higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

CHEMISTRY N4

21 November 2023

This marking guideline consists of 6 pages.

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QUESTION 1

1.1 1.1.1 False✓ − electrovalent compounds exist as hard crystals√ with high melting points and ions of opposite charge arranged in a symmetrical array.√

1.1.2 True✓ − the electrons are not equally shared;√ the electron pair constituting the single covalent bond is displaced towards the atom with the greater electron affinity.√

1.1.3 True✓ − since it is easy to visualise the atoms altering their positions,√ as though they had slipped over each other, when subjected to stress or strain.√

1.1.4 False✓ − a bond formed between two atoms of similar electronegativity will be essentially covalent.✓

1.1.5 False✓ − the liquefaction and eventual solidification of noble gases is explained by postulating so-called Van der Waal forces.✓

(5 × 2) (10)

1.2 1.2.1 E
1.2.2 A
1.2.3 B
1.2.4 C
1.2.5 D

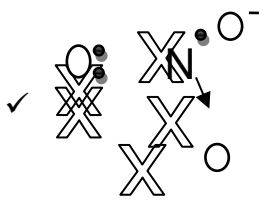
(5 × 1) (5)

1.3 Electrovalent compounds exist as high melting-point, brittle solids✓ in which a symmetrical arrangement of ions within the crystal is apparent.✓
The arrangement of the ions within the crystal is determined by the magnitude of their charges and their relative sizes.✓

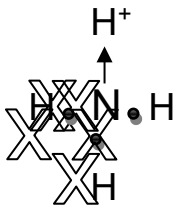
Covalent compounds contain bonds which have directional properties,✓ and the overall molecule has a definite shape.✓
Van der Waal's forces are responsible for the small intermolecular attractions.✓

(Any 2 × 2) (4)

1.4 1.4.1



✓✓ The octet rule is obeyed.

1.4.2 

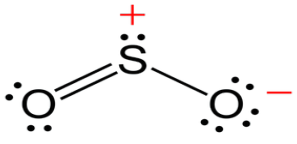
✓ ✓ The octet rule is obeyed. ✓

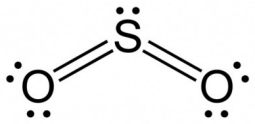
(2 × 3) (6)
[25]

QUESTION 2

2.1 2.1.1 Li^+ has a greater radius.✓ The radii of isoelectronic positive ions decrease with increasing charge.✓ (2)

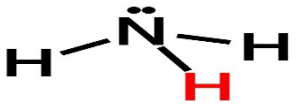
2.1.2 Iso-electropositive ions are cations with the same number of valence electrons. (1)

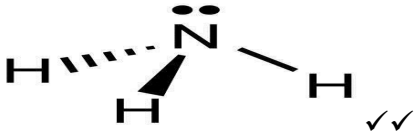
2.2 2.2.1 

✓ ✓ **OR** 

✓✓

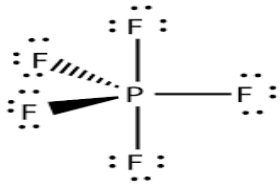
Triangular planar structure✓

2.2.2 

✓✓ **OR** 

✓✓

Tetrahedral structure✓

2.2.3 

✓✓

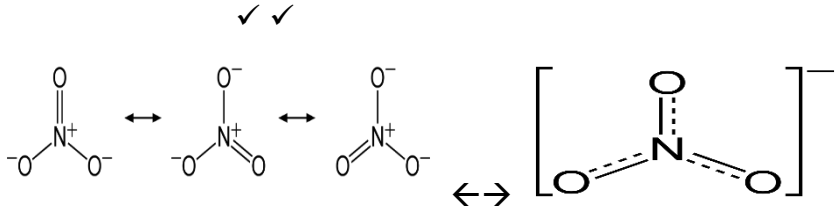
Trigonal bi pyramidal structure✓

(3 × 3) (9)

2.3 Lone pairs repel each other as well as other bonds in their vicinity√ and lead to the closing of the bond angle.√ The greater the number of lone pairs the smaller the bond angle.√
NH_2^- has two lone pairs,√ NH_3 has one lone pair√ and NH_4^+has no lone pairs.√ (3)

2.4
- Resonance is the equivalence of all three bonds in the anion✓
- Each structure contributes equally✓
- The bond length will be a hybrid of the limiting structures✓

OR



(3)
[18]

QUESTION 3

3.1 Substances which contain hydrogen ions and give hydrogen ions in aqueous solution are acids.✓ Bases are substances which produce hydroxyl ions when dissolved in water.✓ (2)

3.2 3.2.1 $K_a = \frac{[H_3O^+][NO_3^-]}{[HNO_3]}$ √√✓ (2)

3.2.2 The calculated K_a value will be high✓ because nitric acid is a strong acid.✓ (2)

3.2.3 $HNO_3(aq) + H_2O(l) \leftrightarrow H_3O^+(aq) + NO_3^-(aq)$
a_1 √ b_2 √ a_2 √ b_1 √

OR

HNO_3√ : NO_3^-√ and H_3O^+√ : H_2O√ (2)

3.2.4 Nitric acid is acting as a proton donor. (1)

3.3 3.3.1 An acid is a substance which can accept a pair of electrons,✓ and a base is a substance which can donate a pair of electrons.✓

3.3.2 BF_3 is a Lewis acid✓ because it accepts a pair of electrons.✓
(2 × 2) (4)
[13]

QUESTION 4

4.1
- Action of water on metals
- Action of diluted acids on metals
- Action of strong alkalis on zinc and aluminium (3)

4.2 4.2.1 $2Al(s) + 2OH^-(aq) + 6H_2O(l) \rightarrow 2Al(OH)_4^-(aq)$✓ + $3H_2(g)$✓ (2)

4.2.2 $H_2(g) + S(l) \leftarrow \rightarrow H_2S(g)$ (1)

4.2.3 $WO_3(s) + 3H_2(g) \rightarrow W(s)$ ✓+ $3H_2O(l)$ ✓ (2)

4.3
- Ordinary hydrogen (1)
- Deuterium (2)
- Tritium (3) (3)

[11]

QUESTION 5

5.1 Diamond✓ and graphite✓ (2)

5.2
- In oilwell drills
- An abrasive for sharpening very hard tools
- In dies for the manufacture of tungsten filaments for electric light bulbs (3)

5.3 5.3.1 $CS_2(l) + 3Cl_2(g) \rightarrow CCl_4(l)$ ✓ + $S_2Cl_2(l)$ ✓

5.3.2
- As a solvent
- As a fire extinguisher

(2 × 2) (4)

[9]

QUESTION 6

6.1
- Provide an inert atmosphere when handling easily oxidisable chemicals
- A carrier gas in vapour phase chromatography
- Production of chemical compounds (Any 2 × 1) (2)

6.2 6.2.1 $N_2(g) + 3H_2(g) \leftarrow \rightarrow 2NH_3(g)$ (2)

6.2.2 Haber process (1)

6.3
- Nitrous acid (HNO_2)
- Nitric acid (HNO_3) (2)

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6.4 6.4.1 Covalent

6.4.2 Ionic

6.4.3 Interstitial

(3 × 1) (3)
[10]

QUESTION 7

7.1
- Oxygen is obtained from the atmosphere by first removing carbon dioxide and water vapour
- Liquefaction of the remaining gasses
- Fractional distillation to deliver oxygen and nitrogen (3)

7.2 A slow dry stream of oxygen✓ is passed through a silent electric discharge✓ and up to 10 per cent conversion to ozone occurs. (2)

7.3 This might slowly deplete the concentration of the ozone layer in the upper atmosphere.✓ The ozone layer protects the earth from ultraviolet radiation.✓ (2)

7.4
- Very basic oxides
- Moderately basic oxides
- Amphoteric oxides
- Acid oxides
- Neutral oxides (Any ONE) (1)

7.5 7.5.1 Temporary hardness in water exists when the water contains carbonates✓ of calcium and magnesium.✓

7.5.2
- Temporary hardness in water is removed by boiling,✓ and as the hydrogen carbonate decomposes readily and the insoluble carbonate is precipitated.
- Addition of slaked lime✓ (Clark's process).

(2 × 2) (4)

7.6
- Distillation
- Use of ion exchange resins (2)

[14]

TOTAL: 100

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