$	elimination (1)	conc. $\text{H}_2\text{SO}_4$ (1)
$\text{CH}_3\text{CH}=\text{CH}_2 \rightarrow$  $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{OH}$	addition  <b>or</b> oxidation (1)	$\text{KMnO}_4/\text{MnO}_4^-$ (1)

[10]

[Total: 10]

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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 $C_2H_5CO_2CH_3$
<b>W</b>	<b>X</b>	<b>Y</b>	<b>Z</b>

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]