Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2023

Chemistry

Assessment Unit AS 1

assessing

Basic Concepts in Physical and Inorganic Chemistry

[SCH14]

TUESDAY 16 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 B

2 D

3 D

4 A

5 B

6 C

7 B

8 D

9 B

10 B

[1] for each correct answer

10

Section B

AVAILABLE MARKS

11 **(a)** **(i)** protons = 12
neutrons = 14
electrons = 12 [1]

(ii) $1s^2\ 2s^2\ 2p^6\ 3s^2$ [1]

(b) **(i)** the mass of an atom of an isotope of an element relative to one-twelfth of the mass of an atom of carbon-12 [2]

(ii) RAM = $\dfrac{(79.0 \times 23.985) + (10.0 \times 24.986) + (11.0 \times 25.983)}{100}$ = 24.3 [2]

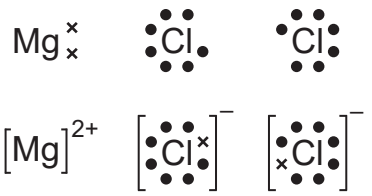
(c) **(i)** the energy required to convert one mole of gaseous ions with a double positive charge into gaseous ions with a triple positive charge [2]

(ii) $Mg^{2+}(g) \rightarrow Mg^{3+}(g) + e^-$ [1]

(iii) 3s ☐
2p ↿⇂ ↿⇂ ↿⇂
2s ↿⇂
1s ↿⇂ [1] for arrows [1] for label [2]

(iv) third electron is closer to the nucleus [1]
third electron is less shielded by inner electrons [1]
third electron removed from a filled subshell [1]
greater ratio of protons to electrons [1] any [3]

(d) **(i)** oxidation: $Mg \rightarrow Mg^{2+} + 2e^-$ [1]
reduction $Cl_2 + 2e^- \rightarrow 2Cl^-$ [1] [2]

(ii) 

[2]

18

12 **(a)** sulfate(VI) [1]

(b) **(i)** $NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$ [1]

(ii) apply a glass rod dipped in concentrated ammonia solution [1]
white smoke [1] [2]

(c) $2HBr + H_2SO_4 \rightarrow Br_2 + SO_2 + 2H_2O$ [2]

(d) **(i)** electron donor [1]

(ii) outer electron in iodide is further from nucleus/outer electron in iodide is more shielded [1]

(e) **(i)** SO_2: +4
S 0
H_2S –2 [2]

(ii) smell of rotten eggs [1]

(iii) yellow solid [1]

(iv) $SO_4^{2-} + 10H^+ + 8e^- \rightarrow H_2S + 4H_2O$ [2]

(v) $2I^- \rightarrow I_2 + 2e^-$ [1]

(vi) $SO_4^{2-} + 10H^+ + 8I^- \rightarrow H_2S + 4H_2O + 4I_2$ [1] 16

AVAILABLE MARKS

AVAILABLE MARKS

13 (a) indicative content:

Graphite:

- covalent bonding
- giant covalent structure
- layer structure with weak van der Waals' forces between layers
- high melting point due to substantial energy required to break strong covalent bonds

Oxygen:

- covalent bonding
- molecular covalent structure
- low melting point due to little energy required to break weak van der Waals' forces between molecules

Band	Response	Mark
A	Candidates must use appropriate specialist terms including a minimum of 6 points of indicative content. They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
B	Candidates must use appropriate specialist terms to explain the trend using a minimum of 4 points of indicative content. They must use satisfactory spelling, punctuation and grammar and the form and style are of a good standard.	[3]–[4]
C	Candidates explain partially the trend using a minimum of 2 points of indicative content. They use limited correct 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) (i) $3C + 2O_3 \rightarrow 3CO_2$ [1]

(ii) limewater changes (from colourless) to milky [1]

(iii) symmetrical/linear [1]
dipoles cancel/equally polar bonds cancel [1] [2]

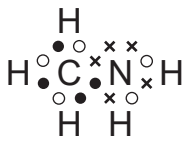
(c) (i) does not conduct electricity when solid but does when molten [1]

(ii) $2KOH + CO_2 \rightarrow K_2CO_3 + H_2O$ [1]

(iii) dip nichrome wire into concentrated hydrochloric acid [1]
dip wire into the test solid and hold in a blue Bunsen burner flame [1]
lilac colour indicates presence of potassium ions [1] [3]

15

14 (a) (i)



[1]

(ii) H—C—H bond angle = 109.5° [1]

(iii) pyramidal [1]
three bonding pairs of electrons and one lone pair of electrons [1]
lone pair repels more than bonding pairs/lone pair-bonding pair repulsion greater than bonding pair-bonding pair repulsion [1] [3]

(b) (i) the extent to which an atom attracts the bonding electrons in a covalent bond [1]

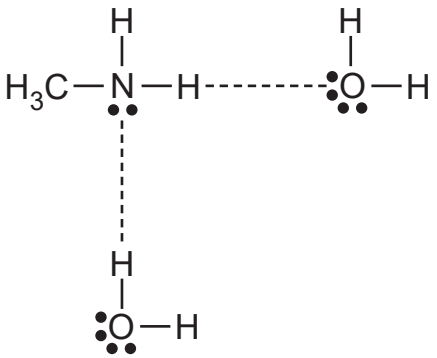
(ii) $N^{\delta-}—H^{\delta+}$ [1]

(iii) methylamine [1]
permanent dipole-dipole attractions/hydrogen bonding between methylamine molecules which are much stronger than van der Waals' forces [1]
van der Waals' forces only between ethane molecules [1] [3]

(c) (i) $2CH_3NH_2 + H_2SO_4 \rightarrow (CH_3NH_3)_2SO_4$ [2]

(ii) co-ordinate bond [1]
shared pair of electrons, both electrons from N [1] [2]

(iii)



[2]

16

AVAILABLE MARKS

15 (a) (i) $Mg^{2+}(aq) + 2OH^{-}(aq) \rightarrow Mg(OH)_2(s)$ [2]

(ii) moles of NaOH = 0.0175
moles of $MgCl_2$ = 0.0125
limiting reactant = NaOH
moles of $Mg(OH)_2$ formed = 0.00875
mass of $Mg(OH)_2$ = 0.508 g [4]

(b) (i)

	Rough	**Accurate 1**	**Accurate 2**
Initial burette reading/cm^3	1.5	**23.4**	24.9
Final burette reading/cm^3	23.4	44.5	**46.2**
Titre/cm^3	**21.9**	**21.1**	21.3

[1] per column [3]

(ii) moles of NaOH = $\frac{21.2 \times 0.18}{1000} = 3.816 \times 10^{-3}$

moles of H_2SO_4 = $\frac{3.816 \times 10^{-3}}{2} = 1.908 \times 10^{-3}$

concentration of $H_2SO_4 = 1.908 \times 10^{-3} \times 40 = 0.07632$ mol dm^{-3}
concentration of $H_2SO_4 = 0.07632 \times 98 = 7.5$ g dm^{-3} (2sf) [4]

(iii) phenolphthalein/methyl orange [1]
colourless to pink/red to yellow [1] [2]

	AVAILABLE MARKS
	15
Section A	**10**
Section B	**80**
Total	**90**