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] 20

Section A **20**

Section B

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[RCl][NaOH] [1] [3]

(ii) 170940 [1] $mol^{-1}dm^3s^{-1}$ [1] [2]

(iii) nucleophilic substitution [1]

(iv) primary – reaction is second order overall [1] 12

12 (a) $C_6H_{12}O$ [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 $\begin{matrix}CO_3^{2-}\\HCO_3^-\end{matrix}$ to liquid lauric acid [1] fizzing/test for CO_2 [1] [2]

(d) $C_{11}H_{23}COOH + SOCl_2 \rightarrow C_{11}H_{23}COCl + HCl + SO_2$ [2]

(e) (i) $C_{11}H_{23}COOH + 4[H] \rightarrow C_{11}H_{23}CH_2OH + H_2O$ [2]

(ii) lithium aluminium hydride [1]

(f) (i) alkaline [1] hydrolysis [1] [2]

(ii) $C_3H_5(OCOC_{11}H_{23})_3 + 3NaOH \rightarrow C_3H_5(OH)_3 + 3C_{11}H_{23}COONa$

or

$$\begin{matrix}CH_2OCOC_{11}H_{23}\\|\\CHOCOC_{11}H_{23}\\|\\CH_2OCOC_{11}H_{23}\end{matrix} + 3NaOH \rightarrow \begin{matrix}CH_2OH\\|\\CHOH\\|\\CH_2OH\end{matrix} + 3\,C_{11}H_{23}COONa$$

[2]

(iii) saponification value = 260 mg = 0.26 g, moles KOH = 0.26/56 = 4.64×10^{-3}
(×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 = $20.1 cm^3$
each error [–1]

or

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

(1:3) n_{KOH} required = 8.09×10^{-3}

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

n_{HCl} required = 1.91×10^{-3}

Volume HCl required = $1.91 \times 10^{-3} \times \frac{1000}{0.1} = 19.1\,cm^3$ [4] 19

13 (a) (i) $2HClO_4 \rightarrow Cl_2O_7 + H_2O$ [1]

(ii) $P_4O_{10} + 6H_2O \rightarrow 4H_3PO_4$ [2]

(b) P +5 [1]
Cl +7 [1] [2]

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

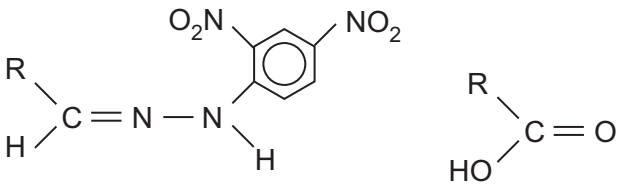
14 (a) same molecular formula [1] different structural formula [1] [2]

(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]

(d) (i)

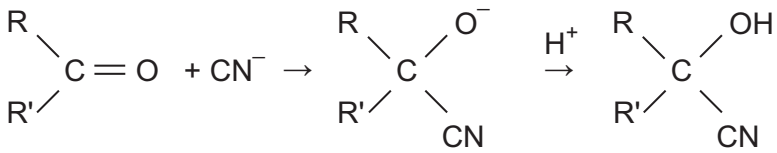


[2]

(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]

(e)



[3] 21

15 **(a)** **(i)** gases absorb/prevent escape of [1] infrared radiation [1] [2]

(ii) global warming [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 → atmospheres [4]

(ii) shifts equilibrium to LHS [1] as there are fewer molecules, to reduce pressure [1] [2]

(iii) no effect [1] 10

16 **(a)** two carboxyl groups [1]

(b) **(i)** ability to rotate the plane [1] of plane polarised light [1] [2]

(ii) middle two carbons [1]

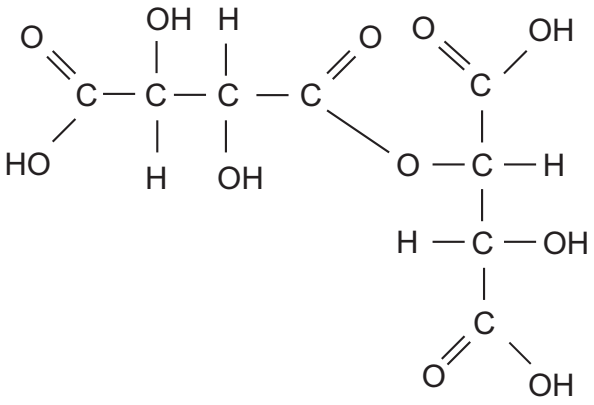
(iii) equal proportions [1]

(c) $10^{-2.9} = [H^+]^2/0.1$ $[H^+] = 0.01122$ pH = 1.95 [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 × 750 = 4.41 g [4]

(e)



[2]

(f) $C_4H_5O_6^- + H^+ \rightarrow C_4H_6O_6$ [1]

$C_4H_6O_6 + OH^- \rightarrow C_4H_5O_6^- + H_2O$ [1] [2] 18

17 **(a)** $Ca^{2+}(g) + 2Cl(g) + 2e^{-}$ [1]

$Ca(s) + Cl_2(g)$ [1] [2]

(b) second [1] ionisation energy of calcium [1] [2]

(c) $\Delta H_{latt} = -(-795) + 190 + 590 + 1146 + 242 + 2(-348) = +2267\ kJ\,mol^{-1}$ [2]

(d) $\Delta H_{sol} = \Delta H_{latt} + \Delta H_{hyd}(Ca^{2+}) + 2\ \Delta H_{hyd}(Cl^{-})$

$= (+2267) + (-1651) + 2(-364) = -112\ kJ\,mol^{-1}$ [2] [2]

(e) pH is 7 [1] formed from a strong acid and a strong base [1] [2]

(f) $\Delta G = \Delta H - T\Delta S$

$= (-795) - 298\ (-\frac{152}{1000})$

$= -749.7\ (kJmol^{-1})$ [2]

Reaction is spontaneous as ΔG is negative [1] 13

Section B	**100**
Total	**120**