



## Questions ON Comparative Study OF S AND P Blocks

comparative study of s and p blocks (Kenyatta University)

Answer questions one and any other two questions.

QUESTION ONE - (30 MARKS)

a) Hydrogen has a very rich chemistry, despite its simplicity. Discuss the following;

(i) Isotopes of hydrogen (3 Marks)

There are three isotopes of hydrogen that is: Hydrogen (Protium), Hydrogen (Deuterium), Hydrogen (Tritium)

(ii) Industrial preparation of hydrogen (3 Marks)

There are ways of Hydrogen production :Catalytic steam\_ Hydrocarbon process where hydrocarbons are treated at high pressure with high steam over nickel catalyst

Non\_ catalytic partial oxidation of hydrocarbons under elevated pressure

(iii) Uses of hydrogen (3 Marks)

- It is used in the catalytic hydrogenation of Organic compounds
- Used as a primary Rocket fuel for combustion with Oxygen
- Direct reduction of Iron ores to metallic Iron
- Manufacture of Ammonia in the Haber-borsch process
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b) Account for the decrease in first ionization energy between phosphorous (P) and sulphur (S).

The 3p electrons in Sulphur are paired, Sulphur has more electron repulsion in those orbital than Phosphorous does so it takes less energy to remove an electron from Sulphur

(2 Marks)

c) Cyanide ion ( $\text{CN}^-$ ) and carbon monoxide (CO) are isoelectronic and both are poisonous; — (i) Define the term isoelectronic (1 Mark)

It refers to two or more elements that have the same number of valence electrons and same structure but differ in the number of elements involved

(ii) Explain their toxicity (3 Marks)

Carbon monoxide **binds to hemoglobin so strongly**, you can be poisoned by carbon monoxide even at very low concentrations if you are exposed for a long period of time. While CO is less dense than air; so it will rise. Cyanide prevents the cells of the body from using oxygen. When this happens, the cells die. Cyanide is more harmful to the heart and brain than to other organs because the heart and brain use a lot of oxygen.

(iii) State their differences in coordination chemistry (2 Marks)

Virtually the same mechanism: ligand to metal sigma bond and metal to ligand pi back bonding.

These 2 ligands mainly differ by 1 proton.

CO forms a weaker sigma bond but a strong pi bond with metal because of the additional proton.

d) State three anomalous behavior of Boron (B) compared to the other elements in group III A. (4 Marks) Boron forms mostly covalent bonds, while the other elements in Group 3A form mostly **ionic bonds**. The Group 3A metals have three valence electrons in their highest-energy orbitals ( $ns^2p^1$ ). They have higher ionization energies than the Group 1A and 2A elements, and are ionized to form a 3+ charges.

e)  $CCl_4$  is unreactive to water, while  $SiCl_4$  is rapidly hydrolyzed.

$CCl_4$  doesnot undergo hydrolysis by **water** because the carbon atom is small and is shielded by larger chlorine atoms. ... In  $SiCl_4$ , the silicon atom is larger than the carbon atom and also has available 3d atomic orbitals for bonding, thus hydrolysis is possible.

Explain. (4 Marks) Meru University of Science & Technology is ISO 9001:2015 Certified Foundation of Innovations Page 2 f)  $Li_2CO_3$  is used in medicine as therapeutic drug.

It is used to **bipolar disorder**. It works to stabilize the mood and reduce extremes in behavior by restoring the balance of certain natural substances in the brain.

Using chemical equations show two ways in which  $Li_2CO_3$  can be prepared in the laboratory. (2 Marks)



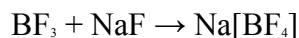
g) Describe how Grignard reagent is prepared. (3 Marks)

Grignard reagents are made by adding the halogenoalkane to small bits of magnesium in a flask containing ethoxyethane The flask is fitted with a reflux condenser, and the mixture is warmed over a water bath for 20 minutes

QUESTION TWO (20 MARKS)

a) Predict the probable products of the following reactions, and write the balanced chemical equations;

(i)  $BF_3$  and excess NaF in acidic aqueous solution. (3 Marks)



(ii)

(iii)  $BCl_3$  and excess NaCl in acidic aqueous solution (3 Marks)

(iv)

b) (i) What are interhalogens? (1 Mark)

a molecule which contains two or more different halogen atoms and no atoms of elements from any other group.

(ii) Give an example of neutral and cationic interhalogen. (2 Marks)

### Bromine trifluoride (BrF<sub>3</sub>)

c) Distinguish between Electronegativity and electron affinity. (2 Marks)

Electronegativity refers to the ability of the atoms to attract the electrons from the other elements while Electron affinity refers to the amount of energy that is liberated whenever a molecule or a neutral atom tends to acquire an electron from the other elements.

d) Explain the meaning of the following terms; (i) Nanotubes (2 Marks)

This is a microscopic tube whose diameter is measured in nanometer

e) Compare the reducing abilities in group I and II elements. (3 Marks)

The group 1 elements are highly electropositive and are strong reducing agents. while group 2 elements are also strong reducing agents but less than group 11 and they have least negative value and high enthalpy of formation.

f) Explain the observation; that F – F bond is very weak. (2 Marks)

Bonds between like atoms usually become *weaker* as we go down a column And halogens have weaker bonds. This because of strong repulsive interactions between lone pairs of electrons on adjacent atoms.

### QUESTION THREE (20 MARKS)

Explain the following observations. (4 Marks)

The boiling point of hydride of oxygen is higher than of sulphur.

Oxygen is more electronegative than Sulphur. Therefore the dipoles are more strongly charged in H<sub>2</sub>O. The intermolecular bonds formed in H<sub>2</sub>O are stronger and it takes more energy to break those bonds in H<sub>2</sub>O therefore to break those bonds and change state requires more temperature in H<sub>2</sub>O the boiling point of H<sub>2</sub>O is higher than that of H<sub>2</sub>S

(ii) Nitrogen is considered inactive

Nitrogen is an inactive element as it has a high bond dissociation energy due to the presence of triple bond N≡N. Hence, viewed as a non-reactive element.