Rewarding Learning

ADVANCED
General Certificate of Education
2013

Chemistry

Assessment Unit A2 2

assessing

Analytical, Transition Metals, Electrochemistry and Further Organic Chemistry

[AC222]

TUESDAY 4 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.

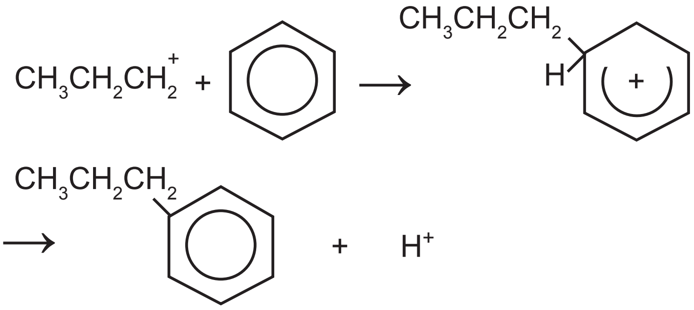
Section A

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

Section B

AVAILABLE MARKS

11 (a) (i) [3]



(ii) Zinc oxide is a catalyst [1]
Conditions are high temperature [1] and pressure [1] [3]
or finely divided catalyst or lack of air/oxygen

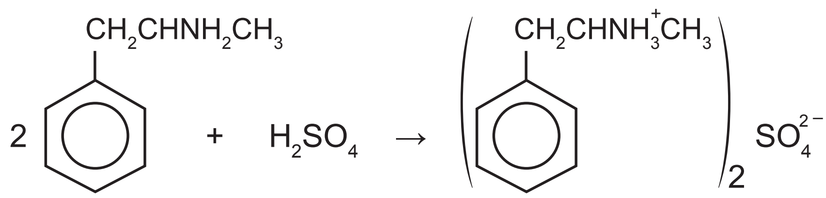
(iii) Hydrogen bromide [1]

(iv) Ammonia [1]

(b) (i) Primary amine [1]
NH_2 is attached to one carbon atom [1] [2]

(ii) It is stronger [1] because the lone pair on nitrogen is more readily available (compared to phenylamine) [1] [2]

(c) (i)



[2]

(ii) Ionic salt is (more) soluble (than benzedrine) [1]
or ionic salt is solid

(iii) Potassium/sodium hydroxide [1]
Aqueous/heat [1] [2]

(d) (i) Four different atoms/groups attached to a carbon atom [1]

(ii) One structure fits into the "enzyme" better than the other
i.e. by a lock and key mechanism [1]

(e) (Drugs injected into GLC equipment and) pass through at different speeds/retention times [1]
Each drug produces a distinct peak/retention time [1] [2] 21

AVAILABLE MARKS

12 **(a)** **(i)** iron(II) oxalate $Fe\begin{pmatrix}COO\\ |\\ COO\end{pmatrix}$ or $Fe(COO)_2$ or FeC_2O_4 [1]

iron(III) oxalate $Fe_2\begin{pmatrix}COO\\ |\\ COO\end{pmatrix}_3$ or $Fe_2(C_2O_4)_3$ [1]

(ii) iron(II) oxalate green [1]

iron(III) oxalate yellow/orange [1]

(iii) Green [1] precipitate [1] (of iron(II) hydroxide) [2]
Rust/brown [1] precipitate [1] (of iron(III) hydroxide) [2] [4]

(b) $Fe\begin{pmatrix}COO\\ |\\ COO\end{pmatrix} \rightarrow FeO + CO + CO_2$ [1]

(c) **(i)** $3MnO_4^- + 24H^+ + 5Fe(COO)_2 \rightarrow 3Mn^{2+} + 12H_2O + 5Fe^{3+} + 10CO_2$ [2]

(ii) $18.2\,cm^3$ of 0.002 M potassium manganate(VII) solution contains

$18.2 \times 10^{-3} \times 0.002$ mole of MnO_4^- $= 0.0364 \times 10^{-3}$ mol

$= 3.64 \times 10^{-5}$ mol

$3MnO_4^- = 5Fe(COO)_2 = 5Fe$

hence moles of Fe in $20\,cm^3$ $= \frac{5}{3} \times 3.64 \times 10^{-5}$ mol

$= 6.067 \times 10^{-5}$ mol

hence grams of Fe in $20\,cm^3$ $= 56 \times 6.067 \times 10^{-5}$ mol

$= 3.397 \times 10^{-3}$ g

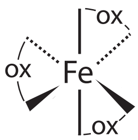
in $100\,cm^3$ of solution $= 5 \times 3.397 \times 10^{-3} = 0.017$ g

$= 17$ (mg) [4]

(d) **(i)** A central metal ion/atom, with ligands attached by coordinate bonds [2]

(ii) An ion or molecule ligand which uses two lone pairs of electrons to form two coordinate bonds with a central metal ion in a complex [2]

(iii)



$ox = \begin{matrix}COO^-\\ |\\ COO^-\end{matrix}$

[2]

(iv) It is not superimposable on its mirror image/rotates the plane of plane polarised light [2]

(e) edta replaces the oxalate ions [1]
there is an increase in entropy [1] [2]

25

AVAILABLE MARKS

13 (a) (i) $CH_3CH_2COOH + NH_3 \rightarrow CH_3CH_2COONH_4$ [1]

(ii) $CH_3CH_2COONH_4 \rightarrow CH_3CH_2CONH_2 + H_2O$ [1]

(b) (i) It only produces one signal (for the methyl groups) [1]
which is out of the region for most proton spectra [1] [2]

(ii) The proton is next to a methylene/CH_2 group [1]

(iii) The proton is next to a methyl/CH_3 group [1]

(iv) The protons are next to nitrogen which is deshielding/withdraws electrons [1]

(v) An extra peak [1]
which would be below the quartet [1]
The integration would show 3:2:1:3 [1]
Some/all the peaks would change their chemical shift [1]
To a maximum of [3] [3]

(c) (i) 29 $C_2H_5^+$ [1]
44 $CONH_2^+$ [1]

(ii) (A positively charged ion produced when) the molecular ion [1]
breaks apart [1] [2]

(iii) Base peak = 44 [1]

(d) (i) $CH_3CH_2CONH_2 + NaOH \rightarrow CH_3CH_2COONa + NH_3$ [2]

(ii) The hydroxide ion is attracted to the $\delta+$ of the carbonyl group [1]

(e) (i) $HOOC(CH_2)_4COOH + NH_2(CH_2)_6NH_2 \rightarrow –OC(CH_2)_4CONH(CH_2)_6NH– + H_2O$ [3]

(ii) e.g. ropes/brushes/clothes [2]

(iii) Nylon is a polyamide/amide
hence can be hydrolysed (to form the original molecules)
Polythene cannot be hydrolysed (as it contains carbon–carbon bonds)
hence it is either dumped
or burned
To a maximum of [4] [4]

Quality of written communication [2] 29

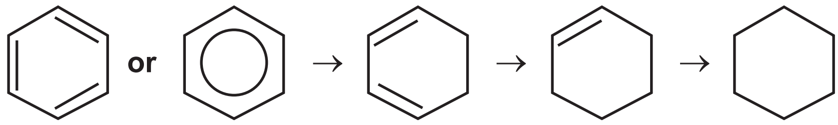
AVAILABLE MARKS

14 **(a)** CH [1]

(b) (Hexagonal and) planar/flat [1]

(c) **(i)** $C_6H_6 + 3H_2 \rightarrow C_6H_{12}$ [1]

(ii) No need for the presence of hydrogen



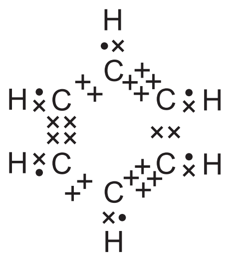
[2]

(iii) Adsorption on the surface/formation of bonds [1]
Orientation of molecules/d-orbitals involved [1]
Bonds weakened within reactants/bonds formed in products [1] [3]

(d) **(i)** –360 kJ [1]

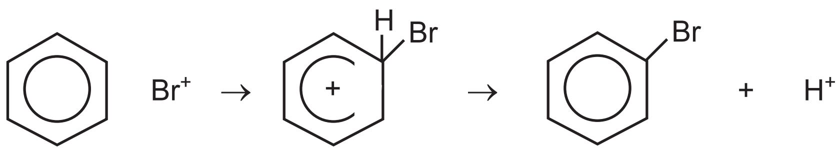
(ii) Benzene is more stable/the bonds are delocalised/the bonds are not real double bonds [1]

(e)



[3]

(f) **(i)**



[3]

(ii) $CH_2{=}CH_2 + Br^+ \rightarrow \overset{+}{C}H_2{-}CH_2Br \xrightarrow{Br^-} CH_2Br{-}CH_2Br$

[3]

(iii) The double bonds in the benzene molecules are stable/delocalised [1]
electrons in the ethene double bond are more readily available [1] [2]

(g) Pentacene has an extensively delocalised electron system [1]
The energy levels are close together [1]
Less energy is needed to raise the electrons to a higher level [1]
Energy is thus in the visible region [1]
Colours other than red are absorbed (by pentacene) [1]
To a maximum of [4] [4] 25

Section B 100

Total 120