higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

CHEMISTRY N4

15 November 2022

This marking guideline consists of 6 pages.

Copyright reserved

QUESTION 1: CHEMICAL BONDING

1.1 1.1.1 True
1.1.2 True
1.1.3 False
1.1.4 False
1.1.5 False

(5 × 1) (5)

1.2 1.2.1
- $Na(s) \rightarrow Na(g)$
- $Na(g) \rightarrow Na^+(g) + e^-$
- $\frac{1}{2} Cl_2 \rightarrow Cl(g)$
- $Cl(g) + e^- \rightarrow Cl^-$
- $Na^+(g) + Cl^-(g) \rightarrow Na^+Cl^-$ (5)

OR

- $\frac{1}{2} Cl_2 \rightarrow Cl(g)$
- $Cl(g) + e^- \rightarrow Cl^-$
- $Na(s) \rightarrow Na(g)$
- $Na(g) \rightarrow Na^+(g) + e^-$
- $Na^+(g) + Cl^-(g) \rightarrow Na^+Cl^-$

1.2.2
- Ionisation energy
- Electron affinity
- Lattice energy (3)

1.2.3 Structure:
- Electrovalent compounds exist as high melting point brittle solids, with a symmetrical arrangement of ions within a crystal.
- Covalent compounds contain bonds which have directional properties and the molecules have a definite shape.

Conduction of electricity:
- Electrovalent compounds are electrolytes when fused or in solution.
- Covalent compounds are generally non-electrolytes. However, some conduct if dissolved in polar solvents.

(2 × 2) (4)

1.2.4
- Electronegativity is the measure of the power of an atom to attract electrons.

OR

- Electronegativity is the arithmetical mean of the first ionization energy and the electron affinity of an atom.

(Any ONE of the above) (2)

1.3 1.3.1
- Be ($1s^2 2s^2$); – ground state
- Be($1s^2 2s^1 2p^1$) – valency state
- Cl($1s^2 2s^2 2p^6 3s^2 3p^5$) – valency state (3)

1.3.2 No, the beryllium chloride compound does not conform to the octet rule✓ as it has only four electrons in its valency shell and not eight.✓ (2)

1.3.3 Van der Waals forces. (1)

[25]

QUESTION 2: CHEMICAL GEOMETRY

2.1 2.1.1 Increase (1)

2.1.2 The number of electronic shells increases✓ and the increase in nuclear charge is insufficient to counteract this expansion.✓ (2)

2.1.3 Be^{2+} (1)

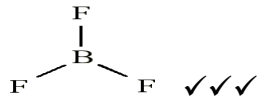
2.2 2.2.1 Boron trifluoride. (1)

2.2.2
- The arrangement in space of the covalent bonds in multi covalent atoms✓ are very simply related to the number of electrons in their valency shells.✓
- Electron pairs would arrange themselves so as to be as far apart as possible because of their mutual repulsion.✓ (3)

2.2.3 Three (1)

2.2.4 Triangular planar (1)

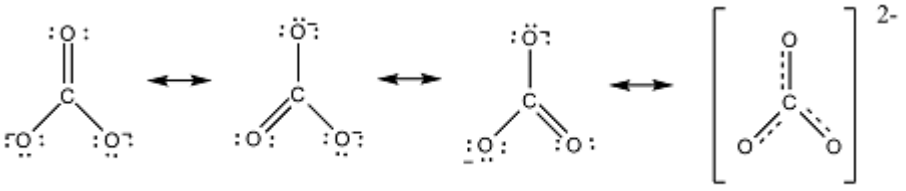
2.2.5 120° (1)

2.2.6 

✓✓✓ (3)

2.3 2.3.1 Linear
2.3.2 Tetrahedron
2.3.3 Trigonal bipyramid
2.3.4 Octahedron
2.3.5 Pentagonal bipyramid
(5 × 1) (5)

2.4 Lewis structure representation with the same√ placement of atoms, but different√ arrangement of single and double bonds.



Resonance Hybrid ✓✓✓ (4)

2.5 It increase the stability of the compound in which it occurs. (2)
[25]

QUESTION 3: ACIDS AND BASES

3.1 3.1.1 An Arrhenius base is a substance that produces hydroxyl ions when dissolved in water.

3.1.2 A Bronsted-Lowry acid is a substance existing as a molecule or ion that can donate protons (proton donor).

3.1.3 A Lewis base is a substance that can donate a pair of electrons.
(3 × 1) (3)

3.2 3.2.1 $CH_3COOH\ (aq) + H_2O\ (l) \leftrightarrow CH_3COO^-\ (aq) + H_3O^+\ (aq)$ (2)

3.2.2
- $CH_3COOH\ (aq)/CH_3COO^-\ (aq)$: conjugate acid/base pair
- $H_3O^+\ (aq)/H_2O\ (l)$: conjugate acid/base pair (2)

3.3 3.3.1 H_2SO_4 is the stronger acid.

3.3.2 The effect of an extra oxygen atom has a pronounced effect on the acidity of the molecule.

3.3.3 Oxoacids
(3 × 1) (3)
[10]

QUESTION 4: HYDROGEN

4.1 4.1.1 $^1_1H \rightarrow {}^4_2He + 2\ (^0_{+1}e)$ (energy released) and $(^0_{+1}e)$ is a positron.

4.1.2 Ethyne/Acetylene
(2 × 2) (4)

4.2 4.2.1 Ionic hydride
4.2.2 Covalent hydride
4.2.3 Interstitial hydride
(3 × 1) (3)

4.3 Tritium (1)

4.4
- Manufacture of ammonia by the Haber process
- Manufacture of hydrogen chloride and hydrochloric acid
- Manufacture of organic chemicals e.g. methanol (CH3OH)
- Manufacture of margarine
- Extraction of some metals from their oxides
- Liquid hydrogen has been used as a rocket fuel (Any 2 × 1) (2)

[10]

QUESTION 5: CARBON

5.1 5.1.1
- Diamond
- Graphite (2)

5.1.2
- A lubricant either as a powder or as a dispersion
- When mixed with clay it is used in lead pencils
- Used as anode material in electrolytic processes
- Used to make crucibles (Any 2 × 1) (2)

5.2 $Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(s) + 3CO_2(g)$ (2)

5.3 Interstitial carbides are formed by many transitional metals where carbon atoms occupy the space within the crystal.✓ They have high melting points and are conductors of electricity,✓ e.g. Fe_3C;Ni_3C: CO_3C✓ (Any example) (3)

5.4
- Manufacture of hydrogen (H_2) (g)
- Manufacture of methanol (CH_3OH) (l)
- Manufacture of higher alcohols ($CH_3CH_2CH_2CH_2OH$) (l)
- Manufacture of ethanoic acid (CH_3COOH) (l) (Any ONE) (1)

[10]

QUESTION 6: NITROGEN

6.1 $2\ NH_3\ (g) + 3\ CuO(s) \rightarrow N_2(g) + 3\ H_2O(l) + 3\ Cu(s)$ (3)

6.2 Haber process (1)

6.3 The low K_b value means that an aqueous solution of ammonia is a weak alkali. (1)

6.4 Dinitrogen trioxide (N_2O_3). (1)

6.5
- Manufacture of nitrogenous fertilisers
- Production of explosives
- Manufacture of dyes (Any 2 × 1) (2)

6.6 Aqua regia is a solution of 3 volumes of concentrated hydrochloric acid and 1 volume of concentrated nitric acid.✓ It is used to dissolve gold and platinum which are resistant to attacks by nitric acid.✓ (2)
[10]

QUESTION 7: OXYGEN

7.1 Oxygen is obtained from the atmosphere by first removing carbon dioxide and water vapour.✓ The remaining gases are then liquefied and fractionally distilled to give oxygen and nitrogen.✓ (2)

7.2 $NO + O_3 \rightarrow NO_2 + O_2$ (2)

7.3 Suboxide: C_3O_2 (O=C=C=C=O)
Mixed oxide: Pb_3O_4($2PbO:PbO_2$); Fe_3O_4(Fe_2O_3:FeO) (2)

7.4 Permanent hardness in water is introduced when water passes over rocks containing the sulphates✓ calcium and magnesium.✓ (2)

7.5 $Ba^{2+}\ (O\text{-}O)^{2-}(s) + (H^+)_2SO_4^{2-}\ (aq) \rightarrow Ba^{2+}SO_4^{2-}\ (s) + H_2O_2(aq)$ (2)
[10]

TOTAL: 100

Copyright reserved