Ionic bond

1. State whether the following are ionic or covalent :

(i) Na_2S (ii) $SnCl_4$ (iii) diamond (iv) CaC_2 (v)NaH
(vi) C_2H_4 (vii) $CaCl_2$ (viii) HCl gas (ix) NH_4^+ (x) KBr

2. Indicate whether the following pairs of elements form ionic or covalent compounds and write down the molecular formula of the compound formed.

(i) Sodium and chlorine (ii) carbon and sulphur (iii) sulphur and oxygen (iv) calcium and hydrogen

3. What type of bonds are present in the following molecules ?

(i) MgF_2 (ii) BrCl (iii) CBr_4 (iv) H_2SO_4 (v) SO_2
(vi) HNO_3

4. Most predominantly ionic compounds are obtained by the combination of elements of the groups :

(A) 1 and 7 (B) 2 and 6 (C) 4 and 8 (D) 3 and 5

5. Which set have strongest tendency to form anions :

(A) Ga, In, Te (B) Na, Mg, Al (C) N, O, F (D) V, Cr, Mn

6. Which lewis dot structure for O^{2-} ion is correct–

(A)  (B) (C)  (D)

7. Which of the following bonds is most polar ?

(A) O – H (B) P – H (C) C – F (D) S – Cl

8. Two elements X and Y have following electronic configuration. X : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$ Y : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$,The expected compound formed by combination of X and Y will be expressed as-

(A) XY_2 (B) X_5Y_2 (C) X_2Y_5 (D) XY_5

9. The electronegativity of O,F,N, Cl and H are 3.5, 4.0, 3.0, 3.2 and 2.1 respectively.The strongest bond will be

(A) F – H (B) H – Cl (C) N – H (D) O – H

10. Ionic bonds are usually formed by combination of elements with

(A) high ionisation potential and low electron affinity (B) low ionisation potential and high electron affinity
(C) high ionisation potential and high electron affinity(D) low ionisation potential and low electron affinity

Lattice energy

11. For lattice energy the following statements are false :

(A) it increases with increase in charge on cation.
(B) it increases with increase in charge on anion.
(C) it increases with decrease in inter ionic distance
(D) it increases with increase in size of cations and anions.

12. Which of the following sequences represents the correct order of lattice energies ?

(A) LiI > LiBr < LiCl < LiF (B) KBr < KCl < KF < KI
(C) NaF < NaCl < NaBr > NaI (D) LiF > LiCl > LiBr > LiI

13. The correct expected order of decreasing lattice energy is

(A) CaO > $MgBr_2$ > CsI (B) $MgBr_2$ > CaO > CsI
(C) CsI > $MgBr_2$ > CaO (D) CsI > CaO > $MgBr_2$

14. Which of the following is the right order of lattice energy

(A) Na_2O < Al_2O_3 < MgO (B) MgO < Al_2O_3 < Na_2O
(C) Al_2O_3 < MgO < Na_2O (D) Na_2O < MgO < Al_2O_3

15. If it is known that on heating a ionic compound of a polyhalide with a cation it decomposese into more stable halide of that cation due to high lattice energy, for example $CsI_3 \xrightarrow{\Delta} CsI + I_2$

The complex compound Rb[IBrCl] after strong heating will

(A) RbI + BrCl (B) RbCl + IBr (C) RbBr + ICl (D) None

Hydration energy

16. Find the correct ionic mobility order-

(A) F^- (aq) > Cl^- (aq) (B) Li^+ (aq) > Be^{2+} (aq) (C) Ca^{2+} (aq) > Ba^{2+}(aq)(D) Li^+ (aq) < Al^{3+} (aq)

17. Choose the INCORRECT order of hydrated size of the ions -

(A) $F^{\ominus}_{(aq.)} > Cl^{\ominus}_{(aq.)} > Br^{\ominus}_{(aq.)} > I^{\ominus}_{(aq.)}$ (B) $Rb^{\oplus}_{(aq.)} > K^{\oplus}_{(aq.)} > Na^{\oplus}_{(aq.)} > Li^{\oplus}_{(aq.)}$

(C) $Na^{\oplus}_{(aq.)} > Mg^{2+}_{(aq.)} > Al^{3+}_{(aq.)}$ (D) $Be^{2+}_{(aq.)} > Mg^{2+}_{(aq.)} > Ca^{2+}_{(aq.)} > Sr^{2+}_{(aq.)}$

18. Find the INCORRECT ionic mobility order from the following options-

(A) $Be^{2+}_{(aq.)} < Li^{+}_{(aq.)}$ (B) $Mg^{2+}_{(aq.)} < Sr^{2+}_{(aq.)}$

(C) $Fe^{2+}_{(aq.)} < Fe^{3+}_{(aq.)}$ (D) $Br^{-}_{(aq.)} < I^{-}_{(aq.)}$

Polarisation (Fajan's rule)

19. Polarisibility of halide ions increases in the order

(A) F^-, I^-, Br^-, Cl^- (B) Cl^-, Br^-, I^-, F^- (C) I^-, Br^-, Cl^-, F^- (D) F^-, Cl^-, Br^-, I^-

20. Which of the following is most covalent ?

(A) AlF_3 (B) $AlCl_3$ (C) $AlBr_3$ (D) AlI_3

21. Among LiCl, $BeCl_2$, BCl_3 and CCl_4, the covalent bond character follows the order -

(A) LiCl < $BeCl_2$ > BCl_3 > CCl_4 (B) LiCl > $BeCl_2$ < BCl_3 < CCl_4

(C) LiCl < $BeCl_2$ < BCl_3 < CCl_4 (D) LiCl > $BeCl_2$ > BCl_3 > CCl_4

22. Which has maximum covalent character ?

(A) NaCl (B) $SiCl_4$ (C) $AlCl_3$ (D) $MgCl_2$

23. Choose the correct statement

(A) A cation with pseudo noble gas configuration is more polarising than the cation with noble gas configuration.

(B) Small cation has minimum capacity to polarise an anion.

(C) Small anion has maximum polarizability.

(D) None of these

24. Magnesium cation has plarisation power close to that of :-

(1) Li^+ (2) Na^+ (3) K^+ (4) Cs^+

25. Which of the following combination of ion will have highest polarisation :-

(A) Fe^{2+}, Br^- (B) Ni^{4+}, Br^- (C) Ni^{2+}, Br^- (D) Fe, Br^-

26. An ion without pseudo-inert gas configuration is :

(A) Ag^+ (B) Cd^{2+} (C) Zn^{2+} (D) Fe^{3+}

SIMILAR QUESTIONS BELONGS TO NCERT TEXT BOOK

Problem - 4.1, 4.2, 4.3

Excercise - 4.4, 4.5, 4.6, 4.12, 4.19, 4.20

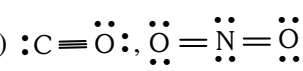
Lewis theory and formal charge

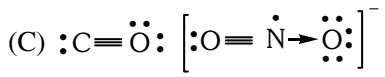
1. In ammonium ion, bond in between ammonia molecule and a proton is form by–

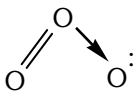
(A) Complete transfer of electron from NH_3 to H^+ (B) electrostatic attraction between NH_4^+ & H^+

(C) equal contribution of electrons by NH_3 & H^+ (D) One sided sharing of electrons

2. The correct structure of CO and NO_2^- are–

(A)  (B)

(C)  (D)

3. Lewis structure of O_3 is drawn as  : therefore formal charge on oxygen atoms are–

(A) 0, 0, 0 (B) 0, +1, –1 (C) 0, +1, +1 (D) –1, +1, –1

Paragraph for Q.4 to Q.5

The formal charge of an atom in a polyatomic molecule or ion may be defined as the difference between the number of valence electrons of that atom in an isolated or free state and the number of electrons assigned to that atom in the Lewis structure. It is

expressed as :

Formal charge [F.C.] on an atom in a Lewis structure = [total number of valence electron in the free atom] — [total number of non bonding (lone pair) electrons] — (1/2) [total number of bonding shared electrons]

4. Find the formal charge on "O" atom in given structure (I) & (II) respectively :

(I)  (II)

(A) –1, –1 (B) –2, 0 (C) –1, 0 (D) 0, –1

5. Select correct about CO_3^{2-} carbonate ion in one of the lewis structure based on the presence of two single bonds and one double bond between carbon and oxygen atoms :

(A) Total number of lone pair = 8

(B) Formal charge on two oxygen = –1 and one oxygen = zero

(C) Oxidation number of C = +4 & Formal charge on C = zero

(D) All are correct

6. The Lewis theory does not account for the–

(A) cause of bond formation (B) Shape of molecules

(C) Strength of chemical bond (D) All

7. Draw the Lewis structure and find Formal charge of each atom:

1.	CO	2.	CO_2	3.	NO_2^-	4.	NO_3^-	5.	CCl_3^-	6.	$COCl_2$
7.	N_3^-	8.	O_3	9.	CH_3Cl	10.	NH_4^+	11.	NH_2Cl	12.	OCN^-
13.	CN^-	14.	SCN^-	15.	HCN	16.	HNC	17.	SiF_4	18.	$SnCl_3^-$

19. BF_4^-	20. BH_4^-	21. BeF_4^{2-}	22. H_3O^+	23. SO_3	24. SO_2
25. CO_3^{2-}	26. NO_2Cl	27. NOCl	28. F_2O	29. SO_4^{2-}	30. PO_4^{3-}
31. SF_2	32. CF_4	33. PF_5	34. PF_4^+	35. PCl_3	36. PCl_5
37. SI_2	38. SF_6	39. SO_4^{2-}	40. $POCl_3$	41. ClO_4^-	42. OF_2
44. NO_3^-	45. ClO_4^-	46. PCl_4^+	47. I_3^+	48. ClO_3^-	49. OCl_2
50. $SnCl_3^-$	51. HPO_3^{2-}	52. SO_3^{2-}	53. IO_3^-	54. XeO_3	55. NO_2^-

8. Which of the following species does not obey octet rule ?

(A) SiF_4 (B) PCl_5 (C) ICl (D) BF_4

9. Hypervalent compound is(are) :

(A) SO_3 (B) PO_4^{-3} (C) SO_4^{-2} (D) All of these

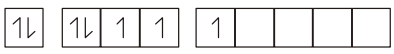
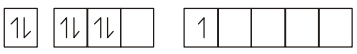
10. The octet rule is not valid for the molecule :

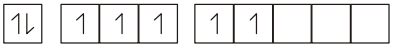
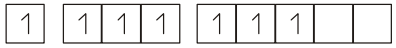
(A) CO_2 (B) H_2O (C) SF_2 (D) $Al_2(CH_3)_6$

11. In which of the excitation state of chlorine ClF_3 is formed

(A) In ground state (B) In triple excited state (C) In single excited state (D) In double excited state

12. Which of the following configuration shows second excitation state of Iodine

(A)  (B) 

(C)  (D) 

13. Highest extent of variable covalency is exhibited by.

(A) P and S (B) N and O (C) N and P (D) F and Cl

14. Which of the following species are hypervalent ?

(I) ClO_4^- (II) BF_3 (III) SO_4^{-2} (IV) CO_3^{-2}

(A) I, II, III (B) I, III (C) III, IV (D) I, III, IV

15. Find the number of isoelectronic species from the following having 14 electrons.

Mg^{2+} , Na^+, N^{3-} , S^{2-} , K^+, CN^- , N_2 , NO^+, PH_3, P^+

VBT based questions

16. A sigma bond is formed by the overlapping of

(A) s-s orbital alone (B) s and p orbitals alone

(C) s–s, s–p or p–p orbitals along internuclear axis (D) p–p orbital along the sides

17. Which overlapping is involved in HCl molecule

(A) s–s overlap (B) p–p overlap (C) s–d overlap (D) s–p overlap

18. Which of the following bonds will have directional character

(A) Ionic bond (B) Metallic bond (C) Covalent bond (D) Both covalent & metallic

19. Which of the following compound is formed in the second excitation state of sulphur atom :

(A) SF_4 (B) SF_6 (C) SF_2 (D) None

SIMILAR QUESTIONS BELONGS TO NCERT TEXT BOOK

Excercise - 4.13, 4.19, 4.22, 4.23, 4.25, 4.26

1. Which is not a characteristic of π-bond

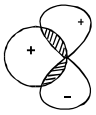
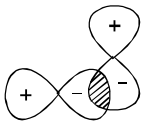
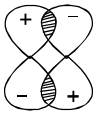
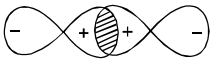
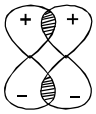
(A) π - bond is formed when a sigma bond already formed

(B) π - bond are formed from hybrid orbitals

(C) π - bond may be formed by the overlapping of p-orbitals

(D) π-bond results from lateral overlap of atomic orbitals

2. Which of the following atomic orbital overlappings would not lead to bond formation ?

(i)  (ii)  (iii)  (iv)  (v) 

(A) All (B) (i) (ii) (iii) (C) (i) (iii) (v) (D) (ii) only

3. Which of the following overlaps is **INCORRECT** [assuming z-axis to be the internuclear axis]

(a) $2p_y + 2p_y \rightarrow \pi\ 2p_y$ (b) $2p_z + 2p_z \rightarrow \sigma\ 2p_z$ (c) $2p_x + 2p_x \rightarrow \pi\ 2p_x$ (d) $2p_y + 3d_{xy} \rightarrow \pi(2p\text{-}3d)$

(A) 'a' & 'b' (B) 'b' & 'd' (C) only 'd' (D) None of these

4. Which of the following can lead to π-bond formation.

(A) d_{xy}-d_{yz} (B) d_{zx}-d_{zx} (C) d_{zx}-p_z (D) $d_{x^2-y^2} - p_x$

5. If the molecular axis is Z then which of the following overlapping is not possible.

(A) $p_z + p_z = \sigma$ bond (B) $p_x + p_y = \pi$ bond (C) $p_x + p_x = \pi$ bond (D) $p_y + p_y = \pi$ bond

6. Which of the following molecule(s) is/are having $2p\pi - 3d\pi$ bonding -

(A) SO_3 (B) NO_3^- (C) PO_4^{3-} (D) SO_4^{2-}

7. Strongest bond is formed by the head on overlapping of :

(A) 2s- and 2p- orbitals (B) 2p- and 2p- orbitals

(C) 2s- and 2s- orbitals (D) All

8. π bond is formed

(A) By overlapping of hybridised orbitals (B) Overlapping of s - s orbitals

(C) Head on overlapping of p -p orbitals (D) By p - p collateral overlapping

9. Weakest bond is formed by the orbital overlapping of

(A) $sp^2 - s$ (B) $sp^3 - p$ (C) $s - s$ (D) p – p co-lateral

10. Overlapping of 2 hybrid orbitals can lead to the formation of

(A) Ionic bond (B) π –bond (C) σ –bond (D) (B) and (C) both

11. Which of the following bonds is most stable ?

(A) 1s – 1s (B) 2p – 2p (C) 2s – 2p (D) 1s – 2p

12. Which of the following statements is not correct ?

(A) Double bonds is shorter than a single bond (B) σ – bond is weaker than a π bond

(C) Double bond is stronger than a single bond (D) Covalent bond is stronger than a hydrogen bond

13. Which of the following compounds has an atom without stable duplet or octet configuration ?

(A) NaCl (B) LiH (C) B_2H_6 (D) HF

14. Answer the following :

(i) What is the co-valency of carbon in C_2H_4 and C_2H_2 ?

(ii) What types of bonds and how many of each are present in NH_4^+ ?

15. The bonds present in N_2O_5 (g) are :

(A) only ionic (B) covalent and co-ordinate

(C) only covalent (D) covalent and ionic

16. The compound which contains both ionic and covalent bonds is :

(A) CH_4 (B) H_2 (C) KCN (D) KCl

17. Which one of the following molecules are formed by p-p overlapping ?

(A) Cl_2 (B) HCl (C) H_2O (D) NH_3

18. Find σ and π bonds in the following molecules :

(i) CH_3CH_3 , (ii) $CH_2 = CH_2$, (iii) $HC \equiv CH$, (iv) $CH_2 = CHCOOH$, (v) $C_2(CN)_4$ (vi) $H_2S_2O_8$ (vii) $H_2S_4O_6$

19. A sigma bond may be formed by the overlap of two atomic orbitals of atoms Aand B. If the bond is formed along the x-axis, which of the following overlaps is acceptable ?

(A) s orbital of A and p_z orbital of B (B) p_x orbital of A and p_y orbital of B

(C) p_z orbital of A and p_x orbital of B (D) p_x orbital of A and s orbital of B

20. The pair of compounds which can form a co–ordinate bond is.

(A) $(C_2H_5)_3B$ and $(CH_3)_3N$ (B) HCl and HBr

(C) BF_3 and NH_3 (D) (A) & (C) both

VSEPR theory based question

21. The shape of sulphate ion is

(A) Hexagonal (B) Square planar (C) Trigonal bipyramidal (D) Tetrahedral

22. In which following set of compound/ion has linear shape ?

(A) CH_4, NH_4^+, BH_4^- (B) CO_3^{-2}, NO_4^-, BF_3 (C) NO_2^+, CO_2, XeF_2 (D) $BeCl_2$, BCl_3, CH_4

23. Shape of a molecule having 4 bond pairs and two lone pairs of electrons, will be

(A) Square planar (B) Tetra hedral (C) Linear (D) Octa hedral

24. Hybridisation in $XeOF_2$, XeO_2F_2 is sp^3d. But shape will be respectively

(A) T, 'V' shape (B) T shape, distorted trigonal bipyramidal

(C) Both have T shape (D) T shape, irregular octahedral

25. The shape of IF_4^+ will be

(A) Square planar (B) See Saw (C) Pentagonal bipyramidal(D) Distorted tetrahedual

26. Which following compound, has four bond pair and one lone pair on central atom?

(A) NH_4^+ (B) ICl_4^- (C) SF_4 (D) XeF_4

27. A σ bonded molecule MX_3 is T–shaped. The number of non–bonding pairs of electrons is

(A) 0 (B) 2

(C) 1 (D) Can be predicted only if atomic number of M is known.

28. Incorrect code regarding shape is

(A) Linear : N_3^-, $(CN)_2$, ICl_2^- (B) Pyramidal : CH_3^-, NH_3, XeO_3

(C) Trigonal planar : $CH_3^{\oplus}$, CH_3, $CH_3^{\ominus}$ (D) Tetrahedral : SiH_4, NH_4^+ , XeO_4

29. In molecules of the type AX_2L_n (where L represents lone pairs and n is its number) there exists a bond between element A and X. The $\angle$ X A X bond angle.
(A) Always decreases if n increases (B) Always increases if n increases
(C) Will be maximum for n = 3, 0 (D) No effect of value of n

30. Which of the following pairs of species have identical shapes ?
(A) NO_2^+ and NO_2^- (B) PCl_5 and BrF_5 (C) XeF_4 and ICl_4^- (D) $TeCl_4$ and XeO_4

31. The shape of CFClBrI will be
(A) Irregular tetrahedral (B) Octahedral (C) See-saw (D) Trigonal bipyramidal

32. The structure of O_3 and N_3^- are -
(A) both linear(B) Linear and bent respectively. (C) both bent (D) Bent and linear respectively.

33. Which of the following shape can not be obtained from sp^3d^2 hybridisation.
(A) Square planar (B) Square pyramidal (C) Tetrahedral (D) Octahedral

Hybridisation

34. Hybridization of orbitals of carbon in CH_4 is necessary to explain which of the following ?
(A) Equality of strength of all C-H bonds (B) Methane is non-polar
(C) Tetravalency of carbon (D) Carbon has complete octate

35. The d- orbitals involved in sp^3d hybridisation is
(A) $d_{x^2-y^2}$ (B) d_{z^2} (C) d_{xy} (D) d_{xz}

36. Hybridization of 2^{nd} & 3^{rd} carbon in $CH{\equiv}C{-}CH{=}CH_2$ are respectively :-
(A) sp & sp^2 (B) sp^3 & sp^2 (C) sp^2 & sp (D) sp^2 & sp^2

37. Which of the following contains Co-ordinate and covalent bonds.
(a) $N_2H_5^+$ (b) H_3O^+ (c) HCl (d) H_2O Correct answer is
(A) a & d (B) a & b (C) c & d (D) Only a

38. Predict the hybridisation on the central atom of following molecules :

1. ICl_4^-	2. BeF_2	3. CO_2	6. BF_3	36. ICl_2^-
7. $CH_2 = CH_2$	9. HNO_3	10. HNO_2	11. SO_2	12. SO_3
13. HCO_3^-	14. CO_3^{-2}	15. NHO_4	16. $SnCl_2$	17. $AlCl_3$
18. CH_4	19. NH_4^+	20. BF_4^-	22.NF_3	23. PF_3
24. $AsCl_3$	25. NH_3	27. H_2O	28. OF_2	30. PCl_5
31. $SbCl_5$	32. SF_6	33. SeF_6	34. PF_6^-	37. ICl_5
38. XeF_4				

SIMILAR QUESTIONS BELONGS TO NCERT TEXT BOOK

Excercise - 4.33, 4.34, 4.36, 4.40

1. Which starred carbon atom in the following molecules does not show sp^2 hybridisation :

(A) CH_3C^*HO (B) CH_3C^*OCl (C) $(C^*H_3)_3N \rightarrow O$ (D) $CH_3C^*OCH_2C^*OOC_2H_5$

2. In which of the following 'N' atom is sp^2 hybridised

(A) NH_3 (B) NH_4^+ (C) $\overset{\ominus}{N}H_2$ (D) $B_3N_3H_6$

3. Carbon atoms in $C_2(CN)_2$ are :

(A) All sp-hybridised (B) sp^3, sp^2 ,sp—hybridised

(C) sp^2, sp, sp^3—hybridised (D) sp, sp^3 , sp^2—hybridised.

4. $BF_3 + F^- \rightarrow BF_4^-$

What is the hybridiation state of B in BF_3 and BF_4^- ?

(A) sp^2, sp^3 (B) sp^3, sp^3 (C) sp^2, dsp^2 (D) sp^2d, sp^2

5. In a change from $PCl_3 \longrightarrow PCl_5$, the hybrid state of P changes from

(A) sp^2 to sp^3 (B) sp^3 to sp^2 (C) sp^3 to sp^3d (D) sp^3 to dsp^2

6. In which of the following process hybridisation of the central atom changes -

(A) $H_2O + H^+ \longrightarrow H_3O^+$ (B) $NF_3 + F^+ \longrightarrow NF_4^+$

(C) $BF_3 + F^- \longrightarrow BF_4^-$ (D) $NH_3 + H^+ \longrightarrow NH_4^+$

7. Match the species in column (I) with that geometry in column (II)

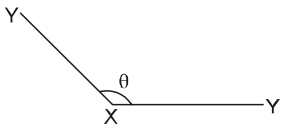
Column-I	**Column-II**
(P) BH_4^-	(1) 2 bond pair and 3 lone pair
(Q) ICl_2^+	(2) 4 bond pair and no lone pair
(R) ICl_2^-	(3) 3 bond pair and 1 lone pair
(S) ICl_4^-	(4) 2 bond pair and 2 lone pair
	(5) 4 bond pair and 2 lone pair

(A) P = 2; Q = 4; R = 3; S = 1 (B) P = 2; Q = 4; R = 1; S = 5

(C) P = 2; Q = 1; R = 5; S = 4 (D) P = 2; Q = 1; R = 3; S = 4

Dipole Moment.

10. Which bond angle θ would result in the maximum dipole moment for the triatomic molecule XY_2 shown below



(A) θ = 90° (B) θ = 120° (C) θ = 0° (D) θ = 180°

11. Which of the following molecule is/are non polar

(A) XeF_2 (B) PCl_3F_2 (C) XeF_4 (D) All

12. Which of the following molecule will not show zero dipole moment :

(A) CH_4 (B) CCl_4 (C) CO_2 (D) $CHCl_3$

13. The dipole moments of the given molecules are such that :

(A) $BF_3 > NF_3 > NH_3$ (B) $NF_3 > BF_3 > NH_3$ (C) $NH_3 > NF_3 > BF_3$ (D) $NH_3 > BF_3 > NF_3$.

14. Arrange in order of increasing dipole moment : BF_3, H_2S, H_2O.

15. In which type of molecule, the dipole moment may be non zero.

(A) AB_2L_2 (B) AB_2L_3 (C) AB_4L_2 (D) AB_4

Where A – Central atom, B – Bonded atom, L – Lone pair

16. A polar molecule AB have dipole moment 3.2 D (Debye) while the bond length is 1.6 Å. Find the percentage ionic character in the molecule.

(A) 31% (B) 41.6% (C) 39.6% (D) None of these

17.

Column–I	**Column–II**
(a) XeO_4^{2-}	(p) sp^3 with zero dipole moment
(b) PCl_2F_3	(q) sp^3d with nonzero dipole moment
(c) XeO_2F_2	(r) Shows resonance stability
(d) SO_4^{2-}	(s) No lone pair on central atom

18. Which of the following species is non polar with presence of polar bond and lone pair of electron on central atom.

(A) CO_2 (B) SF_4 (C) XeF_4 (D) CF_4

19. Which of the following molecule is planer as well as polar :

(A) PCl_3 (B) SF_4 (C) ClF_3 (D) None of thes

Hydrogen bond

20. The order of strength of hydrogen bond is :

(A) Cl–H....Cl > N–H....N > O–H....O > F–H....F (B) N–H....N > Cl–H....Cl > O–H....O > F–H....F

(C) O–H....O > N–H....N > Cl–H....Cl > F–H....F (D) F–H....F > O–H....O > N–H....N > Cl–H....Cl

21. Which one among the following does not have hydrogen bonds ?

(A) boric acid (solid) (B) N_2H_4 (liquid) (C) H_2O_2 (liquid) (D) C_6H_6 (liquid)

22. Which of the following substances does not exhibit H-bonding with water ?

(A) CH_3CH_2OH (B) $CH_3-\overset{\overset{O}{\|}}{C}-OH$ (C) $CH_3-CH_2-CH_3$ (D) $CH_3-\overset{\overset{O}{\|}}{C}-NH_2$

23. **I.** When ice is melted, hydrogen bond starts breaking, molecule of water come closer by moving into vacant space. As a result, density of water decreases upto 4°C.

II. Due to open cage like structure, ice has a relatively large volume for a given mass of liquid water.

III. In ice, there are four water molecules attached tetrahedrally.

Which of the above statement is/are true.

(A) I, II and III (B) I and III (C) II and III (D) II only

24. Which of the following conditions is required for the formation of the hydrogen bond

(A) Hydrogen atom should be bonded to a highly electronegative atom

(B) The size of electronegative atom should be small

(C) There should be a lone pair of electron on the electronegative atom.

(D) All of the above

25. ***Assertion :-*** Acetylene is not soluble in H_2O but is highly soluble in acetone.

Reason :- Acetylene forms intermolecular H-bond with acetone easily but not with H_2O as water molecules themselves are highly associated through intermolecular H-bonding.

(A) A (B) B (C) C (D) D

26. Match the column :-

Column–I	**Column–II**
(a) Chloral hydrate	(P) Form Zig-zag chain
(b) HF	(Q) Form 2–D–sheet structure
(c) H_3BO_3	(R) Have low volatility
(d) H_2SO_4	(S) Intramolecular H-bond
	(T) Inter molecular H-bond

27. The maximum possible number of hydrogen bonds in which H_2O_2 molecule can participate:-

(A) 6 (B) 4 (C) 5 (D) 8

28. ***Statement 1 :-*** Boiling point of HF is lesser than water.

Statement 2 :- Hydrogen bond strength is stronger in water.

(A) Statement-1 and Statement-2 are true, Statement-2 is a correct explanation of Statement-1.

(B) Statement-1 and Statement-2 are true, Statement-2 is not the correct explanation of Statement-1.

(C) Statement-1 is true and Statement-2 is false.

(D) Statement-1 is false and Statement-2 is true.

29. Which of following statement is incorrect :-

(A) Boiling point of H_2O_2 is greater than that of H_2O

(B) Ethylene glycol is less viscous than glycerol

(C) o–nitrophenol can be separated from its meta and para isomer using its steam volatile property

(D) In ice each 'O' atom is tetrahedrally arranged by four H-atom which are all covalently bonded.

31. When two ice cubes are pressed over each other, they unit to form one cube. Which of the following force is responsible for holding them together

(A) Vander Waal's forces (B) Hydrogen bond

(C) Covalent attraction (D) Dipole-dipole attraction.

32. Arrange the following gases in the increasing order of their intermolecular forces of attraction (CO_2 , H_2O , H_2):

(A) $H_2 < CO_2 < H_2O$ (B) $H_2O < CO_2 < H_2$ (C) $CO_2 < H_2O < H_2$ (D) $H_2O < H_2 < CO_2$.

33. Which is **<u>incorrect</u>** order for net dipole moment -

(A) HF > HCl > HBr > HI (B) $CH_3 – F > CD_3 – F$

(C) $SO_3 > SO_2$ (D) $CH_3 – CH = CHCl$ (cis) $> CH_3 – CH = CHCl$ (trans)

34. Classsify the type of force of attraction existing in the sample of following compounds :

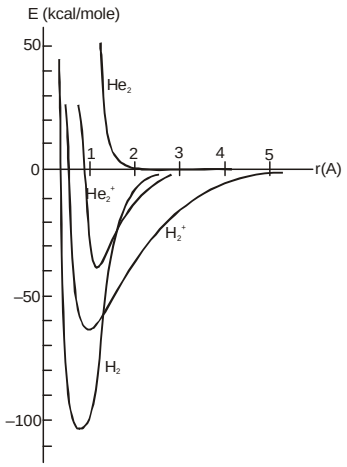
(i) $CH_3 — O — CH_3$	(ii) sugar	(iii) ice	(iv) $CH_3 CO CH_3$
(v) $CH_3 — OH$	(vi) $N(CH_3)_3$	(vii) gold	(viii) $CH_3 — NH_2$
(ix) H_2S	(x) (aq.) Na^+	(xi) CCl_4	(xii) diamond
(xiii) Cl_2	(xiv) NH_4Cl	(xv) HCl and Cl_2	(xvi) Ar

NCERT HOME WORK:

Exercise Q 4.16,4.22,4.23. Q 4.39

MOT

1. The following graph is given, between total energy and distance between the two nuclei for species H_2^+, H_2, He_2^+ & He_2, which of the following statements is correct :



(A) He_2^+ is more stable than H_2^+.

(B) Bond dissociation energy of H_2^+ is more than bond dissociation energy of He_2^+.

(C) Since bond orders of He_2^+ and H_2^+ are equal hence both will have equal bond dissociation energy.

(D) Bond length of H_2^+ is less than bond length of H_2 .

2. **Match the following :**

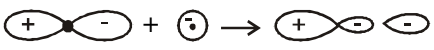
Column	**Column**
(A) N_2^+ is stable than N_2^-	(p) due to one have higher electrons in antibonding than other
(B) NO can easily loose its electron than N_2	(q) one have B.O. 3 and other have 2.5
(C) NO have large bond length than NO^+	(r) It is easy to remove electron from higher energy level
(D) He_2^+ exist but less stable than H_2^+	(s) ABMO has more energy than corresponding BMO

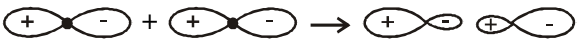
3. How many nodal plane is/are present in σ_{1s} bonding molecular orbital?

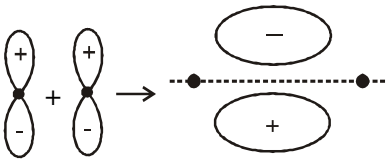
(A) zero (B) 1 (C) 2 (D) 3

4. Which of the following combination of orbitals is correct?

(A) 

(B) 

(C) 

(D) 

5. Which of the following statements is not correct regarding bonding molecular orbitals?

(A) Bonding molecular orbtials possess less energy than the atomic orbitals from which they are formed

(B) Bonding molecular orbtials have low electron density between the two nuclei

(C) Every electron in bonding molecular orbitals contributes to the attraction between atoms

(D) They are formed when the lobes of the combining atomic orbtials have the same sign

7. Fill in the blanks :

Molecule or ion	MO configuration	Bond order	Magnetic Behaviour
H_2	$(\sigma 1s^2)$	1	Diamagnetic
H_2^+	–	–	–
H_2^-	–	–	–
He_2	–	–	–
N_2	–	–	–
O_2	–	–	–
O_2^+	–	–	–
O_2^{2+}	–	–	–
F_2	–	–	–
Ne_2	–	–	–
CO	–	–	–
CN	–	–	–
CN^-	–	–	–

8. In the following which of the two are paramagnetic

(a) N_2 (b) CO (c) B_2 (d) NO_2, Then Correct answer is

(A) a and c (B) b and c (C) c and d (D) b and d

9. Of the following species, which has the highest bond order and shortest bond length ?NO, NO^+, NO^{2+}, NO^-

10. Which of the following pairs of species would you expect to have largest difference in magnetic moment ?

(A) O_2, O_2^+ (B) O_2,O_2^{2-} (C) O_2^+, O_2^{2-} (D) O_2^-, O_2^+

11. Order of stability of N_2, N_2^+ and N_2^- is

(A) $N_2 > N_2^+ > N_2^-$ (B) $N_2^+ > N_2 > N_2^-$ (C) $N_2^- > N_2 > N_2^+$ (D) $N_2^- = N_2^+ > N_2$

12. Which of the following forms only π-bond using M.O. theory :

(A) Li_2 (B) C_2 (C) N_2 (D) O_2

13. According to M.O. theory HOMO in O_2^- is :

(A) $\pi 2p_x = \pi 2p_y$ (B) $\pi 2p_x = \pi 2p_y$ (C) $\sigma 2p_z$ (D) $\sigma 2p_z$

Basic stoichiometry

1. What is the weight of oxygen required for the complete combustion of 2.8 kg of ethylene (C_2H_4)

(A) 2.8 kg (B) 6.4 kg (C) 6.72 kg (D) 9.6 kg

2. At 25°C for complete combustion of 5 mol propane (C_3H_8). The required volume of O_2 at STP will be.

(A) 5.6 L (B) 560 L (C) 360 L (D) 360 L

3. According to the following reaction the minimum quantity in gm of H_2S needed to precipitate 63.5 gm of Cu^{2+} ions will be nearly $Cu^{+2} + H_2S \rightarrow CuS + 2H^+$

(A) 63.5 gm (B) 31.75 gm (C) 34 gm (D) 20 gm

4. When 280 gm of ethylene polymerises to polyethylene according to the equation.

$$n(CH_2 = CH_2) \longrightarrow -(CH_2-CH_2)_n-$$

The weight and mole of polyethylene formed will be-

(A) 280, 10n (B) $\frac{280}{n}, n$ (C) $\frac{280}{n}, 280$ (D) 280, $\frac{10}{n}$

5. 27 gm of Al with react completely with :

$$4Al + 3O_2 \longrightarrow 2Al_2O_3$$

(A) 24 gm of O_2 (B) 0.75 moles of O_2

(C) 16.8 L of O_2 at 1atm,273K (D) 0.75 N_A molecules of O_2

6. 1.5 g of oxygen is produced by heating $KClO_3$. How much KCl is produced in the reaction :

$$2KClO_3(s) \longrightarrow 2KCl(s) + 3O_2(g)\uparrow$$

(A) 4.15×10^2 mol (B) 4.33 g (C) 3.12×10^{-2} mol (D) 2.33 g

Problem based on limiting reagent

7. For the reaction: $7A + 13B + 15C \longrightarrow 17P$

If 15 moles of A, 26 moles of B & 30.5 moles of C are taken initially then limiting reactant is

(A) A (B) B (C) C (D) None of these

8. For the reaction : $2A + 3B \rightarrow 4C + D$, 5 moles of A and 8 moles of B will produce

(A) 4 moles of C, 1 mole of D (B) 20 moles of C, 5 moles of D

(C) 10 moles of C, 2.5 moles of D (D) $\frac{32}{3}$ moles of C, $\frac{8}{3}$ moles of D

9. For reaction $A + 2B \longrightarrow C$. The amount of C formed by starting the reaction with 5 moles of A and 8 moles of B is:

(A) 5 mol (B) 8 mol (C) 16 mol (D) 4 mol

10. Calculate the number of moles of $SO_3(g)$ which are produced by the reaction of 5 moles of S and 6 moles of O_2 gas

(A) 2 moles (B) 6 moles (C) 4 moles (D) 8 moles

11. 446 g of PbO, 46 g of NO_2 and 16 g of O_2 are allowed to react according to the equation

$$PbO + 2NO_2 + \frac{1}{2}O_2 \rightarrow Pb(NO_3)_2$$

The amount of $Pb(NO_3)_2$ that can be produced is (At. wt. of Pb = 207)

(A) 331 gm (B) 662 gm (C) 165.5 gm (D) None of these

12. The mass of P_4O_{10} produced if 440 gm of P_4S_3 is mixed with 384 gm of O_2 is $P_4S_3 + O_2 \longrightarrow P_4O_{10} + SO_2$

(A) 568 gm (B) 426 gm (C) 284 gm (D) 396 gm

13. 0.6 mol of barium chloride in solution is mixed with 0.2 mol of sodium phosphate, the amount of barium phosphate produced is

(A) 0.1 mol (B) 0.3 mol (C) 0.4 mol (D) 0.5 mol

14. What is the number of moles of $Fe(OH)_3$ that can be produced by allowing 1 mole of Fe_2S_3, 2mole of H_2O and 3 mole of O_2 to react

$2Fe_2S_3 + 6H_2O + 3O_2 \longrightarrow 4Fe(OH)_3 + 6S$

(A) 2 (B) 1.33 (C) 3.52 (D) None

15. 28 gm lithium is mixed with 48 gm O_2 to react according to the following reaction.

$$Li + O_2 \rightarrow Li_2O$$

The mass of Li_2O formed is :

(A) 30 gm (B) 35 gm (C) 45 gm (D) 60 gm

16. Three substances A, B and C can react to form D and E as shwon :

$$2A + 3B + C \rightarrow 4D + 2E$$

If molar masses of A, B, C and D are 40, 30 , 20 and 15 respectively and 285 gm of mixture of A, B and C is reacted then maximum mass of E which can be obtained will be :

(A) 285 gm (B) 200 gm (C) 195 gm (D) 100 gm

17. How many moles of potassium chlorate need to be heated to produce 11.35 litre oxygen at STP ?

(A) $\frac{1}{2}$ mol (B) $\frac{1}{3}$ mol (C) $\frac{1}{4}$ mol (D) $\frac{2}{3}$ mol

18. In the reaction $4A + 2B + 3C \rightarrow A_4B_2C_3$ what will be the number of moles of product formed ? Starting from 2 moles of A, 1.2 moles of B and 1.44 moles of C.

(A) 0.5 (B) 0.6 (C) 0.48 (D) 4.64

19. 12 g of alkaline earth metal gives 14.8 g of its nitride, Atomic weight of metal is :

(A) 12 (B) 20 (C) 40 (D) 14.8

20. If 10 g of Ag reacts with 1 g of sulphur, the amount of Ag_2S formed will be :

[Atomic weight of Ag = 108, S = 32]

(A) 7.75 g (B) 0.775 g (C) 11 g (D) 10 g

21. According to following reaction :

$$A + BO_3 \rightarrow A_3O_4 + B_2O_3$$

The number of moles of A_3O_4 produced if 1 mole of A is mixed with 1 mole of BO_3 is :

(A) 3 (B) $\frac{1}{2}$ (C) $\frac{1}{3}$ (D) $\frac{2}{3}$

Problem based on mixtures

1. 3 litre of mixture of propane (C_3H_8) & butane (C_4H_{10}) on complete combustion gives10 litre CO_2. Find the composition of mixture.

(A)C_3H_8 2L and C_4H_{10} 1L (B) C_3H_8 3L and C_4H_{10} 0L(C)C_3H_8 1.5L and C_4H_{10} 1.5L(D) C_3H_8 0L and C_4H_{10} 3L

2. 0.01 mole of iodoform (CHI_3) reacts with Ag to produce a gas whose volume at NTP is

$2CHI_3 + 6Ag \longrightarrow 6AgI(s) + C_2H_2(g)$

(A) 224 ml (B) 112 ml (C) 336 ml (D) None of these

3. One mole mixture of CH_4 and air (containing 80% N_2 20% O_2 by volume) of a composition such that when underwent combustion gave maximum heat (assume combustion of only CH_4). Then which of the statements are correct, regarding composition of initial mixture. (X presents mole fraction).

(A) $X_{CH_4} = \frac{1}{11}, X_{O_2} = \frac{2}{11}, X_{N_2} = \frac{8}{11}$ (B) $X_{CH_4} = \frac{3}{8}, X_{O_2} = \frac{1}{8}, X_{N_2} = \frac{1}{2}$

(C) $X_{CH_4} = \frac{1}{6}, X_{O_2} = \frac{1}{6}, X_{N_2} = \frac{2}{3}$ (D) Data insufficient

4. A mixture of KBr and NaBr weighing 0.560 gm was treated with aqueous Ag^+ and all the bromide ion was recovered as 0.970 gm of pure AgBr. The fraction by weight of KBr in the sample is (approximately)

(A) 0.25 (B) 0.50 (C) 0.40 (D) 0.28

5. 40 gram of a carbonate of an alkali metal or alkaline earth metal containing some inert impurities was made to react with excess HCl solution. The liberated CO_2 occupied 12.315 lit. at 1 atm & 300 K. The correct option is

(A) Mass of impurity is 1 gm and metal is Be (B) Mass of impurity is 3 gm and metal is Li

(C) Mass of impurity is 5 gm and metal is Be (D) Mass of impurity is 2 gm and metal is Mg

Problem based on % yield and % purity

6. Calculate the weight of lime (CaO) obtained by heating 200 kg of 95% pure lime stone ($CaCO_3$).

(A) 104.4 kg (B) 105.4 kg (C) 212.8 kg (D) 106.4 kg

7. A silver coin weighing 11.34 g was dissolved in nitric acid. When sodium chloride was added to the solution all the silver (present as $AgNO_3$) was precipitated as silver chloride. The weight of the precipitated silver chloride was 14.35 g. Calculate the percentage of silver in the coin

(A) 4.8% (B) 95.2% (C) 90% (D) 80%

8. For the reaction

$2Fe(NO_3)_3 + 3Na_2CO_3 \rightarrow Fe_2(CO_3)_2 + 6NaNO_3$

initially 2.5 mol of $Fe(NO_3)_2$ and 3.6 mol of Na_2CO_3 is taken. If 6.3 mol of $NaNO_3$ is obtained then % yield of given reaction is

(A) 50% (B) 84% (C) 87.5% (D) 100%

9. For the reaction, $2x + 3y + 4z \longrightarrow 5w$ Initially if 1 mole of x, 3 mole of y and 4 mole of z is taken and 1.25 mole of w is obtained then % of this reaction is

(A) 25% (B) 50% (C) 75% (D) None of these

Problem based on sequential and parallel reaction

10. 120 g Mg was burnt in air to give a mixture of MgO and Mg_3N_2. The mixture is now dissolved in HCl to form $MgCl_2$ and NH_4Cl, if 107 gram NH_4Cl is produced. Then the moles of $MgCl_2$ formed is :

$$Mg + \frac{1}{2}O_2 \longrightarrow MgO \quad \text{.... (i)}$$

$$3Mg + N_2 \longrightarrow Mg_3N_2 \quad \text{.... (ii)}$$

$$MgO + 2HCl \longrightarrow MgCl_2 + H_2O \quad \text{.... (iii)}$$

$$Mg_3N_2 + 8HCl \longrightarrow 2NH_4Cl + 3MgCl_2 \quad \text{.... (iv)}$$

(A) 3 moles (B) 6 moles (C) 5 moles (D) 10 moles

Paragraph Question No. 11 to 13

NaBr, used to produced AgBr for use in photography can be self prepared as follows :

$Fe + Br_2 \longrightarrow FeBr_2$ ... (i)

$FeBr_2 + Br_2 \longrightarrow Fe_3Br_8$ ... (ii) (not balanced)

$Fe_3Br_8 + Na_2CO_3 \longrightarrow NaBr + CO_2 + Fe_3O_4$ ... (iii) (not balanced)

11. Mass of iron required to produce 4120 gm NaBr

(A) 420 gm (B) 840 kg (C) 840 gm (D) 420 kg

12. If the yield of (ii) is 50% and (iii) reaction is 60% then mass of iron required to produce 2060 gm NaBr

(A) 25 mol (B) 50 mol (C) 75 mol (D) 100 mol

13. If yield of (iii) reaction is 90% then mole of CO_2 formed when 1030 gm NaBr is formed

(A) 20 (B) 5 (C) 10 (D) 40

14. Two substance P_4 & O_2 are allowed to react completely to form mixture of P_4O_6 & P_4O_{10} leaving none of the reactants. Using this information calculate the composition of final mixture when mentioned amount of P_4 & O_2 are taken.

$$P_4 + 3O_2 \longrightarrow P_4O_6, \quad P_4 + 5O_2 \longrightarrow P_4O_{10}$$

(i) If 1 mole P_4 & 4 mole of O_2 (ii)If 3 mole P_4 & 11 mole of O_2

(iii)If 3 mole P_4 & 13 mole of O_2

15. Sulphur trioxide may be prepared by the following two reactions :

$S_8 + 8O_2(g) \rightarrow 8SO_2(g)$, $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$

How many grams of SO_3 will be produced from 1 mol of S_8?

HOME WORK

NCERT 1.1

Concentration terms

1. 8 g NaOH is dissolved in one litre of solution, its molarity is

(A) 0.8 M (B) 0.4 M (C) 0.2 M (D) 0.1 M

2. For preparing 0.1 M solution of H_2SO_4 in one litre, we need H_2SO_4

(A) 0.98 g (B) 4.9 g (C) 49.0 g (D) 9.8 g

3. What is mass percent of the solute in the solution obtained by mixing 5 g of the solute in 50 g of water ?

(A) 10 % (B) 9.1 % (C) 91 % (D) 50 %

4. The number of moles of NaCl present in its 250 cm^3, 0.5 M solution are

(A) 0.5 mol (B) 0.25 mol (C) 0.125 mol (D) 12.5 mol

5. How many grams of NaOH are needed to prepare 250 cm^3 of 0.4 M NaOH solution ?

(A) 8 g (B) 40 g (C) 80 g (D) 4 g

6. The molarity of sugar ($C_{12}H_{22}O_{11}$) solution if its 20 g are dissolved in 2 litre solution, is

(A) 0.029 M (B) 0.29 M (C) 2.9 M (D) 0.0029 M

7. Determine mole fraction of CH_3OH in a solution obtained by mixing 1.2 mole CH_3OH with 4.8 mole H_2O

(A) 0.8 (B) 0.2 (C) 0.25 (D) 0.5

8. Calculate the volume in litre of 0.1 M solution of HCl which contains 0.365 g HCl ?

(A) 10^{-2} L (B) 0.1 L (C) 1 L (D) 10 L

9. The molarity of a HCl solution, which is 1.825 % (w/v) is :

(A) M/10 (B) M/2 (C) M/5 (D) M/20

10. What volume of a 0.8 M solution contains 100 millimoles of the solute ?

(A) 80 mL (B) 125 mL (C) 125 L (D) 80 L

11. What approximate volume of 0.40 M $Ba(OH)_2$ solution must be added to 50.0 mL of 0.30 M NaOH solution to get a solution in which the molarity of the OH^- ions is 0.50 M ?

(A) 33 mL (B) 66 mL (C) 133 mL (D) 100 mL

12. Equal moles of H_2O and NaCl are present in a solution. Hence, molality of NaCl solution is :

(A) 0.55 (2) 55.5 (C) 1.00 (D) 0.18

13. Calculate molality of a solution in which 5.6 g KOH is dissolved in 200 g water

(A) 0.5 m (B) 1.5 m (C) 1.5 m (D) 0.05 m

14. 1000 g aqueous solution of $CaCO_3$ contains 10 g of calcium carbonate. Concentration of solution is

(A) 10 ppm (B) 100 ppm (C) 1000 ppm (D) 10000 ppm

15. Calculate the molarity when

(a) 4.9 gm H_2SO_4 acid dissolved in water to result 500 ml solution

(b) 56 gm of KOH dissolved in water to result 500 ml solution

15. The mole fraction of I_2 in C_6H_6 is 0.02, then molality of solution approxmately will be:

(A) 0.16 (B) 0.26 (C) 2.6 (D) 1.6

Interconversions of different conentration terms

17. Arrange in increasing order of Molarity of solute in following solutions considering water as solvent. Show your calculations:

(i) 224 gm/lit. KOH (ii) 11.2% w/v KOH (iii) 5m KOH (d = 0.64 gm/ml)

(A) (ii) < (iii) < (i) (B) (iii) < (ii) < (i) (C) (iii) < (i) < (ii) (D) (i) < (ii) < (iii)

18. A solution of A(mol. wt. = 20) and B(mol. wt. = 10), [Mole fraction $X_B = 0.6$] having density 0.7 gm/ml then molarity and molality of B in this solution will be _____ and _____ respectively.

(A) 30 M, 75 m (B) 75 m, 30 M (C) 7.5 m, 30 M (D) None of these

19. **Match the column :**

Column I	**Column II**
(A) 16% w/v. $H_2C_2O_4$ (d = 1.1602 g/ml.)	(P) 1.78 M
(B) 17.45 % w/v H_2SO_4 (d = 1.1745 g/ml)	(Q) 1.78 m
(C) Pure water	(R) 1.5 M
(D) 5 % w/w NaOH (d = 1.2 gm/ml)	(S) 55.5 M

20.

Column I	**Column II**
(A) 10 M MgO ($d_{solution}$ = 1.20 gm/ml) Solute : MgO, Solvent: H_2O	(P) $W_{solvent}$ = 120 gm per 100 ml of solution
(B) 40% w/v NaOH ($d_{solution}$ = 1.6 gm/ml) Solute : NaOH, Solvent: H_2O	(Q) $W_{solution}$ = 150 gm per 100 gm solvent
(C) 8 m $CaCO_3$ Solute : $CaCO_3$, Solvent: H_2O	(R) W_{solute} = 120 gm per 100 gm of solvent
(D) 0.6 mol fraction of 'X' (molecular mass = 20) in 'Y' (molecular mass 25) Solute : X, Solvent : Y	(S) $W_{solvent}$ = 125 gm per 100 gm of solute

Mixing of solutions

1. 20 mL of 0.2M $Al_2(SO_4)_3$ is mixed with 30 mL of 0.6 M $BaCl_2$. Calculate the mass of $BaSO_4$ formed in solution.

$BaCl_2 + Al_2(SO_4)_3 \rightarrow BaSO_4 + AlCl_3$

2. 300 ml of 3.0 M NaCl solution is added to 200 ml of 4.0 M $BaCl_2$ solution. The concentration of Cl^- ions in the resulting solution is

(A) 7 M (B) 6 M (C) 5.5 M (D) 5 M

3. What volumes should you mix of 0.2 M NaCl and 0.1 M $CaCl_2$ solution so that in resulting solution the concentration of positive ion is 40% lesser than concentration of negative ion. Assuming total volume of solution 1000 ml.

(A) 400 ml NaCl, 600 ml $CaCl_2$ (B) 600 ml NaCl, 400 ml $CaCl_2$

(C) 800 ml NaCl, 200 ml $CaCl_2$ (D) None of these

4. Assuming complete precipitation of AgCl, calculate the sum of the molar concentration of all the ions if 2 L of 2 MAg_2SO_4 is mixed with 4 L of 1 M NaCl solution is

(A) 4 M (B) 2 M (C) 3 M (D) 2.5M

5. What approximate volume of 0.40 M $Ba(OH)_2$ solution must be added to 50.0 mL of 0.30 M NaOH solution to get a solution in which the molarity of the OH^- ions is 0.50 M ?

(A) 33 mL (B) 66 mL (C) 133 mL (D) 100 mL

6. How many grams of sodium dichromate, $Na_2Cr_2O_7$, should be added to a 50.0mL volumetric flask to prepare 0.025 M $Na_2Cr_2O_7$ when the flask is filled to the mark with water ?

7. Calculate molarity of NaOH in a solution made by mixing 2 lit. of 1.5 M NaOH, 3 lit. of 2M NaOH and 1 lit. water.

8. How would you prepare exactly 3.0 litre of 1.0 M NaOH by mixing proportions of stock solution of 2.50 M NaOH and 0.40 M NaOH. No water is to be used. Find the ratio of the volume (v_1/v_2).

9. The concentration of H_2SO_4 in a solution which has a density 1.2 g /ml. and mass percent of H_2SO_4 is 9.8%, is

(A) 9.8 M (B) 1.2 M (C) 0.6 M (D) 1.8 M

10. What volume of 0.250 MHNO_3 (nitric acid) reacts with 50mL of 0.150MNa_2CO_3 (sodium carbonate) in the following reaction ?

$2HNO_3(aq) + Na_2CO_3(aq) \rightarrow 2NaNO_3(aq) + H_2O(l) + CO_2(g)$

11. 20 ml of 0.2 M $Al_2(SO_4)_3$ is mixed with 20 ml of 0.6 M $BaCl_2$. Concentration of Al^{3+} ion in the solution will be

(A) 0.2 M (B) 10.3 M (C) 0.1 M (D) 0.25 M

12. 5 g of K_2SO_4 was dissolved in water to prepare 250 mL of solution. What volume of this solution should be used so that 2.33 g of $BaSO_4$ may be precipitated from $BaCI_2$ solution.

$K_2SO_4 + BaCl_2 \longrightarrow BaSO_4 + 2KCl$

(A) 87 mL (B) 174 mL (C) 8.7 mL (D) 17.4 mL

EUDIOMETRY

13. $C_6H_5OH\ (g) + O_2\ (g) \longrightarrow CO_2\ (g) + H_2O\ (l)$

Magnitude of volume change if 30 ml of C_6H_5OH (g) is burnt with excess amount of oxygen, is

(A) 30 ml (B) 60 ml (C) 20 ml (D) 10 ml

14. 10 ml of a compound containing 'N' and 'O' is mixed with 30 ml of H_2 to produce H_2O (*l*) and 10 ml of N_2(g). Molecular formula of compound if both reactants reacts completely, is

(A) N_2O (B) NO_2 (C) N_2O_3 (D) N_2O_5

15. When 20 ml of mixture of O_2 and O_3 is heated, the volume becomes 29 ml and disappears in alkaline pyragallol solution. What is the volume precent of O_2 in the original mixture?

(A) 90% (B) 10% (C) 18% (D) 2%

16. A mixture of C_2H_2 and C_3H_8 occupied a certain volume at 80 mm Hg. The mixture was completely burnt to CO_2 and $H_2O(l)$. When the pressure of CO_2 was found to be 230 mm Hg at the same temperature and volume, the fraction of C_2H_2 in mixture is

(A) 0.125 (B) 0.5 (C) 0.87 (D) 0.25

17. 20 mL of a mixture of CO and H_2 were mixed with excess of O_2 and exploded & cooled. There was a volume contraction of 23 mL. All volume measurements corresponds to room temperature (27°C) and one atmospheric pressure. Determine the volume ratio $V_1 : V_2$ of CO and H_2 in the original mixture

(A) 6.5 : 13.5 (B) 5 : 15 (C) 9 : 11 (D) 7 : 13

18. The % by volume of C_4H_{10} in a gaseous mixture of C_4H_{10}, CH_4 and CO is 40. When 200 ml of the mixture is burnt in excess of O_2. Find volume (in ml) of CO_2 produced.

(A) 220 (B) 340 (C) 440 (D) 560

COMPREHENSION

A 10 ml mixture of N_2, a alkane & O_2 undergo combustion in Eudiometry tube. There was contraction of 2 ml, when residual gases are passed through KOH. To the remaining mixture comprising of only one gas excess H_2 was added & after combustion the gas produced is absorbed by water, causing a reduction in volume of 8 ml.

19. Gas produced after introduction of H_2 in the mixture ?

(A) H_2O (B) CH_4 (C) CO_2 (D) NH_3

20. Volume of N_2 present in the mixture?

(A) 2 ml (B) 4 ml (C) 6 ml (D) 8 ml

21. Volume of O_2 remained after the first combustion?

(A) 4 ml (B) 2 ml (C) 0 ml (D) 8 ml

22. Identify the hydrocarbon.

(A) CH_4 (B) C_2H_6 (C) C_3H_8 (D) C_4H_{10}

Types of redox reaction and oxidation number

1. Calculate individual and average Oxidation number (if required) of the marked element and also draw the structure of the following compounds or molecules.

(1) $Na_2\underline{S}_2O_3$ (2) $Na_2\ \underline{S}_4O_6$ (3) $H_2\underline{S}\ O_5$ (4) $H_2\ \underline{S}_2O_8$

(5) $H_2\underline{S}_2O_7$ (6) $\underline{S}_8$ (7) $(CH_3)_2\underline{S}O$ (8) $H\underline{N}O_4$

(9) $\underline{C}_3O_2$ (10) $\underline{O}sO_4$ (11) $\underline{P}H_3$ (12) $\underline{C}rO_4^{2-}$

(13) $\underline{Cr}_2O_7^{2-}$ (14) $\underline{Cr}\ O_2Cl_2$ (15) $\underline{Cr}O_5$ (16) $Na_2H\ \underline{P}O_4$

(17) $\underline{Fe}S_2$ (18) $\underline{C}_6H_{12}O_6$ (19) $\underline{N}H_4\ \underline{N}O_3$

2. Calculate individual and average Oxidation number (if required) of the marked element and also draw the structure of the following compounds or molecules.

(1) $F\underline{N}O_3$

(2) $CaO\underline{Cl}_2$ (3) $\underline{X}eO_3F_2$ (4) $Li\ \underline{Al}\ H_4$ (5) $Na_3\underline{Al}F_6$

(6) $\underline{P}_4$ (7) $\underline{O}_3$ (8) $\underline{I}(\underline{I}O_3)_3$ (9) $\underline{Fe}_3O_4$

(10) $Cs\underline{I}_3$ (11) $K\underline{O}_3$ (12) $\underline{O}_2F_2$ (13) $H_2\underline{Si}F_6$

(14) $\underline{P}(OH)_3$ (15) $\underline{P}OCl_3$ (16) $\underline{Si}(OH)_4$ (17) $Mg_2\underline{C}_3$

(18) $Ca\underline{C}_2$ (19) $Be_2\underline{C}$

3. The reaction $3ClO^-(aq.) \rightarrow ClO_3^-(aq.) + 2Cl^-(aq.)$ is an example of

(A) oxidation (B) reduction (C) disproportionation (D) decomposition reaction

4. White phosphorus reacts with caustic soda, the products are PH_3 and NaH_2PO_2. This reaction is an example of

(A) Oxidation (B) Reduction (C) Disproportionation (D) Neutralisation

5. In the reaction $4P + 3KOH + 3H_2O \rightarrow 3KH_2PO_2 + PH_3$

(A) P undergoes reduction only (B) P undergoes oxidation only

(C) P undergoes both oxidation and reduction (D) neither undergoes oxidation nor reduction

6. Which of the following species does not show disproportionation :-

(A) ClO^- (B) ClO_2^- (C) ClO_3^- (D) ClO_4^-

7. Which of the following reagent can act as reducing agent with SO_2 :-

(A) Cl_2 (B) $KMnO_4$ (C) H_2O (D) H_2S

8. Which of the following can only acts as oxidising agent ?

(A) $KMnO_4$ (B) K_2MnO_4 (C) H_2O_2 (D) SO_2

9. Which will be the proper alternative in place of A in the following equation

$2Fe^{3+}(aq) + Sn^{2+}(aq) \rightarrow 2Fe^{2+}(aq) + A$

(A) Sn^{4+} (B) Sn^{3+} (C) Sn^{2+} (D) Sn^0

10. Which of the following reactions does not involve either oxidation or reduction ?

(A) $VO^{2+} \rightarrow V_2O_3$ (B) $Na \rightarrow Na^+$ (C) $Zn^{+2} \rightarrow Zn$ (D) $CrO_4^{-2} \rightarrow Cr_2O_7^{-2}$

11. Identify the oxidant and the reductant in the following reactions :

(A) $KMnO_4 + KCl + H_2SO_4 \longrightarrow MnSO_4 + K_2SO_4 + H_2O + Cl_2$

(B) $FeCl_2 + H_2O_2 + HCl \longrightarrow FeCl_3 + H_2O$

(C) $Cu + HNO_3\ (dil) \longrightarrow Cu(NO_3)_2 + H_2O + NO$

(D) $Na_2HAsO_3 + KBrO_3 + HCl \longrightarrow NaCl + KBr + H_3AsO_4$

(E) $I_2 + Na_2S_2O_3 \longrightarrow Na_2S_4O_6 + NaI$

n-factor calculation

12. Find the **n** factor in following non-redox interaction.

(a) Of base

(i) $Ba(OH)_2 + HCl \rightarrow BaCl_2 + H_2O$ (ii) $Al(OH)_3 + H_2SO_4 \rightarrow Al(OH)(HSO_4)_2 + H_2O$

(b) Of acid

(i) $H_3SbO_4 \xrightarrow{KOH} KH_2SbO_4 + H_2O$ (ii) $H_3SbO_4 + KOH \rightarrow K_2HSbO_4 + H_2O$

13. Find the **n** factor of underlined compound in following interaction

(i) $\underline{Pb(NO_3)_2} + \underline{Cr_2(SO_4)_3} \longrightarrow \underline{PbSO_4} + \underline{Cr(NO_3)_3}$ (ii) $\underline{KMnO_4} + \underline{MnSO_4} \longrightarrow \underline{MnO_2}$

(iii) $\underline{P_4} \longrightarrow \underline{H_2PO_2^-} + \underline{PH_3}$

14. In the reaction, $2S_2O_3^{2-} + I_2 \rightarrow S_4O_6^{2-} + 2I^-$, the eq. wt. of $S_4O_6^{-2}$ is equal to its -

(A) Mol. wt. (B) Mol. wt./2 (C) 2 × mol. wt. (D) Mol. wt./6

15. Equivalent weight of NH_3 in the change $N_2 \rightarrow NH_3$ is :

(A) 17/6 (B) 17 (C) 17/2 (D) 17/3

16. The molecular weight of the compounds (a) Na_2SO_4, (b) $Na_3PO_4 . 12H_2O$ and (c) $Ca_3(PO_4)_2$ respectively are X, Y and Z. the correct set of their equivalent weights will be -

(A) (a) $\frac{X}{2}$ (b) $\frac{Y}{3}$ (c) $\frac{Z}{6}$ (B) (a) X (b) $\frac{Y}{3}$ (c) $\frac{Z}{3}$ (C) (a) $\frac{X}{2}$ (b) Y (c) $\frac{Z}{3}$ (D) (a) X (b) Y (c) Z

17. In the following change -

$3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$. If the atomic weight of iron is 56, then its equivalent weight of Fe will be

(A) 42 (B) 21 (C) 63 (D) 84

18. When one mole NO_3^- is converted into 1 mole NO_2, 0.5 mole N_2 and 0.5 mole N_2O respectively. It accepts x, y and z mole of electrons - x , y and z are respectively -

(A) 1, 5, 4 (B) 1 ,2 , 3 (C) 2 , 1 , 3 (D) 2, 3, 4

19. In the reaction $2CuSO_4 + 4KI \longrightarrow Cu_2I_2 + I_2 + 2K_2SO_4$ the equivalent weight of Cu in $CuSO_4$

(A) 31.75 (B) 63.5 (C) 127 (D) 15.88

20. In the following reaction hydrazine is oxidized to N_2.

$N_2H_4 + OH^- \longrightarrow N_2 + H_2O + e$

The equivalent weight of N_2H_4 (hydrazine) is

(A) 8 (B) 16 (C) 32 (D) 64

21. Calculate the equivalent mass of each oxidant and reductant in:

(a) $FeSO_4 + KClO_3 \rightarrow KCl + Fe_2(SO_4)_3$ (b) $Na_2SO_3 + Na_2CrO_4 \rightarrow Na_2SO_4 + Cr(OH)_3$

(c) $Fe_3O_4 + KMnO_4 \rightarrow Fe_2O_3 + MnO_2$ (d) $KI + K_2Cr_2O_7 \rightarrow Cr^{3+} + 3I_2$

Answer key

RACE : 11

1. (i) $Na_2S \rightarrow$ ionic, (ii) $SnCl_4 \rightarrow$ ionic, (iii) Diamond $\rightarrow$ covalent, (iv) $CaC_2 \rightarrow$ ionic
(v) $NaH \rightarrow$ ionic, (vi) $C_2H_4 \rightarrow$ covalent, (vii) $CaCl_2 \rightarrow$ ionic, (viii) $HCl(g) \rightarrow$ covalent
(ix) $NH_4^+ \rightarrow$ covalent, (x) $KBr \rightarrow$ ionic

2. (i) ionic $\rightarrow$ NaCl, (ii) Covalent $\rightarrow$ CS_2, (iii) Covalent $\rightarrow$ SO_2, (iv) ionic $\rightarrow$ CaH_2

3. (i) ionic, (ii) covalent, (iii) covalent, (iv) covalent, (v) covalent, (vi) covalent

4. (A) **5.** (C) **6.** (B) **7.** (C) **8.** (A) **9.** (A) **10.** (B)
11. (D) **12.** (D) **13.** (A) **14.** (D) **15.** (B) **16.** (B) **17.** (B)
18. (C) **19.** (D) **20.** (D) **21.** (C) **22.** (B) **23.** (A) **24.** (A)
25. (B) **26.** (D)

RACE : 12

1. (D) **2.** (B) **3.** (B) **4.** (C) **5.** (D) **6.** (D) **8.** (B)
9. (D) **10.** (C) **11.** (C) **12.** (C) **13.** (A) **14.** (4) **15.** (3)
16. (C) **17.** (D) **18.** (C) **19.** (A)

RACE : 13

1. (B) **2.** (B) **3.** (D) **4.** (BC) **5.** (B) **6.** (A) **7.** (B)
8. (D) **9.** (D) **10.** (C) **11.** (A) **12.** (B) **13.** (B)
14. (i) 4 (ii) Two types (i) Covalent three (ii) Co-ordinate one **15.** (B) **16.** (C) **17.** (A)
18 (i)$\sigma = 7, \pi = 0$ (ii) $\sigma = 5, \pi = 1$ (iii) $\sigma = 3, \pi = 2$ (iv) $\sigma = 8, \pi = 2$ (v) $\sigma = 5, \pi = 6$ (vi) $\sigma = 11, \pi = 4$ (vii) $\sigma = 11, \pi = 4$
19. (D) **20.** (D) **21.** (D) **22.** (C) **23.** (A) **24.** (B) **25.** (B)
26. (C) **27.** (B) **28.** (C) **29.** (C) **30.** (C) **31.** (A) **32.** (D)
33. (C) **34.** (A) **35.** (B) **36.** (3) **37.** (B)
38. (1) sp^3d^2 (2) sp (3) sp (4) sp^2 (36) sp^3d (7) sp^2 (9) sp^2 (10) sp^2 (11) sp^2 (12) sp^2 (13) sp^2
(14) sp^2 (15) sp^2 (16) sp^2 (17) sp^2 (18) sp^3 (19) sp^3 (20) sp^3 (22) sp^3 (23) sp^3 (24) sp^3 (25) sp^3 (27) sp^3 (28) sp^3
(30) sp^3d (31) sp^3d (32) sp^3d^2 (33) sp^3d^2 (34) sp^3d^2 (37) sp^3d^2 (38) sp^3d^2

RACE : 14

1. (C) **2.** (D) **3.** (A) **4.** (A) **5.** (C) **6.** (C) **7.** (B)
10. (C) **11.** (D) **12.** (D) **13.** (C) **14.** $H_2O > H_2S > BF_3$ **15.** (A)
16. (B) **17.** a–qr, b–qs, c–q, d–prs **18.** (C) **19.** (C) **20.** (D) **21.** (D)
22. (C) **23.** (C) **24.** (D) **25.** (A) **26.** a–S, b–p, c–Q, d–TR **27.** (B)
28. (C) **29.** (D) **31.** (B) **32.** (A) **33.** (A)
34. (i) diple-dipole (ii)H-bonding (iii)H-bonding (iv)dipole-dipole
(v) H-bonding (vi) dipole-dipole (vii) Metallic (viii) H-bonding
(ix) dipole-dipole (x) ion-dipole (xi) London-forces (xii) co-valent bond
(xiii) London forces (xiv) Ionic (xv) dipole-induced dipole (xvi)London forces

RACE : 15

1. (B) **2.** A–p, B–r, C–q, D–s **3.** (A) **4.** (C) **5.** (B) **7.** –
8. (C) **9.** NO^+ **10.** (B) **11.** (A) **12.** (B) **13.** (B)

RACE : 16

1.	(D)	**2.**	(B)	**3.**	(C)	**4.**	(D)	**5.**	(ABCD)	**6.**	(D)	**7.**	(C)
8.	(C)	**9.**	(D)	**10.**	(C)	**11.**	(C)	**12.**	(B)	**13.**	(A)	**14.**	(B)
15.	(D)	**16.**	(C)	**17.**	(B)	**18.**	(C)	**19.**	(C)	**20.**	(A)	**21.**	(C)

RACE : 17

1.	(A)	**2.**	(B)	**3.**	(A)	**4.**	(C)	**5.**	(B)	**6.**	(D)	**7.**	(B)
8.	(C)	**9.**	(B)	**10.**	(C)	**11.**	(B)	**12.**	(A)	**13.**	(B)		

14. (i)$P_4O_{6,}$= 0.5 mole,P_4O_{10}= 0.5 mole, (ii) $P_4O_{6,}$= 2 mole,P_4O_{10}= 1 mole, (iii) $P_4O_{6,}$= 1 mole,P_4O_{10}= 2 mole

15. 640 gram

RACE : 18

1.	(C)	**2.**	(D)	**3.**	(B)	**4.**	(C)	**5.**	(D)	**6.**	(A)	**7.**	(B)
8.	(B)	**9.**	(B)	**10.**	(B)	**11.**	(A)	**12.**	(B)	**13.**	(A)	**14.**	(D)
15.	(a) 0.1M (b) 2 M			**15.**	(B)	**17.**	(A)	**18.**	–				
19.	(A)→P,Q; (B)→P,Q; (C)→S (D)→R					**20.**	**(A)→Q (B)→P (C)→S (D)→R**						

RACE : 19

1.	2.79 gram	**2.**	(D)	**3.**	(D)	**4.**	(B)	**5.**	(A)	**6.**	0.3275 gram		
7.	1.5 M	**8.**	0.34	**9.**	(B)	**10.**	60 ml	**11.**	(A)	**12.**	(A)		
13.	(B)	**14.**	(C)	**15.**	(B)	**16.**	(C)	**17.**	(D)	**18.**	(C)		
19.	(D)	**20.**	(B)	**21.**	(C)	**22.**	(A)						

RACE : 20

1.	(+4/2, +2)	**2.**	(10/4)	**3.**	(+6)	**4.**	(+6)	**5.**	(+6)	**6.**	(0)	**7.**	(0)
8.	(+5)	**9.**	(+4/3)	**10.**	(+8)	**11.**	(-3)	**12.**	(+6)	**13.**	(+6)	**14.**	(+6)
15.	(+6)	**16.**	(+5)	**17.**	(+2)	**18.**	(0)	**19.**	(-3, +5)				

20.	**1.**	(+5)	**2.**	(–1,1,0)	**3.**	(+8)	**4.**	(+3)	**5.**	(+3)	**6.**	(0)	**7.**	(0)
	8.	(+3, +5, 4.5)	**9.**	(8/3)	**10.**	(-1/3)		**11.**	(-1/3)		**12.**	(+1)	**13.**	(+4)
	14.	(+3)	**15.**	(+5)	**16.**	(+4)	**17.**	(-4/3)	**18.**	(-1)	**19.**	(-4)		
3.	(C)	**4.**	(C)	**5.**	(C)	**6.**	(D)	**7.**	(D)	**8.**	(A)	**9.**	(A)	**10.**	(D)

11.	(A)	(B)	(C)	(D)	(E)
Oxidant	- $KMnO_4$	H_2O_2	HNO_3	$KBrO_3$	I_2
Reductant-	KCl	$FeCl_2$	Cu	Na_2HAsO_3	$Na_2S_2O_3$

12. (a) (i) 2 (ii) 2 (b)(i) 1 (ii) **2** **13.** *(i) 2, 6, 2, 3* *(ii)* $3,2,\frac{6}{5}$ *(iii) 3,1,3*

14.	(B)	**15.**	(D)	**16.**	(A)	**17.**	(B)	**18.**	(A)	**19.**	(B)	**20.**	(A)

21. (a) $FeSO_4 = \frac{152}{1} = 152$ $KClO_3 = \frac{122.5}{6} = 20.4$ (b) $Na_2SO_3 = \frac{126}{2} = 63$ $Na_2CrO_4 = \frac{162}{4} = 40.5$

(c) $Fe_3O_4 = \frac{232}{1} = 232$ $KMnO_4 = \frac{158}{3} = 52.67$ (d) $KI = \frac{166}{1}$ $K_2Cr_2O_7 = \frac{294}{6} = 49$