

## Session 14 - Metals, Metalloids, and Nonmetals

- 1) Using right → left or left → right, and top → bottom or bottom → top, explain how the following trends increase. Define them as well.

a) Tonization energy

- the energy required for a neutral atom to lose a valence electron

→ Increases left → right & bottom → top

b) Atomic radius

- a measure of the size of the atom

Increases right → left & top → bottom

c) Electronegativity

- the tendency of an atom to attract a shared pair of electrons towards itself

Increases left → right & bottom → top

- 2) What are representative elements?

1-2,  
3  
4  
5-18

The elements having their s & p orbitals filled. Groups 1-2 on the left & the last 6 groups on the right. They are fairly reactive & not usually found unreacted in nature. This also includes group 12, because the last electron they fill is in the s orbital.

- 3) What is passivation?

The formation of an oxide covering on a purified representative element that prevents further reaction

- 4) Using either the word metals or nonmetals, which would have the following properties? Also, list the opposite property.

a) Forms cations (+)

Metals form cations & nonmetals form anions (-)

b) Dull

Nonmetals are dull & metals have luster.

c) Malleable and ductile

Metals are malleable/ductile & nonmetals are brittle

d) Insulators

Nonmetals are insulators & metals conduct heat & electricity. Metalloids are considered semiconductors

e) Acidic oxides

Nonmetals form acidic oxides & metals form basic oxides.

5) Describe group 1 metals.

These Alkali metals form very basic solutions. They only form +1 ions & are soft metallic solids. They are found in nature as ions & have biological importance.

6) Describe group 2 metals.

These Alkaline Earth metals also form basic solutions & are only found as +2 ions. They also have biological importance.

7) Describe group 12 metals.

Are included w/ representative elements because their last orbital filled is the s orbital. These form +2 ions. Mercury can be found as  $Hg_2^{2+}$

8) Describe group 13.

B is a metalloid, Al is amphoteric (can react w/ either an acid or base), & the rest are metals

9) Describe group 14.

These form +2 ions & have a +4 oxidation state in ~~most~~ covalent compounds. They can also have different allotropes (elemental forms)

10) Define allotropes.

The different forms of an element that can exist. Carbon allotropes include graphite, charcoal & diamonds

11) How are representative metals prepared.

Electrolysis is used to prepare the more active metals & chemical reduction is used for those ~~are~~ that are less reactive.

12) What type of bonding do metalloids participate in?

Covalent

13) Describe Boron.

A metalloid that is found in nature as compounds w/ oxygen. These are electron-deficient compounds

14) Describe Silicon.

A metalloid that is the second-most abundant compound in Earth's crust. It is obtained from  $\text{SiO}_2$  & has a diamond-type structure.

15) True or false: silicon cannot form Si-Si multiple bonds as carbon does.

False

16) What is the most abundant element in the Earth's crust?

Oxygen

17) What is the most abundant element in the universe?

Hydrogen

18) What is the second most abundant element in the universe?

Helium

19) Describe the capabilities of Hydrogen.

H can form 3 different isotopes ( $^1\text{H}$ ,  $^2\text{H}$ ,  $^3\text{H}$ ).

Can donate an electron, receive one, or participate in covalent bonds (sharing electrons).

20) Describe the capabilities of Carbon.

There are 3 allotropes (diamond, graphite, & fullerenes). They can also form inorganic compounds like oxides ( $\text{CO}$  &  $\text{CO}_2$ ), carbonic acids, carbonates & cyanides.

21) Describe the capabilities of Nitrogen.

$\text{N}_2$  is a stable compound ( $\text{N} \equiv \text{N}$ ). Oxidation states of -3 or +5. Can form oxides ( $\text{N}_2\text{O}$ ,  $\text{NO}$ ,  $\text{NO}_2$ ) & oxyacids ( $\text{HNO}_2$  &  $\text{HNO}_3$ )

22) Describe the capabilities of Phosphorus.

There are several allotropes & it can be obtained from phosphate minerals. It can form oxides & oxoacids. They also have biological importance in things like DNA & ATP.

23) Describe the capabilities of Oxygen.

Has 2 allotropes ( $\text{O}_2$  &  $\text{O}_3$ ).  $\text{O}_2$  is paramagnetic & a strong oxidizing agent. It is also the #3 industrial chemical.

Oxygen forms oxides w/ a -2 ox. state & peroxides w/ a -1.

24) Describe the capabilities of Sulfur.

There are several allotropes & it can have oxidation states of -2 or +6. They are found biologically in amino acids.

25) Describe the other elements of group 6.

Se is an essential trace element, Te only forms toxic compounds & Po is radioactive.

26) Describe group 7 elements.

They are all very reactive & form -1 oxidation states in halides. Almost all of them are of biological importance

27) Describe the capabilities of Fluorine.

The most electronegative element. Can only be found w/ -1 or 0 ox. states. Very reactive

28) Describe the capabilities of chlorine.

The most abundant ion in body fluids & ox. states of -1 & +7.

29) Describe group 8 elements.

All monoatomic gases & are very unreactive.

30) What is the only liquid nonmetal?

Bromine

31) What are the general electron configurations of these last 6 groups of representative elements?

Group 3:  $ns^2 np^1 \rightarrow (n=8)$

Group 4:  $ns^2 np^2$

Group 5:  $ns^2 np^3$  Group 8:  $ns^2 np^6$

Group 6:  $ns^2 np^4$

Group 7:  $ns^2 np^5$

Ex: P (group 5):  
 $3s^2 3p^3$

32) What are the four most abundant elements in living organisms?

(CHON) Carbon, Hydrogen, Oxygen & Nitrogen

\* Sometimes phosphorus \*