

9. VALENCY AND IONS

SOLUTIONS

TEACHING TASK

JEE MAINS LEVEL QUESTIONS

Multiple Choice Question Type:

1. Valency electrons and valency respectively in Ar
A) 7,0 B) 8,0 C) 0,7 D) 0,82.

Answer:B

Solution:Argon (Ar) is a noble gas with 8 valence electrons and a valency of 0 because it has a complete octet.

2. A tripositively charged ion of an element 'X' has the same number of electrons as in trinegatively charged N^{3-} . Then identify 'X'.
A) Cu B) Al C) Mg D) Si

Answer:B

Solution:Let the atomic number of 'X' be Z.

Tripositive ion: X^{3+}

Electrons = $Z-3$

Trinegative ion of nitrogen (N^{3-})

Electrons = $7 + 3 = 10$

Thus, $Z-3=10$

$Z=13$, which is Aluminum (Al).

3. The cation present in Al_2O_3 is
A) Al^{2+} B) Al^{+} C) Al^{3+} D) Al^{4+}

Answer:C

Solution:In Al_2O_3 , aluminum has a +3 valency (Al^{3+}), and oxygen has a -2 valency (O^{2-}).

4. Variable valency is exhibited, since electrons are lost from an element from the _____ shell. (valence / penultimate)
A) Valence Shell B) Penultimate Shell
C) Both D) None

Answer:C

Solution:Variable valency is shown by elements (especially transition elements) because:Electrons can be lost from the valence shell (outermost shell).

Electrons can also be lost from the penultimate shell (second outermost shell), particularly the (n-1)d subshell.

5. Valency of tin in $SnCl_2$ and $SnCl_4$ is
A) 3,2 B) 2,3 C) 3,4 D) 2,4

Answer:D

Solution:Tin (Sn) exhibits +2 (stannous) and +4 (stannic) valencies.

6. The valencies of the underlined elements or radicals in the following compounds.
 $\underline{Na}_2O$, $\underline{P}Cl_5$, $\underline{Ca}O$, $\underline{Al}(OH)_3$
A) 1,5,2,1 B) 2,5,2,3 C) 2,3,2,1 D) 1,5,2,3

Answer:D

Solution: $\text{Na}_2\text{O} \rightarrow \text{Na}$ has valency 1

$\text{PCl}_5 \rightarrow \text{P}$ has valency 5

$\text{CaO} \rightarrow \text{Ca}$ has valency 2

$\text{Al}(\text{OH})_3 \rightarrow \text{Al}$ has valency 3

7. Which of the following electronic configuration is not wrong ?

A) Be (3) = 2, 1

B) O (8) = 2, 6

C) S (16) = 2, 6, 8

D) Ca (20) = 2, 8, 10

Answer:B

Solution: Oxygen (O) has 8 electrons, and its correct configuration is 2,6.

Other options are wrong:

Be (4) should be 2,2 (not 2,1).

S (16) should be 2,8,6 (not 2,6,8).

Ca (20) should be 2,8,8,2 (not 2,8,10).

8. Which of the following statement is correct

A) Nickel ion is a Divalent ion

B) Antimonous ion is a Trivalent ion

C) Ammonium ion is a Monovalent ion

D) All the above

Answer:D

Solution: A) Nickel ion (Ni^{2+}) is divalent.

B) Antimonous ion (Sb^{3+}) is trivalent.

C) Ammonium ion (NH_4^+) is monovalent.

9. A neutral atom of an element has a nucleus with a nuclear charge 13 times and mass 27 time that of hydrogen nucleus. How many electrons would be in its stable positively charged ion

A) 27

B) 14

C) 13

D) 10

Answer:D

Solution: Nuclear charge = 13 $\rightarrow$ Atomic number (Z) = 13 (Aluminum).

Stable positively charged ion of Al is Al^{3+} .

Electrons in $\text{Al}^{3+} = 13 - 3 = 10$.

JEE ADVANCED LEVEL QUESTIONS

Multiple Correct Answer Type:

10. Which of the following statement are wrong ?

A) An atom is electrically neutral

B) An atom & its ion have an unequal number of protons

C) The size of a cation is smaller than that of corresponding atom

D) An atom & its corresponding anion have equal number of electrons

Answer:B,D

Solution: A) An atom is electrically neutral $\rightarrow$ Correct (Protons = Electrons).

B) An atom & its ion have an unequal number of protons $\rightarrow$ Wrong (Ions have the same protons but different electrons).

C) The size of a cation is smaller than that of the corresponding atom $\rightarrow$ Correct (Loss of electrons reduces size).

D) An atom & its corresponding anion have an equal number of electrons → Wrong (Anion has more electrons).

11. Which of the following statements are correct

A) Atom can be converted into anion by gaining electrons.

B) Valency and valency shell electrons gives the same meaning.

C) Noble gases are stable regarding chemical reactions.

Answer:A,C

Solution:A) Atom can be converted into an anion by gaining electrons → Correct (e.g., $\text{Cl} \rightarrow \text{Cl}^-$).

B) Valency and valency shell electrons give the same meaning → Wrong (Valency = combining capacity, not just electron count).

C) Noble gases are stable regarding chemical reactions → Correct (Full octet makes them inert).

12. Which of the following atomic numbers shows Valency of 2

A) 4

B) 14

C) 12

D) 20

Answer:A,C,D

Solution:A) 4 (Beryllium, Be) → Electronic config: 2,2 → Valency = 2.

B) 14 (Silicon, Si) → Electronic config: 2,8,4 → Valency = 4 (not 2).

C) 12 (Magnesium, Mg) → Electronic config: 2,8,2 → Valency = 2.

D) 20 (Calcium, Ca) → Electronic config: 2,8,8,2 → Valency = 2.

Elements with valency 2: A (Be), C (Mg), D (Ca)

Statement Type :

A) Both statement I and II are correct and statement II is correct explanation of statement I.

B) Both statement I and II are correct and statement II is not correct explanation of statement I.

C) Statement I is correct and statement II is incorrect.

D) Statement I is incorrect and statement II is correct.

13. **Statement I** : Halogens have 7 Valence electrons

Statement II : Halogens shows valency 7

Answer:C

Solution:Statement I (Correct): Halogens (Group 17) have 7 valence electrons.

Statement II (Incorrect): Halogens do not show valency 7; instead, they typically gain 1 electron to achieve stability (valency = 1).

14. **Statement I** : Elements having 1, 2 or 3 valency electrons are metals

Statement II : Hydrogen has valency 1

Answer:B

Solution:Statement I (Correct): Most elements with 1, 2, or 3 valence electrons are metals (e.g., Na, Mg, Al).

Statement II (Correct): Hydrogen indeed has valency 1.

Comprehension Type:

Comprehension-1

A neutral atom of an element has a nucleus with nuclear charge 11 times and mass 23 times that of hydrogen.

15. Write the electronic configuration of the element

A) 2, 1

B) 2, 8, 1

C) 2, 8

D) 2, 8, 8, 3

Answer:B

Solution:Sodium (Na, Z=11) has 11 electrons in a neutral atom.

Its electronic configuration is:2, 8, 1

16. Find the ratio of electrons to protons present in its stable ion

- A) 1 : 1 B) 5 : 6 C) 10 : 11 D) 12 : 11

Answer:C

Solution:Sodium forms a stable ion (Na^+) by losing 1 valence electron.

Protons (p^+): 11 (unchanged, since atomic number = 11).

Electrons (e^-) in Na^+ : $11 - 1 = 10$.

Ratio ($\text{e}^- : \text{p}^+$) = 10 : 11.

Comprehension-II

When an atom loses one or more electrons to get stability, The number of electrons lost by an atom of an element is its Positive valency and the ion is called Cation or Electropositive ion. Mono, Di, Tri and Tetravalent ions are formed by losing of 1,2,3,4 electrons respectively

17. Which of the following element exist as only trivalent ions

- A) Arsenic B) Cobalt C) Gold D) Boron

Answer:D

Solution:Boron (B) typically forms trivalent ions (B^{3+}) because it has 3 valence electrons and loses all three to achieve stability (e.g., in compounds like B_2O_3).

Other options:

A) Arsenic (As) $\rightarrow$ Forms both +3 (As^{3+}) and +5 (As^{5+}) ions.

B) Cobalt (Co) $\rightarrow$ Shows +2 (Co^{2+}) and +3 (Co^{3+}) valencies.

C) Gold (Au) $\rightarrow$ Exhibits +1 (Au^+) and +3 (Au^{3+}) valencies.

18. Which of the following element shows multiple valencies

- A) Barium B) Aluminium C) Carbon D) Zinc

Answer:C

Solution:Carbon (C) exhibits multiple valencies due to its ability to form covalent bonds with variable sharing of electrons (e.g., +4 in CO_2 and -4 in CH_4).

Other options:

A) Barium (Ba) $\rightarrow$ Only +2 (Ba^{2+}) valency.

B) Aluminium (Al) $\rightarrow$ Only +3 (Al^{3+}) valency.

D) Zinc (Zn) $\rightarrow$ Only +2 (Zn^{2+}) valency.

Integer Answer Type:

19. Valency Exhibited by Nitrogen in N_2O_5 is _____

Answer:5

Solution: N_2O_5

$\text{N}=\text{x}, \text{O} = -2$

$2\text{x} + 5(-2) = 0$

$2\text{x} = 10$

$\text{x} = 10/2 = 5$

Matrix Matching Type:

20.

Column I**Element**

A) Lead

B) Carbon

C) Cobalt

D) Mercury

A) A-R B-R C-P D-Q

C) A-S B-P,Q C-R D-P

Column II**Valency**

P) 2,3

Q) 1,2

R) 2,4

S) 3,4

B)A-R B-R C-S D-P

D)A-S B-P,Q,R,S C-R D-Q

Answer:A

Solution:

Element

A) Lead

B) Carbon

C) Cobalt

D) Mercury

Valency

R) 2,4

R) 2,4

P) 2,3

Q) 1,2

LEARNERS TASK**CONCEPTUAL UNDERSTANDING QUESTIONS (CUQ's)****Multiple Choice Question Type:**1. Fe^{3+} will be pronounced as

A) Ferrous

B) Iron

C) Ferric

D) Ionic

Answer:C

Solution: Fe^{3+} is the ferric ion (higher oxidation state of iron), while Fe^{2+} is the ferrous ion.

2. Which of the following contains positive charge

A) Ammonium

B) Nitrogen

C) Oxide

D) Argon

Answer:A

Solution: Ammonium is a positively charged polyatomic ion (NH_4^+)

3. Reason for variable valency

A) Outer orbit contains different electrons in different conditions

B) Along with valence electrons, inner electrons also participate under such conditions

C) Nuclear charge changes, so attraction decreases in certain conditions

D) All the above

Answer:D

Solution: Variable valency occurs due to:

Different electron configurations (A).

Participation of inner electrons (B).

Changes in nuclear attraction (C).

4. The valency of hydrogen is one in NH_3 . What is the valency of nitrogen
A) 1 B) 2 C) 3 D) 4

Answer:C

Solution: In NH_3 , nitrogen forms 3 bonds with hydrogen (H_3), so its valency is 3.

5. The valency of nitrogen is
A) 1 B) 3 C) 5 D) both B, C

Answer:D

Solution: Nitrogen shows variable valency:

3 (e.g., NH_3 , N_2O_3).

5 (e.g., HNO_3 , N_2O_5).

6. The electronic configuration of calcium with atomic number 20, is
A) 2, 8, 10 B) 2, 9, 9 C) 2, 8, 8, 2 D) 2, 10, 8

Answer:C

Solution: Calcium's configuration is 2 (K), 8 (L), 8 (M), 2 (N).

7. Which of the following elements (atomic number given in brackets) have valency 2 ?
A) C (6) B) P (15) C) Mg (12) D) Ar (18)

Answer:C

Solution: Mg (12): 2,8,2 $\rightarrow$ Valency = 2.

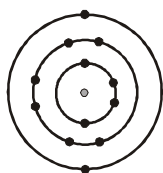
Others:

C (6): 2,4 $\rightarrow$ Valency = 4.

P (15): 2,8,5 $\rightarrow$ Valency = 3 or 5.

Ar (18): Noble gas $\rightarrow$ Valency = 0

8. Given figure represents an atom of



- A) chlorine B) magnesium C) calcium D) Wrong structure

Answer:D

Solution: The diagram shows an impossible electron arrangement.

9. Valence electrons and valency respectively in calcium
A) 2, 1 B) 2, 2 C) 8, 2 D) 2, 8

Answer:B

Solution: Calcium (atomic number 20) has electron configuration: 2,8,8,2

It has 2 valence electrons (outermost shell)

Its valency is 2 because it tends to lose these 2 electrons to achieve stability

10. Two atoms of hydrogen combine with one atom of oxygen to form a molecule of water. The valency of hydrogen is

- A) 3 B) 1 C) 2 D) 4

Answer:B

Solution: In H_2O , each hydrogen atom shares 1 electron with oxygen

Oxygen has valency 2 (needs 2 electrons)

Therefore, two hydrogen atoms (each with valency 1) satisfy oxygen's requirement

JEE MAINS LEVEL QUESTIONS

Multiple Choice Question Type:

1. Number of electrons present in ammonium ion are
A) 9 B) 10 C) 11 D) 12

Answer:B

Solution: Nitrogen (N) has 7 electrons, 4 hydrogens (H) have 1 each $\rightarrow$ Total = $7 + 4 = 11$.

NH_4^+ has a +1 charge, so it loses 1 electron $\rightarrow 11 - 1 = 10$ electrons.

2. The electronic configuration of an element X is 2, 8, 7.
A) O_2 B) H_2 C) Cl D) Ne

Answer:C

Solution: 2, 8, 7 configuration matches chlorine (atomic number 17).

3. The anion is usually
A) larger in size than consecutive atom
B) smaller in size than consecutive atom
C) same in size than consecutive atom
D) None of the above

Answer:A

Solution: Anions gain electrons, increasing electron-electron repulsion and expanding the electron cloud.

4. Valency of Iron in FeCl_2 and FeCl_3 is
A) 3, 2 B) 2, 3 C) 3, 4 D) 2, 4

Answer:B

Solution: In FeCl_2 , iron has a +2 valency (ferrous).

In FeCl_3 , iron has a +3 valency (ferric).

5. Valency of sulphur in SO_2 and SO_3 is
A) 4, 6 B) 6, 4 C) 2, 3 D) 3, 2

Answer:A

Solution: In SO_2 , sulphur shows +4 valency.

In SO_3 , sulphur shows +6 valency.

6. Valency of carbon in $\text{CH}_4, \text{C}_2\text{H}_6, \text{C}_2\text{H}_4, \text{C}_2\text{H}_2$ is
A) 1, 2, 3, 4 B) 4, 3, 4, 2 C) 4, 6, 4, 2 D) 4, 4, 4, 4

Answer:D

Solution: CH_4 (Methane): Carbon forms 4 single bonds with hydrogen $\rightarrow$ Valency = 4.

C_2H_6 (Ethane): Each carbon forms 3 bonds with hydrogens + 1 bond with the other carbon $\rightarrow$ Valency = 4.

C_2H_4 (Ethylene): Each carbon forms 2 bonds with hydrogens + 1 double bond with the other carbon $\rightarrow$ Valency = 4 (double bond counts as 2 bonds).

C_2H_2 (Acetylene): Each carbon forms 1 bond with hydrogen + 1 triple bond with the other carbon $\rightarrow$ Valency = 4 (triple bond counts as 3 bonds).

7. How many times greater is the valency of N in NH_3 than that of Cl in HCl?
A) 2 B) 3 C) 4 D) 5

Answer:B

Solution:Nitrogen in NH_3 has a valency of 3.

Chlorine in HCl has a valency of 1.

Ratio: $3/1 = 3$ times greater.

8. Which of the following is a Divalent Radical

- A) Phosphonium B) Stannous C) Aurous D) Arsenous

Answer:B

Solution:Stannous refers to tin (Sn) with a +2 valency.

9. A trivalent cation of an element contains 10 electrons. The atomic number of the element is -

- A) 10 B) 7 C) 13 D) None of these

Answer:C

Solution:Let atomic number = Z.

Trivalent cation: $Z - 3 = 10 \rightarrow Z = 13$ (Aluminium).

10. Which of the following electronic configuration represents a noble gas ?

- A) 2, 8, 2 B) 2, 8, 6 C) 2, 8 D) 2, 8, 8, 2

Answer:C

Solution:Neon (Ne) has the configuration 2, 8, matching a noble gas.

11. Name and atomic number of an element whose atom has the electronic configuration 2, 8, 4.

- A) Aluminium - 13 B) Sulphur - 14
C) Silicon - 14 D) Phosphorus-15

Answer:C

Solution: $2 + 8 + 4 = 14$ electrons $\rightarrow$ Atomic number 14 (Silicon).

JEE ADVANCED LEVEL QUESTIONS**Multiple Correct Answers Type:**

12. Valency is a

- A) Number of electrons gained B) Number of electrons lost
C) Number of electrons shared D) Valency electrons

Answer:A,B,C

Solution:Valency refers to the ability of an atom to gain, lose, or share electrons to achieve stability

13. Which of the following statements is not correct about Electropositive ions

- A) The number of electrons in electropositive ions are less in number than protons due to loss of electrons
B) The Size of the Electropositive ion is considerably more than a neutral atom due to increase of attractions of Protons on electrons left after forming ion.
C) Size of the Electropositive ion is directly proportional to number of electrons lost for a particular element.

Answer:B,C

Solution:A) Correct Statement:Electropositive ions (cations) lose electrons, so electrons < protons (e.g., Na^+ has 10 e^- vs. 11 p^+).

B) Incorrect Statement:Size of cations is smaller than neutral atoms (due to loss of electron shells, increasing proton-electron attraction). The statement falsely claims cations are "larger."

C) Incorrect Statement: Size of cations is inversely proportional to electrons lost (more electrons lost = smaller ion size). The statement wrongly suggests a direct proportionality.

Comprehension Type:

Comprehension-1

A neutral atom of an element has a nucleus with nuclear charge 11 times and mass 23 times that of hydrogen.

14. The element can form a stable charged ion by
- | | |
|-----------------------|------------------------|
| A) losing 1 electron | B) losing 2 electrons |
| C) gaining 1 electron | D) gaining 2 electrons |

Answer:A

Solution: Sodium achieves stability by losing 1 valence electron to attain a noble gas configuration (2, 8).

Result: Na^+ ion (10 electrons, stable octet).

Comprehension-II

When an atom loses one or more electrons to get stability, The number of electrons lost by an atom of an element is its Positive valency and the ion is called Cation or Electropositive ion. Mono, Di, Tri and Tetravalent ions are formed by losing of 1,2,3,4 electrons respectively

15. Which of the following element exist as both Bivalent and trivalent ions
- | | | | |
|--------|--------------|------------|------------|
| A) Tin | B) Manganese | C) Arsenic | D) Mercury |
|--------|--------------|------------|------------|

Answer:B

Solution: Manganese is a transition metal with variable valency.

Common oxidation states: +2 (Mn^{2+}) and +3 (Mn^{3+}).

Example compounds:

MnCl_2 (Mn^{2+})

Mn_2O_3 (Mn^{3+})

Integer Answer Type:

16. Valency of Mercuric ion is_____

Answer:2

Solution: Mercuric ion = Hg^{2+} (higher oxidation state of mercury).

Valency = +2 (e.g., in HgCl_2).

17. Valency of Plumbic ion is_____

Answer:4

Solution: Plumbic ion = Pb^{4+} (higher oxidation state of lead).

Valency = +4 (e.g., in PbO_2).

18. Valency exhibited by Copper in its "-ic" condition is_____

Answer:2

Solution: Copper has two common ions:

Cuprous (Cu^+) $\rightarrow$ "-ous" = lower valency (+1).

Cupric (Cu^{2+}) $\rightarrow$ "-ic" = higher valency (+2).

19. Common valency exhibited by Tin and Lead is_____

Answer:2

Solution: Tin (Sn): Forms Stannous (Sn^{2+}) and Stannic (Sn^{4+}).

Lead (Pb): Forms Plumbous (Pb^{2+}) and Plumbic (Pb^{4+}).

Both show +2 valency in their "-ous" states (Sn^{2+} , Pb^{2+}).

Matrix Matching Type:

20.	Column I Element	Column II Valence electrons
	A) Sodium	P) 7
	B) Carbon	Q) 2
	C) Magnesium	R) 1
	D) Fluorine	S) 4

Answer: A-R, B-S, C-Q, D-P

Solution:

A) Sodium	R) 1
B) Carbon	S) 4
C) Magnesium	Q) 2
D) Fluorine	P) 7

KEY

Teaching Task

1	2	3	4	5	6	7	8	9	10
B	B	C	C	D	D	B	D	D	B,D
11	12	13	14	15	16	17	18	19	20
AC	ACD	C	B	B	C	D	C	5	A

Learners Task

CONCEPTUAL UNDERSTANDING QUESTIONS (CUQ's)

1	2	3	4	5	6	7	8	9	10
C	A	D	C	D	C	C	D	B	B

JEE MAINS & ADVANCED LEVEL

1	2	3	4	5	6	7	8	9	10
B	C	A	B	A	D	B	B	C	C
11	12	13	14	15	16	17	18	19	20
C	ABC	BC	A	B	2	4	2	2	R,S,Q,P