higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

CHEMISTRY N4

19 November 2024

This marking guideline consists of 6 pages.

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QUESTION 1: CHEMICAL BONDING

1.1 1.1.1 True
1.1.2 False
1.1.3 True
1.1.4 True
1.1.5 False

(5 × 1) (5)

1.2 1.2.1 E
1.2.2 D
1.2.3 B
1.2.4 A
1.2.5 C

(5 × 1) (5)

1.3 1.3.1
- Large difference in electronegativity of groups 1A; 2A and 6B;7B.
- Transfer of electrons takes place leading to formation of stable ions with electronic configuration similar to that of an inert gas. (2)

1.3.2 $Ca(2.8.8.2)\ \surd + O(2.6)\ \surd \rightarrow Ca^{2+}\ (2.8.8)\ \checkmark + O^{2-}\ (2.8)\ \checkmark$

OR

$Ca\surd + ½\ O_2\surd \rightarrow Ca^{2+}\checkmark O^{2-}\checkmark$ (3)

1.4 1.4.1 Electronegativity is a measure of the power of an atom✓ to attract electrons.✓

OR

Arithmetic mean✓ of the first ionization energy and the electron affinity of an atom.✓ (2)

1.4.2 Electronegativity decreases down a particular group.✓
This is because the atom becomes larger and the inner electron shells decrease the attraction between the positive nucleus and peripheral electrons. ✓ (2)

1.4.3 Covalent bond (1)

1.5 A hydrogen bond is an electrostatic force of attraction√ between a hydrogen atom which is covalently bound to a more electronegative atom.√

Hydrogen bonding generally only occurs between hydrogen√ and electronegative elements, fluorine, oxygen and nitrogen.√

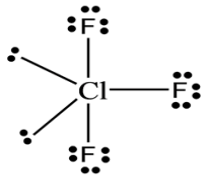
The electronegative atoms of these elements strongly attract the electron pair constituting the bond with the hydrogen,√ and consequently the hydrogen atom carries a net positive charge.√

The hydrogen atom attracts the negative end √of the other molecule.√ (4)
[24]

QUESTION 2: CHEMICAL GEOMETRY

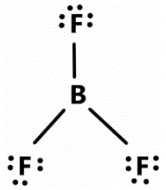
2.1 The radius of Na^+ is larger than that of Mg^{2+}.✓ The two cations have the same number of electrons. The radii of isoelectronic positive ions decrease with increasing charge.✓ (2)

2.2 2.2.1 ✓✓



The trigonal bipyramidal shape.
Chlorine trifluoride has ten valency electrons.✓ (3)

2.2.2 ✓✓



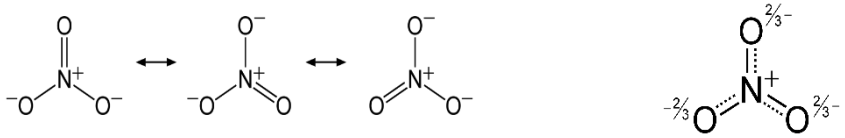
The trigonal planar shape.
Boron trifluoride has six valency electrons.✓ (3)

2.3 2.3.1 An allotrope means each of the two or more different physical forms✓ in which an element can exist.✓ (2)

2.3.2 Graphite (1)

2.3.3 Diamond contains a three-dimensional array of carbon atoms✓ with the valency bonds directed towards the apices of a regular tetrahedron.✓ The bonding is strong and extended in three dimensions.✓ (3)

2.4 ✓ ✓ ✓ ✓



Three resonance structures Hybrid resonance structure (4)

[18]

QUESTION 3: ACIDS AND BASES

3.1 3.1.1 According to the Arrhenius theory, an acid is a substance which contains hydrogen,✓ and gives hydrogen ions in an aqueous solution✓

3.1.2 The Bronsted-Lowry theory defines an acid as a substance existing as a molecule or an ion✓ that can donate protons.✓

(2 × 2) (4)

3.2 3.2.1 $HCl + CH_3COOH \leftrightarrow Cl^- + CH_3COOH^{2+}$
a_1 √ b_2 √ b1 √ a2 √

3.2.2 $K_a = \frac{[CH_3COOH_2^+][Cl^-]}{[HCl]\,[CH_3COOH]}$ √√ ✓

3.2.3 Hydrogen chloride is not such a strong acid in pure ethanoic acid,√ because ethanoic acid is not such a good proton acceptor as water.√ The Ka value will be small indicating that the equilibrium does not go much to the right.✓

(3 × 2) (6)

3.3 NH_3 is the Lewis base in the reaction.✓ It provides a pair of electrons for sharing in bond formation.✓ (2)

[12]

QUESTION 4: HYDROGEN

4.1 4.1.1 Accept a lone pair of electrons.
4.1.2 Gain an additional electron.
4.1.3 Sharing of electrons.

(3 × 1) (3)

4.2
- Odourless gas without taste or smell.
- Can be liquefied under compression and cooling. (2)

4.3 $Zn(s)√ + 2H^+(aq)√ \rightarrow Zn^{2+}(aq)$ ✓ $+ H_2(g)$✓

OR

$Zn(s)$ √ $+ 2HCl(aq)√ \rightarrow ZnCl_2(aq)$✓ $+ H_2(g)$✓ (3)

4.4 4.4.1 $TiH_{1.73}$✓
$ZrH_{1.92}$✓ (Any 1 × 1)

4.4.2 CH_4✓
NH_3✓
H_2S✓
HCl✓ (Any 1 × 1)

4.4.3 Na^+H^-✓
$Ca^{2+}(H^-)_2$✓ (Any 1 × 1)
(3 × 1) (3)
[11]

QUESTION 5: CARBON

5.1
- Charcoal
- Coke
- Animal charcoal
- Carbon black (Any 3 × 1) (3)

5.2 5.2.1 $H_2C=CH_2 + H_2 \rightarrow H_3C\text{-}CH_3$ ✓ (1)
5.2.2 $C + 4HNO_3 \rightarrow 2H_2O(l)$✓ + $4NO_2(g)$✓ + $CO_2(g)$✓ (3)

5.3 5.3.1 Ionic carbide
5.3.2 Interstitial carbide
5.3.3 Covalent carbide
(3 × 1) (3)
[10]

QUESTION 6: NITROGEN

6.1
- Used in agriculture as a fertilizer.
- Used in the manufacture of plastics, explosives and other chemicals.
- Used as a refrigerant. (Any 1 × 1) (1)

6.2 6.2.1 $NH_3(g) + H_2O(l) \leftrightarrow NH_4^+(aq)$ ✓+ $OH^-(aq)$.✓ (2)

6.2.2 $K_b = \frac{[NH_4^+][OH^-]}{[NH_3]}$ ✓✓✓ (3)

6.2.3 The aqueous solution of ammonia indicates ammonia as a weak alkali. ✓This is indicated by the low value of the dissociation constant (K_b) ✓ (2)

6.3 $2NH_3(g)\surd + 3CuO(s)\surd \rightarrow N_2(g)$✓ +3 $H_2O(l)$✓ + 3Cu(s)✓ (4)
[12]

QUESTION 7: OXYGEN

7.1 7.1.1 A slow dry stream of oxygen✓ is passed through a silent electric discharge✓ and up to 10 percent conversion to ozone occurs.

7.1.2 The ozone layer protects the earth's surface✓ from an excessive concentration of ultraviolet radiation.✓

(2 × 2) (4)

7.2 7.2.1 E
7.2.2 G
7.2.3 F
7.2.4 A
7.2.5 B

(5 × 1) (5)

7.3 Temporary hardness in water exists when the water contains carbonates✓ of calcium and magnesium.✓
Permanent hardness in water exists when the water contains sulphates✓ of calcium and magnesium.✓ (4)

[13]

TOTAL: 100

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