Rewarding Learning

ADVANCED
General Certificate of Education
2014

Chemistry

Assessment Unit A2 2

assessing

Analytical, Transition Metals, Electrochemistry and Further Organic Chemistry

[AC222]

TUESDAY 3 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	D		
2	D		
3	B		
4	C		
5	B		
6	C		
7	C		
8	D		
9	A		
10	B		
[2] for each correct answer		[20]	20
		Section A	**20**

Section B

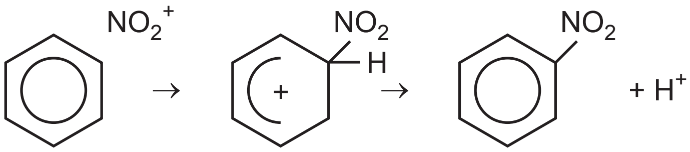
AVAILABLE MARKS

11 $Cu^{2+}(aq)$ blue
$Cr^{3+}(aq)$ green
$Co^{2+}(aq)$ pink
$Fe^{3+}(aq)$ yellow/orange error [–1] [3] **3**

12 **(a)** **(i)** the nitrogen atom has lost one electron (hence positive) [1]

(ii) the nitronium ion is an electrophile [1]
it is attracted to double bonds etc [1] [2]

(iii)



[3]

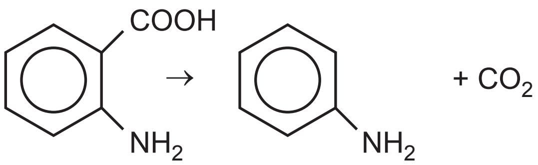
(iv) (overall) electrophilic substitution [1]
nitronium ion replaces H^+ /H [1] [2]

(b) **(i)** 2-nitrobenzoic acid
3-nitrobenzoic acid
4-nitrobenzoic acid [2]

(ii) the ortho compound forms an internal hydrogen bond
hence less bonds available to bond with other molecules
the para cannot form internal bonds hence can bond with other molecules [2]

(iii) tin + (concentrated) hydrochloric acid [1]
add sodium hydroxide (solution) [1] [2]

(c) **(i)** loss of carbon dioxide/carboxyl/carboxylic acid group [1]

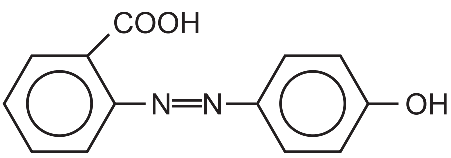


[2] [3]

(ii) anthranilic acid contains an amino group and an acid group
(naturally occurring) amino acids have both groups on the same carbon atom [2]

(iii) ice or $\leqslant 10\,°C$ [1]

(iv)



[2]

(v) (butyl)diazonium ion [1]
is unstable/decomposes [1] [2] **24**

13 (a) (i) an ion/molecule with a lone pair (of electrons) which forms a coordinate bond with a (central) metal atom or ion in a complex [2]

(ii) A (ligand) donates more than one lone pair of electrons to form more than 2 coordinate bonds to a metal atom/ion in a complex [2]

(iii)  [2]

the nitrogen has a lone pair to form a bond with other ions [1] [3]

(b) Sr^{2+} ($ranelate^{2-}$) [1]
two of the carboxylic acid groups form COO^- [1] [2]

(c) more bonds with edta, e.g. 6 rather than ranelic acid, e.g. 4/5 [1]
hence ranelic acid displaced [1] [2]

entropy arguments not true

(d) (i) (magnesium ion solution in flask)
(edta solution in burette)
eriochrome T black [1] (added to flask)
pH 10 buffer/or ammonia/NH_4Cl [1]
magnesium ions with indicator goes red [1]
magnesium ions with edta go blue [1]
complex is red free indicator is blue [1] [5]

Quality of written communication [2]

(ii) 15.6 cm^3 of 0.01 M edta solution = $15.6 \times 10^{-3} \times 0.01$ mol edta
= 1.56×10^{-4} mol $Mg(OH)_2$
$Mg(OH)_2 = 24 + 34 = 58$
1.56×10^{-4} mol = $1.56 \times 10^{-4} \times 58 = 0.009048$ g

in 1 dm^3 there are 40×0.009048 g = 0.36192 g = 361.9 mg [4]

(e) (i) sequesters calcium ions in blood [1]
prevents blood clotting [1] [2]

(ii) removes calcium/magnesium ions [1]
softens water [1] [2]

AVAILABLE MARKS: 26

AVAILABLE MARKS

14 (a) (i) the methylene groups are (chemically) equivalent [1]

(ii) peak X is the –COOH groups [1]
peak Y is the $–CH_2$ groups [1]

(iii) the H in –COOH is next to O [1]
which is deshielding [1] [2]

(iv) the integration curve should be in the ratio 2:1 [1]
curve should start at the beginning and end of the signal [1] [2]

(v) TMS signal is at chemical shift 0.0 either a curve or line [1]

(b) (i) the base peak is the tallest peak in the spectrum [1]

(ii) 55 [1]

(iii) 45 is $COOH^+$ [1]
100 is $(CH_2CO)_2O^+$ [1]

(c) (i) $–[OCCH_2CH_2COOCH_2CH_2O]–$

or $–[OCH_2CH_2OOCCH_2CH_2CO]–$ [3]

(ii) condensation polymerisation [1]

(iii) (succinic acid will have unreacted) –COOH groups at the end of the chain [1]

(iv) because it is an ester [1]
and can be hydrolysed [1] [2]

(d) (i)

CH_2COOH | CH_2COOH → CH_2COONH_4 | CH_2COONH_4 → CH_2CONH_2 | CH_2CONH_2 [2]

(ii) phosphorus pentoxide [1]

(iii) $CH_2CH_2NH_2$ | $CH_2CH_2NH_2$ [2]

(e) (i) the ester is more volatile [1]
passes through the machine/column faster [1] [2]

(ii) one peak with 90% of the area within it [1]
other peak(s) with 10%/the rest of the area [1] [2] 28

In Q15 if the reaction is presumed to go from Mn^{2+} to MnO_4^- the answers are *reversed* in the mark scheme in parts **(a)** to **(d)**

		AVAILABLE MARKS
15 (a)	(the electrons flow in the external circuit in the opposite direction to the current hence they) flow from the negative electrode to the positive electrode in this case the +ve electrode is the manganate cell [2]	
(b)	a redox reaction is when the oxidation number of one element goes up and that of another one goes down in the same reaction [2]	
(c)	$5VO^{2+}(aq) + 5H_2O(l) \rightarrow 5VO_2^+(aq) + 10H^+(aq) + 5e^-$ [1]	
	$MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l)$ [1]	
	$5VO^{2+}(aq) + MnO_4^-(aq) + H_2O(l) \rightarrow Mn^{2+}(aq) + 2H^+(aq) + 5VO_2^+(aq)$ [1] [3]	
(d)	**(i)** from blue to yellow [2]	
	(ii) from pink to colourless [2]	
(e)	+1.51 – (+1.02) = 0.49 V [2]	
(f)	the salt bridge completes the circuit (no metal present) [1] the ions in the salt conduct the electricity [1] [2]	
(g)	hydrogen gas (bubbled) over a platinum electrode (covered with platinum black) [2] temperature 25 °C, $[H^+]$ 1 mol dm^{-3}, pressure 1 atm [2] [4]	19
	Section B	**100**
	Total	**120**