1. In a face centered cubic lattice atoms A are at the corner points and atoms B at the face centered points. If atom B is missing from one of the face centered points, the formula of the ionic compound is :

(1) AB_2

(2) A_5B_2

(3) A_2B_3

(4) A_2B_5

2. Van der Waal's equation for a gas is stated as,

$$p = \frac{nRT}{V - nb} - a\left(\frac{n}{V}\right)^2.$$

This equation reduces to the perfect gas equation, $p = \frac{nRT}{V}$ when ,

(1) temperature is sufficiently high and pressure is low.

(2) temperature is sufficiently low and pressure is high.

(3) both temperature and pressure are very high.

(4) both temperature and pressure are very low.

3. At a certain temperature, only 50% HI is dissociated into H_2 and I_2 at equilibrium. The equilibrium constant is :

(1) 1.0

(2) 3.0

(3) 0.5

(4) 0.25

4. Dissolving 120 g of a compound of (mol. wt. 60) in 1000 g of water gave a solution of density 1.12 g/mL. The molarity of the solution is :

(1) 1.00 M

(2) 2.00 M

(3) 2.50 M

(4) 4.00 M

5. The half-life period of a first order reaction is 15 minutes. The amount of substance left after one hour will be :

(1) $\frac{1}{4}$ of the original amount

(2) $\frac{1}{8}$ of the original amount

(3) $\frac{1}{16}$ of the original amount

(4) $\frac{1}{32}$ of the original amount

Space for rough work

6. The energy of an electron in first Bohr orbit of H - atom is -13.6 eV. The energy value of electron in the excited state of Li^{2+} is :

(1) -27.2 eV

(2) 30.6 eV

(3) -30.6 eV

(4) 27.2 eV

7. The temperature at which oxygen molecules have the same root mean square speed as helium atoms have at 300 K is : (Atomic masses : He = 4 u, O = 16 u)

(1) 300 K

(2) 600 K

(3) 1200 K

(4) 2400 K

8. The standard enthalpy of formation of NH_3 is -46.0 kJ/mol. If the enthalpy of formation of H_2 from its atoms is -436 kJ/mol and that of N_2 is -712 kJ/mol, the average bond enthalpy of N – H bond in NH_3 is :

(1) -1102 kJ/mol

(2) -964 kJ/mol

(3) $+352$ kJ/mol

(4) $+1056$ kJ/mol

9. The amount of oxygen in 3.6 moles of water is :

(1) 115.2 g

(2) 57.6 g

(3) 28.8 g

(4) 18.4 g

10. Which of the following has unpaired electron(s) ?

(1) N_2

(2) O_2^-

(3) N_2^{2+}

(4) O_2^{2-}

Space for rough work

11. The number and type of bonds in C_2^{2-} ion in CaC_2 are :

(1) One σ bond and one π – bond

(2) One σ bond and two π – bonds

(3) Two σ bonds and two π – bonds

(4) Two σ bonds and one π – bond

12. In the hydroboration - oxidation reaction of propene with diborane, H_2O_2 and NaOH, the organic compound formed is :

(1) CH_3CH_2OH

(2) $CH_3CHOHCH_3$

(3) $CH_3CH_2CH_2OH$

(4) $(CH_3)_3COH$

13. For the compounds

CH_3Cl, CH_3Br, CH_3I and CH_3F,

the correct order of increasing C-halogen bond length is :

(1) $CH_3F < CH_3Cl < CH_3Br < CH_3I$

(2) $CH_3F < CH_3Br < CH_3Cl < CH_3I$

(3) $CH_3F < CH_3I < CH_3Br < CH_3Cl$

(4) $CH_3Cl < CH_3Br < CH_3F < CH_3I$

14. The correct set of four quantum numbers for the valence electrons of rubidium atom (Z = 37) is :

(1) $5, 0, 0, +\frac{1}{2}$

(2) $5, 1, 0, +\frac{1}{2}$

(3) $5, 1, 1, +\frac{1}{2}$

(4) $5, 0, 1, +\frac{1}{2}$

15. CsCl crystallises in body centred cubic lattice. If 'a' is its edge length then which of the following expressions is correct ?

(1) $r_{Cs^+} + r_{Cl^-} = 3a$

(2) $r_{Cs^+} + r_{Cl^-} = \frac{3a}{2}$

(3) $r_{Cs^+} + r_{Cl^-} = \frac{\sqrt{3}}{2}a$

(4) $r_{Cs^+} + r_{Cl^-} = \sqrt{3}a$

Space for rough work

16. For complete combustion of ethanol, $C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$, the amount of heat produced as measured in bomb calorimeter, is 1364.47 kJ mol^{-1} at 25°C. Assuming ideality the Enthalpy of combustion, Δ_cH, for the reaction will be :
($R = 8.314$ kJ mol^{-1})

(1) -1366.95 kJ mol^{-1}
(2) -1361.95 kJ mol^{-1}
(3) -1460.50 kJ mol^{-1}
(4) -1350.50 kJ mol^{-1}

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 meaning then the value of x is : (assuming ideality)

(1) -1
(2) $-\frac{1}{2}$
(3) $\frac{1}{2}$
(4) 1

18. Among the following oxoacids, the correct decreasing order of acid strength is :

(1) $HOCl > HClO_2 > HClO_3 > HClO_4$
(2) $HClO_4 > HOCl > HClO_2 > HClO_3$
(3) $HClO_4 > HClO_3 > HClO_2 > HOCl$
(4) $HClO_2 > HClO_4 > HClO_3 > HOCl$

19.). For the non - stoichiometre reaction $2A + B \rightarrow C + D$, the following kinetic data were obtained in three separate experiments, all at 298 K.

Initial Concentration (A)	Initial Concentration (B)	Initial rate of formation of C (mol $L^{-}S^{-}$)
0.1 M	0.1 M	1.2×10^{-3}
0.1 M	0.2 M	1.2×10^{-3}
0.2 M	0.1 M	2.4×10^{-3}

The rate law for the formation of C is :

(1) $\frac{dc}{dt} = k[A]\,[B]$
(2) $\frac{dc}{dt} = k[A]^2\,[B]$
(3) $\frac{dc}{dt} = k[A]\,[B]^2$
(4) $\frac{dc}{dt} = k[A]$

20. The ratio of masses of oxygen and nitrogen in a particular gaseous mixture is 1 : 4. The ratio of number of their molecule is :

(1) 1 : 4
(2) 7 : 32
(3) 1 : 8
(4) 3 : 16

Space for rough work

21. At 300 K and 1 atm, 15 mL of a gaseous hydrocarbon requires 375 mL air containing 20% O_2 by volume for complete combustion. After combustion the gases occupy 330 mL. Assuming that the water formed is in liquid form and the volumes were measured at the same temperature and pressure, the formula of the hydrocarbon is :

(1) C_3H_6

(2) C_3H_8

(3) C_4H_8

(4) C_4H_{10}

22. The species in which the N atom is in a state of *sp* hybridization is :

(1) NO_2^+

(2) NO_2^-

(3) NO_3^-

(4) NO_2

23. The heats of combustion of carbon and carbon monoxide are -393.5 and -283.5 kJ mol^{-1}, respectively. The heat of formation (in kJ) of carbon monoxide per mole is :

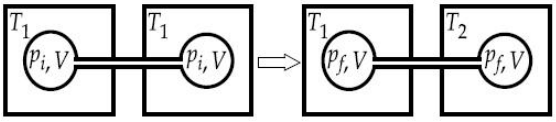
(1) 110.5

(2) 676.5

(3) -676.5

(4) -110.5

24. Two closed bulbs of equal volume (V) containing an ideal gas initially at pressure p_i and temperature T_1 are connected through a narrow tube of negligible volume as shown in the figure below. The temperature of one of the bulbs is then raised to T_2. The final pressure p_f is :



(1) $p_i\left(\frac{T_1T_2}{T_1+T_2}\right)$

(2) $2p_i\left(\frac{T_1}{T_1+T_2}\right)$

(3) $2p_i\left(\frac{T_2}{T_1+T_2}\right)$

(4) $2p_i\left(\frac{T_1T_2}{T_1+T_2}\right)$

25. In the reaction,

$$CH_3COOH \xrightarrow{LiAlH_4} A \xrightarrow{PCl_5} B \xrightarrow{\text{Alc. KOH}} C,$$

the product C is :

(1) Acetylene

(2) Ethylene

(3) Acetyl chloride

(4) Acetaldehyde

Space for rough work

26. The equilibrium constant at 298 K for a reaction $A + B \rightleftharpoons C + D$ is 100. If the initial concentration of all the four species were 1 M each, then equilibrium concentration of D (in mol L^{-1}) will be :

(1) 0.182

(2) 0.818

(3) 1.818

(4) 1.182

27. Decomposition of H_2O_2 follows a first order reaction. In fifty minutes the concentration of H_2O_2 decreases from 0.5 to 0.125 M in one such decomposition. When the concentration of H_2O_2 reaches 0.05 M, the rate of formation of O_2 will be :

(1) 6.93×10^{-2} mol min^{-1}

(2) 6.93×10^{-4} mol min^{-1}

(3) 2.66 L min^{-1} at STP

(4) 1.34×10^{-2} mol min^{-1}

28. Which of the following atoms has the highest first ionization energy ?

(1) Rb

(2) Na

(3) K

(4) Sc

29. Given

$C_{(graphite)} + O_2(g) \rightarrow CO_2(g)$;
$\Delta_r H^\circ = -393.5$ kJ mol^{-1}

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$;
$\Delta_r H^\circ = -285.8$ kJ mol^{-1}

$CO_2(g) + 2H_2O(l) \rightarrow CH_4(g) + 2O_2(g)$;
$\Delta_r H^\circ = +890.3$ kJ mol^{-1}

Based on the above thermochemical equations, the value of $\Delta_r H^\circ$ at 298 K for the reaction
$C_{(graphite)} + 2H_2(g) \rightarrow CH_4(g)$ will be :

(1) -74.8 kJ mol^{-1}

(2) -144.0 kJ mol^{-1}

(3) $+74.8$ kJ mol^{-1}

(4) $+144.0$ kJ mol^{-1}

30. A metal crystallises in a face centred cubic structure. If the edge length of its unit cell is 'a', the closest approach between two atoms in metallic crystal will be :

(1) $\sqrt{2}$ a

(2) $\frac{a}{\sqrt{2}}$

(3) 2a

(4) $2\sqrt{2}$ a

Space for rough work

31. 1 gram of a carbonate (M_2CO_3) on treatment with excess HCl produces 0.01186 mole of CO_2. The molar mass of M_2CO_3 in g mol^{-1} is :

(1) 118.6

(2) 11.86

(3) 1186

(4) 84.3

32. ΔU is equal to :

(1) Adiabatic work

(2) Isothermal work

(3) Isochoric work

(4) Isobaric work

33. The group having isoelectronic species is :

(1) O^{2-}, F^-, Na, Mg^{2+}

(2) O^-, F^-, Na^+, Mg^{2+}

(3) O^{2-}, F^-, Na^+, Mg^{2+}

(4) O^-, F^-, Na, Mg^+

34. pK_a of a weak acid (HA) and pK_b of a weak base (BOH) are 3.2 and 3.4, respectively. The pH of their salt (AB) solution is :

(1) 7.0

(2) 1.0

(3) 7.2

(4) 6.9

35. Two reactions R_1 and R_2 have identical pre-exponential factors. Activation energy of R_1 exceeds that of R_2 by 10 kJ mol^{-1}. If k_1 and k_2 are rate constants for reactions R_1 and R_2 respectively at 300 K, then $\ln(k_2/k_1)$ is equal to :

($R = 8.314$ J $mol^{-1}K^{-1}$)

(1) 6

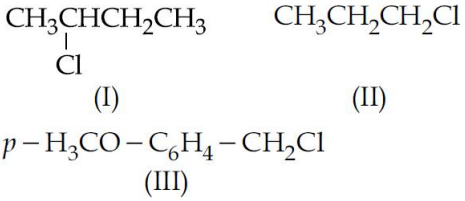
(2) 4

(3) 8

(4) 12

Space for rough work

36. The increasing order of the reactivity of the following halides for the S_N1 reaction is :



(I) (II)

(III)

(1) (I) < (III) < (II)

(2) (II) < (III) < (I)

(3) (III) < (II) < (I)

(4) (II) < (I) < (III)

37. If the shortest wavelength in Lyman series of hydrogen atom is A, then the longest wavelength in Paschen series of He^+ is :

(1) $\frac{5A}{9}$

(2) $\frac{9A}{5}$

(3) $\frac{36A}{5}$

(4) $\frac{36A}{7}$

38. Among the following, the **incorrect** statement is :

(1) At low pressure, real gases show ideal behaviour.

(2) At very low temperature, real gases show ideal behaviour.

(3) At very large volume, real gases show ideal behaviour.

(4) At Boyle's temperature, real gases show ideal behaviour.

39. For a reaction, $A(g) \rightarrow A(l)$; $\Delta H = -3RT$. The **correct** statement for the reaction is :

(1) $\Delta H = \Delta U \neq O$

(2) $\Delta H = \Delta U = O$

(3) $|\Delta H| < |\Delta U|$

(4) $|\Delta H| > |\Delta U|$

40. Excess of NaOH (aq) was added to 100 mL of $FeCl_3$ (aq) resulting into 2.14 g of $Fe(OH)_3$. The molarity of $FeCl_3$ (aq) is :

(Given molar mass of Fe = 56 g mol^{-1} and molar mass of Cl = 35.5 g mol^{-1})

(1) 0.2 M

(2) 0.3 M

(3) 0.6 M

(4) 1.8 M

Space for rough work

41. Addition of sodium hydroxide solution to a weak acid (HA) results in a buffer of pH 6. If ionisation constant of HA is 10^{-5}, the ratio of salt to acid concentration in the buffer solution will be :

(1) 4 : 5

(2) 1 : 10

(3) 10 : 1

(4) 5 : 4

42. The rate of a reaction A doubles on increasing the temperature from 300 to 310 K. By how much, the temperature of reaction B should be increased from 300 K so that rate doubles if activation energy of the reaction B is twice to that of reaction A.

(1) 9.84 K

(2) 4.92 K

(3) 2.45 K

(4) 19.67 K

43. The major product of the following reaction is :

$$CH_3\underset{\underset{Br}{|}}{C}HCH_2\underset{\underset{Br}{|}}{C}HCH_2CH_3 \xrightarrow[heat]{KOH,\ CH_3OH}$$

(1) $CH_2=CHCH_2CH=CHCH_3$

(2) $CH_2=CHCH=CHCH_2CH_3$

(3) $CH_3CH=C=CHCH_2CH_3$

(4) $CH_3CH=CH-CH=CHCH_3$

44. The enthalpy change on freezing of 1 mol of water at 5°C to ice at −5°C is :

(Given $\Delta_{fus}H = 6$ kJ mol^{-1} at 0°C, $C_p(H_2O, l) = 75.3$ J mol^{-1} K^{-1}, $C_p(H_2O, s) = 36.8$ J mol^{-1} K^{-1})

(1) 5.44 kJ mol^{-1}

(2) 5.81 kJ mol^{-1}

(3) 6.56 kJ mol^{-1}

(4) 6.00 kJ mol^{-1}

45. Consider the following ionization enthalpies of two elements 'A' and 'B'.

Element	Ionization enthalpy (kJ/mol)		
	1st	2nd	3rd
A	899	1757	14847
B	737	1450	7731

Which of the following statements is **correct** ?

(1) Both 'A' and 'B' belong to group-1 where 'B' comes below 'A'.

(2) Both 'A' and 'B' belong to group-1 where 'A' comes below 'B'.

(3) Both 'A' and 'B' belong to group-2 where 'B' comes below 'A'.

(4) Both 'A' and 'B' belong to group-2 where 'A' comes below 'B'.

Space for rough work

46. An ideal gas undergoes isothermal expansion at constant pressure. During the process :

(1) enthalpy increases but entropy decreases.

(2) enthalpy remains constant but entropy increases.

(3) enthalpy decreases but entropy increases.

(4) Both enthalpy and entropy remain constant.

47. 50 mL of 0.2 M ammonia solution is treated with 25 mL of 0.2 M HCl. If pK_b of ammonia solution is 4.75, the pH of the mixture will be :

(1) 3.75

(2) 4.75

(3) 8.25

(4) 9.25

48. The electron in the hydrogen atom undergoes transition from higher orbitals to orbital of radius 211.6 pm. This transition is associated with :

(1) Lyman series

(2) Balmer series

(3) Paschen series

(4) Brackett series

49. At 300 K, the density of a certain gaseous molecule at 2 bar is double to that of dinitrogen (N_2) at 4 bar. The molar mass of gaseous molecule is :

(1) 28 g mol^{-1}

(2) 56 g mol^{-1}

(3) 112 g mol^{-1}

(4) 224 g mol^{-1}

50. What quantity (in mL) of a 45% acid solution of a mono-protic strong acid must be mixed with a 20% solution of the same acid to produce 800 mL of a 29.875% acid solution ?

(1) 320

(2) 325

(3) 316

(4) 330

Space for rough work

51. A gas undergoes change from state A to state B. In this process, the heat absorbed and work done by the gas is 5 J and 8 J, respectively. Now gas is brought back to A by another process during which 3 J of heat is evolved. In this reverse process of B to A :

(1) 10 J of the work will be done by the gas.

(2) 6 J of the work will be done by the gas.

(3) 10 J of the work will be done by the surrounding on gas.

(4) 6 J of the work will be done by the surrounding on gas.

52. The electronic configuration with the highest ionization enthalpy is :

(1) [Ne] $3s^2\ 3p^1$

(2) [Ne] $3s^2\ 3p^2$

(3) [Ne] $3s^2\ 3p^3$

(4) [Ar] $3d^{10}\ 4s^2\ 4p^3$

53. If the principal quantum number n = 6, the correct sequence of filling of electrons will be :

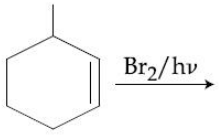
(1) $ns \rightarrow np \rightarrow (n-1)d \rightarrow (n-2)f$

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

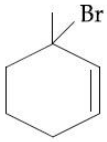
(3) $ns \rightarrow (n-1)d \rightarrow (n-2)f \rightarrow np$

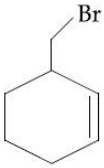
(4) $ns \rightarrow (n-2)f \rightarrow np \rightarrow (n-1)d$

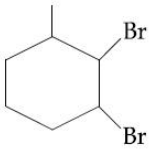
54. The major product of the following reaction is :



(1) 

(2) 

(3) 

(4) 

55. In the long form of the periodic table, the valence shell electronic configuration of $5s^2\ 5p^4$ corresponds to the element present in :

(1) Group 16 and period 6

(2) Group 17 and period 5

(3) Group 16 and period 5

(4) Group 17 and period 6

Space for rough work

56. A sample of a hydrate of barium chloride weighing 61 g was heated until all the water of hydration is removed. The dried sample weighed 52 g. The formula of the hydrated salt is : (atomic mass, Ba = 137 amu, Cl = 35.5 amu)

(1) $BaCl_2 \cdot H_2O$

(2) $BaCl_2 \cdot 2H_2O$

(3) $BaCl_2 \cdot 3H_2O$

(4) $BaCl_2 \cdot 4H_2O$

57. Gaseous N_2O_4 dissociates into gaseous NO_2 according to the reaction

$N_2O_4(g) \rightleftharpoons 2NO_2(g)$

At 300 K and 1 atm pressure, the degree of dissociation of N_2O_4 is 0.2. If one mole of N_2O_4 gas is contained in a vessel, then the density of the equilibrium mixture is :

(1) 1.56 g/L

(2) 3.11 g/L

(3) 4.56 g/L

(4) 6.22 g/L

58. The reaction

$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$

follows first order kinetics. The pressure of a vessel containing only N_2O_5 was found to increase from 50 mm Hg to 87.5 mm Hg in 30 min. The pressure exerted by the gases after 60 min. will be (Assume temperature remains constant) :

(1) 106.25 mm Hg

(2) 116.25 mm Hg

(3) 125 mm Hg

(4) 150 mm Hg

59. The rate of a reaction quadruples when the temperature changes from 300 to 310 K. The activation energy of this reaction is :

(Assume activation energy and pre-exponential factor are independent of temperature; ln 2 = 0.693; R = 8.314 J mol^{-1} K^{-1})

(1) 107.2 kJ mol^{-1}

(2) 53.6 kJ mol^{-1}

(3) 26.8 kJ mol^{-1}

(4) 214.4 kJ mol^{-1}

60. A solution is prepared by mixing 8.5 g of CH_2Cl_2 and 11.95 g of $CHCl_3$. If vapour pressure of CH_2Cl_2 and $CHCl_3$ at 298 K are 415 and 200 mmHg respectively, the mole fraction of $CHCl_3$ in vapour form is : (Molar mass of Cl = 35.5 g mol^{-1})

(1) 0.162

(2) 0.675

(3) 0.325

(4) 0.486

Space for rough work