



Rewarding Learning

ADVANCED
General Certificate of Education
2016

Chemistry

Assessment Unit A2 1

assessing

Periodic Trends and Further Organic,
Physical and Inorganic Chemistry

[AC212]

FRIDAY 27 MAY, MORNING

**MARK
SCHEME**

General Marking Instructions

Introduction

Mark schemes are published to assist teachers and students in their preparation for examinations. Through the mark schemes teachers and students will be able to see what the examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

The purpose of mark schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of students in schools and colleges.

The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and the mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes, therefore, are regarded as part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all the markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents the final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example where there is no absolute correct response – all teachers will be familiar with making such judgements.

Section A

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

[2] for each correct answer

[20]

Section A

**AVAILABLE
MARKS**

20

20

Section B

			AVAILABLE MARKS
11	$\text{Na}_2\text{O} + \text{H}_2\text{O} \rightarrow 2\text{NaOH}$	[1]	5
	$\text{SO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$	[1]	
	$\text{Cl}_2\text{O}_7 + \text{H}_2\text{O} \rightarrow 2\text{HClO}_4$	[1]	
	$\text{P}_2\text{O}_5 + 3\text{H}_2\text{O} \rightarrow 2\text{H}_3\text{PO}_4$	[1]	
	or		
	$\text{P}_4\text{O}_{10} + 6\text{H}_2\text{O} \rightarrow 4\text{H}_3\text{PO}_4$		
	$\text{PCl}_5 + \text{H}_2\text{O} \rightarrow \text{POCl}_3 + 2\text{HCl}$	[1]	
	or		
	$\text{PCl}_5 + 4\text{H}_2\text{O} \rightarrow \text{H}_3\text{PO}_4 + 5\text{HCl}$		
12	(a) (i) e.g. kerosine, diesel, petrol, gasoline, methane, propane, butane Any two	[2]	
	(ii) they burn (and produce carbon dioxide)	[1]	
	(b) (i) carbon dioxide is reduced	[1]	
	photosynthesis causes the carbon dioxide to form sugars etc	[1] [2]	
	(ii) carbon dioxide is increased	[1]	
	(oxidation) of foodstuffs produces carbon dioxide	[1] [2]	
	(iii) carbon dioxide is decreased	[1]	
	the carbon dioxide dissolves in the water	[1] [2]	
	(c) infrared radiation	[1]	
	is absorbed (in the atmosphere)	[1]	
	by carbon dioxide (dependent on saying it is absorbed)	[1] [3]	

13 (a) (i) +159 +520 +218 -73 -915 kJ [2]

(ii) +159 +520 +218 -73 -915 = ΔH_f
+897 -73 -915 = ΔH_f
 $\Delta H_f = -91$ (kJ) [2]

(iii) the ionisation enthalpy (changes) [1]

the atomisation enthalpy (changes) [1] [2]

(b) $\text{Li} + \text{H}_2\text{O} \rightarrow \text{LiOH} + \frac{1}{2}\text{H}_2$ -220 kJ
 $\text{LiOH} + \text{H}_2 \rightarrow \text{LiH} + \text{H}_2\text{O}$ +130 kJ
 $\text{Li} + \frac{1}{2}\text{H}_2 \rightarrow \text{LiH}$ -90 kJ [2]

(c) ΔH is negative [1]

(the reaction forms fewer particles/ ΔS is negative)
 $\Delta H > T\Delta S$ [1] [2]

(d) (i) It is attracted to positive centres/charges/negatively charged [1]

(ii) $\begin{array}{c} \text{CH}_3 \\ \diagdown \\ \text{C}=\text{O} \\ \diagup \\ \text{CH}_3 \end{array} \xrightarrow{\text{H}^-} \begin{array}{c} \text{CH}_3 \quad \text{O}^- \\ \diagdown \quad \diagup \\ \text{C} \\ \diagup \quad \diagdown \\ \text{CH}_3 \quad \text{H} \end{array} \xrightarrow{\text{H}_2\text{O}/\text{H}^+} \begin{array}{c} \text{CH}_3 \quad \text{OH} \\ \diagdown \quad \diagup \\ \text{C} \\ \diagup \quad \diagdown \\ \text{CH}_3 \quad \text{H} \end{array} + \text{OH}^-$
(with H_2O) [3]

(iii) propan-2-ol [1]

(iv) $\text{CH}_3\text{CH}_2\text{COOH} + 4[\text{H}] \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{OH} + \text{H}_2\text{O}$ [2]

AVAILABLE
MARKS

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- 14 (a)** $\text{CH}_2\text{ClCOOK} + \text{KCN} \rightarrow \text{CH}_2\text{CNCOOK} + \text{KCl}$ [1]
- $\text{CH}_2\text{CNCOOK} + \text{HCl} \rightarrow \text{CH}_2\text{CNCOOH} + \text{KCl}$ [1] [2]
- (b) (i)** dissolves a large amount at a high temperature [1]
- dissolves a small amount at a low temperature [1]
- not toxic [1]
- not decompose on heating [1]
- not too flammable [1]
- ... to a maximum of [4] [4]
- (ii)** $\text{CH}_2\text{CNCOOH} \rightarrow \text{CH}_3\text{CN} + \text{CO}_2$ [1]
- (c) (i)** the boiling points are high [1]
- because of the polar bonds i.e. CN and COO [1]
- the boiling points are virtually the same because the rmm are about the same [1]
- leading to greater van der Waals forces [1] [4]
- (ii)** $\text{CH}_2\text{CNCOOH} + \text{CH}_3\text{OH} \rightarrow \text{CH}_2\text{CNCOOCH}_3 + \text{H}_2\text{O}$ [1]
- (iii)** concentrated sulfuric acid [1]
- (d) (i)** methanal [1]
- (ii)**
-
- [2]
- not E/Z – 2 H on one C of C = C [1] [3]
- (iii)**
-
- [2]
- (e) (i)** $K_a = \frac{[\text{H}^+][\text{CH}_2\text{CNCOO}^-]}{[\text{CH}_2\text{CNCOOH}]}$ [2]
- (ii)** $\text{p}K_a = 2.6$ $K_a = 2.51 \times 10^{-3}$ [2]
- (iii)** phenolphthalein [1]
- changes colour in the vertical section of the titration curve [1] [2]

AVAILABLE
MARKS

25

- 15 (a) (i) the oil/fat is (more) soluble in ethanol [1]
 (ii) (organic) bonds strong (and take longer to break) [1]
 (iii) helps the liquid to boil/like boiling chips [1]
 (iv) the oil/fat had disappeared [1]
 (v) 15 cm^3 of $0.50 \text{ M HCl acid} = 7.5 \text{ cm}^3$ of 1.00 M HCl acid

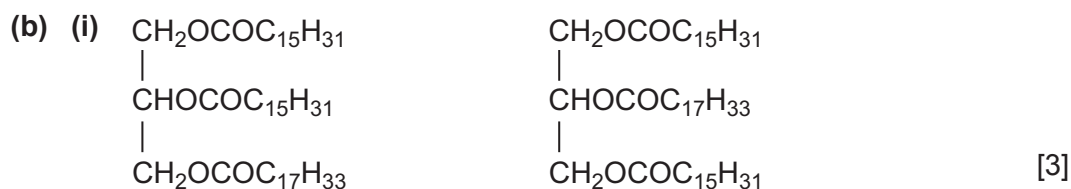
Hence 42.5 cm^3 of 1.00 M KOH have reacted

$$= 42.5 \text{ cm}^3 \text{ of } 1.00 \text{ M KOH} = 42.5 \times 10^{-3} \text{ mol KOH} = 0.0425 \times 56 \text{ g KOH}$$

$$= 2.38 \text{ g} = 2380 \text{ mg}$$

9g of oil/fat react with 2380mg

1g of oil/fat react with 264mg which is the saponification value [3]



(ii) the first structure [1]

four different groups around the (central) carbon atom [1] [2]



(ii) 0.036 g of silver = $0.036/108 = 3.333 \times 10^{-4} \text{ mol}$ of silver

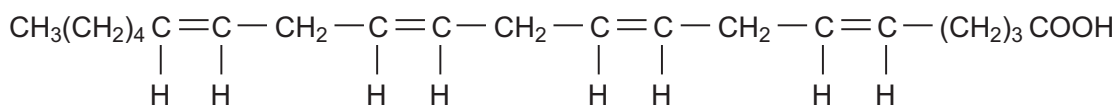
$$0.130 \text{ g of the silver salt} = 3.333 \times 10^{-4} \text{ mol}$$

$$\text{one mole of silver salt} = 0.130/3.3 \times 10^{-4} \text{ g} = 390 \quad [3]$$

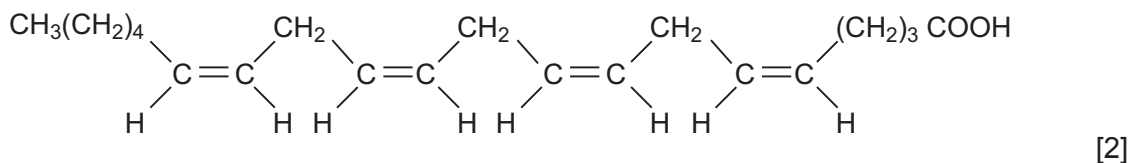
(iii) $390 - 108 = 282$

$$\text{C}_{18}\text{H}_{34}\text{O}_2 = 216 + 34 + 32 = 282 \text{ hence it is oleic acid} \quad [1]$$

(d)



or



AVAILABLE
MARKS

			AVAILABLE MARKS
(e) (i)	hydrocarbon chain (cannot form bonds with water)	[1]	24
(ii)	ionic substance	[1]	
	ions are more easily solvated	[1] [2]	
(iii)	oleic acid is a weak acid and sodium hydroxide is a strong base	[1]	
	alkaline (dependent)	[1] [2]	
16 (a)	separating funnel		
	use more than one portion of cyclohexane		
	shake the funnel		
	run off the lower layer and keep the upper layer (of cyclohexane)/ identify layers		
	distil off/evaporate off the cyclohexane	[5]	
	Quality of written communication	[2]	
(b) (i)	the equilibrium constant decreases with temperature increase in temperature moves the reaction to the LHS, exothermic	[1] [1] [2]	
(ii)	dissolve the reactants in a solvent and determine the concentration of iodine via colour	[1]	
	have solutions of iodine of various molar concentrations	[1]	
	match the colours with the standards at various times	[1] [3]	
	or titrate with thiosulfate using starch indicator [3]		
(iii)	the rates become equal to each other	[1]	
(iv)	$K = 13 = 0.001/0.01 \times [I_2]$ $[I_2] = K = 13 = 0.001/0.01 \times 13$ $= 0.0077M$ $0.0077 \times 254 = 1.96g$	[3]	
(c)	the iodine colour does not totally disappear	[1]	17
	or iodine is not (sufficiently) soluble in water		
	Section B		100
	Total		120