Final Step - A | Chemistry

Stoichiometry & Redox Reaction

CHOOSE THE CORRECT ALTERNATIVE. ONLY ONE CHOICE IS CORRECT. HOWEVER, QUESTIONS MARKED '*' MAY HAVE MORE THAN ONE CORRECT OPTION.

1. In which of the following reactions H_2O_2 acts as a reducing agent?

1. $H_2O_2 + 2e^- + 2H^+ \longrightarrow 2H_2O$ **2.** $H_2O_2 - 2e^- \longrightarrow O_2 + 2H^+$

3. $H_2O_2 + 2e^- \longrightarrow 2OH^-$ **4.** $H_2O_2 + 2OH^- - 2e^- \longrightarrow O_2 + 2H_2O$

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

2. What product are expected from the disproportionation reaction of hypochlorous acid ?

(A) $HClO_3$ & Cl_2O **(B)** $HClO_2$ & $HClO_4$ **(C)** HCl & Cl_2O **(D)** HCl & $HClO_3$

3. Which of the following chemical reactions depicts the oxidizing behaviour of H_2SO_4 ?

(A) $2HI + H_2SO_4 \longrightarrow I_2 + SO_2 + 2H_2O$ **(B)** $Ca(OH)_2 + H_2SO_4 \longrightarrow CaSO_4 + 2H_2O$

(C) $NaCl + H_2SO_4 \longrightarrow NaHSO_4 + HCl$ **(D)** $2PCl_5 + H_2SO_4 \longrightarrow 2POCl_3 + 2HCl + SO_2Cl_2$

4. The oxidation state of Cr in $[Cr(NH_3)_4Cl_2]^+$ is :

(A) 0 **(B)** +1 **(C)** +2 **(D)** +3

5. MnO_4^- is a good oxidizing agent in different medium changing to :

$MnO_4^- \longrightarrow Mn^{2+}$; $MnO_4^- \longrightarrow MnO_4^{2-}$; $MnO_4^- \longrightarrow MnO_2$; $MnO_4^- \longrightarrow Mn_2O_3$

Changes in oxidation number respectively, are :

(A) 1, 3, 4, 5 **(B)** 5, 4, 3, 2 **(C)** 5, 1, 3, 4 **(D)** 2, 6, 4, 3

6. Which of the following reaction is possible at anode ?

(A) $F_2 + 2e^- \longrightarrow 2F^-$ **(B)** $2H+ + \frac{1}{2}O_2 + 2e^- \longrightarrow H_2O$

(C) $2Cr^{3+} + 7H_2O \longrightarrow Cr_2O_7^{2-} + 14H^+ + 6e^-$ **(D)** None of the above

7. A measured temperature on Fahrenheit scale is 200 °F. What will this reading be on Celsius scale ?

(A) 40°C **(B)** 94°C **(C)** 93.3°C **(D)** 30°C

8. The number of atoms present in one mole of an element is equal to Avogadro number. Which of the following element contains the greatest number of atoms ?

(A) 4g He **(B)** 46g Na **(C)** 0.40g Ca **(D)** 12g He

9. One mole of any substance contains 6.022×10^{23} atoms/molecules. Number of molecules of H_2SO_4 present in 100 mL of 0.02 M H_2SO_4 solution is _____ .

(A) 12.044×10^{20} molecules **(B)** 6.022×10^{23} molecules

(C) 1×10^{23} molecules **(D)** 12.044×10^{23} molecules

10. If the density of a solution is $3.12\,g\ mL^{-1}$, the mass of 1.5 mL solution in significant figure is _____ .

(A) 4.7g **(B)** $4680 \times 10^{-3}\,g$ **(C)** 4.680g **(D)** 46.80g

11. Which of the following statements about a compounds is incorrect ?

(A) A molecule of a compound has atoms of different elements

(B) A compound cannot be separates into its constituent elements by physical methods of separation

(C) A compound retains the physical properties of its constitution elements

(D) The ratio of atoms of different elements in a compound is fixed

12. Which of the following statements indicates that law of multiple proportion is being followed.

(A) Sample of carbon dioxide taken from any source will always have carbon and oxygen in the ratio $1:2$

(B) Carbon forms two oxides namely CO_2 and CO, where masses of oxygen which combine with fixed mass of carbon are in the simple ratio $2:1$

(C) When magnesium burns in oxygen, the amount of magnesium taken for the reaction is equal to the amount of magnesium in magnesium oxide formed

(D) At constant temperature and pressure 200mL of hydrogen will combine with 100 mL oxygen to produce 200 mL of water vapour

***13.** One mole of oxygen gas at STP is equal to _____ .

(A) 6.022×10^{23} molecules of oxygen **(B)** 6.022×10^{23} atoms of oxygen

(C) 16g of oxygen **(D)** 32g of oxygen

***14.** Which of the following solutions have the same concentration ?

(A) 20 g of NaOH in 200 mL of solution **(B)** 0.5 mol of KCl in 200 mL of solution

(C) 40 g of NaOH in 100 mL of solution **(D)** 20 g of KOH in 200 mL of solution

***15.** Which of the following terms are unitless ?

(A) Molality **(B)** Molarity **(C)** Mole fraction **(D)** Mole percent

***16.** One of the statements of Dalton's atomic theory is given below: "Compounds are formed when atoms of different elements combine in a fixed ratio". Which of the following laws is not related to this statement ?

(A) Law of conservation of mass **(B)** Law of definite proportions

(C) Law of multiple proportions **(D)** Avogadro law

17. Thiosulphate reacts differently with iodine and bromine in the reactions given below : $2S_2O_3^{2-} + I_2 \rightarrow S_4O_6^{2-} + 2I^-$

$S_2O_3^{2-} + Br_2 + 5H_2O \rightarrow 2SO_4^{2-} + 2Br^- + 10H^+$

Which of the following statements justifies the above dual behaviour of thiosulphate ?

(A) Bromine is a stronger oxidant than iodine **(B)** Bromine is a weaker oxidant than iodine

(C) Thiosulphate undergoes oxidation by bromine and reduction by iodine in the reactions.

(D) Bromine undergoes oxidation and iodine undergoes reduction in these reactions.

18. The oxidation number of an element in a compound is evaluated on the basis of certain rules. Which of the following rules is not correct in this respect ?

(A) The oxidation number of hydrogen is always $+1$

(B) The algebraic sum of all the oxidation numbers in a compound is zero

(C) An element in the free or the uncombined state bears oxidation number zero

(D) In all its compounds, the oxidation number of fluorine is -1

19. In which of the following compounds, an element exhibits two different oxidation states.

(A) NH_2OH **(B)** NH_4NO_3 **(C)** N_2H_4 **(D)** N_3H

20. The largest oxidation number exhibited by an element depends on its outer electronic configuration. With which of the following outer electronic configurations the element will exhibit largest oxidation number ?

(A) $3d^1 4s^2$ **(B)** $3d^3 4s^2$ **(C)** $3d^5 4s^1$ **(D)** $3d^5 4s^2$

21. Identify disproportionation reaction :

(A) $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$ **(B)** $CH_4 + 4Cl_2 \longrightarrow CCl_4 + 4HCl$

(C) $2F_2 + 2OH^- \longrightarrow 2F^- + OF_2 + H_2O$ **(D)** $2NO_2 + 2OH^- \longrightarrow NO_2^- + NO_3^- + H_2O$

***22.** Which of the following statement(s) is(are) not true about the following decomposition reaction?

$2KClO_3 \rightarrow 2KCl + 3O_2$

(A) Potassium is undergoing oxidation **(B)** Chlorine is undergoing oxidation

(C) Oxygen is reduced

(D) None of the species are undergoing oxidation or reduction

***23.** Identify the correct statement (s) in relation to the following reaction : $Zn + 2HCl \rightarrow ZnCl_2 + H_2$

(A) Zinc is acting as an oxidant **(B)** Chlorine is acting as a reductant

(C) Hydrogen ion is acting as an oxidant **(D)** Zinc is acting as a reductant

***24.** The exhibition of various oxidation states by an element is also related to the outer orbital electronic configuration of its atoms. Atom(s) having which of the following outermost electronic configurations will exhibit more than one oxidation state in its compounds.

(A) $3s^1$ **(B)** $3d^1 4S^2$ **(C)** $3d^2 4s^2$ **(D)** $3s^2 3p^3$

Reasoning Type Questions for 25 - 26

(A) Both A and R are true and R is the correct explanation of A

(B) Both A and R are true but R is not the correct explanation of A

(C) A is true but R is false

(D) Both A and R are false

25. **Assertion (A) :** Among halogens F_2 is the best oxidant.
Reason (R) : **F** is the most electronegative atom.

26. **Assertion (A) :** In the reaction between potassium permanganate and potassium iodide, permanganate ions act as oxidising agent.
Reason (R) : Oxidation state of manganese changes from $+2$ to $+7$ during the reaction.

27. A gaseous hydrocarbon give upon combustion, 0.72 g of water and 3.08 g of CO_2. The empirical formula of the hydrocarbon is :

(A) C_2H_4 **(B)** C_3H_4 **(C)** C_6H_5 **(D)** C_7H_8

28. The density of a solution prepared by dissolving 120 g of urea (mol. mass = 60 u) in 1000 g of water is 1.15 g/mL. The molarity of this solution is :

(A) 0.50 M **(B)** 1.78 M **(C)** 1.02 M **(D)** 2.05 M

29. The mass of potassium dichromate crystals required to oxidise 750 cm^3 of 0.6 M Mohr's salt solution is: (Molar mass = 392)

(A) 0.49 g **(B)** 0.45 g **(C)** 22.05 g **(D)** 2.2 g

30. Amount of oxalic acid present in a solution can be determined by its titration with $KMnO_4$ solution in the presence of H_2SO_4. The titration gives unsatisfactory result when carried out in the presence of result when carried out in the presence of HCl because HCl :

(A) Gets oxidised by oxalic acid to chlorine

(B) Furnishes H^+ ions in addition to those form oxalic acid

(C) Reduces permanganate to Mn^{2+} **(D)** Oxidises oxalic acid to carbon dioxide and water

31. In the reaction : $2Al(s) + 6HCl(aq) \longrightarrow 2Al^{3+}(aq) + 6Cl^-(aq) + 3H_2(g)$

(A) 6L HCl(aq) is consumed for every 3L H_2(g) produced

(B) 33.6 L H_2(g) is produced T and P for every mole Al that reacts

(C) 67.2 L H_2 (g) at STP is produced for every mole Al that reacts

(D) 11.2 L H_2(g) at STP is produced for every mole HCl(aq) consumed

32. If we consider that 1/6, in place 1/12, mass of carbon atom is taken to be the relative atomic mass unit, the mass of one mole of a substance will :

(A) Be a function of the molecular mass of the substance **(B)** Remain unchanged

(C) Increase two fold **(D)** Decrease twice

33. What volume of hydrogen gas, at 273 K and 1 atm pressure will be consumed in obtaining 21.6 g of elemental boron (atomic mass 10.8) from the reduction of boron trichloride by hydrogen?

(A) 89.6 L **(B)** 67.2 L **(C)** 44.8 L **(D)** 22.4 L

34. In an organic compound of molar mass 108 g mol^{-1} C, Hand N atoms are present in $9:1:3.5$ by weight. Molecular formula can be :

(A) $C_6H_8N_2$ **(B)** $C_7H_{10}N$ **(C)** $C_5H_6N_3$ **(D)** $C_4H_{18}N_3$

35. In the reaction : $2Ag + 2H_2SO_4 \longrightarrow Ag_2SO_4 + 2H_2O + SO_2$. Sulphuric acid acts as :

(A) an oxidizing agent **(B)** a reducing agent **(C)** a catalyst

(D) an acid as well as an oxidant

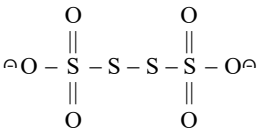
36. What is the equivalent weight of $FeSO_4$ in the following reaction?

$$FeSO_4 \longrightarrow Fe_2(SO_4)_3$$

(A) M/2 **(B)** 2M **(C)** M **(D)** M/4

(M = molecular weight of $FeSO_4$)

37. Oxidation state of sulphur atoms in $S_4O_6^{2-}$ from left to right respectively are :



(A) + 6, 0, 0, +6 **(B)** +3, +1, + 1, + 3 **(C)** +5, 0, 0, +5 **(D)** +4, +1, +1 , +4

38. Select the correct statement in the following reaction : $NH_4NO_2 \longrightarrow N_2 + 2H_2O$

(A) Oxidation number of N has changed from – 2 to +2

(B) Oxidation number of N in NH_4^+ changed from –3 to 0 and that in NO_2^- changed from + 3 to 0

(C) Oxidation number of N in NH_4^+ changed from + 1 to 0 and that in NO_2^- changed from – to 0

(D) No change

39. 1 mole of FeC_2O_4 is oxidized by x moles of $Cr_2O_7^{2-}$ in acidic medium, x is :

(A) 3 **(B)** 1.5 **(C)** 0.5 **(D)** 1.0

***40.** 0.1 mole of $NaHC_2O_4$ is :

(A) Neutralized by 0.1 mole of NaOH **(B)** Neutralized by 0.05 mole of $Ca(OH)_2$

(C) Oxidized by 0.04 mole of $KMnO_4/H^+$ **(D)** Oxidized by 0.02 mole of K_2MnO_4/OH^-

41. What is the mass of the precipitate formed when 50 mL of 16.9% solution of $AgNO_3$ is mixed with 50 mL of 5.8 % NaCl solution ? (Ag = 107.8, N = 14, O = 16, Na = 23, Cl = 35.5)

(A) 3.5 g **(B)** 7 g **(C)** 14 g **(D)** 28 g

42. If avogardo number N_A, is changed from 6.022×10^{23} mol^{-1} to 6.022×10^{20} mol^{-1}, this would change :

(A) the mass of one mole of carbon

(B) the ratio of chemical species to each other in a balanced equation

(C) the ratio of elements to each other in a compound

(D) the definition of mass in units of grams

43. Equal masses of H_2, O_2 and methane have been taken in a container of volume V at temperature $27^\circ C$ in identical conditions. The ratio of the volumes of gases $H_2 : O_2$: methane would be :

(A) 8 : 16 : 1 **(B)** 16 : 8 : 1

(C) 16 : 1 : 2 **(D)** 8 : 1 : 2

44. 6.02×10^{20} molecules of urea are present in 100 mL of its solution. The concentration of solution is :

(A) 0.001 M **(B)** 0.1 M **(C)** 0.02 M **(D)** 0.01 M

45. 10 g of hydrogen and 64 g of oxygen were filled in a steel vessel and exploded. Amount of water produced in this reaction will be :

(A) 3 mol **(B)** 4 mol **(C)** 1 mol **(D)** 2 mol

46. An element, X has the following isotopic composition :

^{200}X : 90% ^{199}X : 8.0% ^{202}X : 2.0%

The weighted average atomic mass of the naturally-occurring element X is closed to :

(A) 201 amu **(B)** 202 amu **(C)** 199 amu **(D)** 200 amu

47. The maximum number of molecules is present in:

(A) 15 L of H_2 gas at STP **(B)** 5 L of N_2 gas at STP

(C) 0.5 g of H_2 gas **(D)** 10 g of O_2 gas

48. Given the numbers: 161 cm, 0.161 cm, 0.0161 cm. The number of significant figures for the three numbers is :

(A) 3, 3 and 4 respectively **(B)** 3, 4 and 4 respectively

(C) 3, 4 and 5 respectively **(D)** 3, 3 and 3 respectively

49. Haemoglobin contains 0.334% of iron by weight. The molecular weight of haemglobin is approximately 67200. The number of iron atoms (Atomic weight of Fe is 56) present in one molecule of haemoglobin is :

(A) 4 **(B)** 6 **(C)** 3 **(D)** 2

50. In the reaction, $4NH_{3(g)} + 5O_{2(g)} \rightarrow 4NO_{(g)} + 6H_2O_{(l)}$ when 1 mole of ammonia and 1 mole of O_2 are made to react to completion :

(A) All the oxygen will be consumed **(B)** 1.0 mole of NO will be produced

(C) 1.0 mole of H_2O is produced **(D)** All the ammonia will be consumed

51. At S.T.P. the density of CCl_4 vapour in g/L will be nearest to :

(A) 6.87 **(B)** 3.42 **(C)** 10.26 **(D)** 4.57

52. One litre hard water contains 12.00 mg Mg^{2+}. Milli-equivalents of washing soda required to remove its hardness is :

(A) 1 **(B)** 12.16 **(C)** 1×10^{-3} **(D)** 12.16×10^{-3}

53. The pair of compounds that can exist together is :

(A) $FeCl_3$, $SnCl_2$ **(B)** $HgCl_2$, $SnCl_2$ **(C)** $FeCl_2$, $SnCl_2$ **(D)** $FeCl_3$, KI

54. I. $H_2O_2 + O_3 \longrightarrow H_2O + 2O_2$ II. $H_2O_2 + Ag_2O \longrightarrow 2Ag + H_2O + O_2$

Role of hydrogen peroxide in the above reactions is respectively :

(A) oxidizing in I and reducing in II **(B)** reducing in I and oxidizing in II

(C) reducing in both I and II **(D)** oxidizing in both I and II

55. A mixture of potassium chlorate, oxalate acid and sulphuric acid is heated. During the reaction which element undergoes maximum change in the oxidation number ?

(A) S **(B)** H **(C)** Cl **(D)** C

56. Number of moles of MnO_4^- required to oxidize one mole of ferrous oxalate completely by acidic medium will be :

(A) 7.5 moles **(B)** 0.2 moles **(C)** 0.6 moles **(D)** 0.4 moles

57. Which is the best description of the behaviour of bromine in the reaction given below ? $H_2O + Br_2 \longrightarrow HOBr + HBr$

(A) Proton acceptor only **(B)** Both oxidised and reduced

(C) Oxidised only **(D)** Reduced only

58. Sodium hypochlorite (NaOCl) is a good oxidizing agent in alkaline medium. What volume of a 0.15 M alkaline solution of NaOCl would be required to oxidize completely a 20 mL 0.2 M $NaCrO_2$ solution according to the reaction:

$$NaOCl + NaCrO_2 + NaOH \rightarrow NaCl + Na_2CrO_4 + H_2O$$

(A) 80 ml **(B)** 40 mL **(C)** 20 mL **(D)** 10 mL

59. 10 mL of H_2O_2 solution (Volume strength = x) required 10 mL of (1/0.56) N MnO_4^- solution in acidic medium. Hence, x is :

(A) 0.56 **(B)** 5.6 **(C)** 0.1 **(D)** 10

60. Which of the following species contain an element in an oxidation state that is not a whole number?

(A) VO_4^{3-} **(B)** Mn_2O_3 **(C)** $S_4O_6^{2-}$ **(D)** Cl_2O_7

Integer Answer Type Questions
The Answer to the following questions are positive integers of 1/2/3 digits and zero

61. 10 gm $CaCO_3$ was strongly heated and CO_2 liberated was absorbed in 1000 ml of 0.5M NaOH. Assuming 90% purity of $CaCO_3$. How much solution of 0.5 M HCl in ml would be required to react with the solution of the alkali to reach phenolphthalein end point ?

62. The equation for complete combustion of methanol is $2CH_3OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 4H_2O(l)$. If 64g of CH_3OH is combined with 44.8L of O_2. measured at STP, the number of moles of CO_2 which can be produced is $\frac{x}{3}$. Find the value of x.

63. A human patient suffering from a duodenal ulcer may show a hydrochloric acid concentration of 0.080 mol/L in his gastric juice. It is possible to neutralize this acid with aluminium hydroxide, $Al(OH)_3$, which reacts with HCl according to the chemical reaction shown below.

$Al(OH)_3 + HCl \rightarrow AlCl_3 + H_2O$ **.** If the patient's stomach receives 3.0L of gastric juice per day, the amount of aluminium hydroxide in gm must be consume per day to counteract the acid is 624×10^{-x}. Find the value of x.

64. Find (p + q) – (a + b) in the chemical reaction:

$a\ MnO_4^- + b\ C_2O_4^{2-} + H_2O \rightarrow pMnO_2 + OH^- + q\ CO_2$

[a, b, p & q are smallest possible integers]

65. A 7.32 gm sample of $BaCl_2.2H_2O$ is dissolved and excess of CrO_4^{2-} is added to the solution. Barium chromate is filtered, washed and dissolved in suitable acid to convert CrO_4^{2-} into $Cr_2O_7^{2-}$. An excess of KI is added, the liberated iodine requires 90 ml of 0.2 M $Na_2S_2O_3$ for complete reaction. Find the percentage purity of the sample.

66. The number of moles of ferrous oxalate oxidized by one mole of aluminium per manganate in acidic medium is —

67. The formula weight of an acid is 82g. 100 cm^3 of a solution of this acid containing 39 g of the acid per litre were completely neutralized by 95 cm^3 of aqueous NaOH containing 40 g of NaOH per litre. What is the basicity of the acid?

68. 3gm mixture of SiO_2 and Fe_2O_3 on very strong heating leaves a residue weighing 2.92 gm because of conversion of Fe_2O_3 to Fe_3O_4 liberating oxygen gas. What is the percentage by mass of SiO_2 in original mixture.

69. A mixture of gas X (mol wt 16) and gas Y (mol. wt 28) in the mole ratio a : b has a mean molecular weight 20. What would be mean molecular weight if the gases are mixed in the ratio b : a under identical conditions (gases are non-reacting)?

70. Two elements A and B combine to form compound X and Y. For the fix mass of A, masses of B combined for the compounds X and Y are in 3 : 7 ratio. If in compound X, 4 gm of A combines with 12 gm B, then in compound Y, 8 gm of A will combine with ……. gm of B.

71. A certain oxide of iron contains 2.5 grams of oxygen for every 7.0 grams of iron. If it is regarded as a mixture of FeO and Fe_2O_3 in the weight ratio a : b. If a is 9, than what is b?

72. 500 ml of 0.2M Na_2SO_4 solution is mixed with 100 ml, 17.1% (w/v) $Al_2(SO_4)_3$ solution and resulting solution is diluted to 5 times. The molarity of SO_4^{2-}. ions in the final solution is $x/12$M. Find the value of *x*.

73. H_2 gas is often used as reducing gas. In a particular set up 17.4 gm of MnO_2 on reacting with excess of Hydrogen gas gives water and new oxide Mn_xO_y. Such that mass of the oxide obtained is 12.6 gm. What will be value of *y* if *x* is 2.

74. If M represents molecular mass of Mn_3O_4, the equivalent mass of Mn_3O_4 is $\frac{x}{26}M$, if it undergoes disproportionation reaction as shown–

$Mn_3O_4 \longrightarrow MnO_4^- + Mn^{2+}$, find the value of *x*.

75. 50 ml 0.1M $CuSO_4$ are mixed with 50 ml of 0.1 M KI. The number of moles of electrons involved in the reaction is 2.5×10^{-x}. Find the value of *x*.

Atomic Structure

CHOOSE THE CORRECT ALTERNATIVE. ONLY ONE CHOICE IS CORRECT. HOWEVER, QUESTIONS MARKED '*' MAY HAVE MORE THAN ONE CORRECT OPTION.

***1.** Which of the following conclusions could be derived from Rutherford's α -particle scattering experiment ?

(A) Most of the space in the atoms is empty

(B) The radius of the atom is about 10^{-10}m while that of nucleus is 10^{-15}m

(C) Electrons move in a circular path of fixed energy called orbits

(D) Electrons and the nucleus are held together by electrostatic forces of attraction

2. Which of the following options does not represent ground state electronic configuration of an atom ?

(A) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^8\ 4s^2$ **(B)** $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^9\ 4s^2$

(C) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^1$ **(D)** $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$

***3.** Which of the following statement is are correct about the characteristics of cathode rays ?

(A) They start from the cathode and move towards the anode

(B) They travel in straight line in the absence of an external electrical or magnetic field

(C) Characteristics of cathode rays do not depend upon the material of electrodes in cathode ray tube

(D) Characteristics of cathode rays do not depend upon the nature of gas present in the cathode ray tube

***4.** Which of the following statements about the electron is(are) correct ?

(A) It is a negatively charged particle **(B)** The mass of electron is equal to the mass of neutron

(C) It is basic constituent of all atoms **(D)** It is constituent of cathode rays

5. Which of the following properties of atom could be explained correctly by Thomson model of atom ?

(A) Overall neutrality of atom **(B)** Spectra of hydrogen atom.

(C) Position of electrons, protons and neutrons in atom **(D)** Stability of atom.

6. Two atoms are said to be isobars if.

(A) They have same atomic number but different mass number

(B) They have same number of electrons but different number of neutrons

(C) They have same number of neutrons but different number of electrons

(D) Sum of the number of protons and neutrons is same but the number of the protons is different

7. The number of radial nodes for 3p orbital is _____ .

(A) 3 **(B)** 4 **(C)** 2 **(D)** 1

8. The number of angular nodes for 4d orbital is _____ .

(A) 4 **(B)** 3 **(C)** 2 **(D)** 1

9. Which of the following is responsible to rule out the existence of definite paths or trajectories of electrons ?

(A) Pauli's exclusion principle **(B)** Heisenberg's uncertainly principle

(C) Hund's rule of maximum multiplicity **(D)** Aufbau principle

10. The pair of ions having same electronic configuration is _____.

(A) Cr^{3+}, Fe^{3+} **(B)** Fe^{3+}, Mn^{2+} **(C)** Fe^{3+}, Co^{3+} **(D)** Sc^{3+}, Cr^{3+}

11. For the electrons of oxygen atoms, which of the following statements is correct ?

(A) Z_{eff} for an electron in a 2s orbital is the same as Z_{eff} for an electron in a 2p orbital

(B) An electron in the 2s orbital has the same energy as an electron in the 2p orbital

(C) Z_{eff} for an electron in 1s orbital is the same as Z_{eff} for an electron in a 2s orbital

(D) The two electrons present in the 2s orbital have spin quantum numbers m_s but of opposite sign

***12.** Identify the pairs which are not of isotopes ?

(A) ${}^{12}_{6}X$, ${}^{13}_{6}Y$ **(B)** ${}^{35}_{17}X$, ${}^{37}_{17}Y$ **(C)** ${}^{14}_{6}X$, ${}^{17}_{7}Y$ **(D)** ${}^{8}_{4}X$, ${}^{8}_{5}Y$

***13.** Out of the following pairs of electrons, identify the pairs of electrons present in degenerate orbitals :

(A) (i) $n = 3,\ l = 2,\ m_l = -2,\ m_s = -\frac{1}{2}$ (ii) $n = 3,\ l = 2,\ m_l = -1,\ m_s = -\frac{1}{2}$

(B) (i) $n = 3,\ l = 1,\ m_l = 1,\ m_s = +1/2$ (ii) $n = 3,\ l = 2,\ m_l = 1,\ m_s = +1/2$

(C) (i) $n = 4,\ l = 1,\ m_l = 1,\ m_s = +1/2$; (ii) $n = 3,\ l = 2,\ m_l = 1,\ m_s = +1/2$

(D) (i) $n = 3,\ l = 2,\ m_l = +2,\ m_s = -1/2$; (ii) $n = 3,\ l = 2,\ m_l = -2,\ m_s = +1/2$

***14.** Which of the following sets of quantum numbers are correct ?

	n	***l***	$\mathbf{m_l}$		**n**	***l***	$\mathbf{m_l}$
(A)	1	1	+2	**(B)**	2	1	+1
(C)	3	2	–1	**(D)**	3	4	–2

***15.** In which of the following pairs, the ions are iso-electronic?

(A) Na^+, Mg^{2+} **(B)** Al^{3+}, O^- **(C)** Na^+, O^{2-} **(D)** N^{3+}, Cl^-

Reasoning Type Questions for 16 - 17

(A) Both A and R true and R is the correct explanation of A

(B) Both A And R are true but R is not correct explanation of A

(C) A is true and R is false.

(D) Both A and R are false.

16. **Assertion (A) :** All isotopes of a given element shown the same type of chemical behaviour.
Reason (R) : The chemical properties of an atom are controlled by the number of electrons in the atom.

17. **Assertion (A) :** Black body is an ideal body that emits and absorbs radiations of all frequencies.
Reason (R) : The frequency of radiation emitted by a body goes from a lower frequency to higher frequency with an increase in temperature.

18. Energy of an electron is given by $E = -2.178\times10^{-18}\,J\left(\frac{Z^2}{n^2}\right)$. Wavelength of light required to excite an electron in an hydrogen atom from level n = 1 to n = 2 will be $\left(h = 6.62\times10^{-34}\ Js\ \&\ c = 3.0\times10^{8}\ ms^{-1}\right)$

(A) 1.214×10^{-7} m **(B)** 2.816×10^{-7} m **(C)** 6.500×10^{-7} m **(D)** 8.500×10^{-7} m

19. The electron identified by quantum number n and l : (Increasing order of energy)

I. n = 4, l = 1 **II.** n = 4, l = 0 **III.** n = 3, l = 2 **IV.** n = 3, l = 1

(A) III < IV < II < I **(B)** IV < II < III < I **(C)** II < IV < I < III **(D)** I < III < II < IV

20. A gas absorbs photon of 355 nm and emits at two wavelengths. If one of the emission is at 680 nm, the other is at :

(A) 1035 nm **(B)** 325 nm **(C)** 743 nm **(D)** 518 nm

21. The frequency of light emitted for the transition n = 4 to n = 2 of He^+ is equal to the transition in H atom corresponding to which of the following?

(A) n = 3 to n = 1 **(B)** n = 2 to n = 1 **(C)** n = 3 to n = 2 **(D)** n = 4 to n = 3

22. The energy required to break one mole of Cl – Cl bonds in Cl_2 is 242 kJ mol^{-1}. The longest wavelength of light capable of breaking a single Cl – Cl bond is :

(A) 594 nm **(B)** 640 nm **(C)** 700 nm **(D)** 494 nm

23. Ionisation energy of He^+ is 19.6×10^{-18} J $atom^{-1}$. The energy of the first stationary state (n =1) of Li^{2+} is :

(A) 4.41×10^{-16} J $atom^{-1}$ **(B)** -4.41×10^{-17} J $atom^{-1}$

(C) -2.2×10^{-15} J $atom^{-1}$ **(D)** 8.82×10^{-17} J $atom^{-1}$

24. In an atom, an electron is moving with a speed of 600 m/s with an accuracy of 0.005%. Certainty with which the position of the electron can be located is :

(A) 1.52×10^{-4} m **(B)** 5.10×10^{-3} m **(C)** 1.92×10^{-3} m **(D)** 3.84×10^{-3} m

25. Which of the following sets of quantum numbers represents the highest energy of an atom?

(A) n = 3, l = 1, m =1, s = +1/2 **(B)** n = 3, l = 2, m = 1, s = +1/2

(C) n = 4, l = 0, m = 0, s = + 1/2 **(D)** n = 3, l = 0, m = 0, s +1/2

26. Which of the following nuclear reactions will generate an isotope?

(A) Neutron particle emission **(B)** Positron emission

(C) α-particle emission **(D)** β-particle emission

27. Uncertainly in the position of an electron moving with a velocity 300 ms^{-1}, accurate upto 0.001% will be :

(A) 19.2×10^{-2}m **(B)** 5.76×10^{-2}m **(C)** 1.92×10^{-2} m **(D)** 3.84×10^{-2}m

28. According to Bohr's theory, the angular momentum of an electron in 5th orbit is :

(A) $25\frac{h}{\pi}$ **(B)** $1.0\frac{h}{\pi}$ **(C)** $10\frac{h}{\pi}$ **(D)** $2.5\frac{h}{\pi}$

29. Which of the following statements in relation to the hydrogen atom is(are) correct?

(A) 3s, 3p and 3d orbitals all have the same energy

(B) 3s and 3p orbitals are of lower energy than 3d orbital

(C) 3p orbital is lower in energy than 3d orbital

(D) 3s orbital is lower in energy than 3p orbital

***30.** In a multi-electron atom, which of the following orbitals described by the three quantum numbers will have the same energy in the absence of magnetic and electric fields?

(A) n = 1, l = 0, m = 0 **(B)** n = 3, l = 2, m = 1

(C) n = 3, l = 2, m = 0 **(D)** n = 2, l = 1, m = 1

31. Which of the following sets of quantum numbers is correct for an electron in 4f orbital?

(A) $n = 4, l = 3, m = +4, s = +1/2$ **(B)** $n = 4, l = 4, m = -4, s = -1/2$

(C) $n = 4, l = 3, m = +1, s = +1/2$ **(D)** $n = 3, l = 2, m = -2, s = +1/2$

32. Consider the ground state of Cr atom (Z = 24). The numbers of electrons with the azimuthal quantum numbers, l = 1 and 2 are, respectively :

(A) 12 and 4 **(B)** 12 and 5 **(C)** 16 and 4 **(D)** 16 and 5

33. In Bohr series of lines of hydrogen spectrum, the third line from the red end corresponds to which one of the following inner-orbit jumps of the electron for Bohr orbits in an atom of hydrogen?

(A) $3 \rightarrow 2$ **(B)** $5 \rightarrow 2$ **(C)** $4 \rightarrow 1$ **(D)** $2 \rightarrow 5$

34. The number of d-electrons retained in Fe^{2+} (Atomic number Fe = 26) ion is :

(A) 3 **(B)** 4 **(C)** 5 **(D)** 6

35. The orbital angular momentum for an electron revolving in an orbit is given by $\sqrt{l(l+1)}\,\frac{h}{2\pi}$. This momentum for *s*-electron will be :

(A) $+\frac{1}{2}\cdot\frac{h}{2\pi}$ **(B)** Zero **(C)** $\frac{h}{2\pi}$ **(D)** $\sqrt{2}\cdot\frac{h}{2\pi}$

36. The energy of H-atom in the ground state is -13.6 eV , then energy in the second excited state is :

(A) -6.8 eV **(B)** -3.4 eV **(C)** -1.51 eV **(D)** -4.53 eV

37. There is a transition from n = 1 to n = 2 and then n = 2 to n = 3, then :

(A) ΔE values as well as frequency are additive **(B)** wavelength as well as frequency are additive

(C) ΔE values as well as wavelength are additive

(D) all of the parameters. (ΔE , frequency and wavelength) are additive.

38. Number of waves made by a Bohr electron in one complete revolution in its fourth orbit is :

(A) 2 **(B)** 3 **(C)** 4 **(D)** ∞

39. An electron in H-atom in its ground state absorbs 1.50 times as much as energy as the minimum required for its escape (13.6 eV) from the atom. Thus KE given to emitted electron is :

(A) 13.6 eV **(B)** 20.4 eV **(C)** 34.0 eV **(D)** 6.8 eV

40. Which of the following electronic transitions requires that the greatest quantity of energy be absorbed by a hydrogen atom?

(A) n = 1 to n = 2 **(B)** n = 2 to n = 4 **(C)** n = 3 to n = 6 **(D)** n = 1 to n ∞

41. The potential energy of an electron in the first Bohr orbit in the He^+ ion is :

(A) -13.6 eV **(B)** -27.2eV **(C)** -54.4 eV **(D)** -108.8 eV

42. Which of the pair of orbitals have electronic density along the axis ?

(A) d_{xz}, d_{yz} **(B)** $d_{x^2-y^2}, d_{z^2}$ **(C)** d_{xy}, d_{yz} **(D)** d_{xy}, d_{z^2}

43. Under the condition given above, magnetic moment of Ti(Z = 22) would have been :

(A) $\sqrt{24}$ BM **(B)** $\sqrt{8}$ BM **(C)** $\sqrt{35}$BM **(D)** 0

44. Which of the following statements about nodal planes in not true?

(A) A plane of which there is zero probability that the electron will be found

(B) A plane on which there is maximum probability that the electron will be found

(C) Both (A) and (B)

(D) None of the above

45. The kinetic energy of an electron in the second Bohr orbit of a hydrogen atom is (a_0 is Bohr's radius)

(A) $\frac{h^2}{4\pi^2 m a_0^2}$ **(B)** $\frac{h^2}{16\pi m a_0^2}$ **(C)** $\frac{h^2}{32\pi^2 m a_0^2}$ **(D)** $\frac{h^2}{64\pi^2 m a_0^2}$

46. Which is the correct order of increasing energy of the listed orbitals in the atom of titanium ? (Atomic Number Z = 22)

(A) 4s 3s 3p 3d **(B)** 3s 3p 3d 4s **(C)** 3s 3p 4s 3d **(D)** 3s 4s 3p 3d

47. The number of d-electrons in Fe^{2+} (Z = 26) is not equal to the number of electrons in which one of the following ?

(A) d-electron in Fe (Z = 26) **(B)** p-electrons in Ne (Z = 10)

(C) s-electron in Mg (Z = 12) **(D)** p-electrons in Cl (Z = 17)

48. What is the maximum number of orbitals that can be identified with the following quantum numbers ?

n = 3, l = 1, m_l = 0

(A) 1 **(B)** 2 **(C)** 3 **(D)** 4

49. Based on equation $E = -2.178 \times 10^{-18}\,J\left(\frac{Z^2}{n^2}\right)$, certain concussions are written. Which of them is not correct ?

(A) Equation can be used to calculate the change in energy when the electron changes orbit

(B) For n = 1, the electron has a more negative energy than it does for n = 6 which means that the electron is more loosely bound in the smallest allowed orbit

(C) The negative sign in equation simply means that the energy of electron bound to the nucleus is lower than it would be if the electrons were at the infinite distance from the nucleus

(D) Larger the value of n, the larger is the orbit radius

50. The orbital angular momentum of a p-electron in given as :

(A) $\frac{h}{\sqrt{2}\,\pi}$ **(B)** $\sqrt{3}\,\frac{h}{2\pi}$ **(C)** $\sqrt{\frac{3}{2}}\,\frac{h}{\pi}$ **(D)** $\sqrt{6}\,\frac{h}{2\pi}$

51. If n = 6, the correct sequence for filling of electrons will be :

(A) $ns \rightarrow (n-2)f \rightarrow (n-1)d \rightarrow np$ **(B)** $ns \rightarrow (n-1)d \rightarrow (n-2)f \rightarrow np$

(C) $ns \rightarrow (n-2)f \rightarrow np \rightarrow (n-1)d$ **(D)** $ns \rightarrow np(n-1)d \rightarrow (n-2)f$

52. Which of the following is not permissible arrangement of electrons in an atom ?

(A) n = 5, l = 3, m = 0, s = + 1/2 **(B)** n = 3, l = 2, m = –3, s = –1/2

(C) n = 3, l = 2, m = –2, s = –1/2 **(D)** n = 4, l = 0, m = 0, s = –1/2

53. If uncertainty in position and momentum are equal, then uncertainty in velocity is :

(A) $\frac{1}{m}\sqrt{\frac{h}{\pi}}$ **(B)** $\sqrt{\frac{h}{\pi}}$ **(C)** $\frac{1}{2m}\sqrt{\frac{h}{\pi}}$ **(D)** $\sqrt{\frac{h}{2\pi}}$

54. The measurement of the electron position is associated with an uncertainty in its momentum, which is equal to $1 \times 10^{-18}\,g\ cm\,s^{-1}$. The uncertainty in electron velocity is : (Mass of an electron is $9 \times 10^{-28}\,g$)

(A) 1×10^5 cm s^{-1} **(B)** 1×10^{11} cm s^{-1} **(C)** 1×10^9 cm s^{-1} **(D)** 1×10^6 cm s^{-1}

55. Consider the following sets of quantum numbers :

	n	***l***	***m***	***s***		***n***	***l***	***m***	***s***
(i)	3	0	0	+1/2	(ii)	2	2	1	+1/2
(iii)	4	3	–2	–1/2	(iv)	1	0	–1	–1/2
(v)	3	2	3	+1/2					

Which of the following sets of quantum number is(are) not possible ?

(A) (i), (ii), (iii) and (iv) **(B)** (ii), (iv) and (v)

(C) (i) and (iii) **(D)** (ii), (iii) and (iv)

56. In hydrogen atom, if energy of first excited state is -3.4 eV, then find out KE of same orbit of hydrogen atom ?

(A) + 3.4 eV **(B)** + 6.8 eV

(C) –13.6 eV **(D)** + 13.6 eV

57. The following quantum numbers are possible for how many orbitals : n = 3, l = 2, m = + 2 ?

(A) 1 **(B)** 2 **(C)** 3 **(D)** 4

58. The de Brogile wave length of a particle with mass 1g and velocity 100 m/s is :

(A) 6.63×10^{-35} m **(B)** 6.63×10^{-34} m

(C) 6.63×10^{-33} m **(D)** 6.65×10^{-35} m

59. The ion that is isoelectronic with CO is :

(A) CN^- **(B)** N_2^+ **(C)** O^{2-} **(D)** N_2^-

60. Which one of the following is not isoelectronic with O^{2-} ?

(A) Mg^+ **(B)** Na^+ **(C)** N^{3-} **(D)** F^-

Integer Answer Type Questions

The Answer to the following questions are positive integers of 1/2/3 digits and zero

61. A sample of hydrogen contains equal number of H^1, H^2 and H^3 atoms. The ratio of total number of protons and neutrons $\left(\frac{P}{n}\right)$ in the sample is:

62. Two bulbs 'A' and 'B' emit red light and yellow light at 8000 Å and 4000 Å respectively. The number of photons emitted by both the bulbs per second is the same. If the red bulb is labelled as 100 watts, x × 10 the wattage of the yellow bulb. Find x

63. Nitrogen has an atomic number of 7 and oxygen has an atomic number of 8. The total number of electron in the nitrate ion $\left(NO_3^-\right)$ is:

64. A light source of wavelength λ illuminates a metal and ejects photoelectron with $(KE)_{max} = 1\,eV$. Another light source of wave length $\frac{\lambda}{3}$, ejects photoelectrons from same metal with $(KE)_{max} = 5\,eV$. Find the value of work function (eV) of metal.

65. The ionisation potential of a hydrogen like species is 36 volt. What is the value of excitation energy from ground state to 1st excited state (in eV) ?

66. The speed of this dust particle (mass $= 10^{-3}\,g$) is measured with the uncertainty of $\frac{3.313}{\pi} \times 10^{-3}\,m/s$. The minimum uncertainty in position of the dust particle (in order of $10^{-26}\,m$) is:

67. de Broglie wavelength 'λ' of an ideal gas molecule at any given temperature is given as $\lambda \propto m^{-x} \times T^{-y}$. Where m = mass of one gas molecule; T = temperature (K).
Give x + y = ?

68. Total different spectral lines observed in between 11th excited state and 3rd energy level in H-atom emission spectrum are:

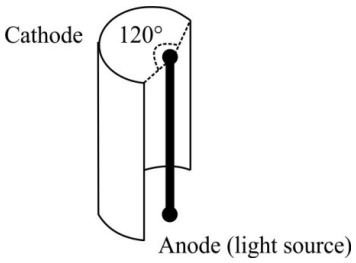
69. 'α particle' of 3.6 MeV are fired towards nucleus ${}_Z^AX$, at point of closest separation distance between 'α particle' and 'X' is $1.6 \times 10^{-14}\,m$. Calculate atomic number of 'X'.

70. A beam of light has three λ, 4144Å, 4972Å and 6216Å with a total intensity of 3.6×10^{-3} Wm^{-2} equally distributed amongst the three λ. The beam falls normally on an area $1.0cm^2$ of a clean metallic surface of work function 2.3 eV. Assume that there is no loss of light by reflection etc. Calculate the number of photoelectrons emitted in 2 sec, in scientific notation, $x\times10^{y}$ find the value of y.

71. A particle of charge equal to that of electron and mass 208 times the mass of the electron moves in a circular orbit around a nucleus of charge $+3e$.
Assuming that the Bohr model of the atom is applicable to this system, find the value of n for which the radius of the orbit is approximately the same as that of the first Bohr orbit of the hydrogen atom.

72. If $n_1+n_2=4\ and\ n_2^2-n_1^2=8,$ then calculate maximum value of wavelength emitted in transition form $n_2\rightarrow n_1$ for Li^{2+} in nm [Given $R_H=10^7m^{-1}$].

73. A cylindrical source of light which emits radiation radially (from curved surface) only, placed at the centre of hollow, metallic cylindrical surface, as shown in diagram.
The power of source is 90 watt and it emits light of wavelength 4000Å only. The emitted photons strike the metallic cylindrical surface which results in ejection of photoelectrons. All ejected photoelectrons reaches to anode (light source). The magnitude of photocurrent (in amp) is:



74. Calculate the energy (in KJ) required to excite one litre of hydrogen gas at 1 atm and 298 K to the first excited state of atomic hydrogen. The energy for the dissociation of H—H is 436 KJ mol^{-1}. Give your answer excluding decimal places.

75. The work function (ϕ) of some metals is listed below. The number of metals which will show photoelectric effect when light of 300 nm wavelength falls on the metal is:

Metal	Li	Na	K	Mg	Cu	Ag	Fe	Pt	W
ϕ (eV)	2.4	2.3	2.2	3.7	4.8	4.3	4.7	6.3	4.75

Periodic Properties of Elements

CHOOSE THE CORRECT ALTERNATIVE. ONLY ONE CHOICE IS CORRECT. HOWEVER, QUESTIONS MARKED '*' MAY HAVE MORE THAN ONE CORRECT OPTION.

1. The correct order of second ionization potential of carbon, nitrogen, oxygen and fluorine is :
(A) C > N > O > F **(B)** O > N > F > C **(C)** O > F > N > C **(D)** F > O > N > C

2. Which has most stable +2 oxidation state?
(A) Sn **(B)** Pb **(C)** Fe **(D)** Ag

3. Consider the isoelectronic species, Na^+, Mg^{2+}, F^- and O^{2-}. The correct order of increasing length of their radii is _____ .
(A) $F^- < O^{2-} < Mg^{2+} < Na^+$ **(B)** $Mg^{2+} > Na^+ > F^- > O^{2-}$
(C) $O^{2-} > F^- > Na^+ > Mg^{2+}$ **(D)** $O^{2-} < F^- < Mg^{2+} < Na^+$

4. Which of the following is not an actinoid ?
(A) Curium (Z = 96) **(B)** Californium (Z = 98)
(C) Uranium (Z = 92) **(D)** Terbium (Z = 65)

5. The order of screening effect of electrons of s, p, d and f orbital of a given shell of an atom on its outer shell electrons is :

(A) $s > p > d > f$ **(B)** $f > d > p > s$ **(C)** $p < d < s < f$ **(D)** $f > p > s > d$

6. The first ionization enthalpies of Na, Mg, Al and Si are in the order :

(A) $Na < Mg > Al < Si$ **(B)** $Na < Mg > Al > Si$

(C) $Na < Mg < Al < Si$ **(D)** $Na > Mg > Al < Si$

7. The electronic configuration of gadolinium (Atomic number 64) is

(A) $[Xe]4f^3 5d^5 6s^2$ **(B)** $[Xe]4f^7 5d^2 6s^1$ **(C)** $[Xe]4f^7 5d^1 6s^2$ **(D)** $[Xe]4f^8 5d^6 6s^2$

8. Which of the following is the correct order of size of the given species :

(A) $I > I^- > I^+$ **(B)** $I^+ > I^- > I$ **(C)** $I > I^+ > I^-$ **(D)** $I^- > I > I^+$

9. The formation of the oxide ion, $O^{2-}(g)$, from oxygen atoms requires first an exothermic and then an endothermic step as shown below :

$$O(g) + e^- \longrightarrow O^-(g) ; \Delta H^\ominus = -141 \text{ kJ mol}^{-1}$$

$$O^-(g) + e^- \longrightarrow O^{2-}(g) ; \Delta H^\ominus = +780 \text{ kJ mol}^{-1}$$

Thus process of formation of O^{2-} in gas phase is unfavourable even through O^{2-} is isoelectronic with neon. It is due to the fact that,

(A) Oxygen is more electronegative.

(B) Addition of electron in oxygen results in larger size of the ion.

(C) Electron repulsion outweighs the stability gained by achieving noble gas configuration.

(D) O^- ion has comparatively smaller size than oxygen atom.

10. Electronic configurations of four elements A, B, C and D are given below :

I. $1s^2 2s^2 2p^6$ **II.** $1s^2 2s^2 2p^4$ **III.** $1s^2 2s^2 2p^6 3s^1$ **IV.** $1s^2 2s^2 2p^5$

Which of the following is the correct order of increasing tendency to gain electrons ?

(A) $I < III < II < IV$ **(B)** $I < II < III < IV$ **(C)** $IV < II < III < I$ **(D)** $IV < I < II < III$

***11.** Which of the following elements can show covalency greater than 4 ?

(A) Be **(B)** P **(C)** S **(D)** B

***12.** Those elements impart colour to the flame on heating in it, the atoms of which require low energy for the ionisation. The elements of which of the following groups will impart colour to the flame ?

(A) 2 **(B)** 13 **(C)** 1 **(D)** 17

***13.** Which of the following elements will gain one electron more readily in comparison to other elements of their group ?

(A) S (g) **(B)** Na (g) **(C)** O (g) **(D)** Cl (g)

***14.** Which of the following statements are correct ?

(A) Helium has the highest first ionisation enthalpy in the periodic table.

(B) Chlorine has less negative electron gain enthalpy than fluorine.

(C) Mercury and bromine are liquids at room temperature.

(D) In any period, atomic radius of alkali metal is the highest.

***15.** Which of the following sets contain only isoelectronic ions ?

(A) $Zn^{2+}, Ca^{2+}, Ga^{3+}, Al^{3+}$ **(B)** $K^+, Ca^{2+}, Sc^{3+}, Cl^-$

(C) $P^{3-}, S^{2-}, Cl^-, K^+$ **(D)** $Ti^{4+}, Ar, Cr^{3+}, V^{5+}$

***16.** In which of the following options order of arrangement does not agree with the variation of property indicated against it ?

(A) $Al^{3+} < Mg^{2+} < Na^+ < F^-$ (increasing ionic size)

(B) $B < C < N < O$ (increasing first IE)

(C) $I < Br < Cl < F$ (increasing electron gain enthalpy)

(D) $Li < Na < K < Rb$ (increasing metallic radius)

***17.** Which of the following have no unit ?

(A) Electronegativity **(B)** Electron gain enthalpy

(C) Ionisation enthalpy **(D)** Metallic character

***18.** Ionic radii very in :

(A) Inverse proportion to the effective nuclear charge.

(B) Inverse proportion to the square of effective nuclear charge.

(C) Direct proportion to the screening effect.

(D) Direct proportion to the square of screening effect.

***19.** An element belongs to 3rd period and group-13 of the periodic table. Which of the following properties will be shown by the element?

(A) Good conductor of electricity **(B)** Liquid, metallic

(C) Solid, metallic **(D)** Solid, non metallic

Reasoning Type Questions for 20 – 21

(A) Assertion is correct statement and reason is wrong statement.

(B) Assertion and reason both are correct statements and reason is correct explanation of assertion.

(C) Assertion and reason both are wrong statements.

(D) Assertion is wrong statement and reason is correct statement.

20. **Assertion (A) :** Generally, ionisation enthalpy increases from left to right in a period.

Reason (R) : When successive electrons are added to the orbitals in the same principle quantum level, the shielding effect of inner core of electrons does not increase very much to compensate for the increased attraction of the electron to the nucleus.

21. **Assertion (A) :** Electrons gain enthalpy generally becomes less negative as we go down a group.

Reason (R) : Size of the atom increases on going down the group and the added electron would be farther from the nucleus.

22. Which of the following represents the correct order increasing first ionization enthalpy for Ca, Ba, S, Se and Ar?

(A) Ca < S < Ba < Se < Ar **(B)** S < Se < Ca < Ba < Ar

(C) Ba < Ca < Se < S < Ar **(D)** Ca < Ba < S < Se < Ar

23. The first ionization potential of Na is 5.1 eV. The value of electron gain enthalpy of Na^+ will be :

(A) –2.55 eV **(B)** –5.1 eV **(C)** –10.2eV **(D)** + 2.55 eV

24. Which one the following orders presents the correct sequence of the increasing basic nature of the given oxides?

(A) $Al_2O_3 < MgO < Na_2O < K_2O$ **(B)** $MgO < K_2O < Al_2O_3 < Na_2O$

(C) $Na_2O < K_2O < MgO < Al_2O_3$ **(D)** $K_2O < Na_2O < Al_2O_3 < MgO$

25. The correct sequence which shows decreasing order of the ionic radii of the elements is :

(A) $Al^{3+} > Mg^{2+} > Na^+ > F^- < O^{2-}$ **(B)** $Na+ > Mg^{2+} > Al^{3+} > O^{2-} > Al^{3+}$

(C) $Na^+ > F^- > Mg^{2+} > O^{2-} > Al^{3+}$ **(D)** $O^{2-} > F^- > Na^+ > Mg^{2+} > Al^{3+}$

26. The set representing the correct order of ionic radius is :

(A) $Li^+ > Be^{2+} > Na^+ > Mg^{2+}$ **(B)** $Na^+ > Li^+ > Mg^{2+} > Be^{2+}$

(C) $Li^{2+} > Na^+ > Mg^{2+} > Be^{2+}$ **(D)** $Mg^{2+} > Be^{2+} > Li^+ > Na^+$

27. The charge/size ratio of a cation determines its polarizing power. Which one of the following sequences represents the increasing order of the polarizing power of the cationic species, K^+, Ca^{2+}, Mg^{2+}, Be^{2+} ?

(A) $Mg^{2+} < Br^{2+} < K+ < Ca^{2+}$ **(B)** $Be^{2+} < K^+ > Ca^{2+} < Mg^{2+}$

(C) $K^+ < Ca^{2+} < Mg^{2+} < Be^{2+}$ **(D)** $Ca^{2+} < Mg^{2+} < Be^+ < K^+$

28. The ionic mobility of alkali metal ions in aqueous solution is maximum for :

(A) K^+ **(B)** Rb^+ **(C)** Li^+ **(D)** Na^+

29. The increasing order of the first ionization enthalpies of the element B, P, S and F (lowest first) is :

(A) F < S < P < B **(B)** S < P < B < F

(C) B < P < S < F **(D)** B < S < P < F

30. Following statements regarding the periodic trends of chemical reactivity of the alkali metals and the halogens are given. Which of these statements give the correct picture ?

(A) The reactivity decreases in the alkali metals but increases in the halogen with increase in atomic number down the group

(B) In both the alkali metals and the halogens the chemical reactivity decreases with increase in atomic number down the group

(C) Chemical reactivity increases with increase in atomic number down the group in both the alkali metals and halogens

(D) In alkali metals, the reactivity increases but in the halogens it decreases with increase in atomic number down the group

31. In which of the following arrangements the order is not according to the property indicated against it ?

(A) Li < Na < K < Rb Increasing metallic radius

(B) I < Br < F < CI Increasing electron gain enthalpy (with negative sign)

(C) B < C < N < O Increasing first ionization enthalpy

(D) $Al^{3+} < Mg^{2+} < Na+ < F^-$ Increasing ionic size.

32. Based on lattice energy and other considerations which one of the following alkali metals chlorides is expected to have the highest melting point?

(A) RbCl **(B)** KCl **(C)** NaCl **(D)** LiCl

33. Which one of the following ions has the highest value of ionic radius?

(A) Li^+ **(B)** B^{3+} **(C)** O^{2-} **(D)** F^-

34. Which among the following factors is the most important in making fluorine the strongest oxidizing agent?

(A) Electron affinity **(B)** Ionisation enthalpy

(C) Hydration enthalpy **(D)** Bond dissociation energy

35. Among Al_2O_3, SiO_2, P_2O_3 and SO_2 the correct order of acid strength is :

(A) $SO_2 < P_2O_3 < SiO_2 < Al_2O_3$ **(B)** $SiO_2 < SO_2 < Al_2O_3 < P_2O_3$

(C) $Al_2O_3 < SiO_2 < SO_2 < P_2O_3$ **(D)** $Al_2O_3 < SiO_2 < P_2O_3 < SO_2$

36. The radius of La^{3+} (atomic number : La = 57) is 1.06 Å . Which one of the following given values will be closest to the radius of Lu^{3+} (atomic number : Lu = 71)?

(A) 1.60 Å **(B)** 1.40 Å **(C)** 1.06 Å **(D)** 0.85 Å

37. The atomic numbers of vanadium (V) chromium (Cr), manganese (Mn) and iron (Fe) are, respectively 23, 24, 25 and 26. Which one of these may be expected to have the highest second ionization enthalpy ?

(A) V **(B)** Cr **(C)** Mn **(D)** Fe

38. Ce^{3+}, La^{3+}, Pm^{3+} and Yb^{3+} have ionic radii in the increasing order as :

(A) $La^{3+} < Ce^{3+} < Pm^{3+} < Yb^{3+}$ **(B)** $Yb^{3+} < Pm^{3+} < Ce^{3+} < La^{3+}$

(C) $La^{3+} < Ce^{3+} < Pm^{3+} < Yb^{3+}$ **(D)** $Yb^{3+} < Pm^{3+} < La^{3+} < Ce^{3+}$

39. Which is not the correct order for the stated property ?

(A) Ba > Sr > Mg ; atomic radius **(B)** F > O > N ; first ionization enthalpy

(C) Cl > F > I ; electron affinity **(D)** O > Se > Te ; electronegativity

***40.** The first element of each group s and p-blocks shows anomalous behavior as compared to the rest of elements in the same group. This is due to :

(A) Very small size as compared to atoms of other elements in the same group

(B) Its comparatively high ionization energy

(C) Its highest electronegativity in the group

(D) Non-availability of d-orbitals for the formation of bond

41. Which one of the following arrangements represents the correct order of least negative to most negative electron gain enthalpy for C, Ca, Al, F and O ?

(A) Al < Ca < O < C < F **(B)** Al < O < C < Ca < F

(C) C < F < O < Al < Ca **(D)** Ca < Al < C < O < F

42. Identify the wrong statement in the following.

(A) Amongst isoelectronic species, smaller the positive charge on the cation, smaller its the ionic radius

(B) Amongst isoelectronic species, greater the negative charge on the anion, larger its the ionic radius

(C) Atomic radius of the elements increases as one moves down the first group

(D) Atomic radius of the elements decreases as one moves across from left to right in the 2nd period of the periodic table

43. What is the value of electron gain enthalpy of Na^+ if IE_1 of Na = 5.1 eV ?

(A) –5.1 eV **(B)** + 5.1 eV **(C)** –10.2 eV **(D)** + 10.2 eV

44. Which one of the following ionic species has the greatest proton affinity to form stable compound ?

(A) NH_2^- **(B)** F^- **(C)** I^- **(D)** HS^-

45. Which one of the following orders is not in accordance with the property stated against it ?

(A) $F_2 > Cl_2 > Br_2 > I_2$: bond dissociation energy **(B)** $F_2 > Cl_2 > Br_2 > I_2$: Oxidising power

(C) HI > HBr > HCl > HF : Acidic property in water **(D)** F > Cl > Br > I : Electronegativity

46. The ions O^{2-}, F^-, Na^+, Mg^{2+} and Al^{3+} are isoelectronic. Their ionic radii show.

(A) a significant increase from O^{2-} to Al^{3+}

(B) a significant decrease from O^{2-} to Al^{3+}

(C) an increase from O^{2-} to F^- and then decrease from Na^+ to Al^{3+}

(D) a decrease from O^{2-} to F^- and then increase from Na^+ to Al^{3+}

47. In the periodic table from left to right in a period, the atomic volume

(A) decreases **(B)** increases

(C) remains same **(D)** first decrease then increases

Integer Answer Type Questions

The Answer to the following questions are positive integers of 1/2/3 digits and zero

48. Find the total number of species having two unpaired electrons from the following species.

$Fe^{2+}, Cr, Cr^{3+}, Ti^{2+}, Mn^{2+}, Mn^{2+}, V^{3+}$

49. Find the number of p-block elements from the following atomic numbers given below.

83 79 42 64 37 54 34

50. Find the total number of paramagnetic species among the following?

$Sc^{3+}, Fe^{3+}, Mn^{2+}, Co^{4+}, Co^{3+}, Cr^+, Fe^{2+}, Mn^{3+}, Cr^{3+}, Zn^{2+}, Ti^{+4}, V^{3+}$

51. Select the number of elements which are called transition metals.

B, Sc, Al, Pd, Os, Zr, Rb, Ba, Fr

52. Among the following species, how many have their ionic size greater than O^{2-} ?

$Se^{2-}, F^-, N^{3-}, P^{3-}$

53. Find the number of species which have size smaller than Cs.

Li, Na, Mg, Rb, Fr, Ba, Sr, Ca

54. Find the number of transition elements in the following:

Zn, Cd, Hg, Pt, U, Sn

55. The element with the lowest atomic number that has a ground-state electronic configuration of $(n-1)d^5ns^2$ is located in ……. Period.

56. Period number of Sc = x
Modern periodic table group number of Tl = y (according to 1 to 18 convention) Find the value of $y - x$.

57. Number of unpaired electrons in Mn^{+7} = a
Number of d-subshell electrons in Cr = b
Number of f-subshell electrons in Hf
(Atomic no. = 72) = c. Find the value of $c - b + a$.

58. The oxidation state of fluorine in F_2 is x. Find value of $|x|$.

59. The number of oxides which are expected to be neutral amongst the oxides of nitrogen (viz. $N_2O, NO, NO_2, N_2O_4, N_2O_5$) = x. The number of oxides which are expected to be more basic with respect to NiO amongst MgO, SrO, K_2O = y . Find the value of x + y.

60. What is the value of $(n + \ell)$ for the unpaired e^- in an atom of an element which is present in the 3rd period and seventeenth group of the periodic table.

61. If $3e^-$ can be accommodated in each orbital then how many elements will be present in the 7th period of periodic table?

62. How many elements are present in the 7th period of periodic table.

Chemical Bonding - 1 & 2

CHOOSE THE CORRECT ALTERNATIVE. ONLY ONE CHOICE IS CORRECT. HOWEVER, QUESTIONS MARKED '*' MAY HAVE MORE THAN ONE CORRECT OPTION.

1. Highest covalent character is found in which of the following ?
(A) CaF_2 **(B)** $CaCl_2$ **(C)** CaI_2 **(D)** $CaBr_2$

***2.** Which is(are) correct among the following ?
(A) Radius of Cl^- ion is 1.56 Å , while that of Na^+ ion is 0.95 Å
(B) Radius of Cl atom is 0.99 while that of Na atom is 1.54
(C) The radius of Cl atom is 0.95, while that of ion is 0.81
(D) Radius of Na atom is 0.95, while that of Na^+ ion is 1.54

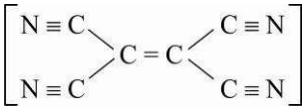
3. Which of the following anions is most easily polarized ?
(A) Cl^- **(B)** Se^{2-} **(C)** Br^- **(D)** Te^{2-}

4. The geometrical configuration (structure) of BF_3 and NF_3 molecules is :
(A) The same because of same covalency of the central atom
(B) Different because BF_3 is polar and NF_3 is non-polar
(C) Different because BF_3 is non-polar and NF_3 is polar
(D) Different because the central atom in BF_3 is sp^2 and NF_3 is sp^3 hybridised

***5.** Select correct statement about valence-bond approach :
(A) Each bond is formed by maximum overlap for its maximum stability
(B) It represents localised electron model of bonding
(C) Most of the electrons retain the same orbital locations as in a separated atoms
(D) The electron share the multi-nuclear system after overlapping

6. The compound $(CH_3 - \overset{\overset{OH}{|}}{C} = CH_2)$ contains
(A) 10σ-bonds, 1π-bond and 1 lone pair **(B)** 8σ-bonds, 2π-bonds and 2 lone pairs
(C) 9σ-bonds, 1π-bond and 2 lone pairs **(D)** 9σ-bonds, 2π-bonds and 1 lone pair

7. How many σ and π-bonds are there in the molecule of tetracyano-ethylene ?



(A) $4\sigma, 14\pi$ **(B)** $5\sigma, 13\pi$ **(C)** $8\sigma, 10\pi$ **(D)** $9\sigma, 9\pi$

8. The BCl_3 is a planar molecule whereas NCl_3 is pyramidal because :

(A) BCl bond is more polar than N—Cl bond

(B) N—Cl bonds is more covalent that B—Cl bond

(C) Nitrogen atom is smaller than boron atom

(D) BCl_3 has no lone pair electrons but NCl_3 has a lone pair of electrons

9. In 1, 3-butadiene ($H_2C=CH–CH=CH_2$), the carbon atoms is(are) hybridised as :

(A) sp **(B)** sp^2 **(C)** sp^3 **(D)** sp^2 and sp^3

***10.** Which of the following statement(s) is(are) true ?

(A) HF is more polar than HBr **(B)** CuCl is more covalent than NaCl

(C) HF is less polar than HBr

(D) Chemical bond formatting takes place when forces of attraction overcome the forces of repulsion

11. In which of the following molecule, all the atoms lie in one plane ?

(A) CH_4 **(B)** BF_3 **(C)** PF_5 **(D)** NH_3

12. In OF_2 number of bond pairs and total lone pairs of electrons are respectively :

(A) 2, 6 **(B)** 2, 8 **(C)** 2, 10 **(D)** 2, 9

13. Isostructural species are those which have the same shape and hybridisation. Among the given species identify the isostructural pairs.

(A) $\left[NF_3 \text{ and } BF_3\right]$ **(B)** $\left[BF_4^- \text{ and } NH_4^+\right]$ **(C)** $\left[BCl_3 \text{ and } BrCl_3\right]$ **(D)** $\left[NH_3 \text{ and } NO_3^-\right]$

14. Polarity in a molecule and hence the dipole moment depends primarily on electronegativity of the constituent atoms and shape of a molecule. Which of the following has the highest dipole moment?

(A) CO_2 **(B)** HI **(C)** H_2O **(D)** SO_2

15. The types of hybrid orbitals of nitrogen in NO_2^+, NO_3^- and NH_4^+ respectively are expected to be :

(A) sp, sp^3 and sp^2 **(B)** sp, sp^2 and sp^3 **(C)** sp^2, sp and sp^3 **(D)** sp^2, sp^3 and sp

16. Hydrogen bonds are formed in many compounds e.g., H_2O, HF, NH_3 . The boiling point of such compounds depends to a large extent on the strength of hydrogen bond and the number of hydrogen bonds. The correct decreasing order of the boiling points of above compounds is :

(A) $HF > H_2O > NH_3$ **(B)** $H_2O > HF > NH_3$ **(C)** $NH_3 > HF > H_2O$ **(D)** $NH_3 > H_2O > HF$

17. In NO_3^- ion, the number of bond pairs and lone pairs of electrons on nitrogen atom are :

(A) 2, 2 **(B)** 3, 1 **(C)** 1, 3 **(D)** 4, 0

18. Which of the following species has tetrahedral shape ?

(A) BH_4^- **(B)** NH_2^- **(C)** CO_3^{2-} **(D)** H_3O^+

19. In which of the following molecule/ion all the bonds are not equal ?

(A) XeF_4 **(B)** BF_4^- **(C)** C_2H_4 **(D)** SiF_4

20. In which of the following substances will hydrogen bond be strongest ?

(A) HCl **(B)** H_2O **(C)** HI **(D)** H_2S

21. If the electronic configuration of an element is $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^2\,4s^2$, the four electrons involved in chemical bond formation will be _____ .

(A) $3p^6$ **(B)** $3p^6, 4s^2$ **(C)** $3p^6, 3d^2$ **(D)** $3d^2, 4s^2$

22. The electronic configuration of the outer most shell of the most electronegative element is :

(A) $2s^2\,2p^5$ **(B)** $3s^2\,3p^5$ **(C)** $4s^2\,4p^5$ **(D)** $5s^2\,5p^5$

23. Amongst the following elements whose electronic configurations are given below, the one having the highest ionization enthalpy is :

(A) $[Ne]3s^2\,3p^1$ **(B)** $[Ne]3s^2\,3p^3$ **(C)** $[Ne]3s^2\,3p^2$ **(D)** $[Ar]3d^{10}\,4s^2\,4p^3$

24. **Assertion (A) :** Among the two $O-H$ bonds in H_2O molecule, the energy required to break the first $O-H$ bond and the other $O-H$ bond is same.

Reason (R) : This is because the electronic environment around oxygen is the same even after breakage of one $O-H$ bond.

(A) A and R both are correct, and R is correct explanation of A.
(B) A and R both are correct, but R is not the correct explanation of A.
(C) A is true not R is false.
(D) A and R both are false.

25. The correct statement for the molecule CsI_3 is :

(A) It is a covalent molecule
(B) It contains Cs^+ and I_3^-
(C) It contains Cs^{3+} and I^- ions
(D) It contains Cs^+, I^- and lattice I_2 molecule

26. The molecule having smallest bond angle is :

(A) NCl_3 **(B)** $AsCl_3$ **(C)** $SbCl_3$ **(D)** PCl_3

27. In which of the following pairs, the two species are not iso-structural?

(A) CO_3^{2-} and NO_3^- **(B)** PCl_4^+ and $SiCl_4$ **(C)** PF_5 and BrF_5 **(D)** AlF_6^{3-} and SF_6

28. Among the following, the maximum covalent character is shown by the compound :

(A) $FeCl_2$ **(B)** $SnCl_2$ **(C)** $AlCl_3$ **(D)** $MgCl_2$

29. The structure of IF_7 is

(A) Square pyramid
(B) Trigonal bipyramid
(C) Octahedral
(D) pentagonal bipyramid

30. Which of the following has maximum number of lone pairs associated with Xe?

(A) XeO_3 **(B)** XeF_4 **(C)** XeF_6 **(D)** XeF_2

31. The number of types of bonds between two carbon atoms in calcium carbide is :

(A) One sigma, two pi **(B)** One sigma, one pi **(C)** Two sigma, one pi **(D)** Two sigma, two pi

32. Which of the following hydrogen bond is the strongest?

(A) $O-H...N$ **(B)** $F-H\cdots F$ **(C)** $O-H\cdots O$ **(D)** $O-H\cdots F$

33. In which of the following molecules/ions, all the bonds are not equal?

(A) SF_4 **(B)** SiF_4 **(C)** XeF_4 **(D)** BF_4^-

34. The decreasing values of bond angles from $NH_3\,(107°)$ to $SbH_3\,(91°)$ down group-15 of the periodic table is due to :

(A) Increasing bp-bp repulsion
(B) Increasing p-orbital character
(C) Decreasing lp-bp repulsion
(D) Decreasing electronegativity

35. Lattice energy of an ionic compound depends upon :

(A) Change on the ion and size of the ion
(B) Packing of ions only
(C) Size of the ion only
(D) Charge on the ion only

36. The molecular shapes of SF_4, CF_4 and XeF_4 are :

(A) Different with 1, 0 and 2 lone pair of electrons on the central atom, respectively
(B) Different with 0, 1 and 2 lone pair of electrons on the central atom, respectively
(C) The same with 1, 1 and 1 lone pair of electrons on the central atom, respectively
(D) The same with 2, 0 and 1 lone pair of electrons on the central atom, respectively

37. The maximum number of 90° angles between bond pair-bond pair of electrons is observed in :
(A) dsp^3 hybridisation **(B)** sp^3d hybridisation **(C)** dsp^2 hybridisation **(D)** sp^3d^2 hybridisation

38. Which one of the following has the regular tetrahedral structure? (Atomic number : B = 5, S = 16, Ni = 28, Xe = 54)
(A) XeF_4 **(B)** SF_4 **(C)** BF_4^- **(D)** $[Ni(CN)_4]^{2-}$

39. The correct order of bond angles (smallest first) in H_2S, NH_3, BF_3 and SiH_4 is :
(A) $H_2S < SiH_4 < NH_3 < BF_3$ **(B)** $NH_3 < H_2S < SiH_4 < BF_3$
(C) $H_2S < NH_3 < SiH_4 < BF_3$ **(D)** $H_2S < NH_3 < SiH_3 < BF_4$

40. The states of hybridisation of boron and oxygen atoms in boric acid (H_3BO_3) are respectively
(A) sp^2 and sp^2 **(B)** sp^2 and sp^3 **(C)** sp^3 and sp^2 **(D)** sp^3 and sp^3

41. The pair of species having identical shapes for molecules of both species, is :
(A) CF_4, SF_4 **(B)** XeF_2, CO_2 **(C)** BF_3, PCl_3 **(D)** PF_5, IF_3

42. Which one of the following compounds has the smallest bond angle?
(A) SO_2 **(B)** OH_2 **(C)** SH_2 **(D)** NH_3

43. Which one of the following pairs of molecules will have permanent dipole moments for both members?
(A) SiF_4 and NO_2 **(B)** NO_2 and CO_2 **(C)** NO_2 and O_3 **(D)** SiF_4 and CO_2

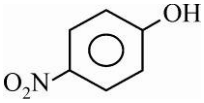
44. Select the correct statement :
(A) When a covalent bond is formed transfer of electrons takes place
(B) Pure H_2O does not contain any ion
(C) A bond is formed when attractive forces overcome repulsive forces
(D) HF is less polar than HBr

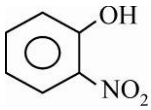
45. Bond angle of 109° 28' is found in :
(A) NH_3 **(B)** H_2O **(C)** $\overset{\oplus}{C}H_5$ **(D)** $\overset{\oplus}{N}H_4$

46. Hybridisation of the underline atom changes in :
(A) $\underline{Al}H_3$ changes to AlH_4^- **(B)** $H_2\underline{O}$ changes to H_3O^+
(C) $\underline{N}H_3$ changes to NH_4^+ **(D)** In all cases

47. Which of the following statement is correct ?
(A) $FeCl_2$ is more covalent than $FeCl_3$ **(B)** $FeCl_3$ is more covalent than $FeCl_2$
(C) Both $FeCl_2$ and $FeCl_3$ are equally covalent **(D)** $FeCl_2$ and $FeCl_3$ do not have any covalent character

48. Out of the two compounds shown below, the vapour pressure of II at a particular temperature is expected to be :

I. 

II. 

(A) Higher than that of I **(B)** Lower than that of I
(C) Same as that of I **(D)** Can be higher or lower depending upon the size of the vessel

49. Which one of the following hydrogen halides has the lowest boiling point ?
(A) HF **(B)** HCl **(C)** HBr **(D)** HI

50. If a molecule MX_3 has zero dipole moment, the sigma bonding orbitals used by M (atomic number < 21) are :
(A) Pure p **(B)** sp hybrid **(C)** sp^2 hybrid **(D)** sp^3 hybrid

51. The set representing the correct order of ionic radius is :
(A) $Li^+ > Na^+ > Mg^{2+} > Be^{2+}$ **(B)** $Mg^{2+} > Be^{2+} > Li^+ > Na^+$
(C) $Li^+ > Be^{2+} > Na^+ > Mg^{2+}$ **(D)** $Na^+ > Li^+ > Mg^{2+} > Be^{2+}$

52. The bond between two identical non-metal atoms has a pair of electrons :

(A) Unequally shared between the two **(B)** Transferred fully from one atom to another

(C) With identical spins **(D)** Equally shared between them

53. The compound in which $\overset{*}{C}$ uses the sp^3 hybrid orbitals for bond formation is :

(A) $H\overset{*}{C}OOH$ **(B)** $(H_2N)_2\overset{*}{C}O$ **(C)** $(CH_3)_3\overset{*}{C}OH$ **(D)** $CH_3\overset{*}{C}HO$

54. The cyanide ion, CN^- and N_2 are isoelectronic. But a contrast to CN^-, N_2 is chemical inert, because of :

(A) Low bond energy **(B)** Absence of bond polarity

(C) Unsymmetrical distribution **(D)** Presence of more number of electrons in bonding orbitals

55. Among the following species, identify the isostructural pairs. NF_3, NO_3^-, BF_3, H_3O^+, HN_3

(A) $[NF_3, NO_3^-]$ and $[BF_3, H_3O^+]$ **(B)** $[NF_3, HN_3^-]$ and $[NO_3^-, BF_3]$

(C) $[NF_3, H_3O^+]$ and $[NO_3^-, BF_3]$ **(D)** $[NF_3, H_3O^+]$ and $[HN_3, BF_3]$

56. Among KO_2, AlO_2^-, BaO_2 and NO_2^+, unpaired electron is present in :

(A) NO_2^+ and BaO_2 **(B)** KO_2 and AlO_2^- **(C)** KO_2 only **(D)** BaO_2 only

57. The correct order of hybridization of the central atom in the following species NH_3, $[PtCl_4]^{2-}$, PCl_5 and BCl_3 is :

(A) dsp^2, dsp^3, sp^2 and sp^3 **(B)** sp^3, dsp^2, dsp^3, sp^2

(C) dsp^2, sp^2, sp^3, dsp^3 **(D)** dsp^2, sp^3, sp^2, dsp^3

58. Specify the coordination geometry around and hybridisation of N and B atoms in a 1 : 1 complex of BF_3 and NH_3 :

(A) N : tetrahedral, sp^3 ; B : tetrahedral, sp^3 **(B)** N : pyramidal, sp^3 ; B : pyramidal, sp^3

(C) N : pyramidal, sp^3 ; B : planar, sp^2 **(D)** N : pyramidal, sp^3 ; B : tetrahedral, sp^3

59. SF_2, SF_4 and SF_6 have the hybridisation on sulphur atoms respectively as :

(A) sp^2, sp^3, sp^2d^2 **(B)** sp^3, sp^3, sp^3d^2

(C) sp^3, sp^3d, sp^3d^2 **(D)** sp^3, spd^2, d^2sp^3

60. Which is correct statement about diborane structure ?

(A) All HBH bond angles are equal **(B)** All H-B bond lengths are equal

(C) It has two three-centre-2 electron bonds **(D)** All hydrogens and boron atoms are in one plane

61. In which pair of species, both species do have the similar geometry ?

(A) CO_2, SO_2 **(B)** NH_3, BH_3 **(C)** CO_3^{2-}, SO_3^{2-} **(D)** SO_4^{2-}, ClO_4^-

62. Which of the following order of energies of molecular orbitals of N_2 is correct ?

(A) $(\pi 2p_y) < (\sigma 2p_z) < (\pi^* 2p_x) \approx (\pi^* 2p_y)$ **(B)** $(\pi 2p_y) > (\sigma 2p_z) > (\pi^* 2p_x) \approx (\pi^* 2p_y)$

(C) $(\pi 2p_y) < (\sigma 2p_z) > (\pi^* 2p_x) \approx (\pi^* 2p_y)$ **(D)** $(\pi 2p_y) > (\sigma 2p_z) < (\pi^* 2p_x) \approx (\pi^* 2p_y)$

63. Which of the following statement is not correct from the view point of molecular orbitals theory ?

(A) Be_2 is not a stable molecule.

(B) He_2 is not stable but He_2^+ is expected to exist.

(C) Bond strength of N_2 is maximum amongst the homonuclear diatomic molecules belonging to the second period.

(D) The order of energies of molecular orbitals in N_2 molecule is

$$\sigma 2s < \sigma^* 2s < \sigma 2p_z < (\pi 2p_x = \pi 2p_y) < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$$

64. Which of the following option represents the correct bond order :

(A) $O_2^- > O_2 > O_2^+$ **(B)** $O_2^- < O_2 < O_2^+$ **(C)** $O_2^- > O_2 < O_2^+$ **(D)** $O_2^- < O_2 > O_2^+$

65. Which one of the following molecules is expected to exhibit diamagnetic behaviour?

(A) C_2 **(B)** N_2 **(C)** O_2 **(D)** S_2

66. In which of the following pairs of molecules/ions both the species are not likely to exist?

(A) H_2^+, He_2^{2-} **(B)** H_2^-, He_2^{2-} **(C)** H_2^{2+}, He_2 **(D)** H_2^-, He_2^{2+}

67. Stability of the species Li_2, Li_2^- and Li_2^+ increases in the order of :

(A) $Li_2 < Li_2^+ < Li_2^-$ **(B)** $Li_2^- < Li_2^+ < Li_2$ **(C)** $Li_2 < Li_2^- < Li_2^+$ **(D)** $Li_2^- < Li_2 < Li_2^+$

68. Using MO theory, predict which of the following species has the shortest bond length?

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

69. Which one of the following pairs of species have the same bond order?

(A) CN^- and NO^+ **(B)** CN^- and CN^+ **(C)** O_2^- and CN^- **(D)** NO^+ and CN^+

70. In which of the following ionisation processes, the bond order has increased and the magnetic behaviour has changed?

(A) $C_2 \rightarrow C_2^+$ **(B)** $NO \rightarrow NO^+$ **(C)** $O_2 \rightarrow O_2^+$ **(D)** $N_2 \rightarrow N_2^+$

71. Which one of the following species is diamagnetic in nature?

(A) H_2^- **(B)** H_2^+ **(C)** H_2 **(D)** He_2^+

72. The bond order in NO is 2.5 while that in NO^+ is 3. Which of the following statements is true for these two species?

(A) Bond length in NO^+ is greater than in NO **(B)** Bond length in NO is greater than in NO^+

(C) Bond length in NO^+ is equal to that in NO **(D)** Bond length is unpredictable

73. Increasing order of bond strength of O_2, O_2^-, O_2^{2-}, and O_2^+ is :

(A) $O_2^+ < O_2 < O_2^- < O_2^{2-}$ **(B)** $O_2 < O_2^+ < O_2^- < O_2^{2-}$

(C) $O_2^- < O_2^{2-} < O_2^+ < O_2$ **(D)** $O_2^{2-} < O_2^- < O_2 < O_2^+$

***74.** Which of the following have identical bond order ?

(A) CN^- **(B)** NO^+ **(C)** O_2^- **(D)** O_2^{2-}

***75.** Which of the following attain the linear structure ?

(A) $BeCl_2$ **(B)** SO_2 **(C)** NO_2 **(D)** CS_2

***76.** CO is isoelectronic with :

(A) NO^+ **(B)** N_2 **(C)** $SnCl_2$ **(D)** NO_2^-

***77.** Which of the following species have the same shape ?

(A) CO_2 **(B)** CCl_4 **(C)** O_3 **(D)** NO_2^-

***78.** Which of the following statement are correct about CO_3^{2-} ?

(A) The hybridization of central atom is sp^3

(B) Its resonance structure has one C – O single bond and two C = O double bonds

(C) The average formal charge on each oxygen atom is 0.67 units

(D) All C – O bond lengths are equal

***79.** Diamagnetic species are those which contain no unpaired electrons. Which among the following are diamagnetic?

(A) N_2 **(B)** N_2^{2-} **(C)** O_2 **(D)** O_2^{2-}

***80.** Species having same bond order are :

(A) N_2 **(B)** N_2^- **(C)** F_2^+ **(D)** O_2^-

81. In which of the following pairs, both the species are not iso-structural ?

(A) Diamond, Silicon carbide **(B)** NH_3, PH_3

(C) XeF_4, XeO_4 **(D)** $SiCl_4$, PCl_4^+

82. Which of the following pairs of ions are isoelectronic and iso-structural ?

(A) SO_3^{2-}, NO_3^- **(B)** ClO_3^-, SO_3^{2-} **(C)** CO_3^{2-}, SO_3^{2-} **(D)** ClO_3^-, CO_3^{2-}

83. Which of the following options represents the correct bound order ?

(A) $O_2^- > O_2 < O_2^+$ **(B)** $O_2^- < O_2 > O_2^+$

(C) $O_2^- > O_2 > O_2^+$ **(D)** $O_2^- < O_2 < O_2^+$

84. Maximum bond angle at nitrogen is present in which of the following ?

(A) NO_2^+ **(B)** NO_3^- **(C)** NO_2 **(D)** NO_2^-

85. Which of the following is electron-deficient ?

(A) $(BH_3)_2$ **(B)** PH_3 **(C)** $(CH_3)_2$ **(D)** $(SiH_3)_2$

86. Dipole-induced dipole interactions are present in which of the following pairs

(A) HCl and He atoms **(B)** SiF_4 and He atoms

(C) H_2O and alcohol **(D)** Cl_2 and CCl_4

87. In which of the following ionization processes the bond energy increases and the magnetic behaviour changes from paramagnetic to diamagnetic.

(A) $O_2 \rightarrow O_2^+$ **(B)** $C_2 \rightarrow C_2^+$ **(C)** $NO \rightarrow NO^+$ **(D)** $N_2 \rightarrow N_2^+$

88. Which of the following species contains three bond pairs and one lone pair around the central atom ?

(A) H_2O **(B)** BF_3 **(C)** NH_2^- **(D)** PCl_3

89. Four diatomic species are listed below. Identify the correct order in which the bond order is increasing in them :

(A) $NO < O_2^- < C_2^{2-} < He_2^+$ **(B)** $O_2^- < NO < C_2^{2-} < He_2^+$

(C) $C_2^{2-} < He_2^+ < O_2^- < NO$ **(D)** $He_2^+ < O_2^- < NO < C_2^{2-}$

90. Which of the two ions from the list given below that have the geometry that is explained by the same hybridization of orbitals, NO_2^-, NO_3^-, NH_2^-, NH_4^+, SCN^- ?

(A) NO_2^- and NO_3^- **(B)** NH_4^+ and NO_3^- **(C)** SCN^- and NH_2^- **(D)** NO_2^- and NH_2^-

91. The correct order of increasing bond length of $C-H$, $C-O$, $C-C$ and $C=C$ is:

(A) $C-H < C=C < C-O < C-C$ **(B)** $C-C < C=C < C-O < C-H$

(C) $C-O < C-H < C-C < C=C$ **(D)** $C-H < C-O < C-C < C=C$

92. In which one of the following species the central atom has the type of hybridization which is not the same as that present in the other three ?

(A) SF_4 **(B)** I_3^- **(C)** $SbCl_5^{2-}$ **(D)** PCl_5

93. What is the dominant intermolecular force or bond that must be overcome in converting liquid CH_3OH to a gas ?

(A) Dipole-dipole interaction **(B)** Covalent bonds

(C) London dispersion force **(D)** Hydrogen bonding

94. Which of the following is not a correct statement ?

(A) Multiple bonds are always shorter than corresponding single bonds

(B) The electron-deficient molecules can act as Lewis acids

(C) The canonical structures have no real existence

(D) Every AB_5 molecule does in fact have square pyramid structure

95. In which of the following bond angle is maximum ?

(A) NH_3 **(B)** NH_4^+ **(C)** PCl_3 **(D)** SCl_2

96. $d\pi - p\pi$ bond present in :

(A) CO_3^{2-} **(B)** PO_4^{3-} **(C)** NO_3^- **(D)** NO_2^-

97. N_2 and O_2 are converted into monocations, N_2^+ and O_2^+ respectively. Which is wrong ?

(A) In O_2 paramagnetism decreases **(B)** N_2^+ becomes diamagnetic

(C) In N_2, the N – N bond weaknes **(D)** In O_2, the O – O bond order increases

98. Which of the following molecule does not possess a permanent dipole moment ?

(A) CS_2 **(B)** SO_3 **(C)** H_2S **(D)** SO_2

99. Which one of the following is the correct order of strengths of interactions ?

(A) Covalent < hydrogen bonding < van der Waals < dipole-dipole

(B) van der Waals < hydrogen bonding < dipole < covalent

(C) van der Waals < dipole-dipole < hydrogen bonding < covalent

(D) Dipole-dipole < van der Waals < hydrogen bonding < covalent

100. Which of the following molecule has the maximum dipole moment ?

(A) CO_2 **(B)** CH_4 **(C)** NH_3 **(D)** NF_3

Integer Answer Type Questions

The Answer to the following questions are positive integers of 1/2/3 digits and zero

101. The number of species which consists of sp^3d hybridized central atom for the underlined atoms in the following species/molecules is/are:

$\underline{X}eF_4, \underline{I}Cl_2^-, \underline{X}eO_3F_2, \underline{P}Cl_4^+, \underline{P}Cl_6^-, \underline{S}F_4, \underline{S}OF_4, \underline{X}eOF_4$

102. Find number of planar species out of $SF_2, SF_4, SF_6, SO_2, SO_3$.

$CH_4, P_4, NO^+, CN^-, CO, N_2O, H_2O$

103. Find the number of ions/molecules which are isoelectronic with O_2^{2+} .

104. No. of $P-O-P$ bonds present in pentamer of cyclometaphosphoric acid are:

105. Find the number of chemical species having $P-H$ linkage as well as $-OH$ linkage.

$H_4P_2O_5, H_3PO_2, H_3PO_3, H_4P_2O_7, H_4P_2O_8, H_3PO_5$

106. Find the number of compounds of Xe which is/are associated with 180° bond angles.

$XeF_2, ICl_2^-, I_3^-, XeF_4, XeO_6^{4-}, XeO_4, XeCl_4, TeCl_4$

107. Find the number of P—O—P linkages in P_4O_{10}, B—O—B linkages in $Na_2B_4O_7 \cdot 10H_2O$, $Si-O-Si$ linkages in $H_6Si_3O_9$ S—O—S linkage in S_3O_9 respectively.

108. How many of the following having regular tetrahedral geometry?

$CCl_4, CHCl_3, SO_3, SiF_4, BF_4^-, NH_3, H_2O, SiO_4^{4-}$

109. Find the total number of correct statements out of following.

(a) Orbitals having large energy difference of an element can participate in hybridization

(b) In XeO_2F_2 all bond lengths are not identical

(c) Dipole moment of CCl_4 is more than NF_3

(d) All allotropes of carbon have same hybridization of each carbon atom

110. Find the total number of molecules in which total number of antibonding e^- are less than the total number of bonding e^-.

O_2, C_2, B_2, F_2, N_2

111. Assuming 2s-2p mixing is not operative, the paramagnetic species among the following are:

$Be_2, B_2, C_2, N_2, O_2, O_2^+, NO$

112. Find the number of molecules which are planar but not polar.

(a) $H_2C = C = CH_2$ (b) $B_3N_3H_6$

(c) SiF_4 (d) $C_3O_2(e)NO_2$

113. Total number of species in which highest occupied molecular orbital has gerade type of symmetry.

$B_2, N_2, C_2, N_2^{2+}, O_2, O_2^{2-}, N_2^{2-}$

114. Find the number of chemical species which are paramagnetic in nature.

$O_2^{2-}, NO, ClO_2, OF, B_2, C_2, N_2$

115. The total number of chemical specie(s) is/are paramagnetic and have fractional bond order:

$B_2, C_2^{2-}, N_2^+, O_2^-, NO^+, OF$

States of Matter

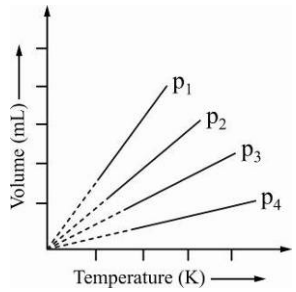
CHOOSE THE CORRECT ALTERNATIVE. ONLY ONE CHOICE IS CORRECT. HOWEVER, QUESTIONS MARKED '*' MAY HAVE MORE THAN ONE CORRECT OPTION.

1. Which of the following property of water can be used to explain the spherical shape of rain droplets ?

(A) Viscosity **(B)** Surface tension

(C) Critical Phenomena **(D)** Pressure

2. A plot of volume (V) versus temperature (T) for a gas at constant pressure is a straight line passing through the origin. The plots at different values of pressure are shown in Fig. 5.1. Which of the following order of pressure is correct for this gas ?



(A) $p_1 > p_2 > p_3 > p_4$

(B) $p_1 = p_2 = p_3 = p_4$

(C) $p_1 < p_2 < p_3 < p_4$

(D) $p_1 < p_2 = p_3 < p_4$

3. The interaction energy of London force is inversely proportional to sixth power of the distance between two interacting particles but their magnitude depends upon ?

(A) Charge of interacting particles **(B)** Mass of interacting particles

(C) Polarisability of interacting particles **(D)** Strength of permanent dipoles in the particles

4. As the temperature increases, average kinetic energy of molecules increases. What would be the effect of increase of temperature on pressure provided the volume is constant ?

(A) Increases **(B)** Decreases

(C) Remains same **(D)** Becomes half

5. Gases possess characteristic critical temperature which depends upon the magnitude of intermolecular forces between the particles. Following are the critical temperatures of some gases.

Gases :	H_2	He	O_2	N_2
T_C (in K)	33.2	5.3	154.3	126

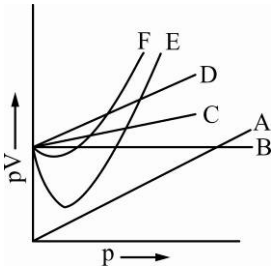
From the above data what would be the order liquefaction of these gases ? Start writing the order from the gas liquefying first:

(A) H_2, He, O_2, N_2 **(B)** He, O_2, H_2, N_2 **(C)** N_2, O_2, He, H_2 **(D)** O_2, N_2, H_2, He

6. What is SI unit of viscosity coefficient (η) ?

(A) Pascal **(B)** Nsm^{-2} **(C)** $km^{-2}s$ **(D)** Nm^{-2}

7. Which curve in the given figure represents the curve for an ideal gas ?



(A) B only **(B)** C and D only **(C)** E and F only **(D)** A and B only

8. Increase in kinetic energy can overcome intermolecular forces of attraction. How will the viscosity of liquid be affected by the increase in temperature ?

(A) Increase **(B)** No effect
(C) Decrease **(D)** No angular pattern will be followed

9. How does the surface tension of a liquid vary with increase in temperature ?

(A) Remains same **(B)** Decreases **(C)** Increases
(D) No regular pattern is followed

***10.** With regard to the gaseous state of matter which of the following statements are correct ?

(A) Complete order of molecules **(B)** Complete disorder of molecules
(C) Random motion of molecules **(D)** Fixed position of molecules

***11.** Under which of the following two conditions applied together, a gas deviates most from the ideal behaviour ?

(A) Low pressure **(B)** High pressure **(C)** Low temperature **(D)** High temperature

***12.** Which of the following charges decrease the vapour pressure of water kept in sealed vessel ?

(A) Decreases the quantity of water **(B)** Adding salt to water
(C) Decreasing the volume of the vessel to one-half **(D)** Decreasing the temperature of water

Reasoning Type Questions for 13 - 17

(A) Both A and R are true and R is the correct explanation of A
(B) Both A and R are true but R is not the correct explanation of A
(C) A is true but R is false
(D) A is false but R is true

13. **Assertion (A) :** Three states of matter are the result of balance between intermolecular forces and thermal energy of the molecules.
Reason (R) : Intermolecular forces tend to keep the molecules together but thermal energy of molecules tends to keep them apart.

14. **Assertion (A) :** At constant temperature, pV vs V plot for real gases is not a straight line.
Reason (R) : At high pressure all gases have $Z > 1$ but at intermediate pressure most gasses have $Z < 1$.

15. **Assertion (A) :** The temperature at which vapour pressure of a liquid is equal to the external pressure is called boiling temperature.
Reason (R) : At high attitude atmospheric pressure is high.

16. **Assertion (A) :** Gases do not liquefy above their critical temperature, even on applying high pressure.
Reason (R) : Above critical temperature, the molecular speed is high and intermolecular attractions cannot hold the molecules together because they escape because of high speed.

17. **Assertion (A) :** Liquids tend to have maximum number of molecules at their surface.
Reason (R) : Small liquid drops have spherical shape.

18. If Z is a compressibility factor, van der Waals' equation at low pressure can be written as :

(A) $Z = 1 + \frac{RT}{pb}$ **(B)** $Z = 1 - \frac{a}{VRT}$ **(C)** $Z = 1 - \frac{pb}{RT}$ **(D)** $Z = 1 + \frac{pb}{RT}$

19. For gaseous state, if most probable speed is denoted by C^*, average speed by $\bar{C}$ and mean square speed by C, then for a large number of molecules, the ratios of these speeds are :

(A) $C^* : \bar{C} : C = 1.225 : 1.128 : 1$ **(B)** $C^* : \bar{C} : C = 1.128 : 1.225 : 1$

(C) $C^* : \bar{C} : C = 1 : 1.128 : 1.225$ **(D)** $C^* : \bar{C} : C = 1 : 1.225 : 1.128$

20. The compressibility factor for a real gas at high P is:

(A) $1 + \frac{RT}{Pb}$ **(B)** 1 **(C)** $1 + \frac{Pb}{RT}$ **(D)** $1 - \frac{Pb}{RT}$

21. a and b are van der Waals' constants for gases. Chlorine is more easily liquefied than ethane because :

(A) a and b for Cl_2 > a and b for C_2H_6 **(B)** a and b for Cl_2 > a and b for C_2H_6

(C) a for Cl_2 > a for C_2H_6 but b for Cl_2 > b for C_2H_6 **(D)** a for Cl_2 > a for C_2H_6 but b for Cl_2 < b for C_2H_6

22. The molecular velocity of any gas is :

(A) Inversely proportional to the square root of temperature
(B) Inversely proportional to absolute temperature **(C)** Directly proportional to square of temperature
(D) Directly proportional to square root of temperature

23. If 10^{-4} dm^3 of H_2O is introduced into 1.0 dm^3 flask at 300K, then how many moles of H_2O are in the vapour phase when equilibrium is established? [V.P = 26.7mm Hg]

(A) 5.56×10^{-3} mol **(B)** 1.53×10^{-2} mol **(C)** 4.46×10^{-2} mol **(D)** 1.42×10^{-3} mol

24. Which one of the following statements is not true about the effect of an increase in temperature on the distribution on molecular speeds in gas?

(A) The area under the distribution curve remains the same as under the lower temperature
(B) The distribution becomes broader
(C) The fraction of the molecules with the most probable speed increases
(D) The most probable speed increases

25. As the temperature is raised from 20°C to 40°C , the average kinetic energy of neon atoms changes by a factor of which of the following?

(A) 1/2 **(B)** $\sqrt{313/293}$ **(C)** 313/293 **(D)** 2

26. In van der Waals' equation of state of the gas law, the constant ' b' is a measure of :

(A) Intermolecular repulsions **(B)** Intermolecular attraction
(C) Volume occupied by the molecules **(D)** Intermolecular collisions per unit volume

27. According to the kinetic theory of gases, in an ideal gas, between two successive collisions a gas molecule travels :

(A) In a circular path **(B)** In a wavy path
(C) In a straight line path **(D)** With an accelerated velocity

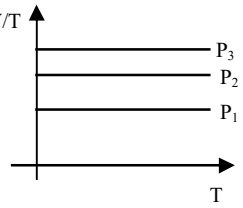
28. Based on kinetic theory of gases following laws can be proved :

(A) Boyle's law **(B)** Charles' law
(C) Avogadro's law **(D)** All of these

29. For an ideal gas, number of moles per litre in terms of its pressure p, temperature T and gas constant R is :

(A) $\frac{pT}{R}$ **(B)** pRT **(C)** $\frac{p}{RT}$ **(D)** $\frac{RT}{p}$

30. The given curve shows the variation of V/T as a function of T for a fixed mass and P of an ideal gas. It follows from the curve that :



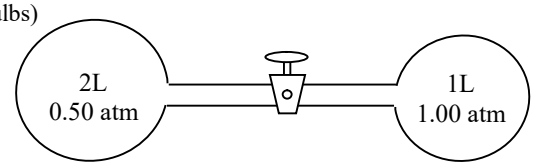
(A) $P_1 = P_2 = P_3$

(B) $P_1 > P_2 > P_3$

(C) $P_1 < P_2 < P_3$

(D) Nothing can be predicted about the pressures

31. Hydrogen gas is contained in two vessels connected by a closed stopcock as shown in the diagram. The volumes and pressure are also shown. When the stopcock is opened and the gases are allowed to mix at constant temperature, the final pressure will be (neglecting the volume of the tube between the bulbs)



(A) 0.50 atm **(B)** 0.75 atm

(C) 0.67 atm **(D)** 1.50 atm

***32.** Which of the following is(are) correct statements ?

(A) The S.I. unit of Boltzmann's constant is $\frac{J}{molK}$

(B) Avogadro's number (N_A) is a dimensionless quantity

(C) The S.I units of van der Waal's constants '*a*' and '*b*' are $\frac{J-m^3}{mol^2}$ and $\frac{m^3}{mol}$ respectively

(D) If $\Delta N_c = 4\pi N a^3 e^{-bc^2} c^2 \Delta c$, where ΔN_c represents the number of molecules having speed between *c* and $c + \Delta c$

33. Maximum deviation from ideal gas is expected from

(A) $CH_{4(g)}$ **(B)** $NH_{3(g)}$ **(C)** $H_{2(g)}$ **(D)** $N_{2(g)}$

34. Equal volume of two monatomic gases, A and B same temperature and pressure are mixed. The ratio of specific heats (C_P/C_V) of the mixture will be :

(A) 0.83 **(B)** 1.50 **(C)** 3.3 **(D)** 1.67

35. A bubble of air is underwater at temperature $15^\circ C$ and the pressure 1.5 bar. If the bubble rises to the surface where the temperature is $25^\circ C$ and the pressure is 1.0 bar, what will happen to the volume of the bubble ?

(A) Volume will become greater by a factor of 1.6 **(B)** Volume will become greater by a factor of 1.1

(C) Volume will become smaller by a factor of 0.70 **(D)** Volume will become greater by a factor of 2.5

36. If a gas expands at constant temperature, it indicates that :

(A) kinetic energy of molecules remains the same **(B)** number of the molecules of gas increases

(C) kinetic energy of molecules decreases **(D)** pressure of the gas increases

37. Which of the following statements is wrong for gases ?

(A) Confined gas exerts uniform pressure on the walls of its container in all directions

(B) Volume of the gas is equal to volume of container confining the gas

(C) Gases do not have a definite shape and volume

(D) Mass of a gas cannot be determined by weighing a container in which it is enclosed

38. Absolute zero is defined as the temperature

(A) at which all molecular motion ceases **(B)** at which liquid helium boils

(C) at which ether boils **(D)** all of the above

39. Pressure remaining the same, the volume of a given mass of an ideal gas increases for every degree centigrade rise in temperature by definite fraction of its volume at :

(A) $0^\circ C$ **(B)** its critical temperature

(C) absolute zero **(D)** it Boyle temperature

40. Correct gas equation is :

(A) $\frac{V_1T_2}{P_1}=\frac{V_2T_1}{P_2}$ **(B)** $\frac{P_1V_2}{P_2V_2}=\frac{T_1}{T_2}$ **(C)** $\frac{P_1T_2}{V_1}=\frac{P_2V_2}{T_2}$ **(D)** $\frac{V_1V_2}{T_1T_2}=P_1P_2$

Integer Answer Type Questions

The Answer to the following questions are positive integers of 1/2/3 digits and zero

41. 3.2g of oxygen (At. wt. = 16) and 0.2g of hydrogen (At. wt. = 1) are placed in a 1.12 litre flask at 0°C. The total pressure (in atm) of the gas mixture will be.

42. Pressure of 1 g of an ideal gas A at 27°C is found to be 2 bar. When 2 g of another ideal gas B is introduced in the same flask at same temperature, the pressure becomes 3 bar. Find the ratio of molecular masses.

43. 127 ml of a certain gas diffuse in the same time as 100 ml of chloride under the same conditions. Calculate the molecular mass of the gas.

44. A gaseous hydrocarbon requires 6 times its own volume of O_2 for complete oxidation and produces 4 times its volume of CO_2. What is its Molecular mass ?

45. Volume of 2.9g of a gas at 95°C occupied the same volume as 0.184g of H_2 gas at 17°C and at the same pressure. What is the molar mass of the gas?

46. The sealed containers of the same capacity and at the same temperature are filled with 44 g of H_2 in one and 44 g of CO_2 in the other. If the pressure of carbon dioxide in the second container is 1 atm. then pressure (in atm) in the first container would be:

47. If pressure becomes double at the same absolute temperature of 2 litre CO_2, then the volume of CO_2 becomes

48. Molecular weight of a gas that diffuses twice as rapidly as the gas will molecular weight 64 is:

49. An LPG cylinder contains 15 kg of butane gas at 27°C and 10 atmospheric pressure. It was leaking and its pressure fell down to 8 atmospheric pressure after one day. The gas (in kg) leaked is

50. The temperature in °C which average velocity of SO_2 gas is equal to the average velocity of O_2 gas at 27°C, is

51. The root mean square velocity of molecules of a triatomic gas μ. If the temperature in Kelvin scale is increased to 3 times, atoms are produced. The runs of the atoms is :

52. To what temperature (in K) should an open vessel be heated to expel two-fifth of air, if initial temperature is 27°C?

53. 40cc of gas 'X' diffuses through a porous pot in 20 second while under the same conditions 80cc of another gas 'y' diffuse in the same time. If the molar mass of 'X' is 128, the molar mass of 'Y' is:

54. A gas gets liquefied at 40 atm when its critical volume is $3L$. What is its critical temperature in K? $\left(R = 0.8 \text{ L atm } K^{-1} \text{ mol}^{-1}\right)$

55. At 2 bar and $27°C$, density of a gas is 5.46 g dm^{-3}. Its density $\left(\text{g dm}^{-3}\right)$ at STP is:

Thermo-chemistry & Thermodynamics

CHOOSE THE CORRECT ALTERNATIVE. ONLY ONE CHOICE IS CORRECT. HOWEVER, QUESTIONS MARKED '*' MAY HAVE MORE THAN ONE CORRECT OPTION.

1. Which of the following statements is correct ?

(A) The presence of reacting species in a covered beaker is an example of open system.

(B) There is an exchange of energy as well as matter between the system and the surroundings in a closed system.

(C) The presence of reactants in a closed vessel made up of copper is an example of a closed system.

(D) The presence of reactants in a thermos flask or any other closed insulated vessel is an example of a closed system

2. The volume of gas is reduced to half from its original volume. The specific heat will be _____.

(A) Reduce to half **(B)** Be doubled **(C)** Remain constant **(D)** Increase four times

3. $\Delta_f H$ of formation of $CH_4(g)$ at certain temperature is -393 kJ mol^{-1}. The value of $\Delta_f H^{\ominus}$ is :

(A) Zero **(B)** $< \Delta_f H^{\ominus}$ **(C)** $> \Delta_f H^{\ominus}$ **(D)** Equal to $\Delta_f H^{\ominus}$

4. In an adiabatic process, no transfer of heat takes place between system and surrounding. Choose the correct option for free expansion of an ideal gas under adiabatic condition from the following.

(A) $q = 0, \Delta T \neq 0, w = 0$ **(B)** $q \neq 0, \Delta T = 0, w = 0$

(C) $q = 0, \Delta T = 0, w = 0$ **(D)** $q = 0, \Delta T = 0, w \neq 0$

5. The pressure-volume work for an ideal gas can be calculated by using the expression $w = -\int_{V_t}^{V_f} p_{ex} dV$. The work can also be calculated from pV– plot by using the area under the curve within the specified limits. When an ideal gas is compressed (a) reversibly or (b) irreversibly from volume V_t to V_f. Choose the correct option.

(A) w (reversible) = w (irreversible) **(B)** w (reversible) < w (irreversible)

(C) w (reversible) > w (irreversible) **(D)** w (reversible) = w (irreversible) $+p_{ex}.\Delta V$

6. The entropy change can be calculated by using the expression $\Delta S = \frac{q_{rev}}{T}$ when water freezes in a glass beaker, choose the correct statement amongst the following :

(A) ΔS (system) decreases but ΔS (surroundings) remains the same.

(B) ΔS (system) increases but ΔS (surroundings) decreases.

(C) ΔS (system) decreases but ΔS (surroundings) increases.

(D) ΔS (system) decreases and ΔS (surroundings) also decreases.

7. On the basis of thermochemical equations (a), (b) and (c), find out which of the algebric relationship given in options (i) to (iv) is correct.

I. $C(\text{graphite}) + O_2(g) \longrightarrow CO_2(g)$; $\Delta_r H = x \text{ kJ mol}^{-1}$

II. $C(\text{graphite}) + \frac{1}{2}O_2(g) \longrightarrow CO(g)$; $\Delta_r H = y \text{ kJ mol}^{-1}$

III. $CO(g) + \frac{1}{2}O_2(g) \longrightarrow CO_2(g)$; $\Delta_r H = z \text{ kJ mol}^{-1}$

(A) $z = x + y$ **(B)** $x = y - z$ **(C)** $x = y + z$ **(D)** $y = 2z - x$

8. Consider the reactions given below. On the basis of these reactions find out which of the algebric relations given in options (i) to (iv) is correct ? ($x < 0$; $y < 0$)

I. $C(g) + 4\,H(g) \longrightarrow CH_4(g)$; $\Delta_r H = x$ kJ mol^{-1}

II. $C(\text{graphite,s}) + 2H_2(g) \longrightarrow CH_4(g)$; $\Delta_r H = y$ kJ mol^{-1}

(A) $x = y$ **(B)** $x = 2y$ **(C)** $x > y$ **(D)** $x < y$

9. The enthalpies of elements in their standard states are taken as zero. The enthalpy of formation of a compound :

(A) is always negative **(B)** is always positive

(C) may be positive or negative **(D)** is never negative

10. Enthalpy of sublimation of a substance is equal to :

(A) Enthalpy of fusion + enthalpy of vapourisation **(B)** Enthalpy of fusion

(C) Enthalpy of vapourisation **(D)** Twice the enthalpy of vapourisation

11. Which of the following is not correct ?

(A) ΔG is zero for a reversible reaction **(B)** ΔG is positive for a spontaneous reaction

(C) ΔG is negative for a spontaneous reaction **(D)** ΔG is positive for a non-spontaneous reaction

***12.** Thermodynamics mainly deals with :

(A) Inter-relation of various forms of energy and their transformation from one form to another.

(B) Energy changes in the processes which depend only on initial and final states of the microscopic systems containing a few molecules.

(C) How and at what rate these energy transformations are carried out.

(D) The system in equilibrium state or moving from one equilibrium state to another equilibrium state.

***13.** In an exothermic reaction, heat is evolved, and system loses heat to the surrounding. For such system :

(A) q_p will be negative **(B)** $\Delta_r H$ will be negative

(C) q_p will be positive **(D)** $\Delta_r H$ will be positive

***14.** The spontaneity means, having the potential to proceed without the assistance of external agency. The processes which occur spontaneously are :

(A) Flow of heat from colder to warmer body. **(B)** Gas in a container contracting into one corner.

(C) Gas expanding to fill the available volume. **(D)** Burning carbon in oxygen to give carbon dioxide.

***15.** For an ideal gas, the work of reversible expansion under isothermal condition can be calculated by using the expression

$$w = -nRT \ln \frac{V_f}{V_t}$$

A sample containing 1.0 mol of an ideal gas is expended isothermally and reversibly to ten times of its original volume, in two separate experiments. The expansion is carried out at 300 K and at 600 K respectively. Choose the correct option.

(A) Work done at 600 K is 20 times the work done at 300 K.

(B) Work done at 300 K is twice the work done at 600 K.

(C) Work done at 600 K is twice the work done at 300 K

(D) $\Delta U = 0$ in both cases.

***16.** Consider the following reaction between zinc and oxygen and choose the correct options out of the options given below :

$$2\,Zn(s) + O_2(g) \longrightarrow 2\,ZnO(s) \; ; \qquad \Delta H = -693.8\,\text{kJ mol}^{-1}$$

(A) The enthalpy of two moles of ZnO is less than the total enthalpy of two moles of Zn and one mole of oxygen by 693.8kJ

(B) The enthalpy of two moles of ZnO is more than the total enthalpy of two moles of Zn and one mole of oxygen by 693.8kJ

(C) 693.8 kJ mol^{-1} energy is evolved in the reaction

(D) 693.8 kJ mol^{-1} energy is absorbed in the reaction

17. **Assertion (A) :** Spontaneous process is an irreversible process and may be reversed by some external agency.
Reaction (R) : Decrease in enthalpy is a contributor factor for spontaneity.
(A) Both A and R are true and R is the correct explanation of A
(B) Both A and R are true but R is not the correct explanation of A
(C) A is true but R is false
(D) A is false but R is true

18. For the complete combustion of ethanol, $C_2H_5OH(\ell) + 3O_2(g) \longrightarrow 2CO_2(g) + 3H_2O(\ell)$ the amount of heat produced as measured in bomb calorimeter is $1364.47\ kJ\ mol^{-1}$ at $25^\circ C$. Assuming ideality, the enthalpy of combustion, $\Delta_C H$ for the reaction will be: $[R = 8.314\ JK^{-1}\ mol^{-1}]$

(A) $-1366.95\ kJ\,mol^{-1}$ **(B)** $-1361.95\ kJ\,mol^{-1}$ **(C)** $-1460.50\ kJ\,mol^{-1}$ **(D)** $-1350.50\ kJ\,mol^{-1}$

19. A piston filled with 0.04 mole of an ideal gas expands reversibly from 50.0 mL to 375 mL at a constant temperature of $37.0^\circ C$. As it is does so, it absorbs 208 J of heat. The values of q and W for the process will be (R = 8.314 J/mol K, ln 7.5 = 2.01)

(A) $q = +208\,J,\ W = -208\,J$ **(B)** $q = -208\,J,\ W = -208\,J$

(C) $q = -208\,J,\ W = +208\,J$ **(D)** $q = +208\,J,\ W = +208\,J$

20. The incorrect expression among the following is :

(A) $\dfrac{\Delta G_{system}}{\Delta S_{system}} = -T$ **(B)** In isothermal process, $W_{reversible} = -nRT\ln\dfrac{V_f}{V_i}$

(C) $\ln K = \dfrac{\Delta H^\circ - T\Delta S^\circ}{RT}$ **(D)** $K = e^{-\Delta G^\circ/RT}$

21. The entropy change involved in the isothermal reversible expansion of 2 moles of an ideal gas from a volume of 10 dm^3 to a volume of 100 dm^3 at $27^\circ C$ is:

(A) $38.3\,J\ mol^{-1}K^{-1}$ **(B)** $35.8\,J\ mol^{-1}K^{-1}$ **(C)** $32.3\,J\ mol^{-1}K^{-1}$ **(D)** $42.3\,J\ mol^{-1}K^{-1}$

22. In view of the signs of $\Delta_r G^\circ$ for the following reactions :

$PbO_2 + Pb \longrightarrow 2PbO,\ \Delta G^\circ < 0$; $SnO_2 + Sn \longrightarrow 2SnO,\ \Delta_r G^\circ > 0$

Which oxidation states are more characteristic for lead and tin?

(A) For lead + 4, for tin + 2 **(B)** For lead + 2, for tin + 2

(C) For lead + 4, for tin + 4 **(D)** For lead + 2, for tin + 4

23. For a particular reversible reaction, at temperature T, ΔH and ΔS were found to be both +ve. If T_e is the temperature at equilibrium, the reaction would be spontaneous when:

(A) $T_e > T$ **(B)** $T > T_e$ **(C)** T_e is 5 times T **(D)** $T = T_e$

24. Oxidising power of chlorine in aqueous solution can be determined by the parameters indicates below

$$\frac{1}{2}Cl_2(g) \xrightarrow{\frac{1}{2}\Delta dissH^\ominus} Cl(g) \xrightarrow{\Delta_{hyd}H^\ominus} Cl^-(aq)$$

The energy involved in the conversion of $\frac{1}{2}Cl_2(g)$ to $Cl^{-1}(aq)$ (using the data, $\Delta_{diss}H^\ominus_{Cl_2} = 240\ kJ\,mol^{-1}$ $\Delta_{EA}H^\ominus_{Cl} = -349\,kJ\ mol^{-1}$, $\Delta_{hyd}H^\ominus_{Cl} = -381\,kJ\ mol^{-1}$) will be:

(A) $+152\,kJ\,mol^{-1}$ **(B)** $-610\,kJ\,mol^{-1}$ **(C)** $-850\,kJ\,mol^{-1}$ **(D)** $+120\,kJ\,mol^{-1}$

25. Identify the correct statement regarding a spontaneous process.
(A) For a spontaneous process in an isolated system, the change in entropy is positive
(B) Endothermic processes are never spontaneous
(C) Exothermic process are always spontaneous
(D) Lowering of energy in the reaction process is the only criteria for spontaneity

26. An ideal gas is allowed to expand both reversibly and irreversibly in an isolated system. If T_i is the initial temperature and T_f is the final temperature, then which of the following statements is correct?

(A) $(T_f)_{irrev} > (T_f)_{rev}$

(B) $T_f > t_i$ for reversible process but $T_f = T_i$ for irreversible process

(C) $(T_f)_{rev} = (T_f)_{irrev}$

(D) $T_f = t_i$ for both reversible and irreversible processes

27. In an irreversible process taking place at constant T and p and in which only pressure – volume work is being done, the change in Gibbs free energy (dG) and change in entropy (dS), satisfy the criteria

(A) $(dS)_{V,E} < 0, (dG)_{T,p} < 0$ **(B)** $(dS)_{V,E} > 0, (dG)_{T,p} < 0$

(C) $(dS)_{V,E} = 0, (dG)_{T,p} = 0$ **(D)** $(dS)_{V,E} = 0, (dG)_{T,p} > 0$

28. For all gases, $C_P - C_V = R$. This R is the :

(A) Change kinetic energy when temperature of 1 mole of a gas is increased by 1°C

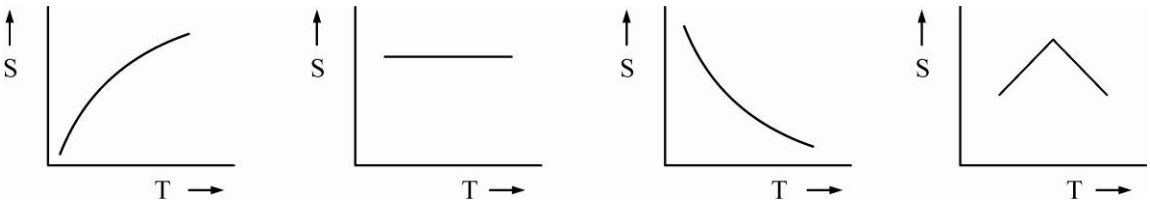
(B) Mechanical work when the temperature of 1 mole of a gas is increased by 1°C

(C) Change in potential energy when gas is allowed to fall

(D) None of these

29. $LiCl(s) + H_2O(\ell) \rightleftharpoons Li^+(aq) + Cl^-(aq) \quad \Delta H = -37.1 \text{ kJ mol}^{-1}$

Variation of solubility s with temperature T is given by :



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

30. Which of the following statements is correct for the spontaneous adsorption of a gas ?

(A) ΔS is negative and, therefore ΔH should be highly positive

(B) ΔS is negative and, therefore ΔH should be highly negative

(C) ΔS is positive and, therefore ΔH should be highly negative

(D) ΔS is positive and, therefore ΔH should also be highly positive

31. A reaction having equal energies of activation for forward and reverse reactions has

(A) $\Delta H = 0$ **(B)** $\Delta H = \Delta G = \Delta S = 0$

(C) $\Delta S = 0$ **(D)** $\Delta G = 0$

32. Standard enthalpy of vaporization $\Delta_{vap}H^\circ$ for water at 100°C is 40.66 kJ mol^{-1} . The internal energy of vaporization of water at 100°C (in kJ mol^{-1}) is :

(A) + 37.56 **(B)** –43.76

(C) + 43.76 **(D)** + 40.66

33. Which of the following is correct option for free expansion of an ideal gas under adiabatic condition ?

(A) $q = 0, \Delta T \neq 0, w = 0$ **(B)** $q \neq 0, \Delta T = 0, w = 0$

(C) $q = 0, \Delta T = 0, w = 0$ **(D)** $q = 0, \Delta T < 0, w \neq 0$

34. For the gas phase reaction, $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$ which of the following conditions are correct ?

(A) $\Delta H < 0$ and $\Delta S < 0$ **(B)** $\Delta H > 0$ and $\Delta S < 0$

(C) $\Delta H = 0$ and $\Delta S < 0$ **(D)** $\Delta H > 0$ and $\Delta S > 0$

35. Identify the correct statement for change of Gibbs energy for a system (ΔG_{system}) at constant temperature and pressure.

(A) If $\Delta G_{system} < 0$, the process is not spontaneous

(B) If $\Delta G_{system} > 0$, the process is spontaneous

(C) If $\Delta G_{system} = 0$, the system has attained equilibrium

(D) If $\Delta G_{system} = 0$, the system is still moving in a particular direction

36. A reaction occurs spontaneously if

(A) $T\Delta S < \Delta H$ and both ΔH and ΔS are + ve

(B) $T\Delta S > \Delta H$ and ΔH is + ve and ΔS is − ve

(C) $T\Delta S > \Delta H$ and both ΔH and ΔS are + ve

(D) $T\Delta S = \Delta H$ and both ΔH and ΔS are + ve

37. Considering entropy (S) as a thermodynamic parameter, the criterion for the spontaneity of any process is :

(A) $\Delta S_{system} + \Delta S_{surroundings} > 0$

(B) $\Delta S_{system} - \Delta S_{surroundings} > 0$

(C) $\Delta S_{system} > 0$ only

(D) $\Delta S_{surroundings} > 0$ only

38. Identify the correct statement regarding entropy.

(A) At absolute zero of temperature, the entropy of all crystalline substances is taken to be zero

(B) At absolute zero of temperature, entropy of a perfectly crystalline substances is +ve

(C) At absolute zero of temperature, entropy of a perfectly crystalline substances is taken to be zero

(D) At $0°C$, the entropy of a perfectly crystalline substances is taken to be zero

39. A chemical reaction is catalyzed by a catalyst X. The catalyst X :

(A) reduces enthalpy of the reaction

(B) does not affect equilibrium constant of reaction

(C) decreases rate constant of the reaction

(D) increases activation energy of the reaction

40. Standard state Gibb's free energy change for isomerization reaction : cis-2-pentene $\rightleftharpoons$ trans-2-pentene is -3.67 kJ/mol at 400 K. If more of trans-2-pentene is added to the system, then :

(A) equilibrium remains unaffected

(B) equilibrium is shifted in the forward direction

(C) more cis-2-pentene is formed

(D) additional trans-2-pentene is formed

Integer Answer Type Questions

The Answer to the following questions are positive integers of 1/2/3 digits and zero

41. Two litres of N_2 at $0°C$ and 5 atm pressure is expanded isothermally against a constant external pressure of 1 atm until the pressure of gas reaches 1 L. Assuming gas to be ideal, calculate the value of work of expansion multiplied by -1.

42. The latent heat of vapourisation of a liquid at 500 K and 1 atm pressure is 30 kcal mol^{-1}. What will be the change in internal energy of mol of liquid at same temperature?

43. When a polyatomic gas undergoes an adiabatic process, its temperature and volume are related by the equation $TV^n = $ constant, the value of $n \times 100$ will be

44. $H_2 + Cl_2 \rightarrow 2HCl$, $\Delta H = 194$ kJ. In this reaction, heat of formation of $HCl(\text{in kJ})$ is

45. If bond dissociation energies of xy, x_2 and y_2 (all diatomic molecules) are in the ratio of $1:1:0.5$ and ΔH_f for the formation of xy is -200 kJ mol^{-1}, the bond dissociation energy of x_2 will be

46. Enthalpy of neutralization of acetic acid by NaOH is -50.6 kj mol^{-1}. Calculate ΔH for ionization of CH_3COOH. Given, the heat of neutralization of a strong acid with a strong base is -55.6 kJ mol^{-1}.

47. One mole of methanol when burnt in O_2, gives out $723\,kJ\ mol^{-1}$ heat. If one mole of O_2 is used, what will be the amount of heat evolved?

48. If $150\,kJ$ of energy is need for muscular work to walk a distance of one km, then how much of glucose one has to consume to walk a distance of $5\,km$, provided only 30% of energy is available for muscular work? (The enthalpy of combustion of glucose is $3000\ kJ\ mol^{-1}$) is

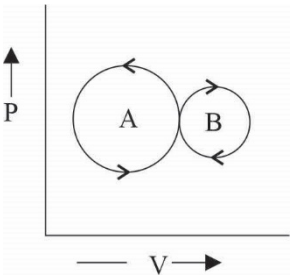
49. Melting point of a solid is $x\ K$ and its latent heat of fusion is $600\ cal\ mol^{-1}$. The entropy change for fusion of $1\ mol$ solid is $2\,cal\ mol^{-1}\ K^{-1}$. The value of x will be

50. For a liquid, enthalpy of fusion is 1.435 kcal mol^{-1} and molar entropy change is 5.26 cal $mol^{-1}K^{-1}$. The freezing point of liquid in Celsius will be:-

51. For the reaction, $Ag_2O(s) \rightleftharpoons 2Ag(s)+\frac{1}{2}O_2(g)\ \Delta H, \Delta S$ and T are $40.63kJ\ mol^{-1}$, $108.8\ J\ K^{-1}\ mol^{-1}$ and $373.4\,K$ respectively. Free energy change ΔG of the reaction will be:

52. $\Delta G°$ for the equilibrium $x+y \rightleftharpoons z$ is -4.606 kcal. The value of equilibrium constant of the reaction at $227°C$ is $\left(x\times10^2\right)$. The value of 'x' is:

53.



In the present graph, the areas of circles A and B are 25 unit and 20 unit respectively. Work done will be …… unit

54. For the reaction

$N_2(g)+3H_2(g)\rightarrow 2NH_3(g)$

Heat of reaction at constant volume exceeds the heat of reaction at constant pressure by the value of xRT. The value of x is:

55. One mole of an ideal gas at $300K$ is expanded isothermally from initial volume of 1 L to 10 L. The ΔU for this process is $\left(R=2\ cal\ mol^{-1}\,K^{-1}\right)$

Chemical & Ionic Equilibrium

CHOOSE THE CORRECT ALTERNATIVE. ONLY ONE CHOICE IS CORRECT. HOWEVER, QUESTIONS MARKED '*' MAY HAVE MORE THAN ONE CORRECT OPTION.

1. For the reaction $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$, the standard free energy is $\Delta G^{\ominus} > 0$. The equilibrium constant (K) would be_____.

(A) K = 0 **(B)** K > 1 **(C)** K = 1 **(D)** K < 1

2. Which of the following is not a general characteristic of equilibria involving physical processes ?

(A) Equilibrium is possible only in a *closed system* at a given temperature.

(B) All measurable properties of the system remain constant.

(C) All the physical processes stop at equilibrium.

(D) The opposing processes occur at the same rate and there is dynamic but stable condition.

***3.** Which of the following statements is correct ?

(A) In equilibrium mixture of ice and water kept in perfectly insulated flask mass of ice and water does not change with time

(B) The intensity of red colour increases when oxalic acid is added to a solution containing iron (III) nitrate and potassium thiocyanate

(C) On addition of catalyst the equilibrium constant value is not affected

(D) Equilibrium constant for a reaction with negative ΔH value decreases as the temperature increases

4. When hydrochloric acid is added to cobalt nitrate solution at room temperature, the following reaction takes place and the reaction mixture becomes blue. On cooling the mixture it becomes pink. On the basis of this information mark the correct answer.

$$\underset{\text{Pink}}{\left[Co(H_2O)_6\right]^{3+}}(aq) + 4Cl^-(aq) \rightleftharpoons \underset{\text{Blue}}{\left[CoCl_4\right]^{2-}}(aq) + 6H_2O\ (l)$$

(A) $\Delta H > 0$ for the reaction

(B) $\Delta H < 0$ for the reaction

(C) $\Delta H = 0$ for the reaction

(D) The sign of ΔH cannot be predicated on the basis of this information.

5. The ionisation constant of an acid, K_a, is the measure of strength of an acid. The K_a values of acetic acid, hypochlorous acid and formic acid are 1.74×10^{-5}, 3.0×10^{-8} and 1.8×10^{-4} respectively. Which of the following orders of pH of $0.1\ \text{mol dm}^{-3}$ solutions of these acids is correct ?

(A) Acetic acid < hypochlorous acid < formic acid **(B)** Hypochlorous acid < acetic acid < formic acid

(C) Formic acid < hypochlorous acid < acetic acid **(D)** Formic acid < acetic acid < hypochlorous acid

6. Acidity of BF_3 can be explained on the basis of which of the following concepts ?

(A) Arrhenius concept **(B)** Bronsted Lowry concept

(C) Lewis concept **(D)** Bronsted Lowry as well as Lewis concept.

7. In which of the following solvents is silver chloride most soluble ?

(A) $0.1\text{mol dm}^{-3}\ AgNO_3$ solution **(B)** $0.1\text{mol dm}^{-3}\ HCl$ solution

(C) H_2O **(D)** Aqueous ammonia

8. Which of the following options will be correct if reaction attains equilibrium at half completion of the reaction $A \rightleftharpoons B$.

(A) $\Delta G = 0$ **(B)** $\Delta G > 0$ **(C)** $\Delta G < 0$ **(D)** $\Delta G = -RT \ln 2$

9. What will be the correct order of vapour pressure of water, acetone and ether at 30°C. Given that among these compounds, water has maximum boiling point and ether has minimum boiling point ?

(A) Water < ether < acetone **(B)** Water < acetone < ether

(C) Ether < acetone < water **(D)** Acetone < ether < water

***10.** For the reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$, the value of K is 50 at 400 K and 1700 at 500 K. Which of the following option is correct?

(A) The reaction is endothermic

(B) The reaction is exothermic

(C) If $NO_2(g)$ and $N_2O_4(g)$ are mixture at 400 K at partial pressures 20 bar and 2 bar respectively, more $N_2O_4(g)$ will be formed

(D) The entropy of the system increases

***11.** At a particular temperature and atmospheric pressure, the solid and liquid phases of a pure substance can exist in equilibrium. Which of the following term defines this temperature ?

(A) Normal melting point **(B)** Equilibrium temperature

(C) Boiling point **(D)** Freezing point

Reasoning Type Questions for 12 - 16

(A) Both A and R are true and R is the correct explanation of A

(B) Both A and R are true but R is not the correct explanation of A

(C) A is true but R is false

(D) Both A and R are false

12. **Assertion (A) :** Increasing order of acidity of hydrogen halides is $HF < HCl < HBr < HI$

Reason (R) : While comparing acid formed by the elements belonging to the same group periodic table, H – A bond strength is a more important factor in determining acidity of an acid than the polar nature of the bond.

13. **Assertion (A) :** The ionisation of hydrogen sulphide in water is low in the presence of hydrochloric acid.

Reason (R) : Hydrogen sulphide is a weak acid.

14. **Assertion (A) :** Aqueous solution of ammonium carbonate is basic.

Reason (R) : Acidic/basic nature of a salt solution of a salt of weak acid and weak base depends on K_a and K_b value of the acid and the base forming it.

15. **Assertion (A) :** An aqueous solution of ammonium acetate can act as a buffer.

Reason (R) : Acetic acid is a weak acid and NH_4OH is a strong base.

16. **Assertion (A) :** In the dissociation of PCl_5 at constant pressure and temperature addition of helium at equilibrium increases the dissociation of PCl_5.

Reason (R) : Helium removes Cl_2 from the field of action.

17. For the reaction, $SO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons SO_3(g)$, if $K_p = K_C (RT)^x$ where the symbols have usual meanings then, the value of x is (assuming ideality).

(A) –1 **(B)** –1/2 **(C)** 1/2 **(D)** 1

18. How many litres of water must be added to 1 L of an aqueous solution of HCl with a pH of 1 to create an aqueous solution with pH of 2?

(A) 0.1 L **(B)** 0.9 L

(C) 2.0 L **(D)** 9.0 L

19. A vessel of 100 K contains CO_2 with a pressure of 0.5 atm. Some of the CO_2 is converted into CO on the addition of graphite. If the total pressure at equilibrium is 0.8 atm, the value of K_p is :

(A) 1.8 atm **(B)** 3 atm

(C) 0.3 atm **(D)** 0.18

20. An acid HA ionizes as $HA \rightleftharpoons H^+ + A^-$. The pH of 1.0 M solution is 5. Its dissociation constant would be :

(A) 1×10^{-10} **(B)** 5

(C) 5×10^{-8} **(D)** 1×10^{-5}

21. There reactions involving $H_2PO_4^-$ are given below :

I. $H_3PO_4 + H_2O \longrightarrow H_3O^+ + H_2PO_4^-$

II. $H_2PO_4^- + H_2O \longrightarrow HPO_4^{2-} + H_3O^+$

III. $H_2PO_4^- + OH^- \longrightarrow H_3PO_4 + O^{2-}$

In which of the above does $H_2PO_4^-$ act as an acid?

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

22. In aqueous solution, the ionization constants for carbonic acid are $K_1 = 4.2 \times 10^{-7}$ and $K_2 = 4.8 \times 10^{-11}$. Select the correct statement for a saturated 0.034 M solution of the carbonic acid.

(A) The concentration of CO_3^{2-} is 0.034 M

(B) The concentration of CO_3^{2-} is greater than that of HCO_3^-

(C) The concentration of H^+ and HCO_3^- are approximately equal

(D) The concentration of H^+ is double that of CO_3^{2-}

23. Solubility product of silver bromide is 5.0×10^{-13}. The quantity of potassium bromide (molar mass taken as 120 g mol^{-1}) to be added to 1 L of 0.05 M solution of silver nitrate to start the precipitation of AgBr is :

(A) 1.2×10^{-10} g **(B)** 1.2×10^{-9} g

(C) 6.2×10^{-5} g **(D)** 5.0×10^{-8} g

24. At 25°C, the solubility product of $Mg(OH)_2$ is 1.0×10^{-11}. At which pH, will Mg^{2+} ions start precipitating in the form of $Mg(OH)^2$ from a solution of 0.001 M Mg^{2+} ions?

(A) 9 **(B)** 10 **(C)** 11 **(D)** 8

25. Four species are listed below :

I. HCO_3^- **II.** H_3O^+ **III.** HSO_4^- **IV.** HSO_3F

Which one of the following is the correct sequence of their acid strength?

(A) IV < II < III < I **(B)** II < III < I < IV

(C) I < III < II < IV **(D)** III < I < IV < II

26. The pK_a of a weak acid, HA is 4.80. The pK_b of a weak base, BOH, is 4.78. The pH of an aqueous solution of the corresponding salt, BA, will be :

(A) 9.58 **(B)** 4.79 **(C)** 7.01 **(D)** 9.22

27. What is the conjugate base of OH^- ?

(A) O^{2-} **(B)** O^- **(C)** H_2O **(D)** O_2

28. For the reaction, $CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g)$ the K_p / K_C is equal to :

(A) 1/RT **(B)** RT **(C)** $\sqrt{RT}$ **(D)** 1.0

29. The conjugate base of $H_2PO_4^-$ is :

(A) PO_4^{3-} **(B)** P_2O_5 **(C)** H_3PO_4 **(D)** HPO_4^{2-}

30. Consider the reaction equilibrium $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ $\Delta H° = -198$ kJ

On basis of Le-Chatelier's principle, the condition favorable for the forward reaction is :

(A) Lowering of temperature as well as pressure

(B) increasing temperature as well as pressure

(C) Lowering the temperature and increasing the pressure

(D) any value of temperature and pressure

31. Which one of the following substances has the highest proton affinity?

(A) H_2O **(B)** H_2S **(C)** NH_3 **(D)** PH_3

***32.** Which one of the following statements is(are) true?

(A) The conjugate base of $H_2PO_4^-$ is HPO_4^{2-}

(B) pH + pOH = 14 for all aqueous solutions at 25°C

(C) The pH of 1×10^{-8} M HCl is 8

(D) 96,500 C of electricity when passed through a $CuSO_4$ solution deposits 1g equivalent of copper at the cathode

33. Aqueous solution of which of the following compounds is the best conductor of electric current ?

(A) Hydrochloric acid, HCl **(B)** Ammonia, NH_3

(C) Fructose, $C_6H_{12}O_6$ **(D)** Acetic acid, $C_2H_4O_2$

34. Which one of the following pairs of solution is not an acidic buffer ?

(A) CH_3COOH and CH_3COONa **(B)** H_2CO_3 and Na_2CO_3

(C) H_3PO_4 and Na_3PO_4 **(D)** $HClO_4$ and $NaClO_4$

35. The K_{sp} of Ag_2CrO_4, AgCl, AgBr and AgI are respectively 1.1×10^{-12}, 1.8×10^{-10}, 5.0×10^{-13}, 8.3×10^{-17}. Which one of the following salts will precipitate last if $AgNO_3$ solution is added to the solution containing equal moles of NaCl, NaBr, NaI and Na_2CrO_4 ?

(A) AgBr **(B)** Ag_2CrO_4

(C) AgI **(D)** AgCl

36. Which of the following salts will give highest pH in water ?

(A) KCl **(B)** NaCl

(C) Na_2CO_3 **(D)** $CuSO_4$

37. Which of these is least likely to act as Lewis base ?

(A) BF_3 **(B)** PF_3 **(C)** CO **(D)** F^-

38. The dissociation constant of a weak acid is 1×10^{-4}. In order to prepare a buffer solution with a pH = 5, the [Salt]/Acid]

(A) 4 : 5 **(B)** 10 : 1 **(C)** 5 : 4 **(D)** 1 : 10

39. For the reaction, $N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$, the equilibrium constant is K_1. The equilibrium constant is K_2 for the reaction, $2NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_{2(g)}$. What is K for the reaction, $NO_{2(g)} \rightleftharpoons \frac{1}{2}N_{2(g)} + O_{2(g)}$?

(A) $\frac{1}{2K_1K_2}$ **(B)** $\frac{1}{4K_1K_2}$ **(C)** $\left[\frac{1}{K_1K_2}\right]^{1/2}$ **(D)** $\frac{1}{K_1K_2}$

40. The dissociation equilibrium of a gas AB_2 can be represented as : $2AB_{2(g)} \rightleftharpoons 2AB_{(g)} + B_{2(g)}$

The degree of dissociation is *x* and is small compared to 1. The expression relating the degree of dissociation (*x*) with equilibrium constant K_P and total pressure P is :

(A) $\left(\frac{2K_P}{P}\right)^{1/2}$ **(B)** $\left(\frac{K_P}{P}\right)$ **(C)** $\left(\frac{2K_P}{P}\right)$ **(D)** $\left(\frac{2K_P}{P}\right)^{1/3}$

41. H_2S gas when passed through a solution of cations containing HCl precipitates the cations of seconds group of qualitative analysis but not those belonging to the fourth group. It is because :

(A) presence of HCl decreases the sulphide ion concentration

(B) solubility product of group II sulphides is more than that of group IV sulphides

(C) presence of HCl increases the sulphide ion concentration

(D) sulphides of group IV cations are unstable in HCl

42. Which statement is wrong about pH and H^+ ?

(A) pH of neutral water is not zero

(B) Adding 1 N solution of CH_3COOH and 1N solution of NaOH, pH will be seven

(C) $[H^+]$ of dilute and hot H_2SO_4 is more than concentrated and cold H_2SO_4

(D) Mixing solution of CH_3COOH and HCl, pH will be less than 7

43. The strongest conjugate base is :

(A) SO_4^{2-} **(B)** Cl^- **(C)** NO_3^- **(D)** CH_3COO^-

44. In liquid-gas equilibrium, the pressure of vapours above the liquid is constant at :

(A) constant temperature **(B)** low temperature

(C) high temperature **(D)** None of these

45. The compound whose water solution has the highest pH is :

(A) NaCl **(B)** $NaHCO_3$

(C) Na_2CO_3 **(D)** NH_4Cl

46. The pH at which $Mg(OH)_2$ begins to precipitate from a solution containing 0.10 M Mg^{2+} ions [K_{sp} of $Mg(OH)_2$ = 1×10^{-11}] is :

(A) 5 **(B)** 9 **(C)** 4 **(D)** 10

47. How many gram of CaC_2O_4 will dissolve in one litre of saturated solution? (K_{sp} of CaC_2O_4 is 2.5×10^{-9} mol^{-2} and its molecular weight is 128).

(A) 0.0064 g **(B)** 0.0128 g

(C) 0.0032 g **(D)** 0.0640 g

48. A buffer solution is prepared by mixing 10 mL of 1.0 M acetic and 20 mL of 0.5 M sodium acetate and then diluted to 100 mL with distilled water. If the pK_a of CH_3COOH is 4.76, what is the pH of the buffer solution prepared?

(A) 5.21 **(B)** 4.76 **(C)** 4.34 **(D)** 5.35

49. In a mixture of CH_3COOH and CH_3COONa, the ratio of salt to acid concentration is increased by ten folds. The pH of the solution will increase by:

(A) Zero **(B)** 1 **(C)** 2 **(D)** 3

50. The volume of water added to 300 ml of 0.1 M CH_3COOH so that the degree of dissociation of acid to be doubled, is : ($K_a(CH_3COOH) = 10^{-5}$)

(A) 1200 ml **(B)** 900 ml

(C) 1000 ml **(D)** 800 ml

Integer Answer Type Questions

The Answer to the following questions are positive integers of 1/2/3 digits and zero

51. The heat of reaction at constant volume for an endothermic reaction equilibrium is 1200 cal more than at constant pressure at 300 K, Determine the value of $\frac{K_p}{K_c} \times 10^4$ in nearest possible integers in L atm R = 2 cal $mol^{-1}K^{-1}$.

52. Calculate the change in pressure (in atm) when 2 mole of NO and 16 gram O_2 in a 6.25 litre originally at 27°C react to produce the maximum quantity of NO_2 possible according to the equation –

$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$

(Take $R = \frac{1}{12}$ litre Atm/mol-K)

53. Calculate the pH at which the following conversion (reaction) will be at equilibrium in basic medium

$$I_2(s) \rightleftharpoons I^-(aq.) + IO_3^-(aq.)$$

When the equilibrium concentration at 300 K are $[I^-] = 0.10$ M and $[IO_3^-] = 0.10$ M

[Given $\rightarrow$ $\Delta G_f^\circ (I^-, aq.) = -50$KJ/mol, $\Delta G_f^\circ (IO_3^-, aq.) = -123.5$ KJ/mol, $\Delta G_f^\circ (H_2O, \ell) = -233$ KJ/mol, $\Delta G_f^\circ (OH^-, aq.) = -150$ KJ/mol, R (Gas constant) $= \frac{25}{3}$ J/mol-K log e = 2.3]

54. 0.1 mole of each C_2H_5OH and CH_3COOH when allowed to react in 100 ml of non-aqueous solution, it is seen

10 ml of the equilibrium mixture require 80 ml of 0.1 (N) NaOH for complete neutralization. The equilibrium constant,

For the reaction $CH_3COOH + C_2H_5OH \underset{\leftarrow}{\overset{K_C}{\rightleftharpoons}} CH_3\ COO\ C_2H_5 + H_2O$ is expressed as K_C and the value of 32 K_C is

55. The plot of log K_p against 1/T for the reaction, $SO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons SO_3(g)$ is a straight line with slope $= 5 \times 10^3$.

Determine $K_p \times 10^{-10}$ in nearest possible integer if standard entropy for $SO_2(g)$, $O_2(g)$ and $SO_3(g)$ are 250, 200 and 250 J K^{-1} mol^{-1} at 25°C respectively.

$R = 8.314$ J K^{-1} mol^{-1}

Given : antilog (0.556) = 3.597

56. The pH of a saturated aqueous solution of CO_2 is 5; For H_2CO_3, $Ka_1 = 10^{-7}$ and $Ka_2 = 10^{-11}$. At the given pressure the solubility of CO_2 in water is 10^{-2}(M). What is the value of $-\log[CO_3^{2-}]$ in the nearest possible integers?

57. How much water in ml must be added to 300 ml of 0.2 M solution of CH_3COOH ($K_a = 1.8 \times 10^{-5}$) for the degree of ionization (α) of the acid to double?

58. K_{SP} of $Mg(OH)_2$ is 4.0×10^{-12}. The number of moles of Mg^{2+} ions in one litre of it's saturated solution in

0.1 M NaOH is (report answer in term of ans $\times 10^{-10}$)

59. In can acid buffer solution, [HA] = 0.01 (M) and [NaA] = 0.1 (M) and for HA, $K_a = 10^{-5}$. In the given buffer solution the degree of hydrolysis, and $h \times 10^7$ is……

60. What is the ratio of moles of $Mg(OH)_2$ and $Al(OH)_3$ in 1 litre of their saturated solution. K_{sp} of $Mg(OH)_2 = 4 \times 10^{-12}$ and K_{sp} of $Al(OH)_3 = 1 \times 10^{-33}$ (give your answer by multiplying the ratio with 10^{-17}).

61. The acid ionization constant of Fe^{3+} to $Fe(OH)^+$ and H^+ is 6.5×10^{-3}. At what maximum pH the 50% of Fe^{3+} exist as Fe^{3+}?

Report your answer in nearest possible integers.

62. 100 ml of 0.1 (M) $MgCl_2$ solution is mixed with 100 ml of 0.2 (M) NaOH solution.

Given for $Mg(OH)_2$ $K_{sp} = 12 \times 10^{-12}$. What is the pH of the resulting solution in nearest possible integers?

$\sqrt{3} = 1.44$; $\log 2.88 = 0.459$

63. 100 ml of 10^{-5}(M) $CaCl_2$ solution is mixed with 100 ml of 10^{-5}(M) Na_2CO_3 solution. In order to observe the precipitation of $CaCO_3$, what percentage of the volume of solution should be reduced in nearest possible integers?

Given: K_{sp} of $CaCO_3 = 49 \times 10^{-10}$

64. In a given solution Zn^{2+} is present at the concentration of 10^{-2}(M). The given solution is saturated H_2S. To obtain the precipitation of ZnS, what should be the minimum pH required × 10 in nearest possible integers?

Given: In aqueous solution ionic product of H_2S is 10^{-22} and K_{sp} of $ZnS = 10^{21}$.

65. A given solution is saturated with both Ag_2CrO_4 and $Ag_2C_2O_4$. The K_{sp} of $Ag_2CrO_4 = 9 \times 10^{-12}$ and K_{sp} of $Ag_2C_2O_4 = 6 \times 10^{-12}$. In the resulting solution determine $[Ag^+] \times 10^5$ in the nearest possible integers.

[Given: $(240)^{1/3} = 6.214$]

Hydrogen, s and p-Block Elements & Compounds

CHOOSE THE CORRECT ALTERNATIVE. ONLY ONE CHOICE IS CORRECT. HOWEVER, QUESTIONS MARKED '*' MAY HAVE MORE THAN ONE CORRECT OPTION.

***1.** The compound(s) formed upon combustion of Na in excess air is(are) :
(A) Na_2O_2 **(B)** Na_2O **(C)** NaO_2 **(D)** NaOH

2. Among the given statements the incorrect one is :
(A) Be differs much more from other alkali earth metals than Li does from others alkali metals
(B) Be forms a very strong complex $[Be(H_2O)_4]^{2+}$
(C) Be generally forms covalent compounds
(D) Be usually has more than four water of crystallisation associated with it

3. Select the incorrect statement :
(A) Hydration enthalpy of metal ions in general decreases down the group
(B) Conductivity of metal ion solutions increases down the group
(C) The hydration number of metal ions decreases down the group
(D) The lattice enthalpy of s-block elements increases down the group

4. Which of the following shows an increase in solubility down the group :
(A) Alkali metals hydroxide **(B)** Alkali metal carbonates
(C) Alkali metal chlorides **(D)** Alkali earth metal sulphates

5. Identify the correct order of increasing thermal stabilities of :
I. K_2CO_3 **II.** $MgCO_3$ **III.** $CaCO_3$ **IV.** $BeCO_3$
The correct option is :
(A) I < II < III < IV **(B)** IV < II < III < I **(C)** IV < II < I < III **(D)** II < IV < III < I

6. Which of the following compounds are paramagnetic :
(A) KO_2 **(B)** Na_2O_2 **(C)** O_3 **(D)** PbO_2

***7.** Choose the correct option(s) :
(A) Baryta water is so sensitive to CO_2 that it turns milky even on exhaling into it
(B) NaOH is more soluble in alcohols than KOH
(C) NaOH is a deliquescent solid
(D) Group II hydroxides are more stable than Group II hydroxides

8. $Na_2O + H_2O \longrightarrow A + B + C$; $Na_2O_2 + H_2O \longrightarrow X + Y + Z$; $KO_2 + H_2O \longrightarrow U + V + W$
(Here 3 symbols in product doesn't mean that reaction has necessarily 3 products. It can have 1, 2 or 3 products).
Choose the possible option :
(A) $A = X = NaOH, Z = O_2$ **(B)** $A = O_2, B = H_2O_2, X = H_2O_2, U = H_2O_2$
(C) $A = NaOH, X = H_2O_2, W = O_2$ **(D)** $A = NaOH, X = NaOH, Y = O_2, V = H_2O_2$

9. Molecular formula of Glauber's salt is :
(A) $Na_2SO_4.10H_2O$ **(B)** $MgSO_4.7H_2O$ **(C)** $FeSO_4.7H_2O$ **(D)** $Na_2CO_3.10H_2O$

***10.** Which of the following cations form solid stable bicarbonates ?
(A) Li^+ **(B)** K^+ **(C)** NH_4^+ **(D)** Ca^{2+}

***11.** Which of the following are manufactured in the solvay's process ?
(A) $Ca(OH)_2$ **(B)** Na_2CO_3 **(C)** $NaHCO_3$ **(D)** $CaCl_2$

***12.** $CaCl_2$ is known to be an excellent drying agent. However it is unable to dry all substances. The compounds which can be dried by using $CaCl_2$ are :
(A) HCl **(B)** CH_3OH **(C)** H_2O **(D)** NH_3

13. When hydrogen gas reacts with CO the product formed is:
(A) HCOOH **(B)** $CO_2 + H_2O$ **(C)** $C + H_2O$ **(D)** CH_3OH

***14.** The reaction calcium carbide with heavy water produces :
(A) $Ca_3(PO_4)_2$ **(B)** $Ca(OD)_2$ **(C)** Na_2CO_3 **(D)** NaOCl

15. Salt used for performing bead test in qualitative inorganic analysis is :
(A) $K_2SO_4.Al_2(SO_4)_3.24\ H_2O$ **(B)** $FeSO_4.(NH_4)_2SO_4.6\ H_2O$
(C) $Na(NH_4)HPO_4.4H_2O$ **(D)** $CuSO_4.5\ H_2O$

16. Crude common salt is hygroscopic because of the presence of impurities of :
(A) $CaSO_4$ and $MgSO_4$ **(B)** $CaCl_2$ and $MgCl_2$
(C) CaBr and $MgBr_2$ **(D)** Ca $(HCO_3)_2$ and Mg $(HCO_3)_2$

17. A compound X on heating gives a colourless gas. The residue is dissolved in water to obtain Y. Excess CO_2 is passed through aqueous solution of Y when Z is formed. Z on gentle heating gives back X. The compound X is :
(A) $NaHCO_3$ **(B)** Na_2CO_3 **(C)** $Ca(HCO_3)_2$ **(D)** $CaCO_3$

18. The raw materials required for the manufacture of Na_2CO_3 by Solvay process are :
(A) $CaCl_2$, $(NH_4)_2CO_3$, NH_3 **(B)** NH_4Cl, NaCl, $Ca(OH)_2$
(C) NaCl, $(NH_4)_2CO_3$, NH_3 **(D)** NaCl, NH_3, $CaCO_3$

19. The reaction of slaked lime with Cl_2 gas gives :
(A) Only $Ca(OCl)_2$ **(B)** Only $CaCl_2$
(C) $Ca(OCl)_2$, $CaCl_2$ and H_2O **(D)** Quick lime

20. In which of the following alloys Mg is not present ?
(A) Electron **(B)** Magnalium
(C) Duraluminium **(D)** Aluminium bronze

***21.** Which of the following statement regarding the oxides of alkali and alkaline metals is correct ?
(A) The reactivity of K_2O towards water is more than that of Na_2O
(B) The oxide of alkaline earth metals are more basic than those of alkali metals
(C) MgO is used as a refractory material for lining of electric furnaces
(D) The milk of lime and lime water are two different solutions

***22.** Select the incorrect statement(s) :
(A) Magnesium can be burnt in the atmosphere of CO_2 and SO_2
(B) Magnesium reacts with alkyl halides to form Grignard's reagent
(C) Out of Mg and Ca, only Mg reacts with N_2 to form magnesium nitride
(D) Calcium is less reactive than magnesium

23. A solution of sodium metal in liquid ammonia is strongly reducing due to the presence of :
(A) Sodium atoms **(B)** Sodium hydride
(C) Sodium amide **(D)** Solvated electrons

***24.** When Zeolite (hydrate sodium aluminate silicate) is treated with hard water the sodium ions are exchanged with :
(A) H^+ ions **(B)** Ca^{2+} ions **(C)** SO_4^{2-} **(D)** Mg^{2+} ions

25. Of the following statements only one is incorrect. The statement is :
(A) Calcium chloride decreases the freezing point of water
(B) The net material consumed in Solvay's process is a mixture of NaCl and $CaCO_3$
(C) Na_2CO_3 and $Ca(OH)_2$ are both used for water softening
(D) Alums form hexagonal crystals

26. Give the correct order of initials T or F for following statements. Use T if statement is true and F if it is false.
I. When lithium is burnt is oxygen, if forms superoxide LiO_3
II. Crude common salt is hygroscopic because of impurities of $CaSO_4$ and $MgSO_4$
III. Solubility of CaI_2, is more than that of $CaCl_2$
IV. A suspension of hydroxide of magnesium is used as a stomach antacid
The correct choice is :
(A) FFTF **(B)** FFFT **(C)** TFTF **(D)** TTFF

27. Why does H^+ ions always get associated with other atoms or molecules?

(A) Ionisation enthalpy of hydrogen resembles that of alkali metals

(B) Its reactivity is similar tohalogens

(C) It resembles both alkali metals and halogens

(D) Loss of an electron from hydrogen atom results in a nucleus of very small size as compared to other atoms or ions. Due to small size it cannot exist free

28. Which of the following hydrides is electron-precise hydride?

(A) B_2H_6 **(B)** NH_3 **(C)** H_2O **(D)** CH_4

29. Which of the following equations depict the oxidizing nature of H_2O_2?

(A) $2MnO_4^- + 6H^+ + 5H_2O_2 \longrightarrow 2Mn^{2+} + 8H_2O + 5O_2$

(B) $2Fe^{3+} + 2H^+ + H_2O_2 \longrightarrow 2Fe^{2+} + 2H_2O + O_2$

(C) $2I^- + 2H^+ + H_2O_2 \longrightarrow I_2 + 2H_2O$

(D) $KIO_4 + H_2O_2 \longrightarrow KIO_3 + H_2O + O_2$

30. Which of the following equation depicts reducing nature of H_2O_2?

(A) $2[Fe(CN)_6]^{4-} + 2H^+ + H_2O_2 \longrightarrow 2[Fe(CN)_6]^{3-} + 2H_2O$

(B) $I_2 + H_2O_2 + 2OH^- \longrightarrow 2I^- + 2H_2O + O_2$

(C) $Mn^{2+} + H_2O_2 \longrightarrow Mn^{4+} + 2OH^-$

(D) $PbS + 4H_2O_2 \longrightarrow PbSO_4 + 4H_2O$

31. Elements of which of the following group(s) of periodic table do **not** form hydrides.

(A) Groups 7, 8, 9 **(B)** Group 13 **(C)** Groups 15, 16, 17 **(D)** Group 14

Reasoning Type Questions for 32 - 33

(A) Statement-1 is True, Statement-2 is True and Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True and Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement-1 is True, Statement-2 is False.
(D) Statement-1 is False, Statement-2 is True.

32. **Statement 1 :** Permanent hardness of water is removed by treatment with washing soda.
Statement 2 : Washing soda reacts with soluble magnesium and calcium sulphate to form insoluble carbonates.

33. **Statement 1 :** Some metals like platinum and palladium, can be used as storage media for hydrogen
Statement 2 : Platinum and palladium can absorb large volumes of hydrogen.

***34.** Which of the following statements are not true for hydrogen?

(A) It exists as diatomic molecule

(B) It has one electron in the outermost shell

(C) It can lose an electron to form a cation which can freely exist

(D) It forms a large number of ionic compounds by losing an electron.

***35.** Dihydrogen can be prepared on commercial scale by different methods. In its preparation by the action of steam on hydrocarbons, a mixture of CO and H_2 gas formed. It is known as_____.

(A) Water gas **(B)** Syngas
(C) Producer gas **(D)** Industrial gas

***36.** Which of the following statement(s) is/are correct in the case of heavy water?

(A) Heavy water is used as a moderator in nuclear reactor.

(B) Heavy water is more effective as solvent than ordinary water.

(C) Heavy water is more associated than ordinary water.

(D) Heavy water has lower boiling point than ordinary water.

***37.** Which of the following statements about hydrogen are correct?

(A) Hydrogen has three isotopes of which protium is the most common
(B) Hydrogen never acts as cation in ionic salts
(C) Hydrogen ion, H^+, exists freely in solution
(D) Dihydrogen does not act as a reducing agent

***38.** Some of the properties of water are described below. Which of them is/are not correct?

(A) Water is known to be a universal solvent
(B) Hydrogen bonding is present to a large extent in liquid water
(C) Three is no hydrogen bonding in the frozen state of water
(D) Frozen water is heavier than liquid water

***39.** Hardness of water may be temporary or permanent. Permanent hardness is due to the presence of

(A) Chlorides of Ca and Mg in water **(B)** Sulphates of Ca and Mg in water
(C) Hydrogen carbonates of Ca and Mg in water **(D)** Carbonates of alkali metals in water

***40.** Which of the following statements is correct?

(A) Elements of group 15 form electron deficient hydrides
(B) All elements of group 14 form electron precise hydrides
(C) Electron precise hydrides have tetrahedral geometries
(D) Electron rich hydrides can act as Lewis acids

***41.** Which of the following statements is correct?

(A) Hydrides of group 13 act as Lewis acids
(B) Hydrides of group 14 are electron deficient hydrides
(C) Hydrides of group 14 act as Lewis acids
(D) Hydrides of group 15 act as Lewis bases

***42.** Which of the following statements is correct?

(A) Metallic hydrides are deficient of hydrogen
(B) Metallic hydrides conduct heat and electricity
(C) Ionic hydrides do not conduct electricity in solid state
(D) Ionic hydrides are very good conductors of electricity in solid state

43. Alkali metals react with water vigorously to form hydroxides and dihydrogen. Which of the following alkali metals reacts with water least vigorous?

(A) Li **(B)** Na **(C)** K **(D)** Cs

44. The reducing power of a metal depends on various factors. Suggest the factor which makes Li, the strongest reducing agent in aqueous solution.

(A) Sublimation enthalpy **(B)** Ionisation enthalpy
(C) Hydration enthalpy **(D)** Electron-gain enthalpy

45. Some of the Group 2 metal halides are covalent and soluble in organic solvents. Among the following metal halides, the one which is soluble in ethanol is :

(A) $BeCl_2$ **(B)** $MgCl_2$ **(C)** $CaCl_2$ **(D)** $SrCl_2$

46. The solubility of metal halides depends on their nature, lattice enthalpy and hydration enthalpy of the individual ions. Amongst fluorides of alkali metals, the lowest solubility of LiF in water is due to :

(A) Ionic nature of lithium fluoride **(B)** High lattice enthalpy
(C) High hydration enthalpy for lithium ion. **(D)** Low ionization enthalpy of lithium atom

47. Which of the following elements does not form hydride by direct heating with dihydrogen?

(A) Be **(B)** Mg **(C)** Sr **(D)** Ba

48. Dehydration of hydrates of halides of calcium, barium and strontium i.e., $CaCl_26H_2O$, $BaCl_2.2H_2O$, $SrCl_2.2H_2O$, can be achieved by heating. These become wet on keeping in air. Which of the following statements is correct about these halides?

(A) Act as dehydrating agent **(B)** Can absorb moisture from air
(C) Tendency to form hydrate decreases from calcium to barium
(D) All of the above

Reasoning Type Questions for 49 - 50

(A) Statement-1 is True, Statement-2 is True and Statement-2 is a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True and Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement-1 is True, Statement-2 is False.
(D) Statement-1 is False, Statement-2 is True.

49. **Statement 1 :** The carbonate of lithium decomposes easily on heating to form lithium oxide and CO_2.
Statement 2 : Lithium being very small in size polarizes large carbonate ion leading to the formation of more stable Li_2O and CO_2.

50. **Statement 1 :** Beryllium carbonate is kept in the atmosphere of carbon dioxide.
Statement 2 : Beryllium carbonate is unstable and decomposes to give beryllium oxide and carbon dioxide.

***51.** Metallic elements are described by their standard electrode potential, fusion enthalpy, atomic size, etc. The alkali metals are characterized by which of the following properties?
(A) High boiling point
(B) High negative standard electrode potential
(C) High density
(D) Large atomic size

***52.** Several sodium compounds find use in industries. Which of the following compounds are used for textile industry?
(A) Na_2CO_3 **(B)** $NaHCO_3$ **(C)** NaOH **(D)** NaCl

***53.** Which of the following compounds are readily soluble in water?
(A) $BeSO_4$ **(B)** $MgSO_4$ **(C)** $BaSO_4$ **(D)** $SrSO_4$

54. The volume strength of 1 N solution of H_2O_2 :
(A) 11.2 V **(B)** 22.4 V **(C)** 1 V **(D)** 5.6 V

***55.** Identify the correct formula of halides of alkaline earth metals from the following.
(A) $BaCl_2.2H_2O$ **(B)** $BaCl_2.4H_2O$
(C) $CaCl_2.6H_2O$ **(D)** $SrCl_2.4H_2O$

***56.** Choose the correct statements from the following.
(A) Beryllium is not readily attacked by acids because of the presence of an oxide film on the surface of the metal
(B) Beryllium sulphate is readily soluble in water as the greater hydration enthalpy of Be^{2+} overcomes of the lattice enthalpy factor
(C) Beryllium exhibits coordination number more than four
(D) Beryllium oxide is purely acidic in nature

***57.** Which of the following are the correct reasons for anomalous behaviour of lithium?
(A) Exceptionally small size of its atom **(B)** Its high polarizing power
(C) It has high degree of hydration **(D)** Exceptionally low ionization enthalpy

58. Moderate electrical conductivity is shown by :
(A) Silica **(B)** Graphite **(C)** Diamond **(D)** None of these

59. Name of the structure of silicates in which three oxygen atoms of $[SiO_4]^{4-}$ are shared.
(A) Pyrosilicate **(B)** Sheet silicate
(C) Linear chain silicate **(D)** 3-D silicate

60. Which of the following halides is least stable and has doubtful existence ?
(A) CCl_4 **(B)** GeI_4
(C) SnI_4 **(D)** PbI_4

61. Me_2SiCl_2 on hydrolysis will produce :
(A) $Me_2Si(OH)_2$ **(B)** $Me_2Si = O$
(C) $[- O - Me_2Si -]_n$ **(D)** $Me_2SiCl(OH)$

62. Aqueous solution of borax reacts with two mole of acids. This is because of :

(A) Formation of 2 mol of $B(OH)_2$ only

(B) Formation of 2 mol of $[B(OH)_4]^-$ only

(C) Formation of 1mol each of $B(OH)_3$ and $[B(OH)_4]^-$

(D) Formation of 2 mol each of $[B(OH)_4]^-$ reacts with acid

63. Which blue-liquid is obtained on reacting equimolar amounts of two gases at –30°C ?

(A) N_2O **(B)** N_2O_3 **(C)** N_2O_4 **(D)** N_2O_5

***64.** Borax is converted into crystalline boron by the following steps : $\text{Borax} \xrightarrow{X} H_3BO_3 \xrightarrow{\Delta} B_2O_3 \xrightarrow[\Delta]{Y} B$

X and Y are respectively :

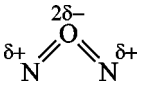
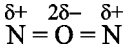
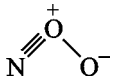
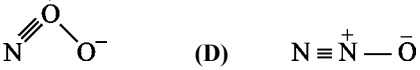
(A) HCl, Mg **(B)** HCl, C **(C)** C, Al **(D)** HCl, Al

65. $(NH_4)_2Cr_2O_7$ on heating liberates a gas. The same gas will be obtained by :

(A) Heating NH_4NO_2 **(B)** Heating NH_4NO_3

(C) Treating Mg_3N_2 with H_2O **(D)** Heating H_2O_2 on $NaNO_2$

66. N_2O is isoelectronic with CO_2 and N_3^-, which is the structure of N_2O?

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

***67.** NH_3 can be obtained by :

(A) Heating NH_4NO_3 or NH_4NO_2 **(B)** Heating NH_4Cl or $(NH_4)_2CO_3$

(C) Heating NH_4NO_3 with NaOH **(D)** Reaction of AIN or Mg_3N_2 or $CaCN_2$ with H_2O

***68.** Which of the following statement are ture?

(A) Cold and very dil.HNO_3 form NH_4NO_3 with Zn or Sn **(B)** Conc. HNO_3 forms NH_4NO_3 with Sn

(C) Cold and more conc. HNO_3 forms N_2 with Cn **(D)** HNO_3 can be stored in Al – vessel

Paragraph for Questions 69 - 70

The following flow diagram represents the industrial preparation of nitric acid from ammonia :

$$NH_3 + \underset{\text{(excess air)}}{O_2} \xrightarrow[900°C]{(A)} NO \;;\; NO \xrightarrow[\text{air}]{(B)} (C) \xrightarrow[\text{water}]{} HNO_3 + NO$$

Answer the questions given below :

69. Which line of entry describes the undefined reagents, products and reaction conditions?

	A	B	C		A	B	C
(A)	Pt	cool (–25° C)	NO_2	**(B)**	Ni	cool (–25° C)	N_2O
(C)	Fe	cool (–11°C)	NO_2	**(D)**	Pd	high pressure	N_2O_3

70. Formation of HNO_3 when (C) is dissolved in H_2O takes place through various reactions. Select the reaction observed in this step.

(A) $NO_2 + H_2O \longrightarrow HNO_3 + HNO_2$ **(B)** $HNO_2 \longrightarrow H_2O + NO + NO_2$

(C) Both of these **(D)** None of these

71. The strongest reducing agent amongst the following is :

(A) $P_2O_7^{4-}$ **(B)** $P_2O_6^{4-}$ **(C)** H_3PO_4 **(D)** $H_2PO_2^-$

72. There is a very little difference in acidic-strengths of H_3PO_4, H_3PO_3 and H_3PO_2 because:

(A) Phosphorous atoms in these acids are in the different oxidation state

(B) Phosphorous is more electronegative than oxygen

(C) Number of unprotonated oxygen responsible for increase of acidic-strength due to inductive effect remains the same

(D) Oxy-acids of phosphorus having same oxidation state of phosphorus

73. A student prepared a sample of silicon chloride by passing chlorine over heated silicon and collecting the condensed silicon chloride in a small specimen tube. He analysed the chloride by dissolving a known mass of it in water, and titrating the solution with standard silver nitrate solution. The formula of the silicon chloride as obtained by this method was $SiCl_6$ as against a 'true' formula of $SiCl_4$.

(A) The silicon chloride contained excess, dissolved chlorine.

(B) The "standard" silver nitrate solution was les concentrated than was stated on the label.

(C) More silicon chloride than the student supposed was actually used owing to inaccurate weighing

(D) The small specimen tube was not dry

74. Which of the following equation in incorrectly written?

(A) $P_4 + 20HNO_3 \rightarrow 4H_3PO_4 + 20NO_2 + 4H_2O$ **(B)** $I_2 + 10HNO_3 \rightarrow 2HIO_3 + 10NO_2 + 4H_2O$

(C) $S + 6HNO_3 \rightarrow H_2SO_4 + 6NO_2 + 2H_2O$ **(D)** None of these

75. When PH_3 is passed through copper sulphate solution, then copper phosphide is obtained. This is because :

(A) PH_3 is highly unstable **(B)** PH_3 shows acidic behaviour

(C) PH_3 is a reducing agent **(D)** PH_3 is a strong base

76. **Statement 1 :** Phosphorus reacts with conc. HNO_3 to form orthophosphoric acid.

Statement 2 : H_3PO_4 is a tribasic acid and has three replaceable H^+ ions.

(A) Statement-1 is True, Statement-2 is True and Statement-2 is a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True and Statement-2 is NOT a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False.

(D) Statement-1 is False, Statement-2 is True.

77. The geometry of a complex species can be understood from the knowledge of type of hybridization of orbital's of central atom. The hybridization of orbitals of central atom in $[B(OH)_4]^-$ and the geometry of the complex are respectively.

(A) sp^3, tetrahedral **(B)** sp^3, square planar **(B)** sp^3d^2, octahedral **(D)** dsp^2, square planar

78. The exhibition of highest co-ordination number depends on the availability of vacant orbitals in the central atom. Which of the following elements is not likely.

(A) B **(B)** Al **(C)** Ga **(D)** In

79. Catenation i.e., linking of similar atoms depends on size and electronic configuration of atoms. The tendency of catenation in Group 14 elements follows the order :

(A) C > Si > Ge > Sn **(B)** C >> Si > Ge ≈ Sn **(C)** Si > C > Sn > Ge **(D)** Ge > Sn > Si > C

80. In the structure of diborance

(A) All hydrogen atoms lie in one plane and boron atoms lie in a plane perpendicular to this plane

(B) 2 boron atoms and 4 terminal hydrogen atoms lie in the same plane and 2 bridging hydrogen atoms lie in the perpendicular plane

(C) 4 bridging hydrogen atoms and boron atoms lie in one plane and two terminal hydrogen atoms lie in a plane perpendicular to this plane

(D) All the atoms are in the same plane

Reasoning for Questions 81 - 82

(A) Statement-I is True, Statement-II is True and Statement-II is a correct explanation for Statement-I.

(B) Statement-I is True, Statement-II is True and Statement-II is NOT a correct explanation for Statement-I.

(C) Statement-I is True, Statement-II is False.

(D) Statement-I is False, Statement-II is True.

81. **Statement 1 :** If aluminium atoms replace a few silicon atoms in three dimensional network of silicon dioxide, the overall structure acquires a negative charge.

Statement 2 : Aluminium is trivalent while silicon is tetravalent.

82. **Statement 1 :** Silicons are water repelling in nature.

Statement 2 : Silicons are organosilicon polymers, which have (– R_2SiO –) as repeating unit.

***83.** The reason for small radius of Ga compared to Al is_____.

(A) Poor screening effect of *d* and *f* orbitals **(B)** Increase in nuclear charge

(C) Presence of higher orbitals **(D)** Higher atomic number

***84.** The linear shape of CO_2 is due to _____.

(A) sp^3 hybridisation of carbon **(B)** sp hybridization of carbon

(C) $p\pi - p\pi$ bonding between carbon and oxygen **(D)** sp^2 hybridisation of carbon

***85.** Me_3SiCl is used during polymerization of organo silicones because

(A) The chain length of organo silicone polymers can be controlled by adding Me_3SiCl.

(B) Me_3SiCl blocks the end terminals of silicone polymer

(C) Me_3SiCl improves the quality and yield of the polymer

(D) Me_3SiCl acts as a catalyst during polymerization

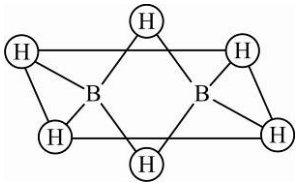
***86.** Which of the following statements are correct?

(A) Fullerenes have dangling bonds **(B)** Fullerenes are cage – like molecules

(C) Graphite is thermodynamically most stable allotrope of carbon

(D) Graphite is slippery and hard and therefore used as a dry lubricant in machines.

***87.** Which of the following statements are correct. Answer on the basis of figure:



(A) The two bridged hydrogen atoms and the two boron atoms lie in one plane

(B) Out of six B – H bonds two bonds can be described in terms of 3 centre 2-electron bonds

(C) Out of six B – H bonds four B – H bonds can be described in terms of 3 centre 2 electron bonds

(D) The four terminal B – H bonds are two centre-two electron regular bonds

***88.** Identify the correct resonance structures of carbon dioxide from the ones given below:

(A) $O - C \equiv O$ **(B)** $O = C = O$

(C) $^{-}O \equiv C - O^{+}$ **(D)** $^{-}O - C \equiv O^{+}$

89. Among the following oxoacids, the correct decreasing order of acid strength is :

(A) $HOCl > HClO_2 > HClO_3 > HClO_4$ **(B)** $HClO_4 > HOCl > HClO_2 > HClO_3$

(C) $HClO_4 > HClO_3 > HClO_2 > HOCl$ **(D)** $HClO_2 > HClO_4 > HClO_3 > HOCl$

90. Which one of the following properties is not shown by NO?

(A) It is diamagnetic in gaseous state **(B)** It is a neutral oxide

(C) It combines with oxygen to form nitrogen dioxide **(D)** Its bond order is 2.5

91. Which of the following is wrong statement?

(A) ONCl and ONO^{-} are not isoelectronic **(B)** O_3 molecule is bent

(C) Ozone is violet – black in solid state **(D)** Ozone is diamagnetic gas

92. Which of the following exists as covalent crystals in the solid state?

(A) Iodine **(B)** Silicon **(C)** Sulphur **(D)** Phosphorus

93. Which of the following on thermal decomposition yields a basic as well as acidic oxide ?

(A) $NaNO_3$ **(B)** $KClO_3$ **(C)** $CaCO_3$ **(D)** NH_4NO_3

94. Very pure hydrogen (99.9) can be made by which of the following processes?

(A) Reaction of methane with steam **(B)** Mixing natural hydrocarbons of high molecular weight

(C) Electrolysis of water **(D)** Reaction of salts like hydrides with water

95. Which of the following statements is wrong?

(A) The stability of hydrides increases from NH_3 to BiH_3 in group 15 of the periodic table

(B) Nitrogen can't form $d\pi - p\pi$ bond

(C) Single N – N bond is weaker than the single P – P bond

(D) N_2O_4 has two resonance structure

96. Which of the following statements regarding sulphur is incorrect?

(A) S_2 molecule is paramagnetic

(B) The vapour at $200^\circ C$ consists mostly of S_8 rings

(C) At $600^\circ C$, the gas mainly consists of S_2 molecules

(D) The oxidation state of sulphur is never less than +4 in its compounds

97. What is the best description of the change that occurs when $Na_2O(s)$ is dissolved in water?

(A) Oxidation number of sodium decreases **(B)** Oxide ion accepts a shared pairs of electrons

(C) Oxide ion donates a pair of electrons **(D)** Oxidation number of oxygen increases

98. Which one of the following order represents the correct sequence of the increasing basic nature of the given oxides?

(A) $MgO < K_2O < Al_2O_3 < Na_2O$ **(B)** $Na_2O < K_2O < MgO < Al_2O_3$

(C) $K_2O < Na_2O < Al_2O_3 < MgO$ **(D)** $Al_2O_3 < MgO < Na_2O < K_2O$

99. Among the following the maximum covalent character is shown by the compound.

(A) $SnCl_2$ **(B)** $AlCl_3$ **(C)** $MgCl_2$ **(D)** $FeCl_2$

100. In which of the following arrangements, the sequence is not strictly according to the property written against it?

(A) $CO_2 < SiO_2 < SnO_2 < PbO_2$ increasing oxidising power

(B) $HF < HCl < HBr < HI$ increasing acid strength

(C) $NH_3 > PH_3 < AsH_3 < SbH_3$ increasing basic strength

(D) $B < C < O < N$ increasing first ionisation enthalpy

101. Which of the following reaction of xenon compounds is not feasible?

(A) $XeO_3 + 6HF \longrightarrow XeF_6 + 3H_2O$

(B) $3XeF_4 + 6H_2O \longrightarrow 2Xe + XeO_3 + 12HF + 1.5O_2$

(C) $2XeF_2 + 2H_2O \longrightarrow 2Xe + 4HF + O_2$

(D) $XeF_6 + RbF \longrightarrow Rb[XeF_7]$

102. The bond dissociation energy of B – F in BF_3 is $646\,kJ\,mol^{-1}$ whereas that of C – F in CF_4 is $515\,kJ\,mol^{-1}$. The correct reason for higher B – F bond dissociation energy as compared to that of C – F is:

(A) Smaller size of B-atom as compared to that of C-atom

(B) Stronger σ-bond between B and F in BF_3 as compared to that between C and F in CF_4

(C) Significant $p\pi - p\pi$ intersection between B and F in BF_3 whereas there is non possibility of such interaction between C and F in CF_4

(D) Lower degree of $p\pi$ $p\pi$ interaction between B and F in BF_3 that between C and F in CF_4

103. Among the following substituted silanes the one which will give rise to cross linked silicone polymer on hydrolysis is:

(A) R_4Si **(B)** $R\,SiCl_3$

(C) R_2SiCl_2 **(D)** R_3SiCl

104. Which one of the following is the correct statement?

(A) Boric acid is a protonic acid

(B) Beryllium exhibits coordination number of six

(C) Chlorides of both beryllium and aluminium have bridged chloride structures in solid phase

(D) $B_2H_6 \cdot 2NH_3$ is known as 'inorganic benzene'

105. Identify the incorrect statement among the following:

(A) Ozone reacts with SO_2 to give SO_3

(B) Silicon reacts with NaOH(aq) in the presence of air to give Na_2SiO_3 and H_2O

(C) Cl_2 reacts with excess of NH_3 to give N_2 and HCl

(D) Br_2 reacts with hot and strong NaOH solution to give NaBr, $NaBrO_4$ and H_2O

106. The stability of dihalides of Si, Ge, Sn and Pb increases steadily in the sequence.

(A) $GeX_2 < SiX_2 < SnX_2 < PbX_2$ **(B)** $SiX_2 < GeX_2 < PbX_2 < SnX_2$

(C) $SiX_2 < GeX_2 < SnX_2 < PbX_2$ **(D)** $PbX_2 < SnX_2 < GeX_2 < SiX_2$

107. Which of the following statements is true?

(A) H_3PO_3 is a stronger acid than H_2SO_3 **(B)** In aqueous medium, HF is a stronger acid than HCl

(C) $HClO_4$ is weaker acid than $HClO_3$ **(D)** HNO_3 is a stronger acid than HNO_2

108. A metal, M forms chlorides in its +2 and +4 oxidation states. Which of the following statements about the chlorides is correct?

(A) MCl_2 is more soluble than MCl_4 **(B)** MCl_2 is more soluble in anhydrous ethanol than MCl_4

(C) MCl_2 is more ionic than MCl_4 **(D)** MCl_2 is more easily hydrolysed than MCl_4

109. The number of hydrogen atom(s) attached to phosphorus atom in hypophosphorous acid is:

(A) three **(B)** one **(C)** two **(D)** zero

110. In silicon dioxide

(A) There are double bonds between silicon and oxygen atoms

(B) Silicon atom is bonded to two oxygen atoms

(C) Each silicon atom is surrounded by two oxygen atom and each oxygen atom is bonded to two silicon atoms

(D) Each silicon atom is surrounded by four oxygen atoms and each oxygen atom is bonded to two silicon atoms

111. The correct order of the thermal stability of hydrogen halides $(H-X)$ is:

(A) HI > HCl > HF > HBr **(B)** HCl < HF > HBr < HI

(C) HF > HCl > HBr > HI **(D)** HI > HBr > HCl > HF

112. Beryllium and aluminium exhibit many properties which are similar. But the two elements differ in

(A) Exhibiting maximum covalency in compounds **(B)** Forming polymeric hydrides

(C) Forming covalent halides **(D)** Exhibiting amphoteric nature in their oxides

113. Which one of the following statements regarding helium is incorrect?

(A) It is used to fill gas balloons instead of hydrogen because it is lighter and non-inflammable

(B) It is used as a cryogenic agent for carrying out experiments at low temperatures

(C) It is used to produce and sustain powerful superconducting magnets

(D) It is used in gas-cooled nuclear reactors

114. The solubilities of carbonates decrease down the magnesium group due to a decrease in

(A) Lattice energies of solids **(B)** Hydration energies of cations

(C) Inter ionic attraction **(D)** Entropy of solution formation

115. PCl_3 and PCl_5 both exist; NCl_3 exists but NCl_5 does not exist. It is due to.

(A) Lower electronegativity of P than N **(B)** Lower tendency of N to form covalent bond

(C) Availability of vacant d-orbital in P but not in N **(D)** Statement is itself incorrect

116. Some statements about heavy water are given below :

I. Heavy water is used as moderator in nuclear reactors.

II. Heavy water is more associated than ordinary water.

III. Heavy water is more effective solvent than ordinary water.

Which of the above statements are correct ?

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

117. Which one of the following pairs of substances on reaction will not evolve H_2 gas ?

(A) Copper and HCl (aqueous) **(B)** Iron and steam

(C) Iron and H_2SO_4 (aqueous) **(D)** Sodium and ethyl alcohol

118. Which of the following groups of ions makes the water hard ?

(A) Sodium and bicarbonate **(B)** Magnesium and chlorine

(C) Potassium and sulphate **(D)** Ammonium and chloride

119. At its melting point ice is lighter than water because :

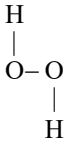
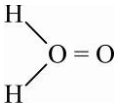
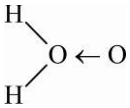
(A) H_2O molecules are more closely packed in solid state

(B) ice crystals have hollow hexagonal arrangement of H_2O molecules

(C) on melting of ice the H_2O molecules shrinks in size

(D) ice forms mostly heavy water on first melting

120. Which of the following is the true structure of H_2O_2 ?

(A) $H-O-O-H$ **(B)**  **(C)**  **(D)** 

121. Solubility of the alkaline earth metal sulphates in water decreases in the sequence :

(A) Sr > Ca > Mg > Ba **(B)** Ba > Mg > Sr > Ca

(C) Mg > Ca > Sr > Ba **(D)** Ca > Sr > Ba > Mg

122. Which of the following alkaline earth metal sulphates has hydration enthalpy higher than the lattice enthalpy ?

(A) $CaSO_4$ **(B)** $BeSO_4$

(C) $BaSO_4$ **(D)** $SrSO_4$

123. In the case of alkali metals, the covalent character decreases in the order :

(A) MF > MCl > MBr > MI **(B)** MF > MCl > MI > MBr

(C) MI > MBr > MCl > MF **(D)** MCl > MI > MBr > MF

124. The correct order of the mobility of the alkali metal ions in aqueous solution is :

(A) $Rb^+ > K^+ > Na^+ > Li^+$ **(B)** $Li^+ > Na^+ > K^+ > Rb^+$

(C) $Na^+ > K^+ > Rb^+ > Li^+$ **(D)** $K^+ > Rb^+ > Na^+ > Li^+$

125. When a substance (A) reacts with water it produces a combustible gas (B) and a solution of substance (C) in water. When another substance (D) reacts with this solution of (C), it also produces the same gas (B) on warming but (D) can produce gas (B) on reaction with dilute sulphuric acid at room temperature. Substance (A) imparts a deep golden yellow colour to a smokeless flame of Bunsen burner. Then (A), (B), (C) and (D) respectively are :

(A) Ca, H_2, $Ca(OH)_2$, Sn **(B)** K, H_2, KOH, Al

(C) Na, H_2, NaOH, Zn **(D)** CaC_2, C_2H_2, $Ca(OH)_2$, Fe

126. The solubility in water of sulphate down the Be group is Be > Mg > Ca > Sr > Ba. This is due to :

(A) decreasing lattice energy **(B)** high heat of solvation for smaller ions like Be^{2+}

(C) increase in melting points **(D)** increasing molecular weight

127. All the following substances react with water. The pair that gives the same gaseous product is :

(A) K and KO_2 **(B)** Na and Na_2O_3

(C) Ca and CaH_2 **(D)** Ba and BaO_2

128. Compared with the alkaline earth metals, the alkali metals exhibit :

(A) smaller ionic radii **(B)** highest boiling points

(C) greater hardness **(D)** lower ionization energies

129. The solubility of +1 oxidation state among Al, Ga, ln and Tl increases in the sequence :

(A) Al < Ga < ln < Tl **(B)** Tl < ln < Ga < Al

(C) ln < Tl < Ga < Al **(D)** Ga < ln < Al < Tl

130. Which of these is not a monomer for a high molecular mass silicone polymer ?

(A) Me_3SiCl **(B)** $PhSiCl_3$

(C) $MeSiCl_3$ **(D)** Me_2SiCl_2

131. The basic structural point of silicates is :

(A) SiO_3^{2-} **(B)** SiO_4^{2-} **(C)** SiO^- **(D)** SiO_4^{4-}

132. Name the structure of silicate in which one oxygen atom of $[SiO_4]^{4-}$ is shared ?

(A) Linear chain silicate **(B)** Sheet silicate

(C) Pyrosilicate **(D)** Three dimensional

133. Which of the following statements is correct ?

(A) Pure sodium metal dissolves in liquid ammonia to give blue solution

(B) NaOH reacts with glass to give sodium silicate

(C) Aluminium reacts with excess NaOH to give $Al(OH)_3$

(D) $NaHCO_3$ on heating gives Na_2CO_3

134. The straight chain polymer is formed by :

(A) hydrolysis of CH_3SiCl_3 followed by condensation polymerisation

(B) hydrolysis of $(CH_3)_4Si$ by addition polymerisation

(C) hydrolysis of $(CH_3)_2SiCl_2$ followed by condensation polymerisation

(D) hydrolysis of $(CH_3)_3SiCl$ followed by condensation polymerisation

135. Which of the following is the most basic oxide ?

(A) SeO_2 **(B)** Al_2O_3 **(C)** Sb_2O_3 **(D)** Bi_2O_3

136. The BCl_3 is a planar molecule whereas NCl_3 is pyramidal because :

(A) nitrogen atom is smaller than boron atom

(B) BCl_3 has no lone pair but NCl_3 has a lone pair of electrons

(C) $B-Cl$ bond is more polar than $N-Cl$ bond **(D)** $N-Cl$ bond is more covalent than $B-Cl$ bond

137. Carbon and silicon belong to (IV) group. The maximum coordination number of carbon in commonly occurring compounds is 4, whereas that of silicon is 6. This is due to :

(A) availability of low lying *d*-orbitals in silicon **(B)** large size of silicon

(C) more electropositive nature of silicon **(D)** Both (B) and (C)

138. Which of the following statements about H_3BO_3 is not correct ?

(A) It has a layer structure in which planar BO_3 units are joined by hydrogen bonds

(B) It does not act as proton donor but acts as a Lewis acid by accepting hydroxyl ion

(C) It is a strong tribasic acid **(D)** It is prepared by acidifying an aqueous solution of borax

Integer Answer Type Questions

The Answer to the following questions are positive integers of 1/2/3 digits and zero

139. What is the degree of hardness (in ppm) of a sample of water containing 48 mg of $MgSO_4$ (molecular mass = 120) per kg of water?

140. $[A] + Na[Cr(OH)_4] \xrightarrow[\text{B oil}]{H_2O_2} \underset{\substack{\text{(yelllow}\\ \text{colour}\\ \text{solution)}}}{[B]} \xrightarrow{H_2SO_4} \underset{\substack{\text{(orange}\\ \text{colour}\\ \text{compound)}}}{[C]}$

What is the molar weight of compound (C)?

(At wt of Cr, S, Na, O are 52, 32, 23 and 16 gm/mole respectively)

141. There are three samples labelled as 10 vol., 150 vol. and 20 vol. Half litre of each sample are mixed and then diluted with double volume of water. What is the volume strength (approx.) of the resulting solution?

142. How many moles of acidified potassium permanganate are reduced by 10 moles of H_2O_2 ?

143. Consider the following elements –

Li, Cs, Mg, Pb, Al, N

$\rightarrow$ x = number of elements which can form MO type of oxides

$\rightarrow$ y = the highest oxidation state shown by any one of them

$\rightarrow$ z = the number of elements which can form amphoteric oxide(s)

Find the sum of x, y and z.

144. $Be_2C + H_2O \rightarrow BeO + X$

$CaC_2 + H_2O \rightarrow Ca(OH)_2 + Y$

What is the sum of molecular wt of X and Y?

145. Reaction of Br_2 with Na_2CO_3 in aqueous solution gives sodium bromide and sodium bromate with evolution of CO_2 gas. The sum of stoichiometric coefficients of product side is –

146. Calcium carbide reacts with nitrogen and forms an important fertilizer, calcium cyanamide. How much calcium cyanamide is formed when 6.4 gm of calcium carbide is completely converted into cyanamide?

147. The number of isomers possible for disubstituted borazine $B_3N_3H_4X_2$ is–

148. Compound (X) on reduction with $LiAlH_4$ gives a hydride (Y) containing 21.72% hydrogen along with other products. The compound (Y) reacts with air explosively resulting in boron trioxide. What is the molecular weight of Y.

149. If X = number of σ -bonds
Y = number of lone pair of electrons
Then, what is the value of (X + Y) for hydrated borax.

150. Borax is represented as $Na_2[B_4O_5(OH)_4].8H_2O$. How many tetrahedral boron atoms are present in the structure of borax?

151. How many negative charges are present on pyrosilicate ion?

152. Total number of methods which can remove permanent hardness of water –
(a) Clark's method
(b) Ion-exchange method
(c) Synthetic resin method
(d) Calgon method
(e) Treatment with sodium carbonate

153. The number of alkali metals capable of forming superoxide amongst (Li, Na, K, Rb, Cs) is –

IOC & GOC

CHOOSE THE CORRECT ALTERNATIVE. ONLY ONE CHOICE IS CORRECT. HOWEVER, QUESTIONS MARKED '*' MAY HAVE MORE THAN ONE CORRECT OPTION.

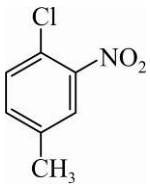
1. Which of the following is correct IUPAC name ?

(A) 3-Ethyl-4, 4-dimethylheptane **(B)** 4, 4-Dimethyl-3-ethylheptane
(C) 3-Ethyl-4-4-dimethylheptane **(D)** 4, 4-Bis(methyl)-3-ethylheptane

2. The IUPAC name for $CH_3 - \overset{O}{\overset{\|}{C}} - CH_2 - CH_2 - \overset{O}{\overset{\|}{C}} - OH$ is _____.

(A) 1-hydroxypentane-1, 4-dione **(B)** 1, 4-dioxopentanol
(C) 3-carboxybutan-3-one **(D)** 4-oxopentanoic acid

3. The IUPAC name for :



(A) 1-Chloro-1-nitro-4-methylbenzene **(B)** 1-Chloro-4-methyl-2-nitrobenzene
(C) 2-Chloro-1-nitro-2-methylbenzene **(D)** m-Nitro-p-chlorotoluene

4. Electronegativity of carbon atoms depends upon their state of hybridisation. In which of the following compounds, the carbon marked with asterisk is most electronegative ?

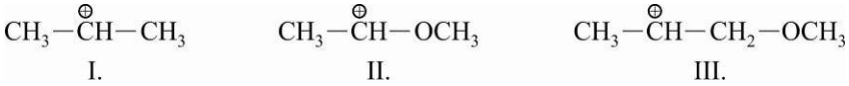
(A) $CH_3 - CH_2 - \overset{*}{C}H_2 - CH_3$ **(B)** $CH_3 - \overset{*}{C}H = CH - CH_3$

(C) $CH_3 - CH_2 - C \equiv \overset{*}{C}H$ **(D)** $CH_2 - CH_2 - CH = \overset{*}{C}H_2$

***5.** In which of the following, functional isomerism is possible ?

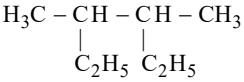
(A) Alcohols **(B)** Aldehydes **(C)** Alkyl halides **(D)** Cyanides

6. What is the correct order of decreasing stability of the following cations.



I. II. III.

(A) II > I > III **(B)** II > III > I **(C)** III > I > II **(D)** I > II > III

7. Correct IUPAC name for  is :

(A) 2-ethyl-3-methylpentane **(B)** 3, 4-dimethylhexane

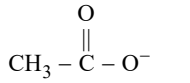
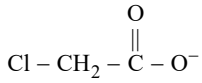
(C) 2-sec-butylbutane **(D)** 2, 3-dimethylbutane

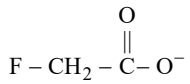
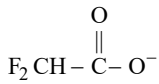
8. In which of the following compounds the carbon marked with asterisk is expected to have greatest positive charge?

(A) $\overset{*}{C}H_3 - CH_2 - Cl$ **(B)** $\overset{*}{C}H_3 - \overset{\delta-}{C}H_2 - Mg^+Cl^-$

(C) $\overset{*}{C}H_3 - CH_2 - Br$ **(D)** $\overset{*}{C}H_3 - CH_2 - CH_3$

9. Which of the following carboxylate ion is the most stable ?

(A)  **(B)** 

(C)  **(D)** 

10. Name the type of intermediate formed in the first step of the following addition reaction.

$H_3C - HC = CH_2 + H^+ \longrightarrow ?$

(A) 2° Carbonion **(B)** 1° Carbocation **(C)** 2° Carbocation **(D)** 1° Carbonion

***11.** Which of the following compounds contain all the carbon atoms in the same hybridisation state ?

(A) $H - C \equiv C - C \equiv C - H$ **(B)** $CH_3 - C \equiv C - CH_3$

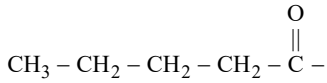
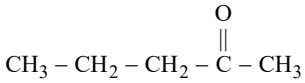
(C) $CH_2 = C = CH_2$ **(D)** $CH_2 = CH - CH = CH_2$

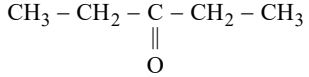
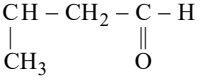
***12.** Electrophilies are electron seeking species. Which of the following groups contain only electrophiles ?

(A) BF_3, NH_3, H_2O **(B)** $AlCl_3, SO_3, NO_2^+$

(C) $NO_2^+, CH_3^+, CH_3 - \overset{+}{C} = O$ **(D)** $C_2H_5^-, \overset{\bullet}{C}_2H_5, C_2H_5^+$

Note : Consider the following four compounds for Question 13 and 14.

I.  II. 

III.  IV. 

***13.** Which of the following pairs are position isomers ?

(A) I and II **(B)** II and III **(C)** II and IV **(D)** III and IV

***14.** Which of the following pairs are not functional group isomers ?

(A) II and III **(B)** II and IV **(C)** I and IV **(D)** I and II

15. Nucleophile is a species that should have :

(A) a pair of electrons to donate **(B)** positive charge

(C) negative charge **(D)** electron deficient species

***16.** Hyperconjugation involves delocalisation of _____ .

(A) Electrons of carbon-hydrogen σ bond of an alkyl group directly attached to an atom of unsaturated system

(B) Electrons of carbon-hydrogen σ bond of alkyl group directly attached to positively charged carbon atom.

(C) π-electrons of carbon-carbon bond

(D) Long pairs of electrons

17. **Assertion (A) :** Energy of resonance hybrid is equal to the average of energies of all canonical forms.
Reason (R) : Resonance hybrid cannot be presented by a single Lewis structure.
(A) Both A and R are correct and R is the correct explanation of A
(B) Both A and R are correct but R is not the correct explanation of A
(C) Both A and R are not correct
(D) A is not correct but R is correct

18. The order of stability of the following carbocations :
I. Allyl carbocation **II.** Isopropyl carbocation **III.** Benzyl carbocation
The correct choice is :
(A) III > II > I **(B)** II > III > I **(C)** I > II > III **(D)** III > I > II

19. Consider thiol anion $(RS^{\ominus})$ and alkoxy anion $(RO^{\ominus})$. Which of the following statements is correct ?
(A) $RS^{\ominus}$ is less basic and less nucleophilic than $RO^{\ominus}$
(B) $RS^{\ominus}$ is less basic but more nucleophilic than $RO^{\ominus}$
(C) $RS^{\ominus}$ is more basic and more nucleophilic than $RO^{\ominus}$
(D) $RS^{\ominus}$ is more basic but less nucleophilic than $RO^{\ominus}$

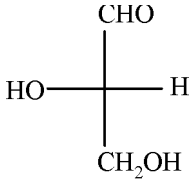
20. The correct order of increasing basicity of the given base (R = CH_3) is :
(A) $R\overline{C}OO < HC = \overline{C} < \overline{R} < \overline{N}H_2$ **(B)** $\overline{R} < HC \equiv \overline{C} < R\overline{C}OO < \overline{N}H_2$
(C) $R\overline{C}OO < \overline{N}H_2 < HC \equiv \overline{C} < \overline{R}$ **(D)** $R\overline{C}OO < HC \equiv \overline{C} < \overline{N}H_2 < \overline{R}$

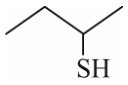
***21.** Out of the following the alkene that exhibits optical isomerism is :
(A) 3-methyl-2-pentene **(B)** 3-Methyl-1-cyclohexene
(C) 3-methyl-1-pentene **(D)** 2-methyl-2-pentene

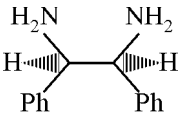
22. Arrange the carbanions, $(CH_3)_3\overline{C}$, $\overline{C}Cl_3$, $(CH_3)_2\overline{C}H$, $C_6H_5\overline{C}H_2$, in order of their decreasing stability :
(A) $C_6H_5\overline{C}H_2 > CCl_3 > (CH_3)_3\overline{C} > (\overline{C}H_3)_2\overline{C}H$ **(B)** $(CH_3)_2\overline{C}H > \overline{C}Cl_3 > C_6H_5\overline{C}H_2 > (CH_3)_3\overline{C}$
(C) $\overline{C}Cl_3 > C_6H_5\overline{C}H_2 > (CH_3)_2\overline{C}H > (CH_3)_3\overline{C}$ **(D)** $(CH_3)_3\overline{C} > (CH_3)_2\overline{C}H > \overline{C}H_2 > \overline{C}Cl_3$

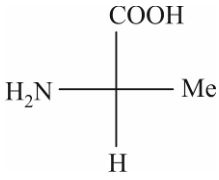
23. The number of stereoisomers possible for a compound of the molecular formula $CH_3 - CH = CH - CH(OH) - Me$ is :
(A) 3 **(B)** 2 **(C)** 4 **(D)** 6

24. The correct decreasing order of priority for the functional groups of organic compounds in the IUPAC system of nomenclature is :
(A) – COOH, – SO_3H, – $CONH_2$, – CHO **(B)** – SO_3H, – COOH, – $CONH_2$ – CHO
(C) – CHO, – COOH, – SO_3H, – $CONH_2$ **(D)** – $CONH_2$, – CHO, – SO_3H, – COOH

***25.** Which of the following molecules is expected to rotate the plane of polarized light ?
(A) 

(B) 

(C) 

(D) 

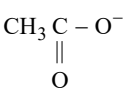
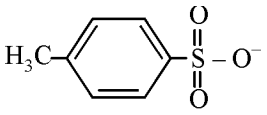
26. Which of the following is the correct order of decreasing S_N2 reactivity ? (X = a halogen)
(A) $RCH_2X > R_3CX > R_2CHX$ **(B)** $RCH_2X > R_2CHX > R_3CX$
(C) $R_3CX > R_2CHX > RCH_2X$ **(D)** $R_2CH_2X > R_3CX > RCH_2X$

27. The increasing order of stability of the following free radicals is :
(A) $(CH_3)_2\dot{C}H < (CH_3)_3\dot{C} < (C_6H_5)_2\dot{C}H < (C_6H_5)_3\dot{C}$
(B) $(C_6H_5)_3\dot{C} < (C_6H_5)_2\dot{C}H < (CH_3)_3\dot{C} < (CH_3)_2\dot{C}H$
(C) $(C_6H_5)_2\dot{C}H < (C_6H_5)_3\dot{C} < (CH_3)_3\dot{C} < (CH_3)_2\dot{C}H$
(D) $(CH_3)_2\dot{C}H < (CH_3)_3\dot{C} < (C_6H_5)_3\dot{C} < (C_6H_5)_2\dot{C}H$

28. Due to the presence of an unpaired electron, free radicals are :

(A) cations **(B)** anions **(C)** chemically inactive **(D)** chemically reactive

29. The decreasing order of nucleophilicity among the nucleophiles :

I.  **II.** CH_3O^- **III.** CN^- **IV.** 

The correct choice is :

(A) III > II > I > IV **(B)** II > III > I > IV **(C)** IV > III > II > I **(D)** IV > I > III > II

30. Which type of isomerism is shown by 2, 3-dichlorobutane?

(A) Structural **(B)** Geometric **(C)** Optical **(D)** Functional

***31.** Which of the following have sp^2 hybridised carbon?

(A) Acetone **(B)** Acetic acid **(C)** Acetonitrile **(D)** Acetamide

32. For which of the following parameters, the structural isomers C_2H_5OH and CH_3OCH_3 would be expected to have the same values? (Assume ideal behaviour)

(A) Heat of vaporization

(B) Vapour pressure at the same temperature

(C) Boiling points

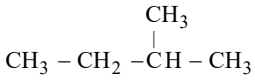
(D) Gaseous densities at the same temperature and pressure

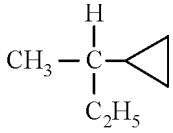
***33.** Which of the following compounds has(have) chiral centre ?

(A) 1-chloropentane **(B)** 2-chloropentane

(C) 1-chloro-2-methyl pentane **(D)** 3-chloro-2-methyl pentane

34. Amongst the following compounds, the optically active alkane having lowest molecular mass is :

(A) $CH_3 - CH_2 - CH_2 - CH_3$ **(B)** 

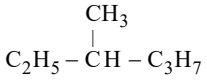
(C)  **(D)** $CH_3 - CH_2 - C \equiv CH$

***35.** Which of the following will have a meso-isomer also?

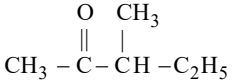
(A) 2-chlorobutane **(B)** 2, 3-dichlorobutane

(C) 2, 3-dichloropentane **(D)** 2, 3-butandiol

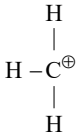
36. Among the following four structures I to IV



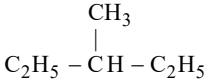
(I)



(II)



(III)



(IV)

It is true that :

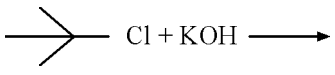
(A) all four are chiral compounds **(B)** only I and II are chiral compounds

(C) only III is a chiral compounds **(D)** only II and IV are chiral compounds

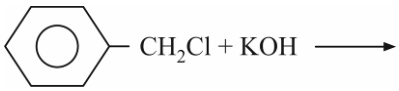
***37.** Underlined carbon is sp^2 hybridised in :

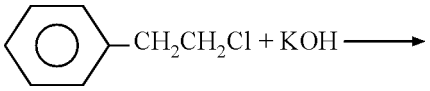
(A) $CH_3\underline{C}H = CH_2$ **(B)** $CH_3\underline{C}H_2NH_2$ **(C)** $CH_3\underline{C}ONH_2$ **(D)** $CH_3CH_2\underline{C}N$

***38.** S_N1 reaction is feasible in

(A) 

(B) 

(C) 

(D) 

39. Following types of compounds (as I, II)

I. $CH_3CH = CHCH_3$ II. $CH_3 - CH(CH_2CH_3) - OH$

Are studied in terms of isomerism in :

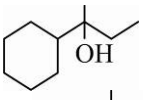
(A) Chain isomerism **(B)** Position isomerism **(C)** Conformers **(D)** Stereoisomerism

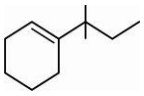
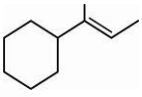
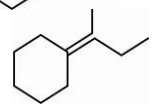
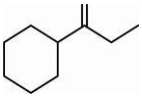
40. The IUPAC name of the compound having formula : $O=C(OH)-CH(NH_2)-CH_2(OH)$

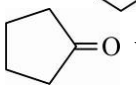
(A) 3-Hydroxy-2-amino-propanoic acid **(B)** 2-Amino-propan-3-oic acid
(C) Amino hydroxyl propanoic acid **(D)** 2-Amino-3-hydroxy-propanoic acid

41. Which of the following statements is not correct for a nucleophile ?

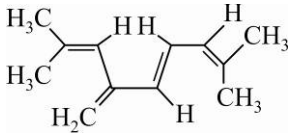
(A) Ammonia is a nucleophile **(B)** Nucleophiles attack low e^- density sites
(C) Nucleophiles are not electron seeking **(D)** Nucleophile is a Lewis acid

42. Which of the following is not the product of dehydration of 

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

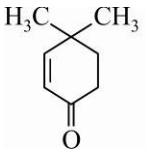
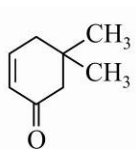
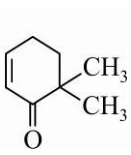
43. Treatment of cyclopentanone  with methyl lithium gives which of the following species ?

(A) Cyclopentanonyl radical **(B)** Cyclopentanonyl biradical
(C) Cyclopentanonyl anion **(D)** Cyclopentanonyl cation

44. The total number of π -bond electrons in the following structure is : 

(A) 12 **(B)** 16
(C) 4 **(D)** 8

45. Given :

Which of the given compounds can exhibit tautomerism ?

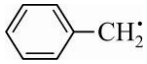
(A) II and III **(B)** I, II and III **(C)** I and II **(D)** I and III

46. In Duma's method for estimation of nitrogen, 0.25g of an organic compound gave 40 mL of nitrogen collected at 300 K temperature and 725 mm pressure. If the aqueous tension at 300 K is 25 mm, the percentage of nitrogen in the compound is :

(A) 16.76 **(B)** 15.76 **(C)** 17.36 **(D)** 18.20

47. In the Kjeldahl's method for estimation of nitrogen present in a soil sample, ammonia evolved from 0.75 g of sample neutralized 10 mL of 1M H_2SO_4. The percentage of nitrogen in the soil is :

(A) 37.33 **(B)** 45.33 **(C)** 35.33 **(D)** 43.33

48. The radical,  is aromatic because it has :

(A) 7 p-orbitals and 7 unpaired electrons **(B)** 6 p-orbitals and 7 unpaired electrons
(C) 6 p-orbitals and 6 unpaired electrons **(D)** 7 p-orbitals and 6 unpaired electrons

49. Nitrogen detection in organic compound is carried out by Lassaigne's test. The blue colour formed corresponds to which of the following formulae ?

(A) $Fe_3[Fe(CN)_6]_2$ **(B)** $Fe_4[Fe(CN)_6]_3$ **(C)** $Fe_4[Fe(CN)_6]_2$ **(D)** $Fe_3[Fe(CN)_6]_3$

50. In Duma's method of estimation of nitrogen 0.35g of an organic compound gave 55 mL of nitrogen collected at 300 K temperature and 715 mm pressure. The percentage composition of nitrogen in the compound would be : (Aqueous tension at 300 K = 15 mm).

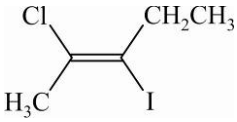
(A) 15.45 **(B)** 16.45 **(C)** 17.45 **(D)** 14.45

51. The Lassaigne's extract is boiled with conc. HNO_3 while testing for halogens. By doing so it :

(A) decomposes Na_2S and NaCN, it formed **(B)** helps in the precipitation of AgCl

(C) increases the solubility product of AgCl **(D)** increases the concentration of NO_3^- ions

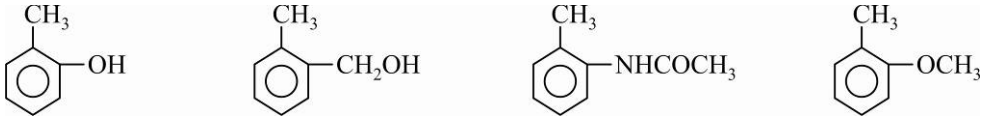
52. The IUPAC name of the following compound is :



(A) trans-2-chloro-3-iodo-2-pentene **(B)** cis-3-iodo-4-chloro-3-pentane

(C) trans-3-iodo-4-chloro-3-pentene **(D)** cis-2-chloro-3-iodo-2-pentene

53. Which is most reactive towards electrophilic reagent ?



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

54. Which of the following species is not electrophilic in nature ?

(A) $\overset{+}{Cl}$ **(B)** BH_3 **(C)** H_3O^+ **(D)** $\overset{+}{N}O_2$

55. For (i) I^-, (ii) Cl^-, (iii) Br^-, the increasing order of nucleophilicity would be :

(A) $Cl^- < Br^- < I^-$ **(B)** $I^- < Cl^- < Br^-$ **(C)** $Br^- < Cl^- < I^-$ **(D)** $I^- < Br^- < Cl^-$

56. The best method for the separation of naphthalene and benzoic acid from their mixture is :

(A) distillation **(B)** sublimation

(C) chromatography **(D)** crystallisation

57. Which one of the following orders of acid strength is correct ?

(A) RCOOH > ROH > HOH > HC ≡ CH **(B)** RCOOH > HOH > ROH > HC ≡ CH

(C) RCOOH > HOH > HC ≡ CH > ROH **(D)** RCOOH > HC ≡ CH > HOH > ROH

58. Which of the following is incorrect ?

(A) $FeCl_3$ is used in detection of phenol

(B) Fehling solution is used in detection of glucose

(C) Tollen's reagent is used in detection of unsaturation

(D) $NaHSO_3$ is used in detection of carbonyl compound

59. A is a lighter phenol and B is an aromatic carboxylic acid. Separation of a mixture of A and B can be carried out easily by using a solution of :

(A) sodium hydroxide **(B)** sodium sulphate

(C) calcium **(D)** sodium bicarbonate

60. An organic compound X(molecular formula $C_6H_7O_2N$) has six carbon atoms in a ring system, two double bonds and a nitrogen group as substituent, X is :

(A) homocyclic but not aromatic **(B)** aromatic but not homocyclic

(C) homocyclic and aromatic **(D)** hetereocyclic and aromatic

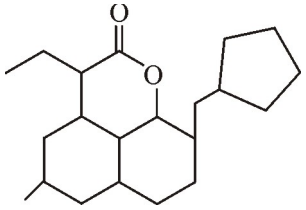
Integer Answer Type Questions

The Answer to the following questions are positive integers of 1/2/3 digits and zero

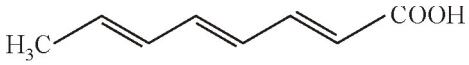
61. The number of stereoisomers possible for a compound of the molecular formula $CH_3 - CH = CH - CH(OH) - CH_3$ is

62. The number of structural isomers for C_6H_{14} is.

63. How many chiral centres are there in the following compound?

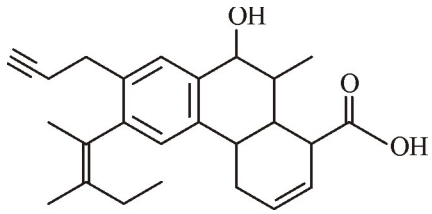


64. How many geometrical isomers are possible for the following compound?



65. How many ethers are possible for the formula $C_5H_{12}O$ including stereosomers?

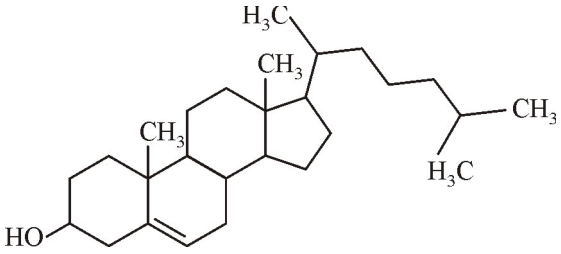
66. How many degrees of unsaturation are there in the following?



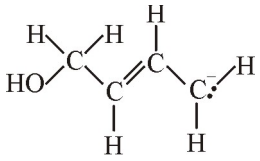
67. Five alcohols can be drawn for formula $C_4H_{10}O$. How many of these are optically active?

68. Total number of benzene derivatives with the molecular formula $C_6H_3Cl_3$ is

69. How many chiral carbons are there in the following compound?



70. The number of resonance contributing structure(s) for the following compound is



71. The total number of non-cyclic isomers formed by C_5H_{10} is _____.

72. The total number of isomers of a disubstituted benzene compound _____.

73. The number of optical isomers for a compound containing 2-dissimilar asymmetric carbon atom is _____.

74. How many carbons are present in smallest optically active alkane?

75. How many total structural isomers can be formed from $C_4H_8Br_2$?

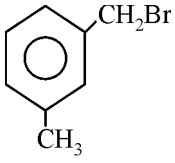
Hydrocarbons

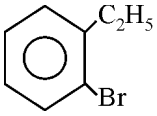
CHOOSE THE CORRECT ALTERNATIVE. ONLY ONE CHOICE IS CORRECT. HOWEVER, QUESTIONS MARKED '*' MAY HAVE MORE THAN ONE CORRECT OPTION.

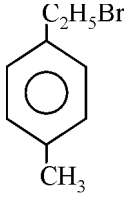
1. The major organic compound formed by the reaction of 1, 1, 1-trichloroethane with silver powder is :

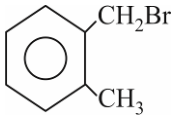
(A) Acetylene **(B)** Ethane **(C)** 2-butyne **(D)** 2-butene

2. Compound (A), C_8H_9Br gives a white precipitate when warmed with alcoholic $AgNO_3$. Oxidation of (A) gives an acid (B), $C_8H_6O_4$. (B) easily forms anyhydride on heating. Identify the compound (A).

(A) 

(B) 

(C) 

(D) 

3. A solution of (*–l*)-chloro-1-phenylethane in toluene racemises slowly in the presence of a small amount of $SbCl_5$, due to the formation.

(A) Carbanion **(B)** Carbine **(C)** Carbocation **(D)** Free radical

4. How many chiral compounds are possible on monochlorination of 2-methyl butane?

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

5. 2-hexyne gives trans-2-hexene on treatment with :

(A) Pt/H_2 **(B)** Li/NH_3 **(C)** $Pd/BaSO_4$ **(D)** $LiAlH_4$

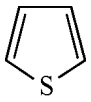
6. Ozonolysis of an organic compound gives formaldehyde as one of the products. This confirms the presence of

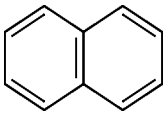
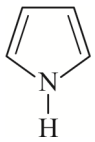
(A) Two ethylenic double bonds **(B)** A vinyl group
(C) An isopropyl group **(D)** An acetylenic triple bond

7. Ozonolysis of an organic comounds a produces acetone and propionaldehyde in equimolar mixture. Identify A from the following compounds.

(A) 2-methyl-1-pentene **(B)** 1-pentene
(C) 2-pentene **(D)** 2-methyl-2-pentene

***8.** The aromatic compound among the following is(are) :

(A)  **(B)** 

(C)  **(D)** 

***9.** The hydrocarbon which can react with sodium in liquid ammonia is :

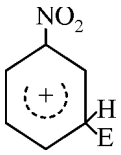
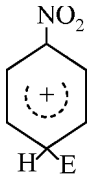
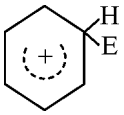
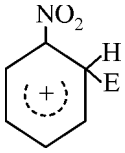
(A) $CHl_3CH_2CH_2C \equiv CCH_2CH_2CH_3$ **(B)** $CH_3CH_2C \equiv CH$

(C) $PhC \equiv CH$ **(D)** $CH_3CH_2C \equiv CCH_2CH_3$

***10.** The treatment of CH_3MgX with $CH_3C \equiv C-H$ produces

(A) $CH_3-CH=CH_2$ **(B)** $CH_3C \equiv C-CH_3$ **(C)** $CH_3C \equiv C-MgX$ **(D)** CH_4

11. The electrophile, E^+ attacks the benzene ring to generate the intermediate σ -complex. Which of the following σ – complex is of lowest energy?

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

12. Alkyl halides react with dialkyl copper reagents to give :

(A) Alkenyl halides **(B)** Alkanes

(C) Alkyl copper halides **(D)** Alkenes

13. Of the five isomeric hexanes, the isomers which can give two monochlorinated compounds, is :

(A) 2-methylpentane **(B)** 2, 2-dimethylbutane

(C) 2, 3-dimethylbutane **(D)** n-hyxane

14. Reaction of one molecule of HBr with one molecule of 1, 3-butadiene at 40°C gives predominantly :

(A) 1-bromo-2-butene under kinetically controlled conditions

(B) 3-bromobutene under thermodynamically controlled conditions

(C) 1-bromo-2-butene under thermodynamically controlled conditions

(D) 3-bromobutene under kinetically controlled conditions

15. Which one of the following is reduced with Zinc amalgam and hydrochloric acid to give the corresponding hydrocarbon?

(A) Ethyl acetate **(B)** Acetic acid **(C)** Acetamide **(D)** Butan-2-one

16. Which one of the following has the minimum boiling point?

(A) n-butane **(B)** 1-butyne **(C)** 1-butene **(D)** Isobutene

17. Butene-1 may be converted to butane by reaction with :

(A) Zn-HCl **(B)** Sn-HCl **(C)** Lindlar catalyst **(D)** Pd/H_2

***18.** Acetylene can reacts with :

(A) Na **(B)** Ammoniacal $AgNO_3$

(C) HCl **(D)** NaOH

19. Acetylene reacts with hypochlorous acid to form :

(A) Cl_2CHCHO **(B)** $ClCH_2COOH$ **(C)** CH_3COCl **(D)** $ClCH_2CHO$

20. CH_3MgI is an organo-metallic compound due to :

(A) Mg-I bond **(B)** C-I bond **(C)** C-Mg bond **(D)** C – H bond

21. Arrange the following in decreasing order of their boiling points.

I. n-butane **II.** 2-methylbutane **III.** n-pentane **IV.** 2,2-dimethylpropane

The correct choice is :

(A) I > II > III > IV **(B)** II > III > IV > I **(C)** IV > III > II > I **(D)** III > II > IV > I

22. Arrange the halogens F_2, Cl_2, Br_2, I_2 in order of their increasing reactivity with alkanes.

(A) $I_2 < Br_2 < Cl_2 < F_2$ **(B)** $Br_2 < Cl_2 < F_2 < I_2$

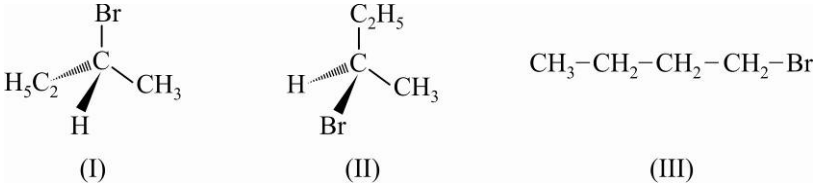
(C) $F_2 < Cl_2 < Br_2 < I_2$ **(D)** $Br_2 < I_2 < Cl_2 < F_2$

23. The increasing order of reactivity of alkyl halides with zinc and dilute HCl is :

(A) R – Cl < R – I < R – Br **(B)** R – Cl < R – Br < R – I

(C) R – I < R – Br < R – Cl **(D)** R – Br < R – I < R – Cl

24. The addition of HBr to 1-butene gives mixture of products A, B and C :



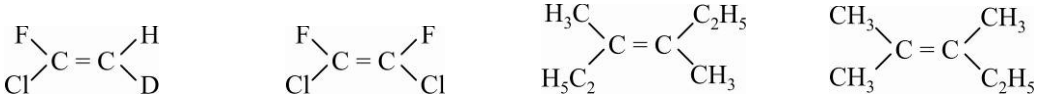
(I) (II) (III)

The mixture consists of :

(A) I and II as major and III as minor products **(B)** II as major, I and III major products

(C) II as minor, I and III minor products **(D)** I and II as minor and III as major products

***25.** Which of the following will show geometrical isomerism ?



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

26. Arrange the following hydrogen halides in order of their decreasing reactivity with propene :

(A) HCl > HBr > HI **(B)** HBr > HI > HCl

(C) HI > HBr > HCl **(D)** HCl > HI > HBr

27. Arrange the following carbanians in order of their stabilities :

(I) $H_3C - C \equiv C^-$ (II) $H - C \equiv C^-$ (III) $H_3C - C\bar{H}_2$

The correct choice is :

(A) I > II > III **(B)** II > I > III

(C) III > II > I **(D)** III > I > II

28. Which of the following reactions of methane is incomplete combustion ?

(A) $2CH_4 + O_2 \xrightarrow{Cu\,/\,523\ K\,/\,100\ atm} 2CH_3OH$ **(B)** $CH_4 + O_2 \xrightarrow{Mo_2O_3} HCHO + H_2O$

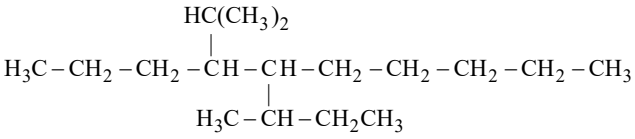
(C) $CH_4 + O_2 \longrightarrow C(s) + 2H_2O\ (l)$ **(D)** $CH_4 + 2O_2 \longrightarrow CO_2(g) + 2H_2O\ (l)$

***29.** Some oxidation reactions of methane are given below. Which of them is(are) controlled oxidation reaction ?

(A) $CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O\ (l)$ **(B)** $CH_4(g) + O_2(g) \longrightarrow C(s) + 2H_2O\ (l)$

(C) $CH_4(g) + O_2(g) \xrightarrow{Mo_2O_3} HCHO + H_2O$ **(D)** $2CH_4(g) + O_2(g) \xrightarrow{Cu\,/\,523\,/\,100\,atm} 2CH_3OH$

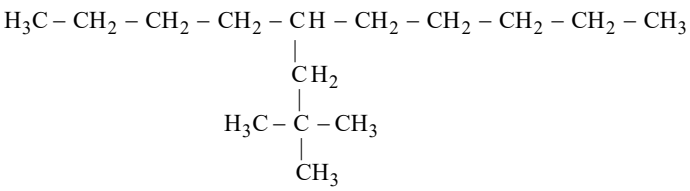
30. Which is correct IUPAC names of the following compound ?



(A) 5-Butyl-4-isopropyldecane **(B)** 5-Ethyl-4-propyldecane

(C) 5-sec-Butyl-4-iso-propyldecane **(D)** 4-(1-Methylethyl)-5-(1-Methylpropyl)-decane

31. Which is correct IUPAC names of the following compound ?



(A) 5-(2′,2′-Dimethylpropyl)-decane **(B)** 4-Butyl-2, 2-dimethylnonane

(C) 2,2-Dimethyl-4-pentyloctane **(D)** 5-neo-Pentyldecane

***32.** For an electrophilic substitution reaction, the presence of a halogen atom in the benzene ring _____.

(A) Deactivates the ring by inductive effect

(B) Deactivates the ring by resonance

(C) Increases the charge density at ortho and para position relative to meta position by resonance

(D) Directs the incoming electrophile to meta position by increasing the charge density relative to ortho and para position

***33.** Which of the following are correct ?

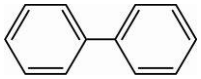
(A) $CH_3-O-CH_2^+$ is more stable than $CH_3-CH_2^+$

(B) $(CH_3)_2CH^+$ is less stable then $CH_3-O-CH_2^+$

(C) $CH_2=CH-CH_2^+$ is more stable than $CH_3-CH_2-CH_2^+$

(D) $CH_2=CH^+$ is more stable than $CH_3-CH_2^+$

***34.** Select the aromatic structures among the following :

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

***35.** The molecules having dipole moment are :

(A) 2, 2-Dimethylpropane **(B)** trans-Pent-2-ene

(C) cis-Hex-3-ene **(D)** 2, 2, 3, 3-Tetramethylbutane

REASONING TYPE FOR QUESTIONS 36 - 37

(A) Statement-1 is True, Statement-2 is True and Statement-2 is a correct explanation for Statement-1.

(B) Statement-1 is True, Statement-2 is True and Statement-2 is NOT a correct explanation for Statement-1.

(C) Statement-1 is True, Statement-2 is False.

(D) Statement-1 is False, Statement-2 is True.

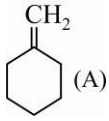
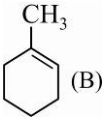
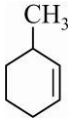
36. **Statement 1 :** The compound cyclooctatetraene has the following structural formula : 
It is cyclic and has conjugate 8π -electron system but it is not an aromatic compound.

Statement 2 : $(4n + 2)\,\pi$ electrons rule does not hold good and ring is not planar.

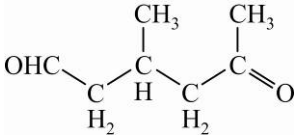
37. **Statement 1 :** Among isomeric pentanes, 2, 2-dimethylpentane has lowest boiling point.

Statement 2 : Branching does not affect the boiling point.

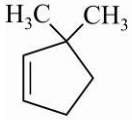
38. In the reaction with HCl, an alkene reacts in accordance with the Markovnikov's rule to give a product 1-chloro-1-methylcyclohexane. The possible alkene is :

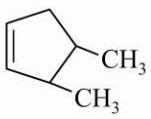
(A)  (A) **(B)**  (B) **(C)** (A) and (B) **(D)** 

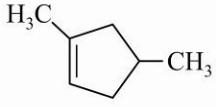
39. A single compound of the structure,

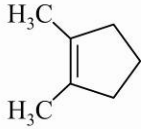


is obtainable from ozonolysis of which of the following cyclic compounds ?

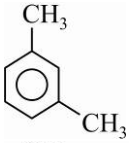
 **(A)**

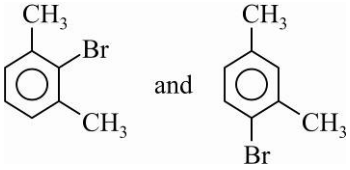
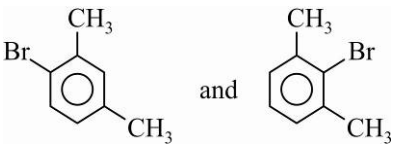
 **(B)**

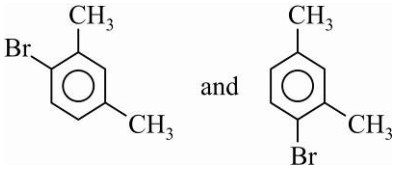
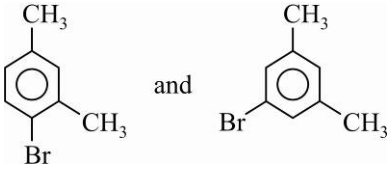
 **(C)**

 **(D)**

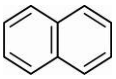
40. What products are formed when the following compound is treated with Br_2 in the presence of $FeBr_3$?



(A)  **(B)** 

(C)  **(D)** 

41. Which of the following chemical system is non-aromatic ?

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

42. In the following reaction : $HC \equiv CH \xrightarrow[Hg^{2+}]{H_2SO_4} P$

Product P will not give :

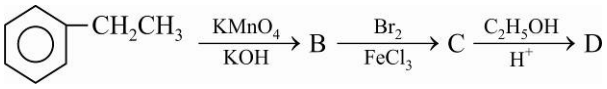
(A) Tollen's reagent test **(B)** Brady's reagent test

(C) Victor Meyer test **(D)** Iodoform test

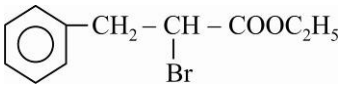
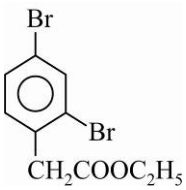
43. Which of the following acids does not exhibit optical isomerism ?

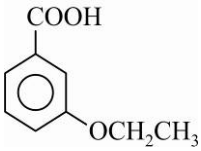
(A) Maleic acid **(B)** α -amino acids **(C)** Lactic acid **(D)** Tartaric acid

44. In a set of reactions, ethylbenzene yielded a product D.

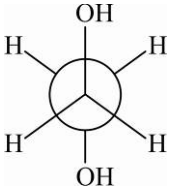
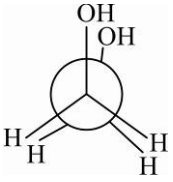
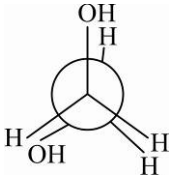
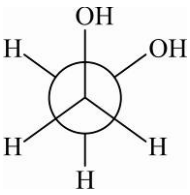


D would be :

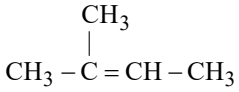
(A)  **(B)** 

(C)  **(D)** 

45. Which of the following conformers for ethylene glycol is most stable ?

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

46. The compound :

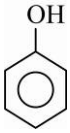


on reaction with $NaIO_4$ in the presence of $KMnO_4$ gives :

(A) CH_3COCH_3 **(B)** $CH_3COCH_3 + CH_3COOH$

(C) $CH_3COCH_3 + CH_3CHO$ **(D)** $CH_3CHO + CO_2$

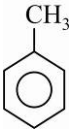
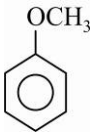
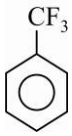
47. The correct acidic order of the following is :

I.  **II.**  **III.** 

The correct choice is :

(A) I > II > III **(B)** III > I > II **(C)** II > III > I **(D)** I > III > II

48. Increasing order of electrophilic substitution for following compounds :

I.  **II.**  **III.**  **IV.** 

The correct choice is :

(A) IV < I < II < III **(B)** III < II < I < IV **(C)** I < IV < III < II **(D)** II < III < I < IV

49. In the commercial gasolines, the type of hydrocarbons which are more desirable is :

(A) linear unsaturated hydrocarbon **(B)** toluene

(C) branched hydrocarbon **(D)** straight-chain hydrocarbon

50. The oxidation of toluene with CrO_3 in the presence of $(CH_3CO)_2O$ gives a product A, which on treatment with aqueous NaOH produces :

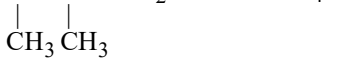
(A) C_6H_5COONa **(B)** 2, 4-diacetyl toluene

(C) C_6H_5CHO **(D)** $C_6H_5CH_2OH$

Integer Answer Type Questions

The Answer to the following questions are positive integers of 1/2/3 digits and zero

51. The number of unhybridized orbitals present in vinyl acetylene is _____.

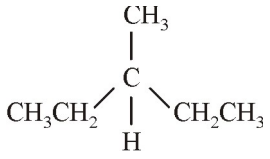
52. Number of CO_2 molecule formed on oxidation of  with $KMnO_4$ are _____.

53. 

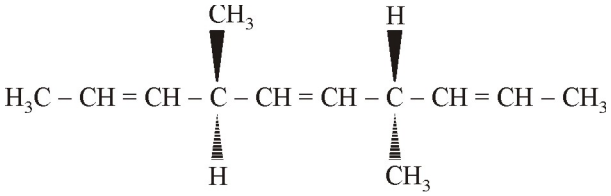
54. How many chiral compounds are possible on monochlorination of 2-methylbutane?

55. The number of stereoisomers obtained by bromination of trans-2-butene is

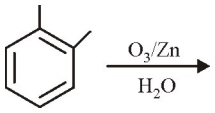
56. The maximum number of isomers (including stereoisomers) that are possible on monochlorination of the following compound is _____.



57. The number of optically active products obtained from the reductive ozonolysis of the complete compound is _____.

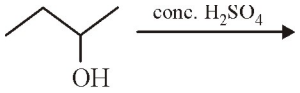


58. The number of possible trans only alkenes formed by reduction of alkyne (C_6H_{10}) with Li/Liq. NH_3 are _____.

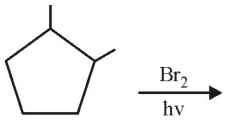
59. 

Total number of possible different products that can be obtained are _____.

60. An alkyne (A) having molecular mass $x \times 10$ is treated with Lindlar's catalyst and H_2 to give a compound (B). (B) reacts with HCl to give a compound (C). When (C) reacts with metallic sodium in presence of ether it gives (D). The molecular mass of (D) is 86. What is the value of x?

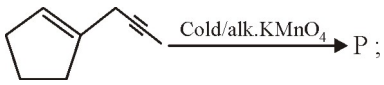
61. 

The total number of possible products is _____.

62. 

Total products upon monohalogenation are:

63. The number of π-bonds in the product formed by passing acetylene through dilute sulphuric acid containing mercuric sulphate is _____.

64. 

Number of sp^2 hybridized carbon in product P are _____.

65. $C_nH_{2n+2} \xrightarrow{Cl_2/nv} P\,(C_nH_{2n+1}Cl)$;

Minimum number of carbon required to make a chiral compound (P : having 1 chiral carbon) are _____.

Environmental Chemistry

CHOOSE THE CORRECT ALTERNATIVE. ONLY ONE CHOICE IS CORRECT. HOWEVER, QUESTIONS MARKED '*' MAY HAVE MORE THAN ONE CORRECT OPTION.

1. Which one of the following is not a common component of Photochemical smog ?

(A) Ozone **(B)** Acrolein

(C) Peroxyacetal nitrate **(D)** Chlorofluorocarbons

2. Which one of the following statements is not true ?

(A) Clean water would have a BOD value of 5 ppm

(B) Fluoride deficiency in drinking water is harmful. Soluble fluoride is often used to bring its concentration upto 1 ppm

(C) When the pH of rain water is higher than 6.5, it is called acid rain

(D) Dissolved Oxygen (DO) in cold water can reach a concentration upto 10 ppm

3. Which one of the following statement is not true ?

(A) pH of drinking water should be between 5.5 – 9.5

(B) Concentration of DO below 6 ppm is good for the growth of fish

(C) Clean water would have BOD value of less than 5 ppm.

(D) Oxides of sulphur, nitrogen and carbon, are the most widespread air pollutant

4. Green chemistry means such reactions which :

(A) are related to the depletion of ozone layer

(B) study the reactions in plants

(C) produce colour during reactions

(D) reduce the use and production of hazardous chemicals

5. Which of the following gases is not a green house gas?

(A) CO **(B)** O_3 **(C)** CH_4 **(D)** H_2O vapour

6. Photochemical smog occurs in warm, dry and sunny climate. One of the following is not amongst the components of photochemical smog, identify it.

(A) NO_2 **(B)** O_3 **(C)** SO_2 **(D)** Unsaturated hydrocarbon

7. Which of the following statements is not true about classical smog?

(A) Its main components are produced by the action of sunlight on emissions of automobiles and factories

(B) Produced in cold and humid climate

(C) It contains compounds of reducing nature

(D) It contains smoke, fog and sulphur dioxide

8. Biochemical Oxygen Demand, (BOD) is a measure of organic material present in water. BOD value less than 5 ppm indicates a water sample to be _____.

(A) rich in dissolved oxygen. **(B)** poor in dissolved oxygen.

(C) highly polluted. **(D)** not suitable for aquatic life.

9. Which of the following statements is wrong?

(A) Ozone is not responsible for green house effect.

(B) Ozone can oxidise sulphur dioxide present in the atmosphere to sulphur trioxide.

(C) Ozone hole is thinning of ozone layer present in stratosphere.

(D) Ozone is produced in upper stratosphere by the action of UV rays on oxygen.

10. Sewage containing organic waste should not be disposed in water bodies because it causes major water pollution. Fishes in such a polluted water die because of

(A) Large number of mosquitoes.

(B) Increase in the amount of dissolved oxygen.

(C) Decrease in the amount of dissolved oxygen in water.

(D) Clogging of gills by mud.

11. Which of the following statements about photochemical smog is wrong?

(A) It has high concentration of oxidising agents.

(B) It has low concentration of oxidising agent.

(C) It can be controlled by controlling the release of NO_2, hydrocarbons, ozone etc.

(D) Plantation of some plants like pinus helps in controlling photochemical smog.

12. The gaseous envelope around the earth is known as atmosphere. The lowest layer of this is extended upto 10 km from sea level, this layer is _____.

(A) Stratosphere **(B)** Troposphere **(C)** Mesosphere **(D)** Hydrosphere

13. Dinitrogen and dioxygen are main constituents of air but these do not react with each other to form oxides of nitrogen because _____.

(A) the reaction is endothermic and requires very high temperature

(B) the reaction can be initiated only in presence of a catalyst

(C) oxides of nitrogen are unstable

(D) N_2 and O_2 are unreactive

14. The pollutants which come directly in the air from sources are called primary pollutants. Primary pollutants are sometimes converted into secondary pollutants. Which of the following belongs to secondary air pollutants?

(A) CO **(B)** Hydrocarbon **(C)** Peroxyacetyl nitrate **(D)** NO

15. Which of the following statements is correct?

(A) Ozone hole is a hole formed in stratosphere from which ozone oozes out.

(B) Ozone hole is a hole formed in the troposphere from which ozone oozes out.

(C) Ozone hole is thinning of ozone layer of stratosphere at some places.

(D) Ozone hole means vanishing of ozone layer around the earth completely.

16. Which of the following practices will not come under green chemistry?

(A) If possible, making use of soap made of vegetable oils instead of using synthetic detergents.

(B) Using H_2O_2 for bleaching purpose instead of using chlorine based bleaching agents.

(C) Using bicycle for travelling small distances instead of using petrol/diesel based vehicles.

(D) Using plastic cans for neatly storing substances.

***17.** Which of the following conditions shows the polluted environment.

(A) pH of rain water is 5.6

(B) amount of carbondioxide in the atmosphere is 0.03%

(C) biochemical oxygen demand 10 ppm

(D) eutrophication

***18.** Phosphate containing fertilisers cause water pollution. Addition of such compounds in water bodies causes _____.

(A) enhanced growth of algae **(B)** decrease in amount of dissolved oxygen in water

(C) deposition of calcium phosphate **(D)** increase in fish population

***19.** The acids present in acid rain are _____.

(A) Peroxyacetylnitrate **(B)** H_2CO_3

(C) HNO_3 **(D)** H_2SO_4

***20.** The consequences of global warming may be _____.

(A) increase in average temperature of the earth **(B)** melting of Himalayan Glaciers

(C) increased biochemical oxygen demand **(D)** eutrophication

Integer Answer Type Questions
The Answer to the following questions are positive integers of 1/2/3 digits and zero

21. Water is considered as pure if it has BOD less than _____ppm.

22. In haemoglobin, CO and not O_2 links to Fe (if both CO and O_2 are present) because CO is a stronger ligand than O_2. The number of groups to which Fe is co-ordinated other than vacant site for CO in haemoglobin is

23. CO is a pollutant produced due to incomplete combustion of butane. One mole of butane requires 6.5 moles of O_2 for complete combustion. If 6 moles of oxygen are available, the no. of moles of CO produced will be

24. $K_2Cr_2O_7$ used as oxidant casues pollution. What is oxidation number of the species formed by reduction?

25. SO_2 (air pollutant) is responsible for acid rain. 1000L of this polluted air at STP (containing SO_2) was passed into H_2O and resulting solution required 7.143×10^{-5} mol of $KMnO_4$ in acidic medium for complete reaction. What is concentration of SO_2 in ppm in air?

26. An approach to control industrial pollution is to recover waste products in usable form. Waste H_2S and SO_2 are recovered as elemental Sulphur liquid. How much Sulphur can be recovered if industrial waste contains 1.867 L SO_2 at STP in a given sample?

27. How many lone pairs are there in ozone.

28. Ozone layer is benig depleted by CFC. How many atoms are there in smallest of unit of CFC?

29. How many of the following gases cause global warming?
$CO_2, N_2O, CH_4, O_3, N_2, CFC, O_2, H_2$

30. Iodine pentaoxide is a very important reagent because it can oxidise CO which is a major pollutant of the atmosphere to carbon dioxide in absence of water. How many moles of carbon monoxide air oxidized per mole of I_2O_5 ?

31. How many of them are effects of photochemical smog?

(i) serious health problem
(ii) Headache, chest pain
(iii) Cough, difficulty in breathing
(iv) Irritation in the eyes
(v) Cracking of rubber
(vi) Extensive damage to plant life
(vii) Corrision of metals, stones, building materials

32. What is maximum prescribed concentration of metal in drinking water of Fe and Zn. (ppm) Multipy both the value and repost the answer.

33. F^- ions make the enamel on teeth much harder by converting "A" into "B"?
Calculate the difference in molecular weight of 'A' and 'B'. $|A-B|$

34. How many paramagnetic specie are present in the reaction of CFC's with normal atmospheric gases in stratosphere, by UV raidations.

35. Dinitorgen and dioxygen gases do not react with each other at normal temperature. But in automobile engine, they combine when fossil fuel is burnt to form two oxides. Report sum of oxidation stataes of nitrogen in both oxides.