



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

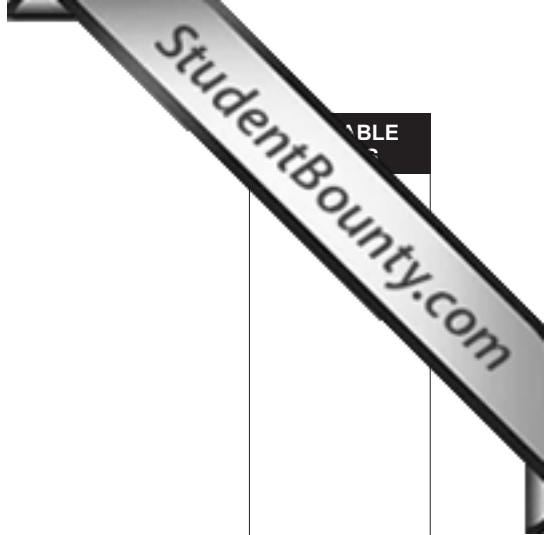
SECTION A

- 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



TABLE

SECTION B

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

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

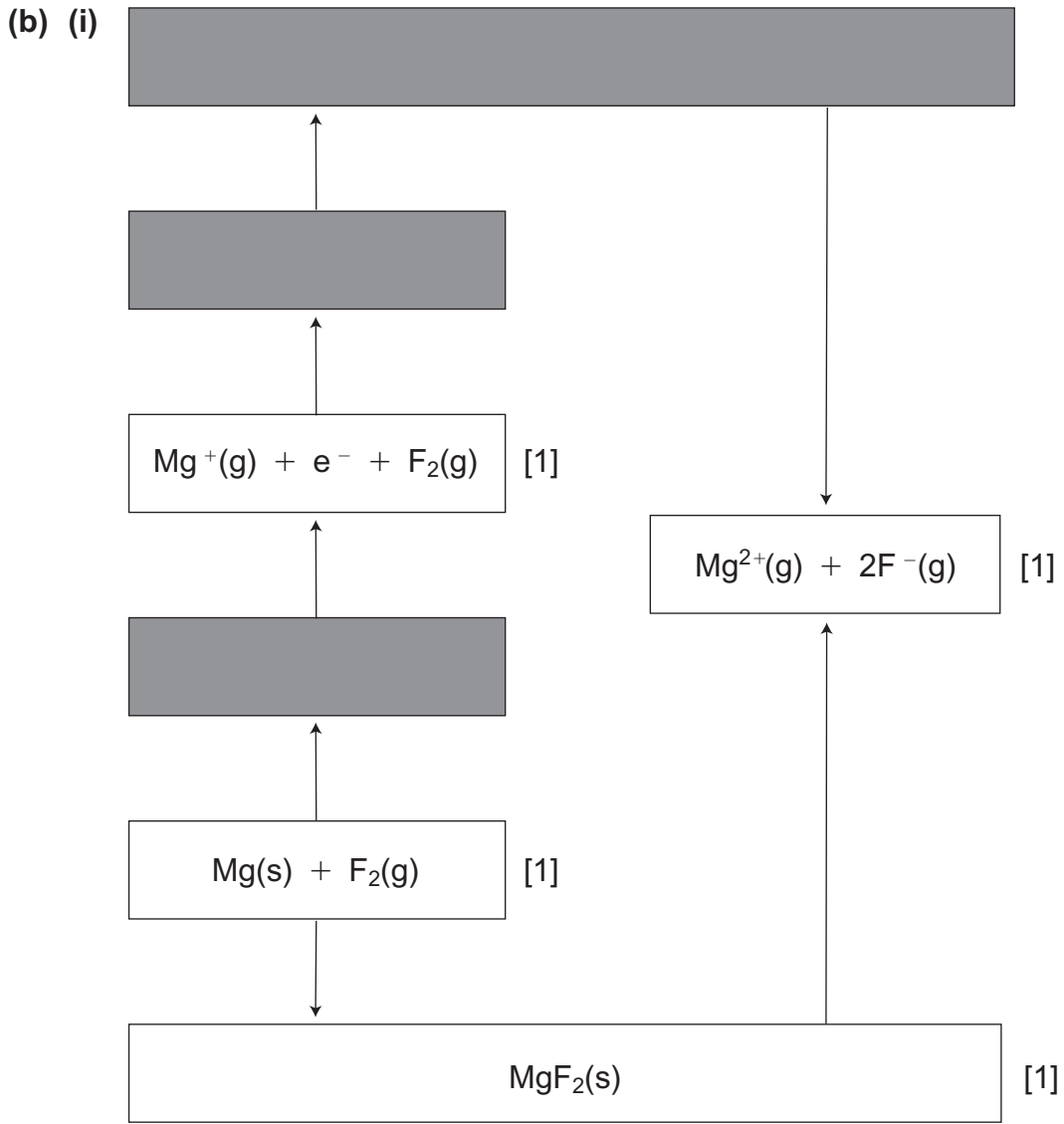
$\Delta G^\circ = \Delta H^\circ - T \Delta S^\circ$
 $= 467.9 - (298 \times 0.5581)$
 $= 301.6 \text{ kJ mol}^{-1}$ [1]

(ii) ΔG° is positive [1]

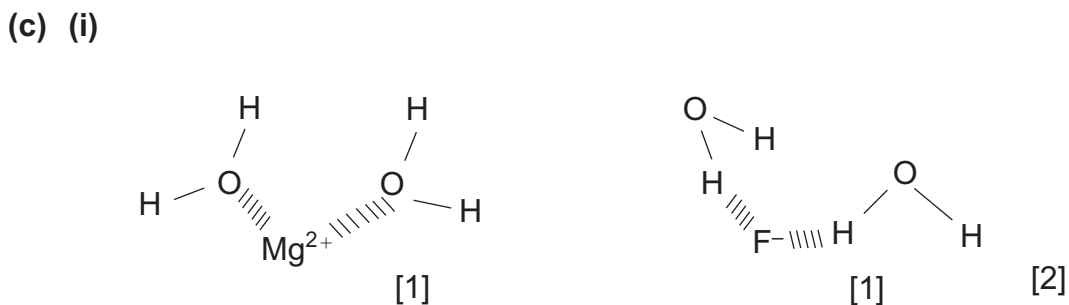
(b) $T = (\Delta H^\circ \div \Delta S^\circ)$
 $= (467.9 \div 0.5581)$
 $= 838 \text{ K}$ [2]

8

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



(ii) $\text{LE} = (+1123) + (150) + (736) + (1450) + (2 \times 79) + (2 \times -348)$
 $= 2921 \text{ kJ mol}^{-1}$ [2]



(ii) $\text{LE} = (-155) - [(-1920) + (2 \times -364)] = 2493 \text{ kJ mol}^{-1}$ [2]

12

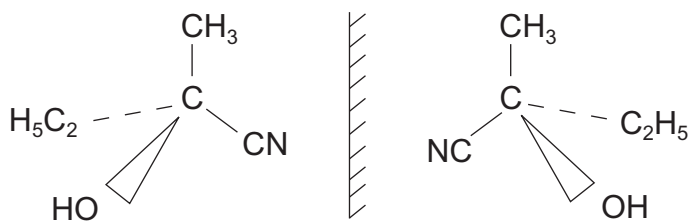
13 (a) (i) 2-hydroxy-2-methylbutanenitrile

[2]

(ii) optical

[1]

(iii)



correct 3D representation

[1]

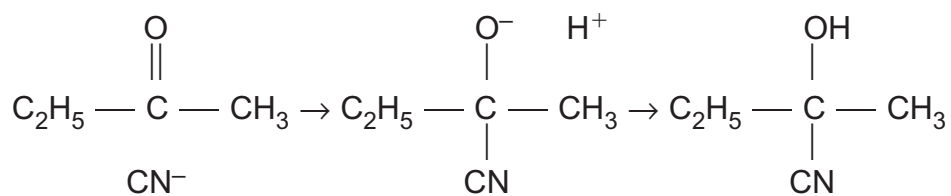
mirror image

[1]

(iv) nucleophilic addition

[1]

(v)



[3]

(b) (i) $\text{CH}_3\text{COCH}_2\text{CH}_3 + 2[\text{H}] \rightarrow \text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$

[2]

(ii) butan-2-ol

[1]

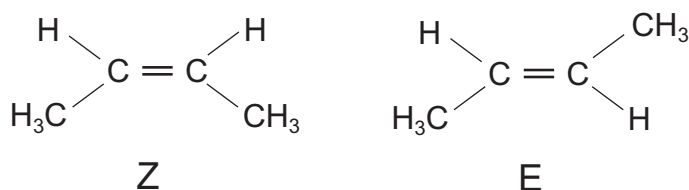
(iii) does not rotate the plane of plane polarised light

[1]

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

[2]

(v)



structures

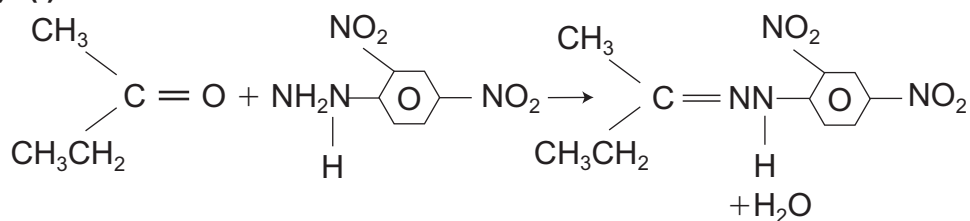
[1]

labels

[1]

- (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

14 (a) (i)
$$K_a = \frac{[\text{CH}_3\text{CH}_2\text{COO}^-][\text{H}^+]}{[\text{CH}_3\text{CH}_2\text{COOH}]}$$
 [1]

(ii)
$$K_a = [\text{H}^+]^2 \div [\text{CH}_3\text{CH}_2\text{COOH}]$$
 [1]

$$[\text{H}^+] = 0.00184$$
 [1]

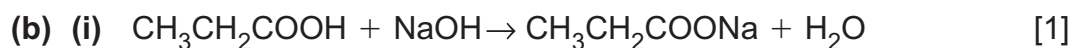
$$\text{pH} = 2.74$$
 [1]

(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 mol dm^{-3})
(Concentration of acid = 0.06 mol dm^{-3})

$$[\text{H}^+] = K_a \times ([\text{acid}]/[\text{salt}]) = 3.38 \times 10^{-5} \text{ mol dm}^{-3}$$

$$\text{pH} = 4.47$$
 [4]



(ii) phenolphthalein [1]
Colourless to pink [2]
Range matches the vertical portion of the titration curve [1]

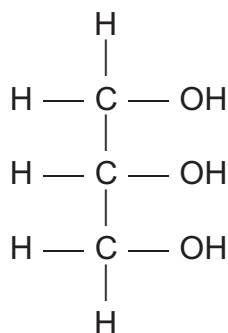
(iii) moles of NaOH = $0.20 \times (18.5/1000) = 0.0037$
Moles of $\text{CH}_3\text{CH}_2\text{COOH} = 0.0037$
Concentration of $\text{CH}_3\text{CH}_2\text{COOH} = 0.148 \text{ mol dm}^{-3}$ [3]

(iv)
$$[\text{H}^+] = K_w \div [\text{OH}^-] = 5 \times 10^{-14} \text{ mol dm}^{-3}$$
 [1]

$$\text{pH} = 13.30$$
 [1]

20

15 (a) (i)

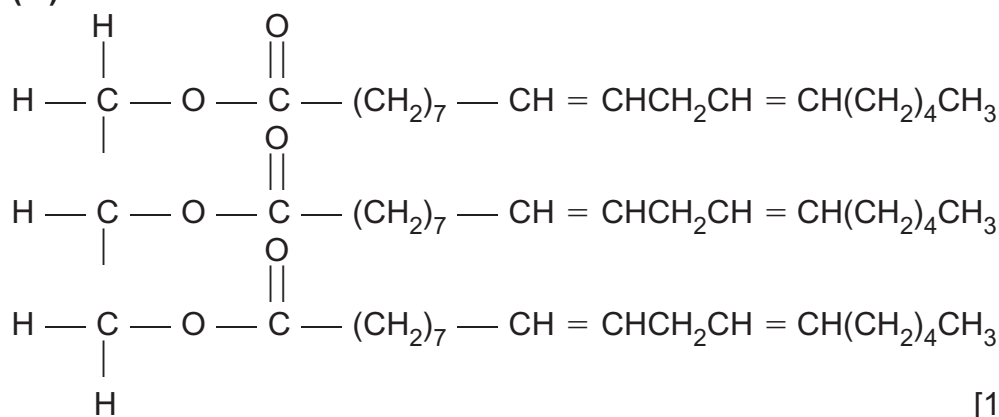


[1]

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

[2]

(iii)



[1]

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

(v) RMM of oil = 878

Moles of oil in 100g = 0.114

Moles of iodine required = 0.683

Mass of iodine = 174

[4]

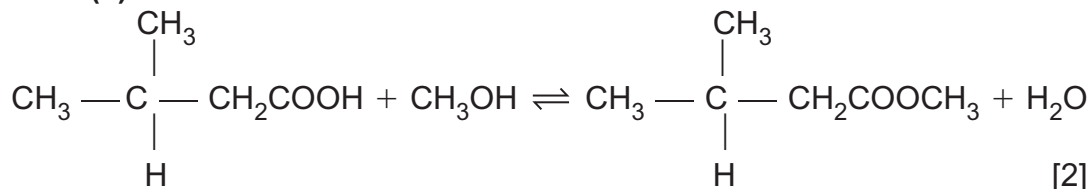
(b) (i) 3-methylbutanoic acid

[1]

Methanol

[1]

(ii)



[2]

(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	[1]	
	solubility of the gas in surface waters	[1]	
(b) (i)	reference to combustion [1] of (hydrocarbon) fuels [1]	[2]	
(ii)	$\text{CO}_2 + 2\text{OH}^- \rightarrow \text{CO}_3^{2-} + \text{H}_2\text{O}$	[2]	
(c) (i)	reference to C = O bonds vibrating more	[1]	
(ii)	prevents IR radiation "escaping" into space	[1]	
	this causes the atmospheric temperature to increase	[1]	9
	Section B		100
	Total		120