Rewarding Learning

ADVANCED
General Certificate of Education
January 2011

Chemistry

Assessment Unit A2 1

assessing

Periodic Trends and Further Organic, Physical and Inorganic Chemistry

[AC212]

WEDNESDAY 26 JANUARY, MORNING

MARK SCHEME

SECTION A

		AVAILABLE MARKS
1 C		
2 D		
3 B		
4 A		
5 B		
6 D		
7 D		
8 D		
9 C		
10 D		
[2] for each correct answer	[20]	20

SECTION B

AVAILABLE MARKS

11 (a) (i) $\Delta H^{\ominus} = \sum \Delta H_f^{\ominus}$ (products) $- \sum \Delta H_f^{\ominus}$ (reactants)
$= [3 \times -393.5] - [2 \times -824.2]$
$= 467.9$ kJ mol^{-1} [2]

$\Delta S^{\ominus} = \sum S^{\ominus}$ (products) $- \sum S^{\ominus}$ (reactants)
$= [(4 \times 27.3) + (3 \times 213.6)] - [(2 \times 87.4) + (3 \times 5.7)]$
$= 558.1$ J K^{-1} mol^{-1} [2]

$\Delta G^{\ominus} = \Delta H^{\ominus} - T\ \Delta S^{\ominus}$
$= 467.9 - (298 \times 0.5581)$
$= 301.6$ kJ mol^{-1} [1]

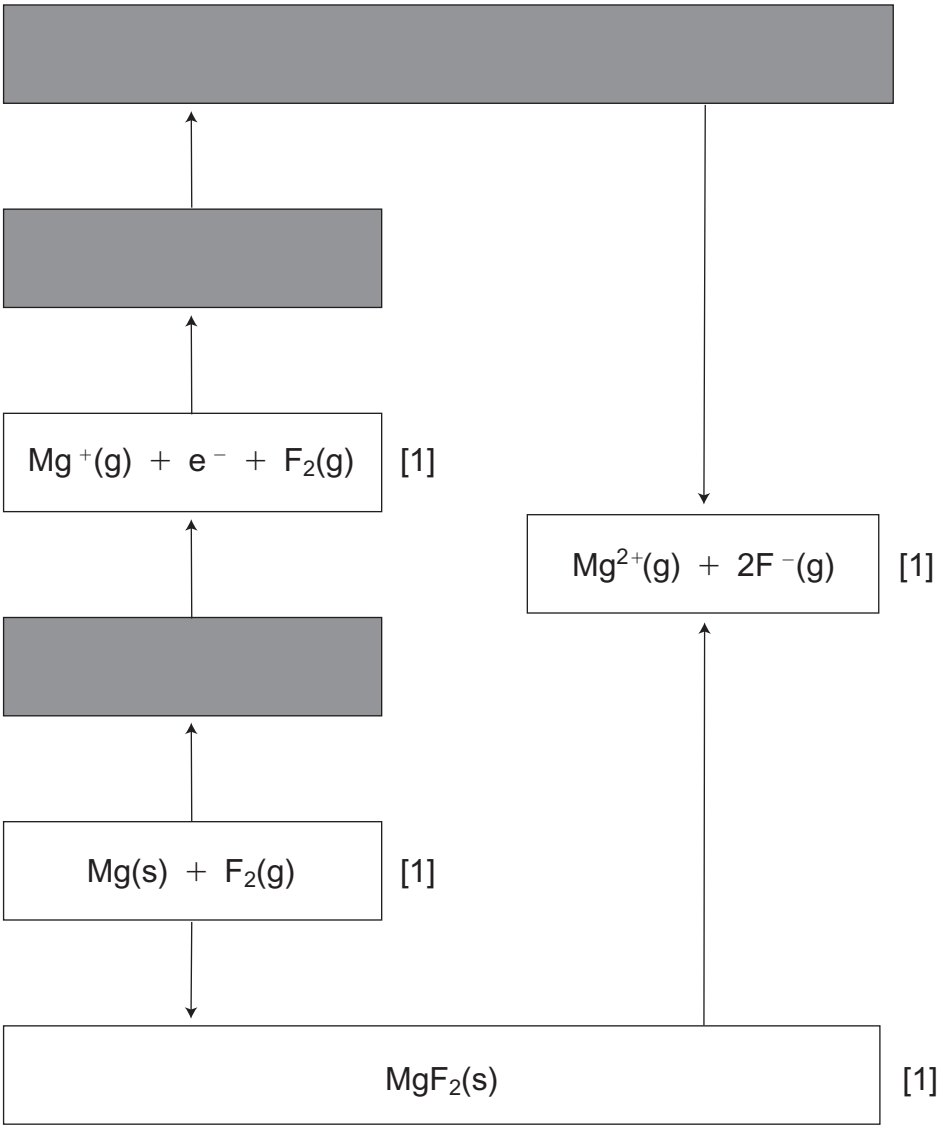
(ii) $\Delta G^{\ominus}$ is positive [1]

(b) $T = (\Delta H^{\ominus} \div \Delta S^{\ominus})$
$= (467.9 \div 0.5581)$
$= 838$ K [2] 8

AVAILABLE MARKS

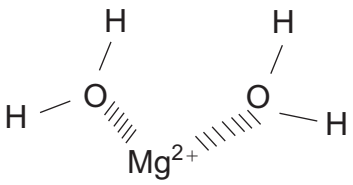
12 **(a)** The energy required to convert 1 mole of an ionic solid into gaseous ions [2]

(b) **(i)**

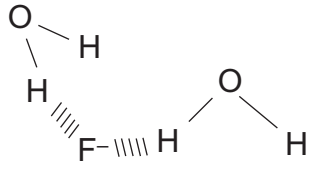


(ii) LE = (+1123) + (150) + (736) + (1450) + (2 × 79) + (2 × −348)
= 2921 kJ mol^{-1} [2]

(c) **(i)**



[1]



[1]

[2]

(ii) LE = (−155) − [(−1920) + (2 × −364)] = 2493 kJ mol^{-1} [2]

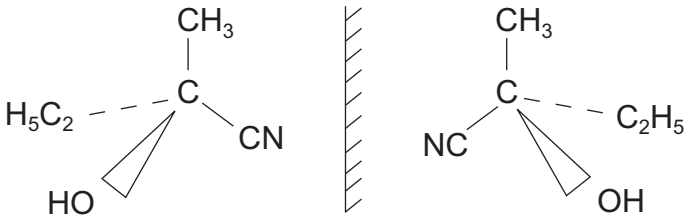
12

AVAILABLE MARKS

13 (a) (i) 2-hydroxy-2-methylbutanenitrile [2]

(ii) optical [1]

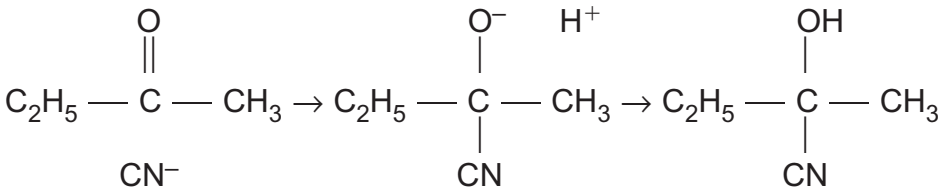
(iii)



correct 3D representation [1]
mirror image [1]

(iv) nucleophilic addition [1]

(v)



[3]

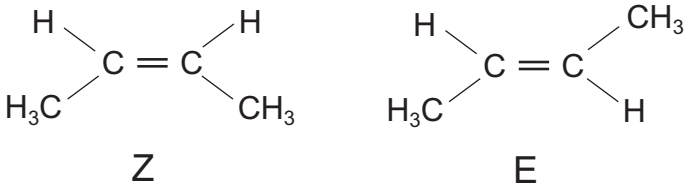
(b) (i) $CH_3COCH_2CH_3 + 2[H] \rightarrow CH_3CH(OH)CH_2CH_3$ [2]

(ii) butan-2-ol [1]

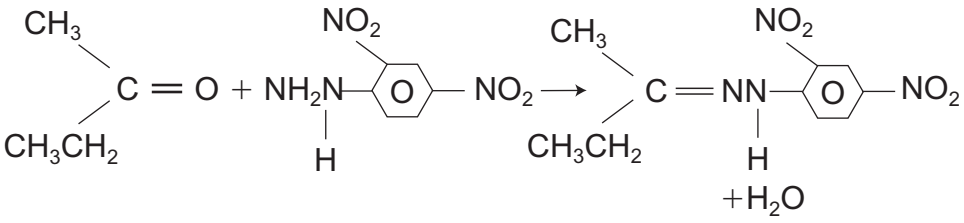
(iii) does not rotate the plane of plane polarised light [1]

(iv) the product contains equal amounts of both optical isomers [2]

(v)



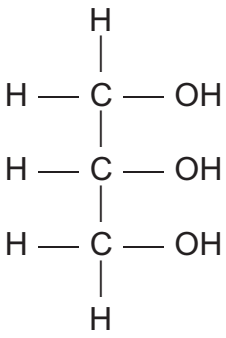
structures [1]
labels [1]

		AVAILABLE MARKS
(c)	Heat [1] with either acidified potassium dichromate Tollens' reagent or Fehling's solution [1] Correct positive result with butanal no change with butanone [1] [3]	
(d)	**(i)**  [3]	
	(ii) yellow/orange [1] solid [1] [2]	
	(iii) capillary tube [1] heat slowly [1] temp (range) when melts [1] comparison [1] [4]	29

		AVAILABLE MARKS
14 (a) (i) $K_a = \frac{[CH_3CH_2COO^-][H^+]}{[CH_3CH_2COOH]}$ [1]		
(ii) $K_a = [H^+]^2 \div [CH_3CH_2COOH]$ [1]		
$[H^+] = 0.00184$ [1]		
pH = 2.74 [1]		
(iii) A solution which minimises changes in pH on addition of small amounts of acid or alkali [2]		
(iv) Moles of acid $0.25 \times 0.3 = 0.075$		
Moles of salt $0.15 \times 0.2 = 0.03$		
(Concentration of acid = 0.15 $moldm^{-3}$)		
(Concentration of acid = 0.06 $moldm^{-3}$)		
$[H^+] = K_a \times ([acid]/[salt]) = 3.38 \times 10^{-5}$ $moldm^{-3}$		
pH = 4.47 [4]		
(b) (i) $CH_3CH_2COOH + NaOH \rightarrow CH_3CH_2COONa + H_2O$ [1]		
(ii) phenolphthalein [1]		
Colourless to pink [2]		
Range matches the vertical portion of the titration curve [1]		
(iii) moles of NaOH $= 0.20 \times (18.5/1000) = 0.0037$		
Moles of $CH_3CH_2COOH = 0.0037$		
Concentration of $CH_3CH_2COOH = 0.148$ $moldm^{-3}$ [3]		
(iv) $[H^+] = K_w \div [OH^-] = 5 \times 10^{-14}$ $moldm^{-3}$ [1]		
pH = 13.30 [1]		20

AVAILABLE MARKS

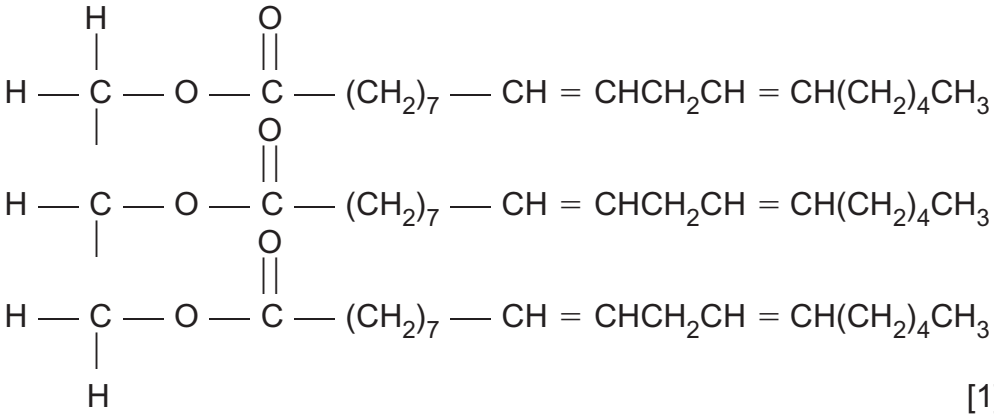
15 (a) (i)



[1]

(ii) propane-1,2,3-triol [2]

(iii)



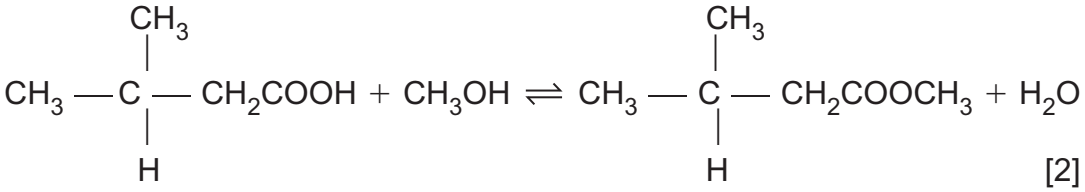
[1]

(iv) the grams of iodine [1] required to saturate 100 g of an oil [1] [2]

(v) RMM of oil = 878
Moles of oil in 100 g = 0.114
Moles of iodine required = 0.683
Mass of iodine = 174 [4]

(b) (i) 3-methylbutanoic acid [1]
Methanol [1]

(ii)



[2]

				AVAILABLE MARKS
	(iii)	Acid and alcohol into round bottomed flask and add concentrated sulphuric acid slowly [1] Add anti-bumping granules Heat under reflux [1] Distill and collect at boiling point of ester [1] Shake with aqueous sodium carbonate and release pressure [1] Separate ester layer using separating funnel [1] Add a named drying agent [1] Decant/filter [1] To a maximum of	[6]	
		Quality of written communication	[2]	22
16	**(a)**	Photosynthesis solubility of the gas in surface waters	[1] [1]	
	(b) **(i)**	reference to combustion [1] of (hydrocarbon) fuels [1]	[2]	
	(ii)	$CO_2 + 2OH^- \rightarrow CO_3^{2-} + H_2O$	[2]	
	(c) **(i)**	reference to C = O bonds vibrating more	[1]	
	(ii)	prevents IR radiation “escaping” into space this causes the atmospheric temperature to increase	[1] [1]	9
		Section B		**100**
		Total		**120**