



Worksheet-08

(B. Inorganic Chemistry)

Groups

- Q.1 Which one of the following properties of IIA group elements increases down the group?
 - A) Melting points and boiling points C) Reducing power

B) ΔH_{hyd}

D) Electron affinity

Q.2 Which of the following elements of IIA group is so reactive that it must be stored under oil to keep it out of contact with air?

A) Mg

C) Sr

B) Ca

D) Ba

Q.3 Which of the following statements is incorrect about IIA and VIIA group elements?

| Opt. | IIA group elements | VIIA group elements | |
|------|---|---|--|
| A) | They are metals | They are non-metals | |
| B) | They form acidic oxide | They form basic oxides | |
| C) | They have tendency to lose electrons | They have tendency to gain electrons | |
| D) | They have general electronic configuration in the valence shell ns ² | They have general electronic configuration in the valence shell ns ² , np ⁵ | |

Q.4 Which of the following elements of IIA group does not react with water even at red hot temperature?

A) Mg

C) Ca

B) Be

D) Ba

Q.5 Which of the following elements reacts with cold water slowly but reacts with steam vigorously. General reaction of a metal is shown in the given equations?

•
$$\mathbf{M}_{(s)}$$
 +2 $\mathbf{H}_2\mathbf{O}(\mathbf{I})$ Slow reaction $\rightarrow \mathbf{M}(\mathbf{OH})_{2(\mathbf{aq})}$ + $\mathbf{H}_{2(\mathbf{g})}$

$$\bullet \quad M_{(s)} \text{+} H_2 O_{(g)} \xrightarrow{\quad steam \quad} M O_{(s)} \text{+} H_{2(g)}$$

A) Mg

C) Sr

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B) Ca

- D) Ba
- Q.6 Which of the following elements of IIA forms amphoteric oxide when treated with oxygen at 800°C?
 - A) Be

C) Sr

B) Ca

- D) Mg
- Q.7 Which one of the following halogens cannot displace all the other halogens in redox reactions?
 - A) F₂

C) Br_2

B) Cl₂

- D) I₂
- Q.8 In which of the following pair of halogens, first halogen is least volatile and second is the most volatile?
 - A) I_2 , F_2

C) Br₂, Cl₂

B) F₂, Br₂

- D) I₂, Br₂
- Q.9 Mg is a metal while chlorine is a non-metal, but even then they have a common property. Which of the following is that property?
 - A) Both are reducing agents
 - B) Both belong to the same period
 - C) Both are oxidizing agents
 - D) Both belong to the same group
- Q.10 Halogens show all of the following properties EXCEPT:
 - A) Among the halogens, F_2 is the strongest oxidizing agent
 - B) Among the halogens acids, HI is the strongest acid
 - C) Among the oxyacids of Cl, HClO₄ is the strongest acid
 - D) Among halogens, F has maximum electron affinity
- Q.11 All of the following are uses of halogens EXCEPT:
 - A) Chlorination of water is used to kill germs
 - B) Fluoridation of water is done to stop dental decay process in human beings
 - C) Flame-retardant plastics do not contain chlorine
 - D) Tincture of iodine is used for dressing of wounds as an antiseptic
- Q.12 Which of the following is not use of helium (He)?
 - A) It is used to fill fluorescent tubes
 - B) It is used in weather balloons
 - C) A mixture of 80%, He and 20% O_2 is used for breathing by the sea divers
 - D) It is used as a cooling medium for nuclear reactors

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Q.13 Consider the following reaction of chlorine with aqueous sodium hydroxide in the cold state:

$$2NaOH_{(aq)} + Cl_{2(g)} \xrightarrow{\quad cold \; state \quad} NaCl_{(aq)} + NaClO_{(aq)} + H_2O$$

Which of the following is type of above reaction?

- A) Acid base reaction
- B) Disproportionation reaction
- C) Elimination reaction
- D) Double displacement reaction
- Q.14 Which of the following halogens acts as a bleaching agent?
 - A) F_2

C) Br₂

B) Cl₂

- D) I₂
- Q.15 Which one of the following is use of radon?
 - A) It is used in radiotherapy for cancer treatment
 - B) It is used in electric light bulb
 - C) It is used in bactericidal lamps
 - D) It is used in making advertising sign
- Q.16 Which of the following oxides is unlikely to be dissolved in sodium hydroxide?
 - A) MgO

C) Al₂O₃

B) SiO₂

- D) NO₂
- Q.17 Which of the following properties decreases down the group in case of halogens?
 - A) Covalent and ionic radii
 - B) Van der waal's forces
 - C) Electronegativity
 - D) Melting points and boiling points
- Q.18 When chlorine (Cl₂) is heated with hot concentrated aqueous NaOH solution at 70°C, a disproportionation reaction takes place as shown below?

NaOH + Cl₂
$$\xrightarrow{70^{\circ}\text{C}}$$

Which of the following products are formed?

- A) NaCl, NaClO
- C) NaClO₃, NaCl, H₂O
- B) NaClO₃, H₂O
- D) NaClO₃, NaClO
- Q.19 Identify the incorrect statements about IIA group



elements:

- A) They are known as alkaline earth metals
- B) They have two electrons in the outermost shell and occupy s sub-shell
- C) Their atomic radii increase down the group
- D) Ionization energy of Ca is higher than that of Mg
- Q.20 When small amount of chlorine is added to water supply, it will kill bacteria and make water safe to drink. As a result of reaction of Cl₂ with water HOCl and HCl are produced. One theory suggests that HOCl produces reactive _____ species that will kill bacteria in water.
 - A) [H]

C) [O]

B) [Cl]

- D) [HC1]
- Q.21 Which of the following halogen acids is the least stable thermally?
 - A) HF

C) HBr

B) HCl

- D) HI
- Q.22 Beryllium becomes passive on reaction with conc. HNO₃ because:
 - A) It is non-reactive metal
 - B) It forms stable layer of oxide
 - C) It has non-reactive nature with the acid
 - D) It has small size
- Q.23 Oxidizing power of halogens does not depend on:
 - A) Electron affinity of atom
 - B) Hydration energies of ions
 - C) Energy of dissociation
 - D) Density

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| ANSWER KEY (Worksheet-08) | | | | | | |
|---------------------------|---|----|---|----|---|--|
| 1 | C | 11 | C | 21 | D | |
| 2 | D | 12 | A | 22 | В | |
| 3 | В | 13 | В | 23 | D | |
| 4 | В | 14 | В | | | |
| 5 | A | 15 | A | | | |
| 6 | A | 16 | A | | | |
| 7 | D | 17 | C | | | |
| 8 | A | 18 | C | | | |
| 9 | В | 19 | D | | - | |
| 10 | D | 20 | C | | · | |

ANSWERS EXPLAINED

- **Q.1** (C) Reducing power of IIA group elements increases down the group because down the group number of inner shells increase, atomic radii increase. and shielding effect increases. As a result ionization decreases and metallic energy character increases and thus reducing group elements power of IIA increases.
- Q.2 (D) In IIA group chemical reactivity of elements increases because atomic size increases with the increase of shielding effect. As a result, nucleus hold on the valence electrons decreases. That is why Ba element of IIA group is so reactive that it must be stored under oil to keep it out of contact with air.
- Q.3 (B) It is incorrect statement. In fact,
 - The elements of IIA group form basic oxide e.g. MgO, CaO.
 - The elements of VIIA group form acidic oxide e.g. Cl₂O₇.
- Q.4 (B) This is because Be has smaller size, stronger nucleus hold on the valence shell electrons and thus has less chemical reactivity.

Q.5 (A) Mg reacts with cold water slowly but reacts vigorously with steam as shown in the reaction:

$$\bullet \quad Mg_{(s)} + 2H_2O_{(I)} \xrightarrow{Slow} Mg(OH)_{2(aq)} + H_{2(g)}$$

•
$$Mg_{(s)} + H_2O_{(g)} \xrightarrow{steam} MgO_{(s)} + H_{2(g)}$$

Q.6 (A) In IIA group, beryllium is the least reactive metal. It is resistant to complete oxidation and stable in air at ordinary temperature but oxidizes rapidly at about 800°C and forms amphoteric oxide as shown in the reaction:

$$2\text{Be} + \text{O}_2 \xrightarrow{800^{\circ}\text{C}} 2\text{BeO}$$

BeO is amphoteric in nature

Q.7 (D) I₂ is the weakest oxidizing agent among all the halogens because it has smaller standard reduction potential (+0.54V) value and smaller electronegativity (2.5). So it cannot displace all the halogens such as F₂, Cl₂ and Br₂ in the redox reactions. Order of decreasing oxidizing power of halogens is as follow:

$$F_{2(g)} > Cl_{2(g)} > Br_{2(l)} > I_{2(s)}$$

Q.8 (A) There are only weak van der waal's between forces their diatomic halogen molecules. These forces increase as the number of electrons in the molecules increases with increasing atomic number. Greater is the number of electrons greater are the opportunities for instantaneous dipole arising within molecules, and for induced dipole to be produced on neighboring molecules. So the larger the molecular size, stronger the van der waal's forces between molecules and thus making iodine the least volatile and fluorine the most volatile of the halogens.

Q.9 (B) Mg and Cl have only common property that they belong to the same period i.e. 3rd period as shown by their electronic configuration:

- ${}_{12}$ Mg $(1s^2, 2s^2, 2p^6, 3s^2)$
- $_{17}\text{Cl} (1\text{s}^2, 2\text{s}^2, 2\text{p}^6, 3\text{s}^2, 3\text{p}^5)$

This configuration clearly shows that these two elements belong to same period (i.e. 3rd period).

- Q.10 (D) In fact, among the halogens, chlorine element has greater electron affinity.

 Order of decreasing electron affinity in halogens is as follow (unit of electron affinity kJmol⁻¹).
 - Cl(-349) > Br(-325) > F(-322) > I(-295)
- Q.11 (C) In fact, flame-retardant plastics often contain **bromine and chlorine.**
- Q.12 (A) In fact, Krypton (Kr) is used to fill fluorescent tubes and in flash lamps for high speed photography not Helium (He).
- Q.13 (B) It is self-oxidation reduction reaction. One Cl-atom is reduced from Cl⁰ to Cl⁻ (such as in Na⁺¹Cl⁻¹) and other atom of Cl is oxidized from Cl⁰ to Cl⁺¹ (such as in Na⁺¹Cl⁺¹O⁻²) in the redox reaction.
- Q.14 (B) Cl₂ gas acts as a bleaching agent.
 - Other bleaching agents are O₃, ClO₂, H₂O₂, NaOCl and SO₂ (temporary bleaching agent)
- Q.15 (A) Radon being radioactive is used in radiotherapy for cancer and for earth quake prediction.
- Q.16 (A) MgO is basic in nature and it does not dissolve in NaOH solution. A is amphoteric while B and D are acidic in nature. They (A, B and D) can react with NaOH except MgO.

Q.17 (C) Electronegativity of halogens decreases down the group, because atomic size and shielding effect increase.

| Property | F | Cl | Br | I |
|-------------------|-----|-----|-----|-----|
| Electronegativity | 4.0 | 3.0 | 2.8 | 2.5 |

- Q.18 (C) $6\text{NaOH} + 3\text{Cl}_2 \xrightarrow{70^{\circ}\text{C}} 5\text{NaCl} + \text{NaClO}_3 + \text{H}_2\text{O}$. The reaction clearly shows that the product formed are NaCl, NaClO₃, H₂O.
- Q.19 (D) Ionization energy of Ca is lower than that of Mg (first ionization energy 738kJmol⁻¹) because the size of Ca (first ionization energy 595kJmol⁻¹) is greater than that of Mg. Greater is the size, smaller is the ionization energy.
- Q.20 (C) When Cl₂ is added in water then as a result of reaction HCl and HOCl are produced as shown in the equation

$$Cl_{2(aq)} \text{+} H_2O_{(I)} \longrightarrow HCl_{(aq)} \text{+} HClO_{(aq)}$$

HOCl is unstable and decomposes slowly in solution. One theory suggests that it produces reactive oxygen atoms that can kill bacteria in water as shown in the equation.

$$HClO \longrightarrow HCl + [O]$$

- **Q.21** (**D**) The halogen acids get less thermally stable going down the group as explained below.
 - The hydrogen halides formed differ in their thermal stability.
 - Hydrogen iodide can be decomposed by inserting a red-hot wire into a sample of hydrogen iodide gas. The purple fumes seen are iodine vapour:

$$2HI_{(g)} {\longrightarrow} H_{2(g)} \hbox{+} I_{2(g)}$$

 By contrast, HF and HCl are not decomposed in temperatures upto
 1500°C.

- Hydrogen bromide is not as stable as HF and HCl, but it is more resistant to decomposition than hydrogen iodide. At 430°C in a closed container, 10% of a sample of HBr will decompose, whereas around 20% of HI decompose at that temperature.
 - Order of thermal stability of hydrides of halogens (halogen acids):
 - HF > HCl > HBr > HI
- We can explain this by looking at the bond energies of the hydrogen-halogen bonds as shown in the tabular form.

| Halogen acids | Bond energy (kJmol ⁻¹) | |
|---------------|------------------------------------|--|
| HF | 566 | |
| HCl | 431 | |
| HBr | 366 | |
| HI | 299 | |

• Conclusion:

From the bond energy value it is clear thermal stability decreases downward.

- **Reason: HI** decomposes because of low bond energy
- On the other hand HF and HCl have high bond energy so they cannot decompose easily.

Most thermally stable HF
Bond energy decreases downward HBr

Least thermally stable HI

Q.22 (B) Beryllium becomes passive on reaction with conc. HNO₃ because it forms stable layer of oxide.

- Q.23 (D) If a halogen has a low energy of dissociation, a high electron affinity and a higher hydration energy of its ions, it will have a high oxidizing power.
 - Oxidizing power of halogens does not depend upon density.



