



Rewarding Learning

ADVANCED
General Certificate of Education
2012

Chemistry

Assessment Unit A2 1

assessing

Periodic Trends and Further Organic,
Physical and Inorganic Chemistry

[AC212]

TUESDAY 15 MAY, AFTERNOON

**MARK
SCHEME**

Section A

- 1 A
- 2 D
- 3 D
- 4 D
- 5 A
- 6 C
- 7 C
- 8 C
- 9 A
- 10 A

[2] for each correct answer

[20]

Section A

**AVAILABLE
MARKS**

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Section B

AVAILABLE
MARKS

- 11 (a) (i) take samples (at regular intervals) [1] (titrate) against standard named acid [1] using named indicator [1] [3]
- (ii) plot graph of concentration (of NaOH) against time [1]
calculate gradient [1] [2]
- (b) (i) 1st order [1]
1st order [1]
Rate = $k[\text{RCI}][\text{NaOH}]$ [1] [3]
- (ii) 170940 [1] $\text{mol}^{-1}\text{dm}^3\text{s}^{-1}$ [1] [2]
- (iii) nucleophilic substitution [1]
- (iv) primary – reaction is second order overall [1] 12
- 12 (a) $\text{C}_6\text{H}_{12}\text{O}$ [1]
- (b) –COOH/ethanoic acid forms H-bonds [1] formed between H of H_2O (or H of COOH) and O of COOH (or O of H_2O) [1]
lauric acid has hydrophobic/long chain [1] [3]
- (c) add CO_3^{2-}
 HCO_3^- – to liquid lauric acid [1] fizzing/test for CO_2 [1] [2]
- (d) $\text{C}_{11}\text{H}_{23}\text{COOH} + \text{SOCl}_2 \rightarrow \text{C}_{11}\text{H}_{23}\text{COCl} + \text{HCl} + \text{SO}_2$ [2]
- (e) (i) $\text{C}_{11}\text{H}_{23}\text{COOH} + 4[\text{H}] \rightarrow \text{C}_{11}\text{H}_{23}\text{CH}_2\text{OH} + \text{H}_2\text{O}$ [2]
- (ii) lithium aluminium hydride [1]
- (f) (i) alkaline [1] hydrolysis [1] [2]
- (ii) $\text{C}_3\text{H}_5(\text{OCOC}_{11}\text{H}_{23})_3 + 3\text{NaOH} \rightarrow \text{C}_3\text{H}_5(\text{OH})_3 + 3\text{C}_{11}\text{H}_{23}\text{COONa}$
- or
- $$\begin{array}{c} \text{CH}_2\text{OCOC}_{11}\text{H}_{23} \\ | \\ \text{CHOCOC}_{11}\text{H}_{23} \\ | \\ \text{CH}_2\text{OCOC}_{11}\text{H}_{23} \end{array} + 3\text{NaOH} \rightarrow \begin{array}{c} \text{CH}_2\text{OH} \\ | \\ \text{CHOH} \\ | \\ \text{CH}_2\text{OH} \end{array} + 3\text{C}_{11}\text{H}_{23}\text{COONa} \quad [2]$$
- (iii) saponification value = 260 mg = 0.26 g, moles KOH = $0.26/56 = 4.64 \times 10^{-3}$
($\times 1.72$) = 7.99×10^{-3}
moles KOH unreacted = $(100 \times 0.1)/1000 - 7.99 \times 10^{-3} = 2.01 \times 10^{-3}$
moles HCl = 2.01×10^{-3} volume HCl = 20.1cm^3
each error [–1]

or

$$n_{\text{oil}} = 1.72/638 = 2.696 \times 10^{-3}$$

$$(1:3) n_{\text{KOH}} \text{ required} = 8.09 \times 10^{-3}$$

$$n_{\text{KOH}} \text{ unreacted} = \left(100 \times \frac{0.1}{1000}\right) - 8.09 \times 10^{-3} = 1.91 \times 10^{-3}$$

$$n_{\text{HCl}} \text{ required} = 1.91 \times 10^{-3}$$

$$\text{Volume HCl required} = 1.91 \times 10^{-3} \times \frac{1000}{0.1} = 19.1 \text{ cm}^3$$

[4]

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(c) $2(35.5)/[2(35.5) + 7(16)] \times 100 = 38.8\%$ (1 d.p.) [2]

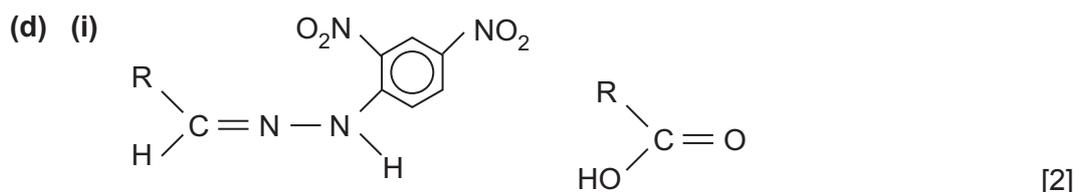
7

14 (a) same molecular formula [1] different structural formula [1] [2]

(b) hydroxyl [1] carbonyl [1] [2]

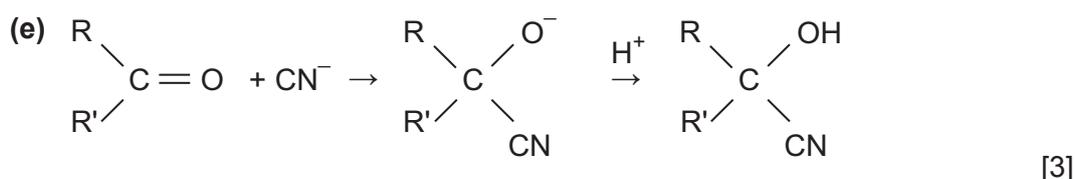
(c) glucose contains primary/secondary alcohol/aldehyde [1]
fructose contains primary/secondary alcohol [1]
silver mirror [1]
red precipitate [1] [4]
Any mention of no observations for fructose [-1]

Quality of written communication [2]

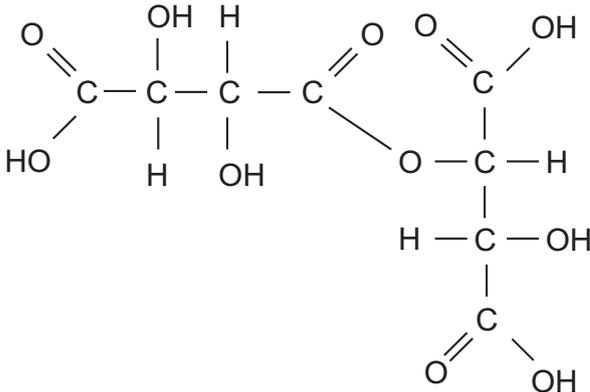


(ii) yellow/orange ppt/solid [2]

(iii) place some sample in (sealed) capillary tube [1]
heat slowly [1]
measure temperature when melting starts and finishes [1]
compare with data book values (for glucose) [1] [4]



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- 15 (a) (i)** gases absorb/prevent escape of [1] infrared radiation [1] [2]
- (ii)** global warming [1] [1]
- (b) (i)** moles O_3 at start = 10; at equilibrium = 7
 moles O_2 at start = 0; at equilibrium = 4.5
 $ppO_3 = (10 \times 7/11.5) = 6.09$
 $ppO_2 = (10 \times 4.5/11.5) = 3.91$
 $K_p = (3.913)^3/(6.087)^2 = 1.62$ units \rightarrow atmospheres [4]
- (ii)** shifts equilibrium to LHS [1] as there are fewer molecules, to reduce pressure [1] [2]
- (iii)** no effect [1] [1]
- 16 (a)** two carboxyl groups [1] [1]
- (b) (i)** ability to rotate the plane [1] of plane polarised light [1] [2]
- (ii)** middle two carbons [1] [1]
- (iii)** equal proportions [1] [1]
- (c)** $10^{-2.9} = [H^+]^2/0.1$ $[H^+] = 0.01122$ $pH = 1.95$ [3] [3]
- (d) (i)** phenolphthalein [1] colour changes in the pH range corresponding to the vertical portion of the titration curve [1] [2]
- (ii)** moles NaOH = $9.8 \times 0.2/1000 = 1.96 \times 10^{-3}$
 (1:2) moles tartaric acid = 9.8×10^{-4}
 mass tartaric acid = $(9.8 \times 10^{-4}) \times 150$
 0.147 g
 $0.147/25 \times 750 = 4.41$ g [4] [4]
- (e)**
- 
- [2] [2]
- (f)** $C_4H_5O_6^- + H^+ \rightarrow C_4H_6O_6$ [1] [1]
- $C_4H_6O_6 + OH^- \rightarrow C_4H_5O_6^- + H_2O$ [1] [2]

AVAILABLE
MARKS

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- 17 (a) $\text{Ca}^{2+}(\text{g}) + 2\text{Cl}(\text{g}) + 2\text{e}^-$ [1]
 $\text{Ca}(\text{s}) + \text{Cl}_2(\text{g})$ [1] [2]
- (b) second [1] ionisation energy of calcium [1] [2]
- (c) $\Delta H_{\text{latt}} = -(-795) + 190 + 590 + 1146 + 242 + 2(-348) = +2267 \text{ kJ mol}^{-1}$ [2]
- (d) $\Delta H_{\text{sol}} = \Delta H_{\text{latt}} + \Delta H_{\text{hyd}}(\text{Ca}^{2+}) + 2 \Delta H_{\text{hyd}}(\text{Cl}^-)$
 $= (+2267) + (-1651) + 2(-364) = -112 \text{ kJ mol}^{-1}$ [2]
- (e) pH is 7 [1] formed from a strong acid and a strong base [1] [2]
- (f) $\Delta G = \Delta H - T\Delta S$
 $= (-795) - 298 \left(-\frac{152}{1000}\right)$
 $= -749.7 \text{ (kJ mol}^{-1}\text{)}$ [2]
- Reaction is spontaneous as ΔG is negative [1]

Section B

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100

Total

120