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Unit 8: Chemical Reactivity
Exercise Questions

Exercise Multiple Choice Question Answers:

1. **Metals can form ions carrying charges:**
   (a) Uni-positive (b) Di-positive (c) Tri-positive (d) All of them
2. **Which one of the following metals burn with brick red flame when heated in air?**
   (a) Sodium (b) Magnesium (c) Iron (d) Calcium
3. **Sodium is extremely reactive metal, but it does not react with:**
   (a) Hydrogen (b) Nitrogen (c) Sulphur (d) Phosphorus
4. **Which one the following is the lightest and floats on water:**
   (a) Calcium (b) Magnesium (c) Lithium (d) Sodium
5. **Pure alkali metals can be cut simply by knife but iron cannot because of alkali metals have:**
   (a) Strong metallic bonding (b) Weak metallic bonding
   (c) Non-metallic bonding (d) Moderate metallic bonding
6. **Which of the following is less malleable?**
   (a) Sodium (b) Iron (c) Gold (d) Silver
7. **Metals lose their electrons easily because:**
   (a) They are electronegative (b) They have electron affinity
   (c) They are electropositive (d) Good conductors of heat
8. **Which one of the following is brittle?**
   (a) Sodium (b) Aluminium (c) Selenium (d) Magnesium
9. **Which one of the following non-metal is lustrous?**
   (a) Sulphur (b) Phosphorus (c) Iodine (d) Carbon
10. **Non-metalsare generally soft, but which one of the following is extremely hard?**
    (a) Graphite (b) Phosphorus (c) Iodine (d) Diamond
11. **Which one of the following will not react with dilute HCl?**
    (a) Sodium (b) Potassium (c) Calcium (d) Carbon

ANSWR KEY

1	d	3	b	5	b	7	c	9	c	11	d
2	d	4	d	6	b	8	c	10	d		

Exercise Short Question Answers

Q.1 Why reactivity of metals increases down the group?

Ans: Reactivity of metals depends upon its tendency to lose electrons which is dependent upon the size of atoms. Thus reactivity of metals increases down the group because of increasing atomic size and decreasing ionization energy.

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Q.2 Why reactivity of metals increases down the group?

Ans: Physical properties of metals:

- **i.** Almost all metals are solids (except mercury).
- **ii.** They have high melting and boiling points.
- **iii.** They possess metallic luster.
- **iv.** They are malleable and ductile.
- **v.** They are good conductors of heat and electricity.
- **vi.** They have high densities.

Q.3 Why nitrogen forms compounds with alkaline earth metals directly?

Ans: Nitrogen forms compounds with alkaline earth metals directly because alkaline earth metals from di-positive cations (M^{++}). They have high charge density and polarization power. They can polarize nitrogen atoms easily and produce stable covalent nitrides with nitrogen.

$$3Mg + N_2 \longrightarrow Mg_3N_2$$

Q.4 Why the second ionization energy of magnesium is higher than the first one?

Ans: Second Ionization energy of magnesium is higher than the first one because after the removal of its electron nuclear charge increases and atomic size decreases. The remaining electrons will be attracted by the nucleus more strongly.

Q.5 How oxygen reacts with group II A metals?

Ans: They are less reactive towards oxygen and they form oxides on heating.

$$2Mg + O_2 \longrightarrow 2MgO$$

Q.6 What is relationship between electro positivity and ionization energy

Ans: Electropositivity depends upon the ionization energy which in turn depends upon size and nuclear charge of the atom. Small sized atoms with high nuclear charge have high ionization energy. Atoms having high ionization energy are less electropositive or metallic.

Q.7 Why electro positivity decreases from left to right in a period?

Ans: Electropositivity decreases across the period from left to right in the periodic table because. Size of atoms decreases due to increase in nuclear charges.

Q.8 How electro positivity depends upon size and nuclear charge of an atom?

Ans: Electropositivity depends upon size and nuclear charge of an atom because when the size of atoms increases, electropositivity increases as it becomes easier to lose electrons. It also depends upon nuclear charge. If nuclear charge increases the electropositivity decreases because it becomes difficult to remove the electrons from outermost shell.

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Q.9 Why ionization energies of alkaline earth metals are higher than alkali metals?

Ans: Ionization energies of alkalme earth metals are higher than alkalimetals because the atomic size of alkalme earth metals one smaller and greater nuclear charge.

Q.10 Why silver and gold are least reactive?

Ans: Silver and gold are least reactive because these metals do not lose their electrons easily. They do not have the tendency to make cations.

Q.11 Can pure gold be used for making ornaments? If not why?

Ans: No, pure gold cannot be used for making ornaments because gold is too soft to be used as such. It is always alloyed with copper, silver or some other metal.

Q.12 Why copper is used for making electrical wires?

Ans: Copper is used for making of electrical wires because it is a good conductor of electricity and can easily be drawn into wires.

Q.13 What is the trend of variation in densities of alkali metals?

Ans: Densities of alkali metals increase down the group in the periodic table due to increase atomic mass.

Q.14 Which metal is used for metal work?

Ans: Metal work means objects that are made in an artistic and skilful way. Copper metal is used in metal work because it is easily workable. It is used in many ornaments, plumbing, roafing and other operations.

Q.15 Why magnesium is harder than sodium?

Ans: Magnesium is harder than sodium because in magnesium metallic bonding is stronger, than sodium. Magnesium involves 2 valence electrons in metallic bonding as compared to sodium which involves only one valence electron. Moreover magnesium has smaller atomic size and high ionization energy.

Q.16 Why calcium is more electropositive than to magnesium?

Ans: Calcium is more electropositive than magnesium because calcium has larger size and greater nuclear charge than magnesium and in turn lower ionization energy than magnesium.

Q.17 Why ionization energy of Na is less than Mg?

Ans: Ionization energy of Na is less than Mg because Na has larger size and lower nuclear charge than Mg. It results in less nuclear attraction on valance electron in sodium.

Q.18 Why the ionization energy of Na is more than K?

Ans: The ionization energy of sodium is more than K because down the group electropositive character increases and ionization energy decreases. It becomes easier for potassium to

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lose electrons than sodium.

Exercise Long Question Answers

Q.1 Compare and contrast the properties of alkali and alkaline earth metals.

Ans: See Q. No. **5** (Subjective Part, Long Questions Answers)

Q.2 Discuss the inert character of silver and gold.

Ans: Silver and gold are inert metals because they both are very less electropositive and do not lose electrons easily.

Inert Character of Silver:

Silver is a white lustrous metal. Formation of thin layer of oxide or sulphide on its surface makes it relatively un reactive. Under normal conditions of atmosphere, air does not affect silver. It tarnishes in presence of sulphur containing compounds like H_2S.

Inert Character of Gold:

Gold is a yellow soft metal. Gold is very non reactive or inert metal. It is not affected by atmosphere. It is not even affected by any single mineral acid or base. It dissolves only in Aqua Regia. Because of its inertness in atmospheres it is an ornamental metal as well as used in making coins.

Q.3 Why cations are smaller and anions are bigger in size than their respective neutral atoms.

Ans: Small Size of Cation (Positive Ion) than its neutral atom:

Cations are smaller than their corresponding neutral atoms because of two reasons.

i) The removal of one or more electrons from a neutral atom usually, results in the loss of the outer most shell.

ii) The removal of electrons causes an imbalance in proton-electron ration thus a cation has smaller number of electrons than its parent atom with the decrease in number of electrons the magnitude of effective nuclear charge increases, which pulls the electrons cloud of the cation near to the nucleus and thus makes the cation smaller in size than its parent neutral atom.

Examples:

The radius of Na is 186pm whereas ionic radius of cation (Na^+) is 102pm.

Large size of anion (Negative Ion) than its neutral atom

A negative ion is always bigger than its parent atom the reason is that the addition of one or more electrons in the shell of a neutral atom enhance the repulsion between the electron causing the expansion of the shell. The added electrons reduce the attraction of nucleus to the electron that is why the size of anion increases as compared to the neutral atom.

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Examples:

Atomic size of Flourine (F) is 71pm whereas anionic size of Fluorine (F^-) is 136 pm.

Q.4 Discuss why hardness and softness of a metal depends upon its metallic bonding.

Ans: The softness and hardness of a metal depends upon the metallic bonding. The strength of the metallic bonds upon the number of valence electrons that each atom contributes for the metallic bonding.

Hardness of a Metal:

Some metals have strong metallic bond due to the greater number of valence electrons in the metal atoms. Such metals are Cord.

Examples:

Magnesium metal has strong metallic bond as compared to sodium metal therefore magnesium is harder than sodium metal.

Softness of a metal

Some metals have weak metallic bond due to the less number valance electrons in the metal atoms. Such metals are soft.

Examples:

Sodium has weak metallic bond as compared to magnesium metal that's why it is soft as compared to magnesium. It has low melting point and can easily be cut with knife.

Q.5 Give the reaction of sodium with; H_20, O_2, Cl_2 and H_2

Ans:

i) Reaction of Sodium with H_2O.

Sodium reacts with water vigorously at room temperature to give strong alkaline solution and hydrogen gas..

$$2Na + 2H_2O \longrightarrow 2NaOH + H_2$$

ii) Reaction f sodium with O_2:

Sodium immediately tarnishes in air giving sodium oxide which forms strong alkali in water.

$$4Na + O_2 \longrightarrow 2Na_2O$$

$$Na_2O + H_2O \longrightarrow 2NaOH$$

iii) Reaction of sodium with Cl_2:

Sodium reacts violently with chlorine at room temperature to give sodium chloride.

$$2Na + Cl_2 \longrightarrow 2NaCl$$

iv) Reaction of sodium with H_2:

Sodium reacts with hydrogen, at high temperature to form sodium hydride.

$$2\text{Na} + \text{H}_2 \longrightarrow 2\text{NaH}$$

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Q.6 What are physical properties of calcium metal? Give its uses.

Ans: Physical properties of calcium metal

Following are physical properties of calcium.

1. Calcium is silvery grey and fairy harder.
2. Its density is 1.55g cm^{-3}
3. It is malleable and ductile.
4. It is good conductor of heat and electricity.
5. Its melting point is 851°C and boiling point is 1484°C.
6. Its flame colour is brick red.
7. Its first ionization energy is 590kj mol^{-1} and second ionization energy is 1145kgmol^{-1}.

Uses of calcium

1. It is used to remove sulphur from petroleum products.
2. it is used as reducing agent to produce Cr, u and Zr,

Q.7 Write down the chemical properties of the non-metals?

Ans: See Q. No. **10** (Subjective Part, Long Questions Answers)

Q.8 Compare the physical properties of metals and non-metals

Ans:

Metals	Non Metals
1. All metals are solids except mercury.	1. Non metals are solid, liquid and gases.
2. They have high melting and boiling point.	2. They have low melting and boiling point.
3. They have metallic luster and can be polished.	3. They do not have metallic luster and cannot be polished they have dull surface.
4. They are malleable and ductile.	4. They are not malleable and ductile.
5. They are good conductor of heat and electricity.	5. They poor conductors of heat and electricity.
6. They have high densities.	6. They have low densities.
7. They are usually hard.	7. They are usually soft.

Q.9 How you can compare the softness and hardness of metals?

Ans: Softness and hardness of metals depends upon the strength of metallic bond present in them.

Dependency of Metallic bond

The strength of a metallic bond depends upon the following factors.

i. Charge present on positive metallic ion.

ii. Number of mobile electrons set free by each atom.

Softness of metals:

Metals having weak metallic bond are soft metals, such metals have low melting points,

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boiling points, densities etc.

Example:

Sodium is a soft metal due to weak metallic bond. It can be cut with a knife. Its melting point is very low as compared to other metals.

Harness of metals:

Metals having strong metallic bond are hard metals. Such metals have high melting points, boiling points densities etc.

Example:

Magnesium is a hard metal due to strong metallic bond, its melting point is 650°C which is very high as compared to sodium.

Q.10 Give the chemical properties of magnesium and its uses

Ans: Chemical properties of magnesium:

i. Reaction with water

Magnesium reacts with water less rigorously and on heating produces weak base.

$$Mg + H_2O \longrightarrow MgO + H_2$$
$$MgO + H_2O \longrightarrow Mg(OH)_2$$

ii. Reaction with oxygen

Magnesium reacts with oxygen on heating and magnesium oxide is formed.

$$2Mg + O_2 \xrightarrow{Heat} 2MgO$$

iii. Reaction with Nitrogen

Magnesium form stable nitride when heat end with nitrogen.

$$3Mg + N_2 \xrightarrow{Heat} Mg_3N_2$$

Uses of Magnesium:

- **i.** Magnesium used in flash light bulbs and in fire works.
- **ii.** It is used in the manufacture of light alloys.
- **iii.** Magnesium ribbon is used in thermite process to ignite aluminium powder.
- **iv.** Magnesium is used as anode for prevention of corrosion. .

Q.11 Write a comprehensive note on the electropositive character of metals?

Ans: See Q. No. **2** (Subjective Part, Long Questions Answers)

Q.12 Compare the ionization energies of alkali and alkaline earth metals.

Ans: See Q. No. **3** (Subjective Part, Long Questions Answers)

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