New Specification

Rewarding Learning

ADVANCED
General Certificate of Education
2018

Chemistry

Assessment Unit A2 2

assessing

Analytical, Transition Metals, Electrochemistry and Further Organic Chemistry

[ACH22]

TUESDAY 12 JUNE, AFTERNOON

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 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 this 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 A	
2 C	
3 B	
4 B	
5 C	
6 A	
7 C	
8 B	
9 C	
10 C	
[1] for each correct answer [10]	10
Section A	**10**

Section B

AVAILABLE MARKS

11 **(a)**

complex	colour
$[Mn(H_2O)_6]^{2+}$	pink
$[Ni(H_2O)_6]^{2+}$	green
$[Co(H_2O)_6]^{2+}$	pink
$[V(H_2O)_6]^{3+}$	green
$[Ni(NH_3)_6]^{2+}$	blue

[5]

(b) **(i)** $1s^2 2s^2 2p^6 3s^2 3p^6 3d^9$ [1] copper can form an ion that has an incompletely filled d-subshell [1] [2]

(ii) an ion or molecule with a lone pair of electrons which forms a co-ordinate bond with a (central) metal atom or ion in a complex [1]

(iii) The chloride ion is bigger than water, (so less chlorides can fit around the metal ion) [1]

(iv) $[Cu(H_2O)_6]^{2+} + 4Cl^- \rightarrow [CuCl_4]^{2-} + 6H_2O$ [2]

(v) Blue → yellow/green [1]

(vi) 5 → 7 [1]
Entropy has increased [1] [2]

(c) Ethylamine (is stronger) [1]
The CH_3CH_2 is electron donating (so the lone pair on the nitrogen is more available in ethylamine) [1] [2]

16

AVAILABLE MARKS

12 (a) (i) potential difference when a half-cell is connected to a (standard) hydrogen electrode under standard conditions [2]

(ii) $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$ [2]

(iii) +0.34 – (–0.76) = +1.10 V [1]

(b)
- hydrogen (gas) at 1 atmosphere pressure/100 kPa
- Pt electrode
- temperature 25 °C/298 K
- 1 mol dm^{-3} hydrochloric acid/H^+
- connect to half-cell via salt bridge
- use voltmeter to measure emf

Response	Mark
Candidates must use appropriate scientific terms, using **5–6** of the points in the indicative content, in a logical sequence. They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates use **3–4** points from the indicative content in a logical sequence using some scientific terms. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates use **1–2** of the points from the indicative content. However these are not presented in a logical sequence. They use limited spelling, punctuation and grammar and make little use of scientific terms. The form and style are of a limited standard.	[1]–[2]
Response not worthy of credit	[0]

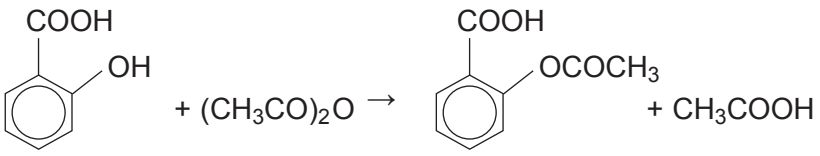
[6]

11

AVAILABLE MARKS

13 (a) (i) ethanoic acid forms an equilibrium/incomplete reaction [1]
ethanoic anhydride is more reactive than ethanoic acid [1] [2]

(ii)



[2]

(iii) phosphoric acid acts as a catalyst [1]

(iv) The water hydrolyses (any remaining) ethanoic anhydride [1]

(v) To dry the product [1]

(vi) Indicative content

- draw pencil line on TLC plate [1] spot reaction mixture [1]
- on the pencil line spot salicylic acid solution
- place in a beaker with ethyl ethanoate
- (remove plate and) use UV light or a locating reagent
- check if there is a spot for salicylic acid in reaction mixture

Band	Response	Mark
A	Candidates must use appropriate specialist terms to explain fully the process of TLC (using 5–6 points of indicative content). They use good spelling, punctuation and grammar and the form and style are of an excellent standard.	[5]–[6]
B	Candidates must use appropriate specialist terms to explain the process of TLC (using 3–4 points of indicative content). They use good spelling, punctuation and grammar and the form and style are of a good standard.	[3]–[4]
C	Candidates explain briefly and partially the process of TLC (using 1–2 points of indicative content). They use limited spelling, punctuation and grammar and the form and style are of a basic standard.	[1]–[2]
D	Response not worthy of credit	[0]

[6]

(b) RMM salicyclic acid = 138

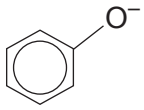
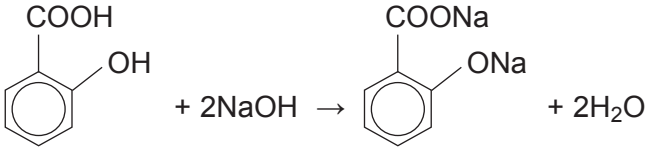
Number of moles of salicyclic acid = 3.00 ÷ 138 = 1/46
(decimal 0.02173913)

Ratio of salicyclic acid to aspirin is 1:1 therefore number of moles aspirin = 1/46/0.022

RMM aspirin = 180

Theoretical mass aspirin = 1/46 × 180 = 90/23 g (decimal 3.913043478)
3.91

Percentage yield = 2.3 ÷ (90/23) × 100 = 58.8% [3]
3.91

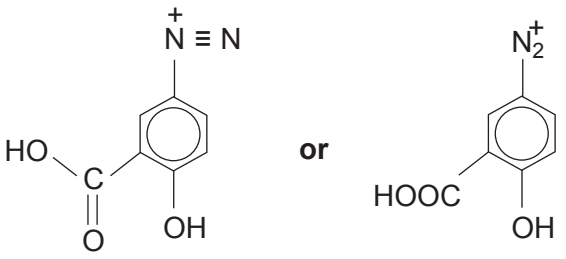
			AVAILABLE MARKS
(c)	**(i)**	benzene ring is electron withdrawing [1] (weakens O–H bond so) proton more easily liberated [1] **or** The product  is more stabilised [1] due to lone pair on O^-/oxygen being delocalised [1] [2]	
	(ii)	 [2]	
	(iii)	(The sodium salt) is more soluble (in water) [1]	
(d)		Iron(III) bromide [1]	22

AVAILABLE MARKS

14 **(a)** **(i)** Step 1 react with concentrated nitric acid and concentrated sulfuric acid [1]

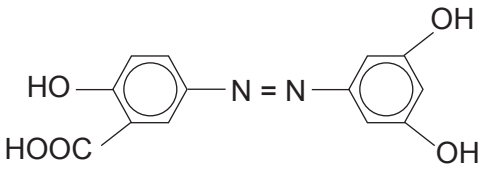
Step 2(react with) tin and concentrated hydrochloric acid [1] [2]

(ii)



[2]

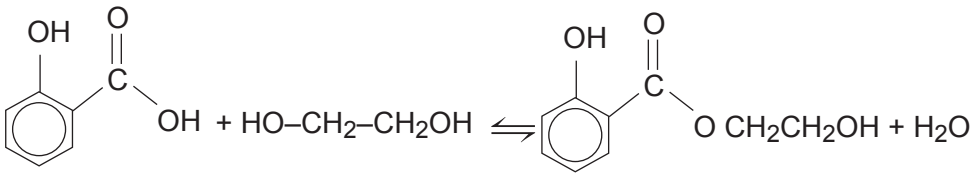
(iii)



[2]

(iv) extensive delocalisation of electrons [1]
Brings energy levels closer together [1]
Absorption of (visible) light (promotes electron)/colour is removed [1]
different/more delocalised [1] [4]

(b)



[2]

(c) **(i)** plastic bottles/clothing [1]

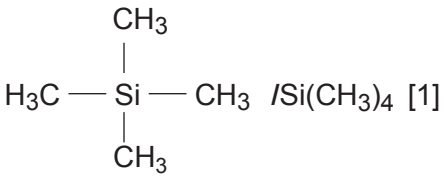
(ii) Ester link can be hydrolysed [1]

14

AVAILABLE MARKS

15 **(a)** **(i)** Hydrogen would produce a signal [1]
e.g. CCl_4 [1] [2]

(ii)



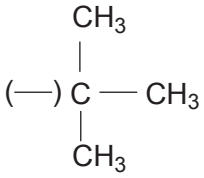
$H_3C-Si(CH_3)(CH_3)-CH_3$ /$Si(CH_3)_4$ [1]

Tetramethylsilane [1] [2]

(iii) inert [1]
All hydrogens are equivalent/produces single peak [1] [2]

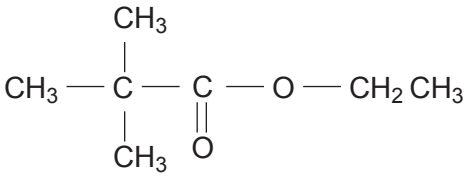
(b) **(i)** ethyl group/a = CH_2 b = CH_3 [2]
a – quartet b – triplet [1]
Max [3]

(ii)



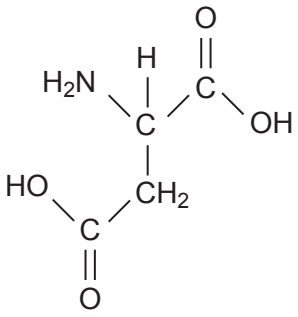
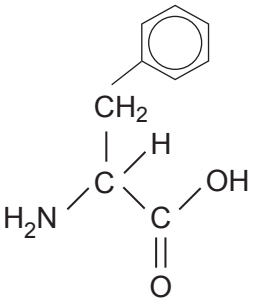
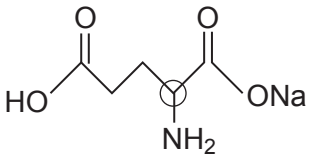
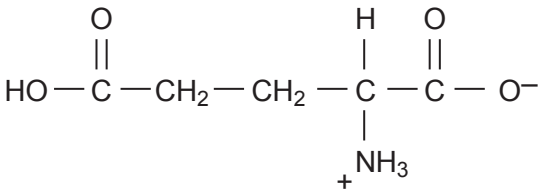
[1]

(c)



[2] 12

					AVAILABLE MARKS
16	**(a)**	**(i)**	$3Br_2 + 6OH^- \rightarrow 5Br^- + BrO_3^- + 3H_2O$	[2]	
		(ii)	red-brown to colourless	[1]	
	(b)	**(i)**	$BrO_3^- + 6H^+ + 6e^- \rightarrow Br^- + 3H_2O$	[1]	
		(ii)	$2I^- \rightarrow I_2 + 2e^-$	[1]	
		(iii)	$BrO_3^- + 6H^+ + 6I^- \rightarrow 3I_2 + 3H_2O + Br^-$	[1]	
	(c)	**(i)**	makes end point clearer	[1]	
		(ii)	Moles of thiosulfate = 23.8/1000 × 0.10 = 0.00238 Ratio of iodine to thiosulfate is 1:2 therefore moles of iodine in 25 cm^3 = 0.00238 ÷ 2 = 0.00119 Moles iodine in 1000 cm^3 = 40 × 0.00119 = 0.0476 Ratio of iodine to bromate is 3:1 therefore moles bromate(V) = 0.0476 ÷ 3 = 0.01587 Concentration bromate(V) = 0.01587 ÷ 0.02 = 0.79 mol dm^{-3}	[4]	11

				AVAILABLE MARKS
17	**(a)**	 aspartic acid  phenylalanine	[2]	
	(b) **(i)**		[1]	
	(ii)		[1]	
	(iii)	$Na_2CO_3 + 2HOOC(CH_2)_2\ CH(NH_2)COOH \rightarrow 2\ HOOC(CH_2)_2CH(NH_2)COONa + CO_2 + H_2O$	[2]	6
18	**(a)**	Stops the replication of DNA (in cancer cells) [1]	[1]	
	(b)	$PtO_4N_2C_6H_{12}$	[1]	
	(c) **(i)**	((Light) reduces platinum from) +4 [1] to +2 [1]	[2]	
	(ii)	A octahedral, co-ordination number 6	[2]	
		B square-planar, co-ordination number 4	[2]	8
			Section B	**100**
			Total	**110**