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

	AVAILABLE MARKS
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]	20
Section A	**20**

Section B

AVAILABLE MARKS

11 $Na_2O + H_2O \rightarrow 2NaOH$ [1]

$SO_3 + H_2O \rightarrow H_2SO_4$ [1]

$Cl_2O_7 + H_2O \rightarrow 2HClO_4$ [1]

$P_2O_5 + 3H_2O \rightarrow 2H_3PO_4$ [1]
or
$P_4O_{10} + 6H_2O \rightarrow 4H_3PO_4$

$PCl_5 + H_2O \rightarrow POCl_3 + 2HCl$ [1] 5
or
$PCl_5 + 4H_2O \rightarrow H_3PO_4 + 5HCl$

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] 12

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

(ii) +159 +520 +218 –73 –915 = ΔH_f
+897 –73 –915 = ΔH_f
ΔH_f = –91 (kJ) [2]

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

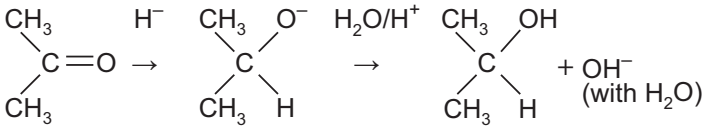
the atomisation enthalpy (changes) [1] [2]

(b) $Li + H_2O \rightarrow LiOH + \frac{1}{2}H_2$ –220 kJ
$LiOH + H_2 \rightarrow LiH + H_2O$ +130 kJ
$Li + \frac{1}{2}H_2 \rightarrow LiH$ –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) 

[3]

(iii) propan-2-ol [1]

(iv) $CH_3CH_2COOH + 4[H] \rightarrow CH_3CH_2CH_2OH + H_2O$ [2]

17

AVAILABLE MARKS

14 **(a)** $CH_2ClCOOK + KCN \rightarrow CH_2CNCOOK + KCl$ [1]

$CH_2CNCOOK + HCl \rightarrow CH_2CNCOOH + KCl$ [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) $CH_2CNCOOH \rightarrow CH_3CN + CO_2$ [1]

(c) **(i)** the boiling points are high [1]

because of the polar bonds i.e. CN and COO [1]

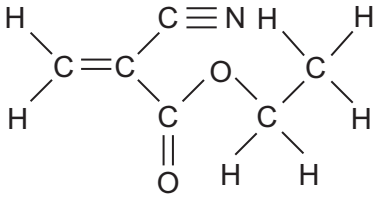
the boiling points are virtually the same because the rmm are about the same [1]
leading to greater van der Waals forces [1] [4]

(ii) $CH_2CNCOOH + CH_3OH \rightarrow CH_2CNCOOCH_3 + H_2O$ [1]

(iii) concentrated sulfuric acid [1]

(d) **(i)** methanal [1]

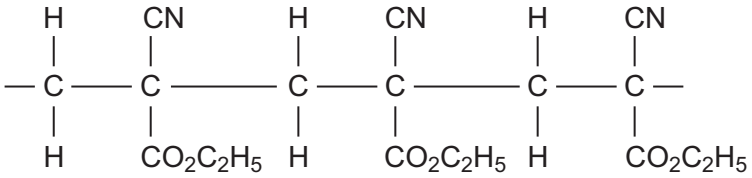
(ii)



[2]

not E/Z – 2 H on one C of C ═ C [1] [3]

(iii)



[2]

(e) **(i)** $K_a = \dfrac{[H^+][CH_2CNCOO^-]}{[CH_2CNCOOH]}$ [2]

(ii) $pK_a = 2.6 \quad K_a = 2.51 \times 10^{-3}$ [2]

(iii) phenolphthalein [1]

changes colour in the vertical section of the titration curve [1] [2]

AVAILABLE MARKS

25

AVAILABLE MARKS

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 M HCl acid = 7.5 cm^3 of 1.00 M HCl acid

Hence 42.5 cm^3 of 1.00 M KOH have reacted

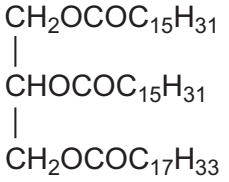
= 42.5 cm^3 of 1.00 M KOH = 42.5 × 10^{-3} mol KOH = 0.0425 × 56 g KOH

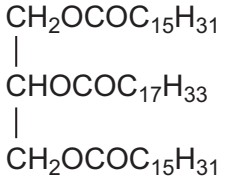
= 2.38 g = 2380 mg

9 g of oil/fat react with 2380 mg

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

(b) (i)





[3]

(ii) the first structure [1]

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

(c) (i) $2RCOOH + Ag_2CO_3 \rightarrow 2RCOOAg + CO_2 + H_2O$ [1]

(ii) 0.036 g of silver = 0.036/108 = 3.333 × 10^{-4} mol of silver

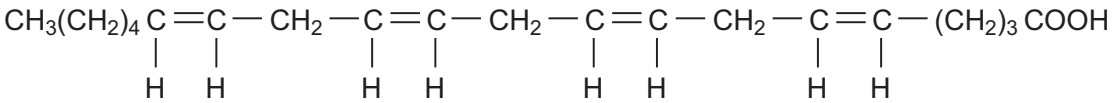
0.130 g of the silver salt = 3.333 × 10^{-4} mol

one mole of silver salt = 0.130/3.3 × 10^{-4} g = 390 [3]

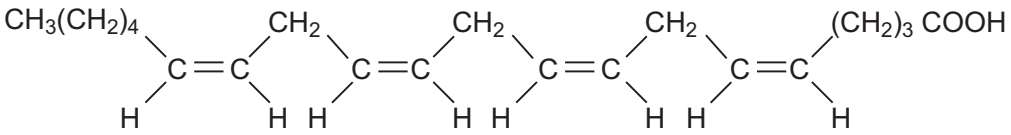
(iii) 390 – 108 = 282

$C_{18}H_{34}O_2$ = 216 + 34 + 32 = 282 hence it is oleic acid [1]

(d)



or



[2]

					AVAILABLE MARKS
(e)	**(i)**	hydrocarbon chain (cannot form bonds with water)		[1]	
	(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]	24
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	[1]		
		increase in temperature moves the reaction to the LHS, exothermic	[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) $K = 13 = 0.001/0.01 \times [I_2]$ $[I_2] = K = 13 = 0.001/0.01 \times 13$			
		$= 0.0077\,M$ $0.0077 \times 254 = 1.96\,g$		[3]	
	(c)	the iodine colour does not totally disappear		[1]	17
		or iodine is not (sufficiently) soluble in water			
				Section B	**100**
				Total	**120**