

REVIEW QUESTIONS

Q.1: Encircle the correct answer:

(i) Which of the following atoms will form an ion of charge -2?

	<u>Atomic Number</u>	<u>Mass Number</u>
A.	12	24
B.	14	28
C.	8	8
D.	10	20

(ii) Which of the following atoms will not form cation or anion.

- A. A (Atomic No. 16)
- B. B (Atomic No. 17)
- C. C (Atomic No. 18)
- D. D (Atomic No. 19)

(iii) Which of the following atoms will form cation.

<u>Atomic Number</u>	
A. 20	B. 18
C. 17	D. 15

(iv) Which of the following atoms obey duplet rule?

- A. O₂
- B. F₂
- C. H₂
- D. N₂

Answers:

1. C	2. C	3. A	4. C	5. C
6. B	7. C	8. D	9. C	

Q.2: Give short answers.

i. State octet and duplet rules.

Ans:

Octet rule:

The tendency of atoms to acquire eight electron configurations in their valence shell, when bonding, is called octet rule.

Remember that each noble gas (except He) has eight electrons configuration in the valence shell. Thus, the octet rule takes its name from this fact about noble gases

Duplet rule:

The tendency of some atoms to acquire two electron configurations in their valence shell, when bonding is called duplet rule.

Helium has two electrons in its valence shell and is also chemically inert. Some elements that are close to He on the periodic table tend to achieve two electron configurations in their valence shell.

For example:

For example, hydrogen, lithium and beryllium etc. tend to achieve two electron configurations in the valence shell.

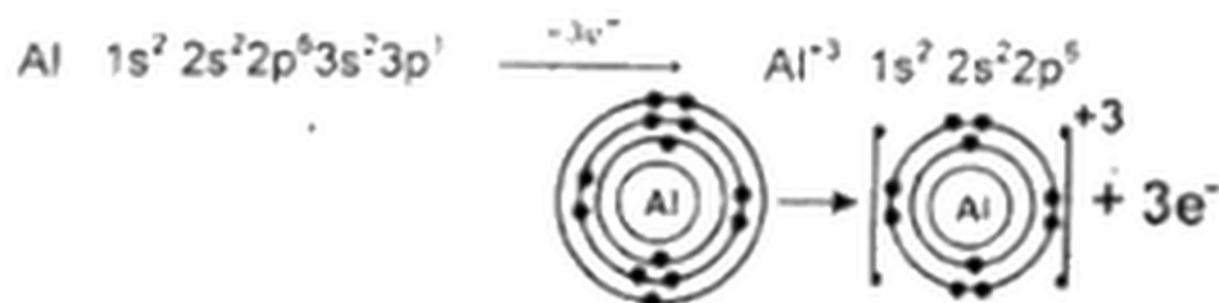
Ans: Consider the formation of N_2 molecule. Nitrogen is in Group VA, so it has 5 electrons in the valence shell. It needs three electrons to complete its octet. So, for sharing each N-atom contributes three electrons.



ii. How does Al form cation?

Ans: Formation of Al^{+3} ion:

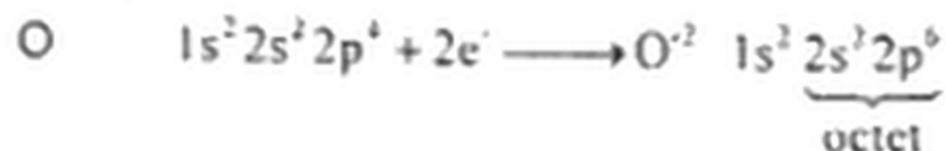
Since Al atom has three electrons in the outer most shell, it loses three electrons to form Al^{+3} ion.



iii. How does O form anion?

Ans: Formation of anion by oxygen atom.

Oxygen belongs to Group VIA on the periodic table. So, it has six electrons in its valence shell. It needs two electrons to achieve noble gas configuration.



You can also represent this by electron dot structure,

Noble gases usually not combine to other elements or themselves. It is due to their electronic configuration. It has only two electrons in its outermost shell, which is also called duplet.

All other elements (Ne, Ar, Kr, Xe, Rn) have 8 electrons in valence shell and called octet. In all noble gases their valence shell is completely filled. Chemical reactivity of an element is related to its number of unpaired electrons in the valence shell. If an element has less than 8 electrons it is unstable. It gets stability by losing, gaining or sharing electrons (Octet rule).

Q.4: Explain how elements/atoms attain stability?

Ans: An atom gains stability by having 8 electrons in its outer shell (or 2 in some cases, Duplet rule). It can do this through covalent bonding, or ionic bonding etc.

If an element has less than 8 electrons it is unstable. It gets stability by losing, gaining or sharing electrons. (Octet rule).

Q.5: Describe the ways in which bonds may be formed.

Ans: The two main types of bonds formed between atoms are ionic bonds and covalent bonds

An ionic bond is formed when one atom accepts or donates one or more of its valence electrons to another atom.

A covalent bond is formed when atoms share valence electrons.

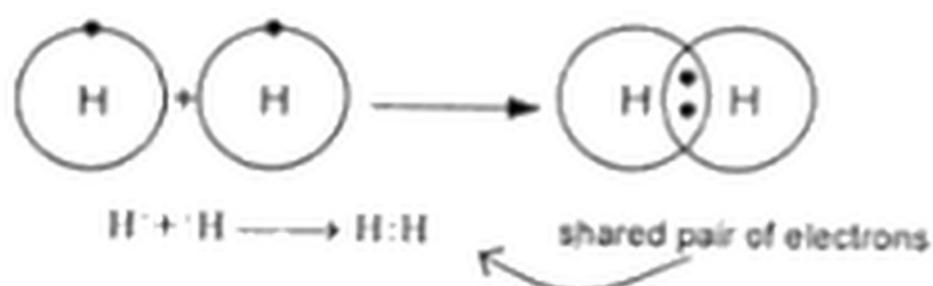
The atoms do not always share the electrons equally, so a polar covalent bond may be the result.

When electrons are shared by two metallic atoms a metallic bond may

Q.6: Describe the formation of covalent bond between two non-metallic elements.

Ans: Formation of covalent bond in hydrogen molecule:

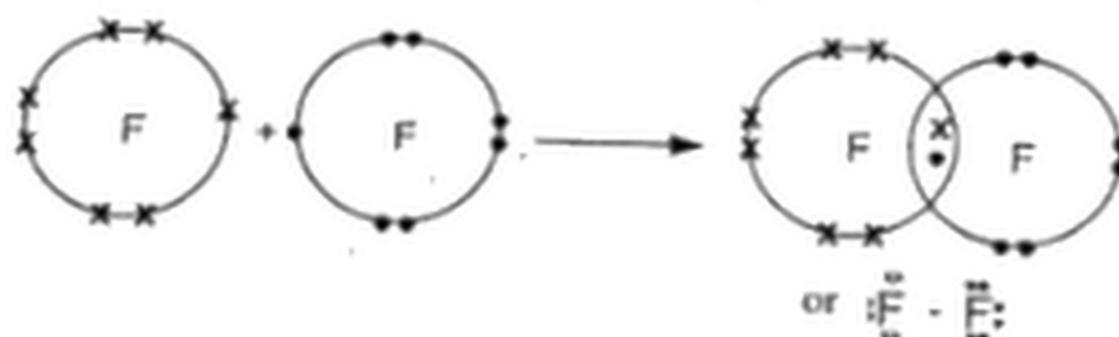
Consider the formation of covalent bond in hydrogen molecule. A hydrogen atom has a single valence electron. Two hydrogen atoms share their valence electrons to form a diatomic molecule.



In the formation of this molecule, each hydrogen atom achieves the electron configuration of the noble gas, helium which has two valence electrons.

Formation of covalent bond in fluorine molecule:

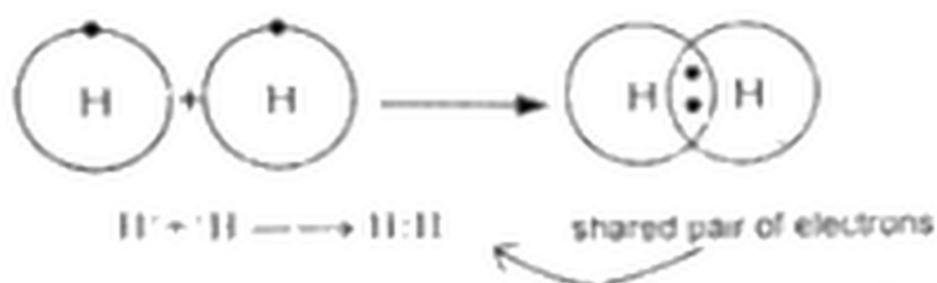
Consider the formation of a bond between two fluorine atoms. Fluorine belongs to Group VIIA, so it has seven electrons in the valence shell. It needs one more electron to attain the electron configuration of a noble gas. Thus, two F-atoms share an electron pair and achieve electron configuration of Ne. For sharing each F. atom contributes one electron to complete the octet.



Q.7: Explain with examples single, double and triple covalent bond

Ans: Formation of single covalent bond in hydrogen molecule:

Consider the formation of covalent bond in hydrogen molecule. A hydrogen atom has a single valence electron. Two hydrogen atoms share their valence electrons to form a diatomic molecule.

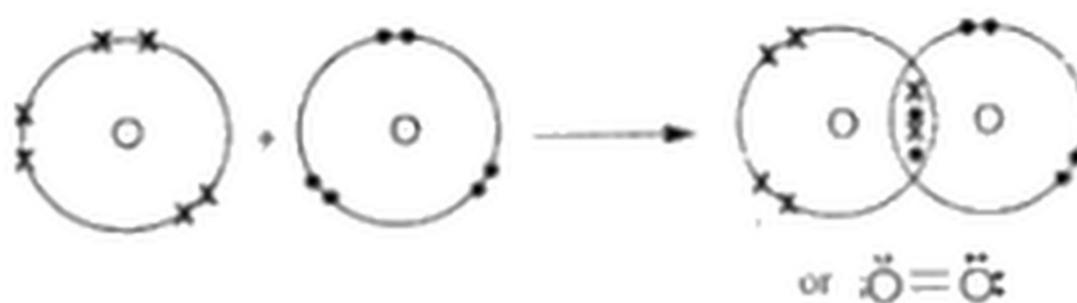


In the formation of this molecule, each hydrogen atom achieves the electron configuration of the noble gas, helium which has two valence electrons.

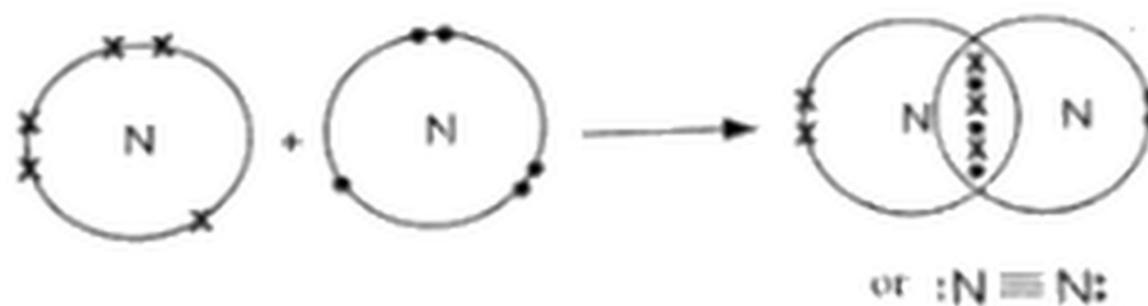
Formation of double covalent bond between two oxygen atoms:

Double covalent bonds are the bonds that are formed by sharing of two electron pairs.

Consider the formation of O_2 molecule. Oxygen is in Group VI A, so it has 6 electrons in the valence shell. It needs two electrons to complete its octet. So, for sharing each O-atom contributes two electrons.

**Formation of triple covalent bond between two nitrogen atoms:**

Ans: Consider the formation of N_2 molecule. Nitrogen is in Group VA, so it has 5 electrons in the valence shell. It needs three electrons to complete its octet. So for sharing each N-atom contributes three electrons.



Q.8: Find the number of valence electrons in the following atoms using the periodic table:

- (a) Boron (b) Neon (c) Rubidium
 (d) Barium (e) Arsenic

Ans:

- (a) Boron (3 electrons group IIIA element).
 (b) Neon (8 electrons group VIIIA element)
 (c) Rubidium (1 electron group IA element)
 (d) Barium (2 electrons group IIA element)
 (e) Arsenic (5 electrons group VA element)

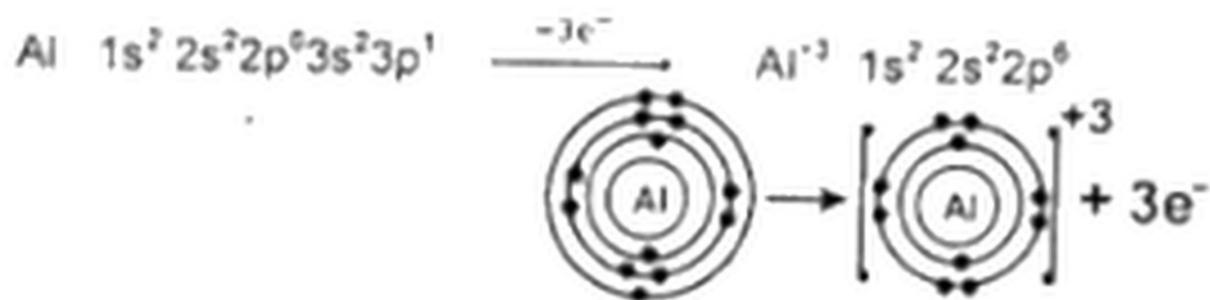
Q.9: Represent the formation of cations for the following metal atoms using electron dot structures.

- (a) Al (b) Sr (c) Ba

Ans:

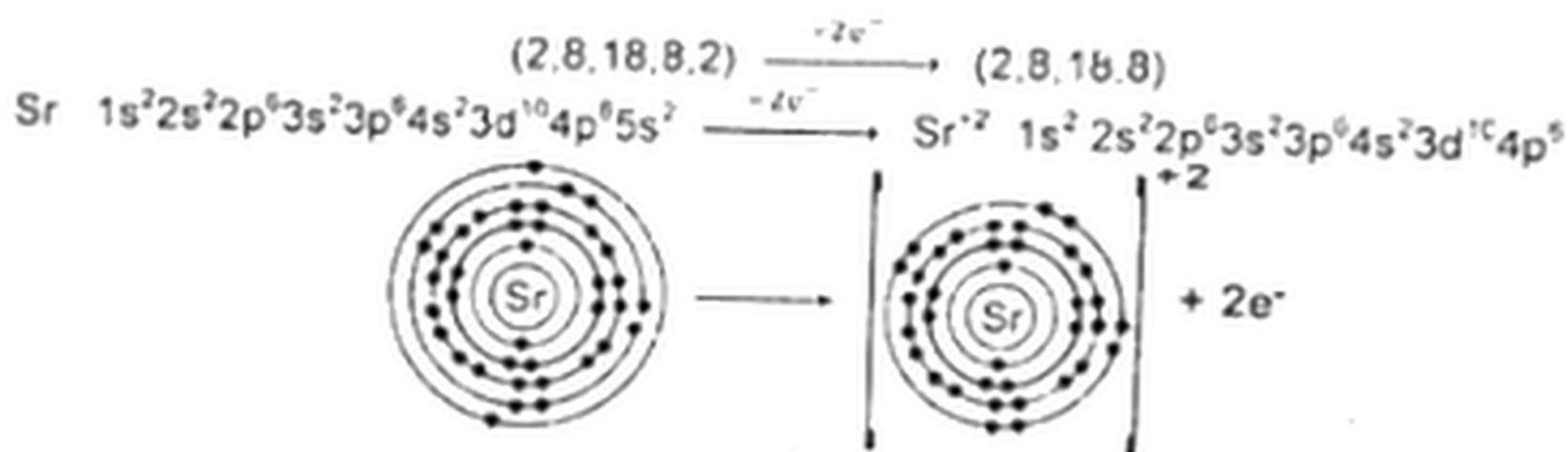
- (a) **Formation of Al^{+3} ion: (Atomic number of Aluminum = 13)**

Since Al atom has three electrons in the outer most shell. It losses three electrons to form Al^{+3} ion.



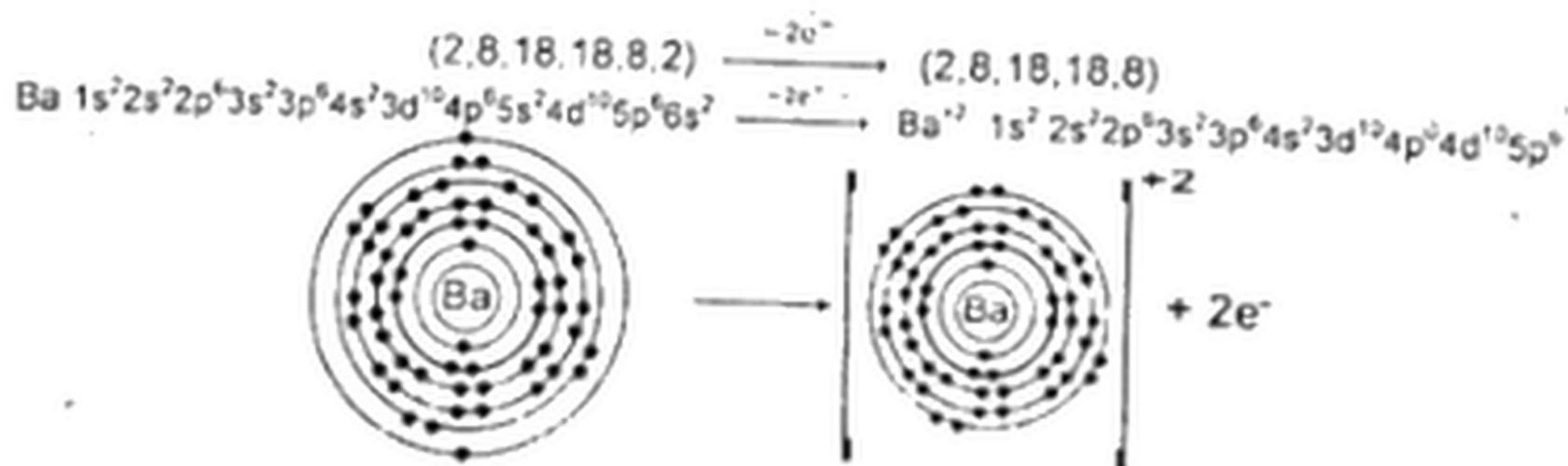
(b) Formation of Sr^{+2} ion: (Atomic number of strontium = 38)

Since Sr atom has two electrons in the outer most shell. It losses two electrons to form Sr^{+2} ion.



(c) Formation of Ba^{+2} ion: (Atomic number of barium = 56)

Since Ba atom has two electrons in the outer most shell. It losses two electrons to form Ba^{+2} ion.



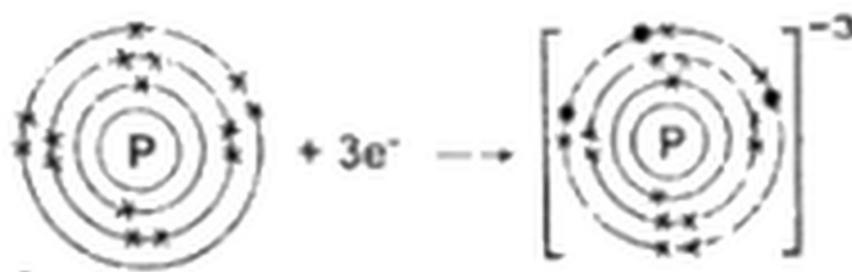
Q.10: Describe the formation of anions for the following non-metal atoms:

(a) P (b) Br (c) H

Ans:

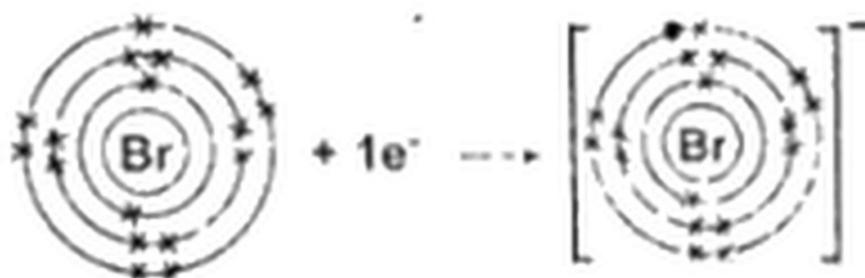
(a) Formation of P^{-3} anion:

Since P atom has five electrons in outermost shell it needs three electrons to complete octet. So, it gains three electrons to form P^{-3} ion.



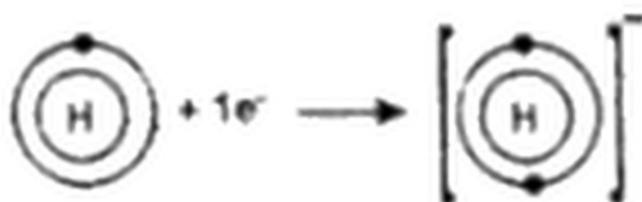
(b) Formation of Br^{-1} anion:

Since Br atom has seven electrons in outermost shell, it needs one electron to complete octet. So, it gains one electron to form Br^{-1} ion.



(c) Formation of H^{-1} anion:

Since H atom has one electron in outermost shell, it needs one electron to complete duplet. So, it gains one electron to form H^{-1} ion.



Q.11: Represent the formation of cations for the following metal atoms using electron dot structures.

(a) Mg

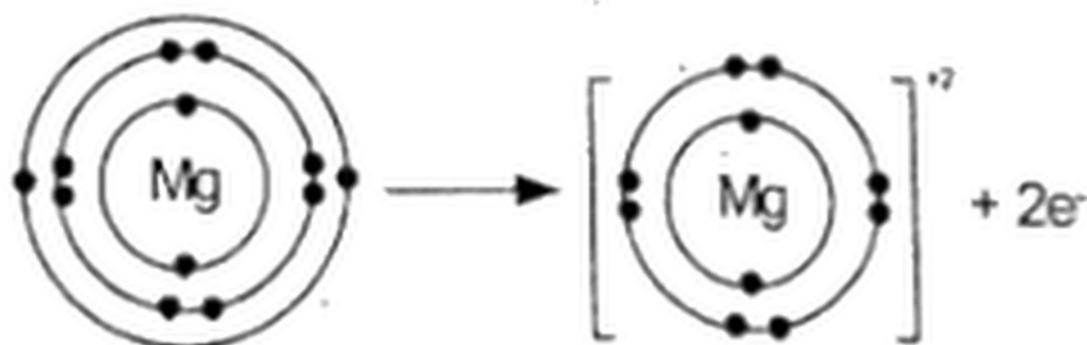
(b) Li

(c) Be

Ans: (a) Formation of Mg^{+2} ion. (Atomic number of Magnesium = 12)



We can also represent this by electron dot structure,



(b) Formation of Li^+ ion. (Atomic number of Lithium = 3)



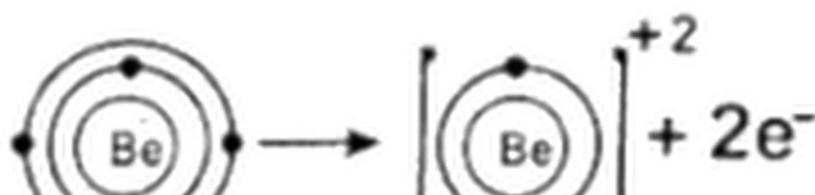
We can also represent Li^+ by following electron dot structure,



(c) Formation of Be^{+2} ion. (Atomic number of beryllium = 4)



We can also represent Be^{+2} by following electron dot structure,



Q.12: For each of the following pairs of atoms, use electron dot and electron cross structures to write the equation for the formation of ionic compound.

(a) K and Cl

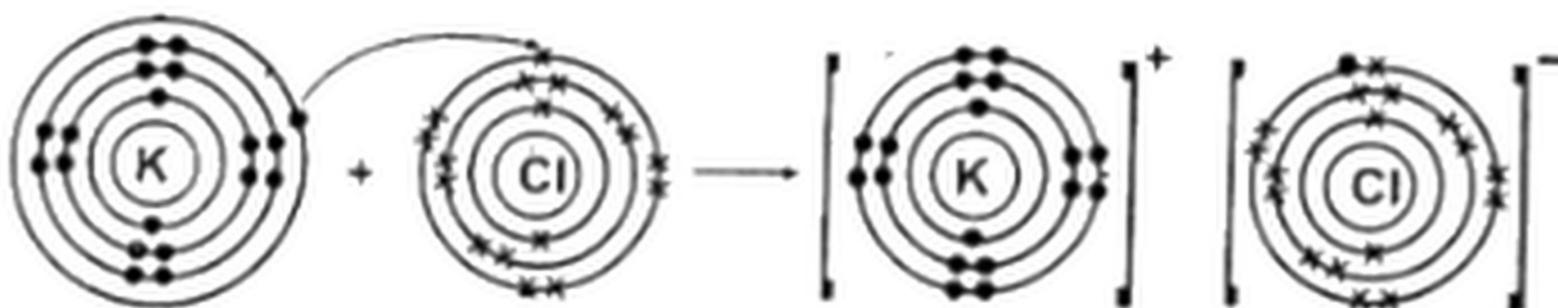
(b) Ca and S

(c) Al and N

Ans: **(a) K and Cl:**

K is metal and Cl is non-metal.

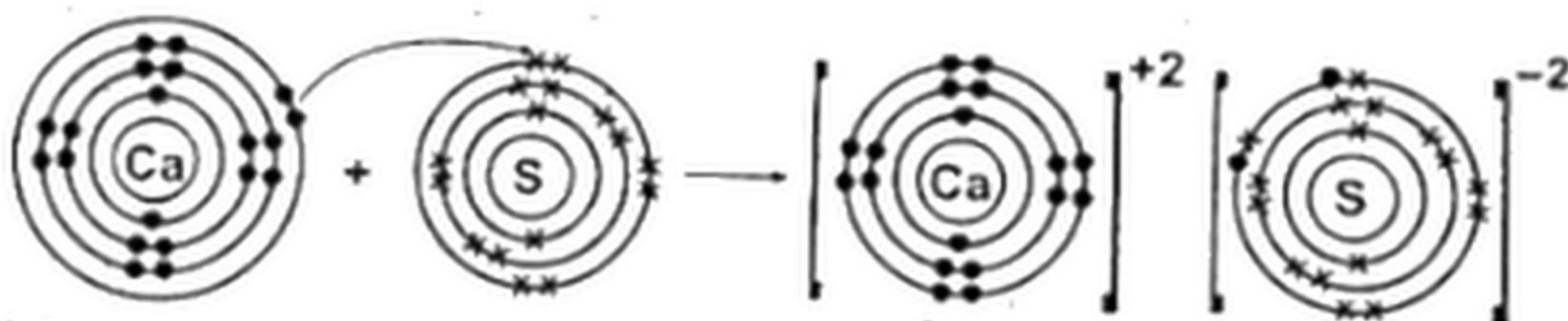
Metal atom tends to lose electrons and non-metal atoms tends to gain electrons to acquire electronic configuration of nearest noble gas. Since K atom has one electron in the outer most shell, it loses one electron to form K^+ ion. Since Cl atom has seven electrons in outermost shell, it needs one electron to complete octet. So it gains one electron to form Cl^- ion. For every K^+ ion, you need one Cl^- ion.



(b) Ca and S:

(b) Ca is metal and S is non-metal.

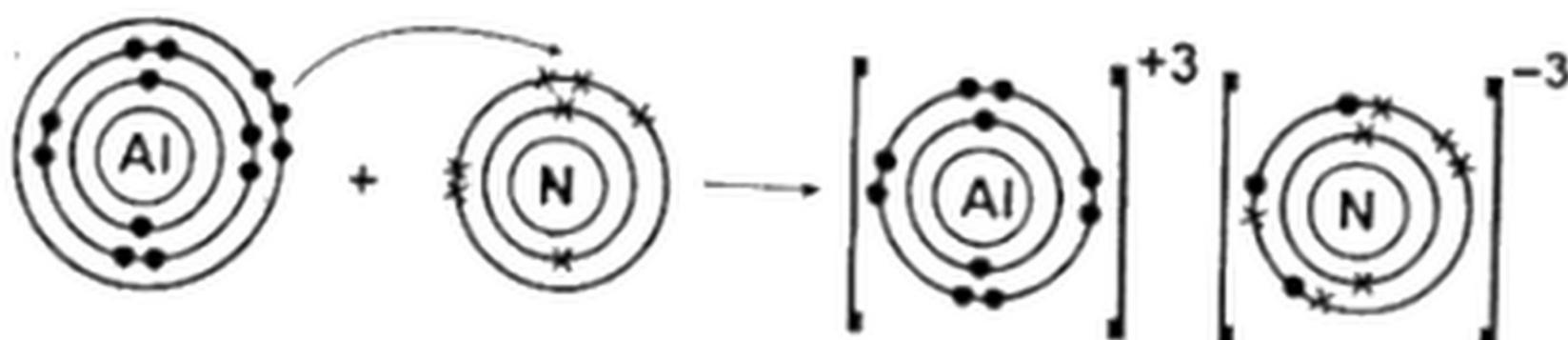
Ca atom has two electrons in outermost shell. It loses two electrons to form Ca^{+2} ion. Since S atom has six electrons in outermost shell, so it gains two electrons to form S^{-2} ion. For every Ca^{+2} ion we need S^{-2} ions.



(c) Al and N:

Al atom has three electrons in outermost shell. It loses three electrons to form Al^{+3} ion. Since N atom has five electrons in outermost shell, so it gains three electrons to form N^{-3} ion.

For every Al^{+3} ion we need N^{-3} ion.



Q.13: Recognize the following compounds as having ionic bonds.

(a) MgCl_2

(b) KBr

(c) NaI

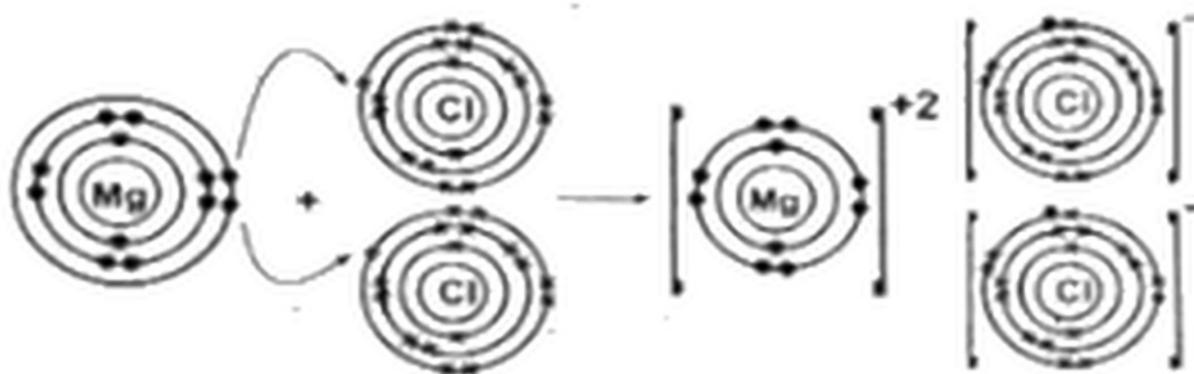
Ans:

(a) MgCl_2 :

Mg is metal and Cl is non-metal.

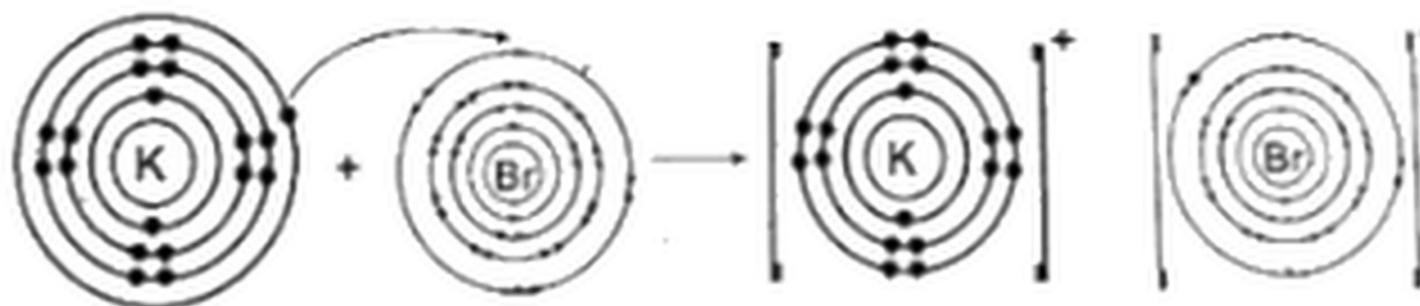
Mg atom has two electrons in outermost shell. It loses two electrons to form Mg^{+2} ion. Since Cl atom has seven electrons in outermost shell, so it gains one electron to form Cl ion.

For every Mg^{+2} ion we need two Cl ions.



(b) KBr :

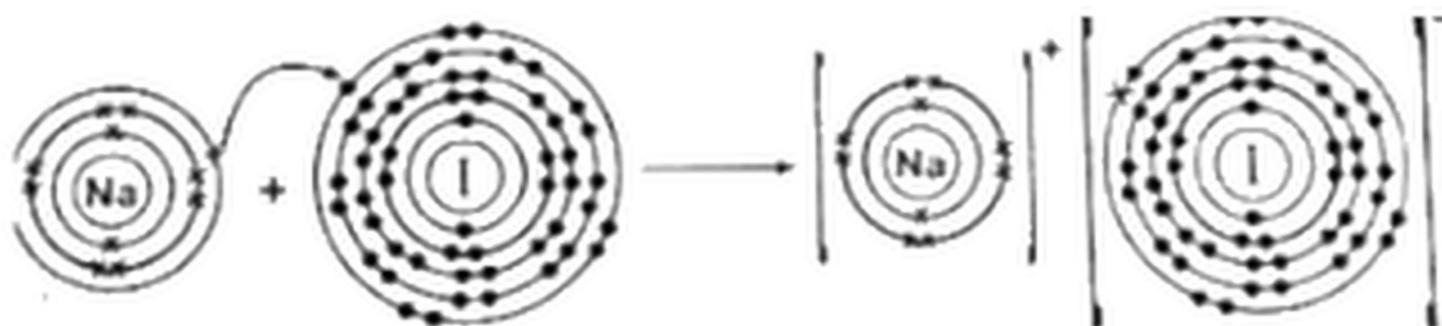
Metal atom tends to lose electrons and non-metal atoms tends to gain electrons to acquire electronic configuration of nearest noble gas. Since K atom has one electron in the outer most shell. Its losses one electron to form K^+ ion. Since Br atom has seven electrons in outermost shell, it needs one electron to complete octet. So, it gains one electron to form Br^- ion. For every K^+ ion, we need one Br^- ion



(c) NaI:

Na is metal and I is non-metal,

Metal atom tends to lose electrons and non-metal atoms tends to gain electrons to acquire electronic configuration of nearest noble gas. Since Na atom has one electron in the outer most shell, It losses one electron to form Na^+ ion. Since I atom has seven electrons in outermost shell, it needs one electron to complete octet. So it gains one electron to form I^- ion. For every Na^+ ion, you need one I^- ion.



Q.14: An atom of an element has atomic number 9 and mass number 19.

(b) State the number of electrons in this atom.

(c) Show with electron cross-dot diagrams, the formation of ions in the reaction of this atom with sodium atom.

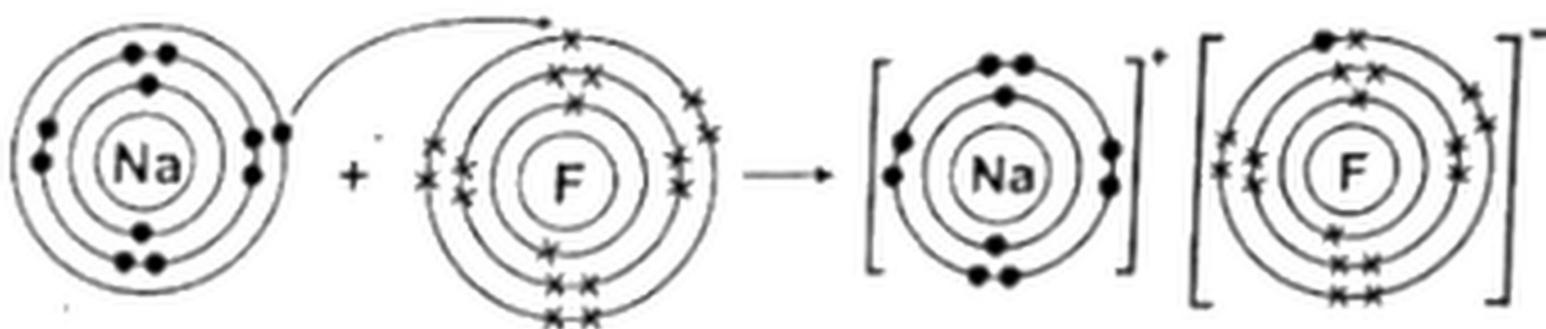
Ans:

a. Number of protons = Atomic number = $Z = 9$

Number of protons = Atomic mass - Atomic number = $A - Z = 19 - 9 = 10$

b. Number of electrons = Atomic number = $Z = 9$

c. Since atomic number = $Z = 9$ therefore element is fluorine.



Q.15: Is there a need for more adhesives?

Ans: Yes, there is a need for more adhesive. The adhesive action of paints and dyes is developed due to hydrogen bonding.

Q.16: What is the importance of glues and adhesives in our society?

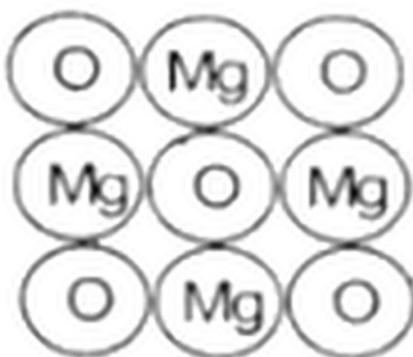
Ans: An adhesive or stick on is a material, usually in a liquid or semi-liquid state, that adheres or bonds items together. Adhesives come from either natural or synthetic sources. The types of materials that can be bonded are vast but they are especially useful for bonding thin materials. Adhesives cure (harden) by either evaporating a solvent or by chemical reactions that occur between two or more constituents.

Adhesives are advantageous for joining thin or dissimilar materials, minimizing weight, and when a vibration-damping joint is needed. A disadvantage of most adhesives is that most do not form an instantaneous joint, unlike many other joining processes, because the adhesive needs time to cure.

Resins are widely used to paint dams, bridges, buildings and automobiles.

Think-Tank

1: Magnesium oxide is a compound made up of magnesium ions and oxide ions.



- What is the charge on these ions?
- How these ions get these charges.
- Show with electron cross-dot diagrams the formation of these ions.

Ans:

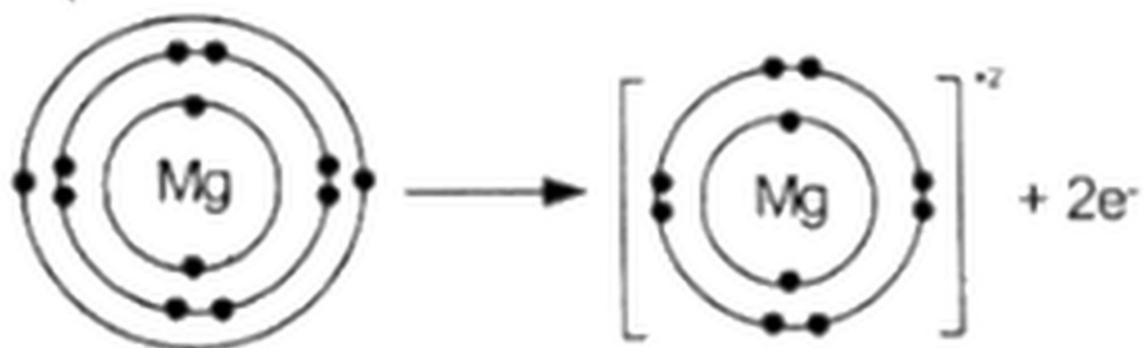
(a) Mg^{+2} and O^{-2}

(b) Mg^{+2} ion is formed by losing two electrons whereas O^{-2} ion is formed by gaining two electrons.

(c) Formation of Mg^{+2} ion.

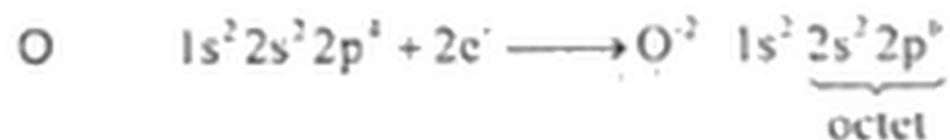


We can also represent this by electron dot structure.



Formation of anion by oxygen atom (O²⁻).

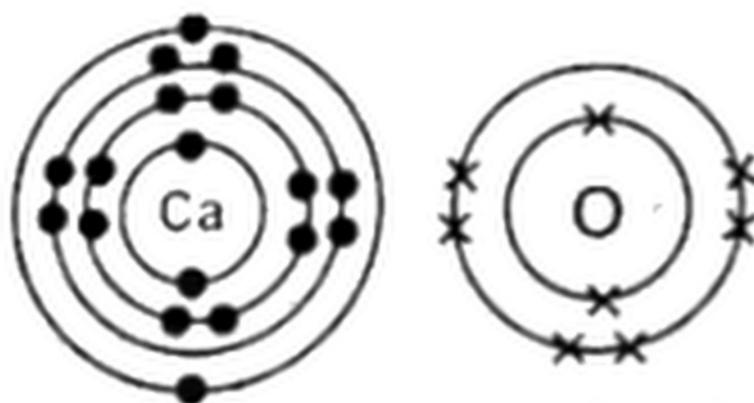
Oxygen belongs to Group. VIA on the periodic table. So, it has six electrons in its valence shell. It needs two electrons to achieve noble gas configuration.



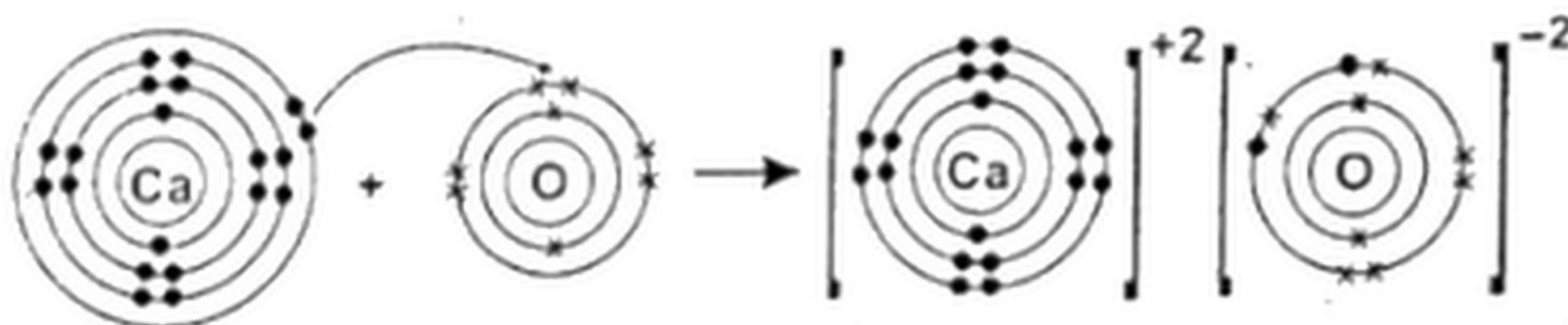
We can also represent this by electron dot structure,



2: The diagrams below show the electronic structures of an atom of calcium and an atom of oxygen.



Ans:

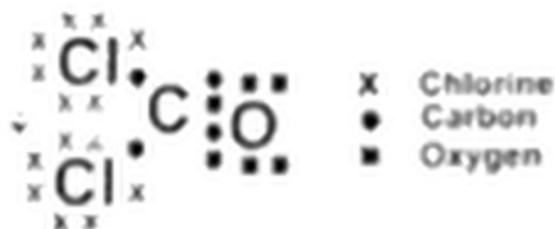


3: Draw electron cross and dot structure for the following molecules:

- (a) COCl_2 a poisonous gas called phosgene that has been used in World War II.
- (b) HOCl , hypochlorous acid is unstable, decomposes to liberate atomic oxygen that makes HOCl a strong oxidizing agent.

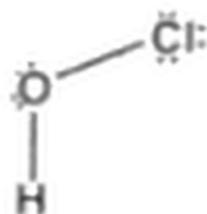
Ans:

(a) Phosgene COCl_2 (Carbonyl chloride):



(b) HOCl (Hypochlorous acid):

Bleach component:



4: The table below shows the properties of four substances:

Substance	Melting point	Electrical Conductivity	
		In solid state	In molten state
A	High	NIL	NIL
B	High	NIL	Good
C	Low	NIL	NIL
D	High	Good	Good

- a) Which substance is a metal?
- b) Which substance is an ionic compound?
- c) Which substance is a covalent compound?
- d) Which substance is a non-metal?

Ans: (a) Substance D is metal because metal conducts electricity in solid or molten state and also has high melting points

(a) Substance B is an ionic compound because ionic compound does not conduct electricity in solid state but they are good conductor in molten state. They have high melting points (e.g. NaCl).

(b) Substance C is a covalent compound because it does not conduct electricity in solid or molten state and has low melting point.

(c) Substance A is a nonmetal which has high melting point and non-conductor in solid or molten state. (e.g. allotropic of carbon diamond)

5: Electronic configuration of two elements X and Y are given below:



Which of the following compounds is likely to form when X and Y react?

Explain.

- (a) A covalent compound of formula XY_2
- (b) An ionic compound of formula XY_2
- (c) An ionic compound of formula XY
- (d) An ionic compound of formula X_2Y

Solution:

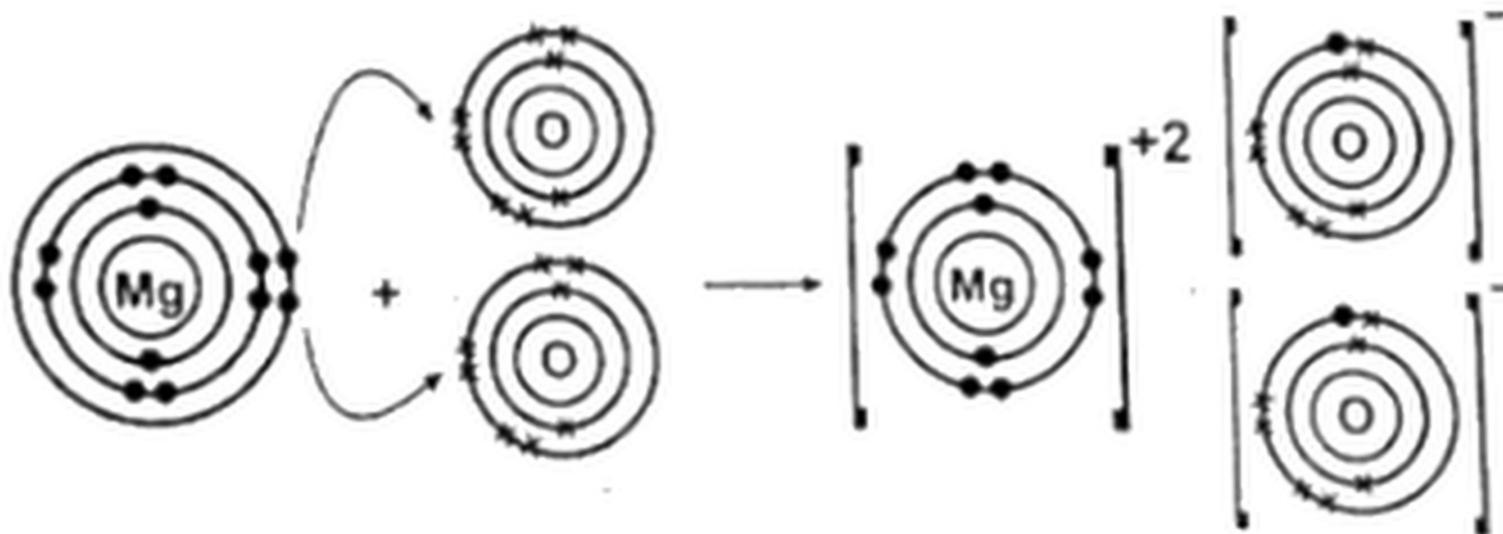
Option (C) is the correct answer. Because X loses 2 electrons from valence shell to form X^{+2} . Whereas Y gains 2 electrons to complete its octet and form Y^{2-} . So ionic compound of formula XY is formed.



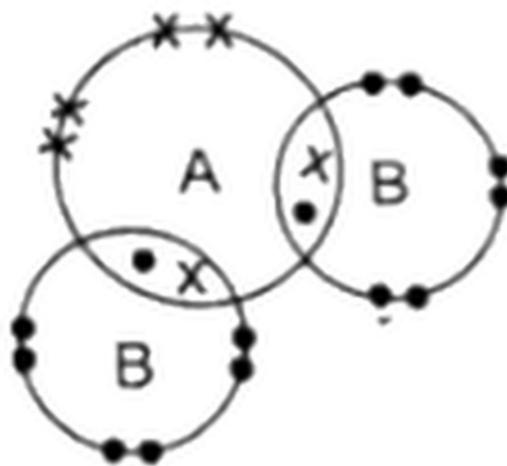
(Atomic number of element X = 12. the name of element is magnesium)



(Atomic number of element Y = 8. the name of element is oxygen)



6: The following figure shows the electron dot and cross diagram of molecule



Ans: The name of element A is oxygen because it contains six electrons in its valance shell. (Group VIA) The name of element B is bromine because it contains seven electrons in its valance shell. (Group VIIA) Element A is oxygen and B is bromine. The molecule formed is bromine monoxide (Br_2O) or Cl_2O .

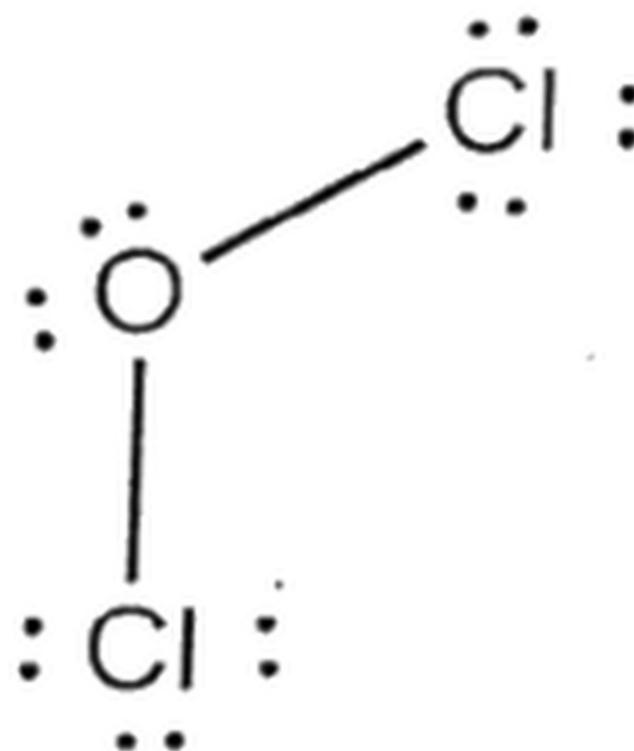
OR

Element A is oxygen and B is chlorine.

Formula: Cl_2O (Dichlorine monoxide)

Molar mass: 86.9054 g/mol

Dichlorine monoxide, Cl_2O , also known as oxygen dichloride, Dichlorine oxide, or chlorine oxide, is a chlorine oxide. It is a brownish-yellow gas at room temperature which can explode in high concentrations when exposed to heat or sparks.



7: What is the total number of shared electrons in a molecule of CO_2 ?

Ans:



Total number of shared electrons in $\text{CO}_2 = 4 + 4 = 8$

