Rewarding Learning

ADVANCED
General Certificate of Education
2016

Chemistry

Assessment Unit A2 2

assessing

Analytical, Transition Metals, Electrochemistry and Further Organic Chemistry

[AC222]

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

Section B

AVAILABLE MARKS

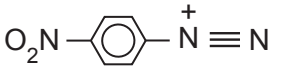
11 nitrogen/helium/inert gas (not gas on its own)
silica/alumina
R_f/retardation factor retention time/time
or retention factor [4] 4

12 **(a)** **(i)** $C_{12}H_9N_3O_4$ [1] 259 [1] [2]

(ii) number of moles of azo violet = 30/259 = 0.116
60% → 100% 0.116/60 × 100 = 0.193
(1:1) number of moles of 4-nitrophenylamine = 0.193
mass of 4-nitrophenylamine = 0.193 × 138 = 26.63 g (units needed) [3]

(b) **(i)** —N═N— circled [1]

(ii) extensive delocalisation (of electrons) and energy levels close together electrons excited/move to higher energy level
removes a colour from light [3]

(c)  (not $-[N \equiv N]^+$) [2]

(d) sodium nitrite [1]
hydrochloric acid [1]
<10 °C [1] 14

13 **(a)** Pt(s) or Platinum (solid)[1]
1 mol dm^{-3} H^+ [1]
1 mol dm^{-3} Cu^{2+} [1]
salt bridge [1] [4]

(b) blue to yellow/brown [2]

(c) **(i)** to neutralise (excess) HNO_3 [1]

(ii) $I_2 + 2S_2O_3^{2-} \rightarrow 2I^- + S_4O_6^{2-}$ [2]

(iii) starch [1] added when mixture is straw coloured [1] [2]

(iv) blue-black to colourless [1]

(v) number of moles of $S_2O_3^{2-}$ = (23.8 × 0.1)/1000 = 0.00238
(2:1) number of moles of I_2 in 25 cm^3 = 0.00119
number of moles of I_2 in 250 cm^3 = 0.0119
(1:2) number of moles of Cu^{2+} = 0.0238
mass of Cu = 0.0238 × 64* = 1.52 g
% Cu = (1.52/2) × 100 = 76.16%/76% [4] 16
*Note that 63.5 can be used instead of 64

14 **(a)** **(i)** green-blue [1]

(ii) $Cr(OH)_3/Cr(OH)_3(H_2O)_3/[(Cr(OH)_3(H_2O)_3]$ [1]

(b) green [1]

(c) **(i)** $[Cr(en)_3]^{3+}$ [1]

(ii) 6 [1]

(d) hydrogen peroxide, potassium hydroxide (solution), (glacial) ethanoic acid [3]

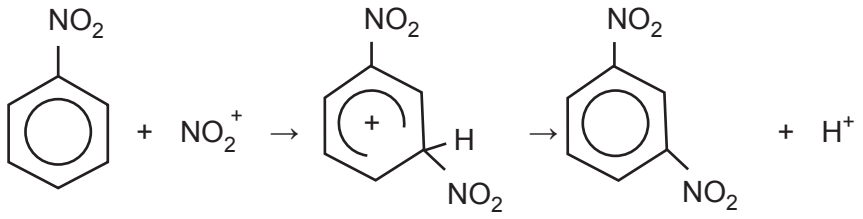
(e) **(i)** ethanol [1] <60 °C [1] sulfuric acid [1] [3]

(ii) $+6 \rightarrow +3$ [1] 12

15 **(a)** **(i)** concentrated sulfuric acid [1] concentrated nitric acid [1] [2]

(ii) nitronium ion [1]
$2H_2SO_4 + HNO_3 \rightarrow NO_2^+ + 2HSO_4^- + H_3O^+$ [1] [2]

(iii)



[3]

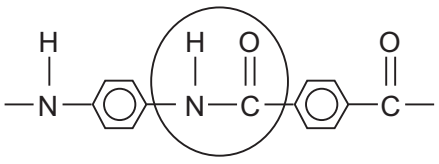
(iv) electrophilic [1] substitution [1] [2]

(b) **(i)** tin and concentrated hydrochloric acid [1] alkali/sodium hydroxide/ potassium hydroxide [1] [2]

(ii) both have a lone pair of electrons on the nitrogen [1] that can bond to a hydrogen ion [1] [2]

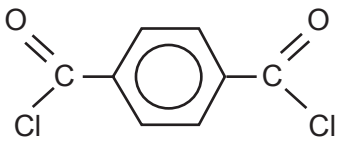
(iii) aromatic ring is electron withdrawing making the lone pair of electrons on nitrogen less available [1]

(c) **(i)**



[2]

(ii)



[1]

(iii) contains an amide group/–CONH– [1] that can be hydrolysed by the action of microorganisms/bacteria [1] [2] 19

AVAILABLE MARKS

16 (a) A ligand which uses six lone pairs to form six coordinate bonds with a central metal atom or ion in a complex [2]

(b) (i) 2 species → 7 species [1] increase in entropy [1] [2]

(ii) Select correct filter/appropriate wavelength [1]
Prepare a range of samples consisting of different volumes/concentrations of $Cu^{2+}(aq)$ and edta solution [1]
Record the absorbance of each sample [1]
Plot a graph of the results [1]
Peak on graph indicates the mixture that is in the correct ratio [1] [5]

Quality of written communication [2]

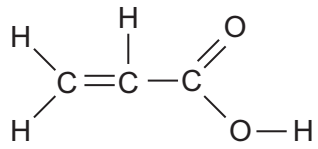
(c) (i) $CH_3COCH_3 \rightarrow CH_2{=}C{=}O + CH_4$ [1]

(ii) heterogeneous [1]
different phases [1] [2]

(iii) reactants adsorb onto the surface [1]
bonds weakened/broken in the reactants/orientation/closer together/lower activation energy [1]
bonds form in products (and products are desorbed from the surface) [1] [3]

AVAILABLE MARKS

17

				AVAILABLE MARKS
17	**(a)**	**(i)** 	[1]	
		(ii) $CH_2{=}CHCOONH_4$	[1]	
		(iii) ammonium propenoate	[1]	
	(b)	**(i)** P_4O_{10}/P_2O_5	[1]	
		(ii) dehydration/elimination	[1]	
		(iii) nmr spectrum of acrylamide has three peaks [1] nmr spectrum of acrylonitrile has two peaks [1] hence spectrum changes (completely) from 3 peaks to 2 peaks	[2]	
	(c)	hydrogen bonds [1] between lone pair of electrons on O of acrylamide and H of H_2O (or between lone pair of electrons on O of H_2O and H of NH_2) [1]	[2]	
	(d)	**(i)** orange solution decolourised	[1]	
		(ii) $CH_2CHCONH_2 + Br_2 \rightarrow CH_2BrCHBrCONH_2$	[1]	
	(e)	**(i)** base peak [1] molecular ion peak [1]	[2]	
		(ii) due to ^{13}C	[1]	
		(iii) $CONH_2^+$	[1]	
	(f)	$1.7 \times 10^{-4} \times 80 = 0.0136$ RMM of acrylamide = 3(12) + 5 + 14 + 16 = 71 mass = 0.0136 × 71 = 0.9656 g = 965.6 mg	[3]	18
			Section B	**100**
			Total	**120**