GEMS OUR OWN INDIAN SCHOOL

Anchored In Excellence

Worksheet Booklet

Name: ______________

Grade: 11

Subject: Chemistry

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Topic: Basic concepts of Chemistry

Answer the following:

1 Calculate the formula mass of calcium chloride.

2 Give the two points of differences between homogeneous and heterogeneous mixtures.

3 Write the empirical formula of the following:
(a) N_2O_4 (b) $C_6H_{12}O_6$ (c) H_2O (d) H_2O_2

4 Define the law of multiple proportions. Explain it with one example.

5 Two vessels of equal capacity contain equal masses of oxygen and ozone respectively at same temperature. Which one will have larger number of molecules?

6 What is the percentage of carbon, hydrogen and oxygen in ethanol?

7 What do mean by molarity? Calculate the molarity of NaOH in the solution prepared by dissolving its 4 g in enough water to form 250 mL of the solution.

8 Classify the following as pure substances or mixture-
(a) Ethyl alcohol (b) Oxygen (c) Blood (d) Carbon (e) Steel (f) Distilled Water

9 Define : (a) Average atomic mass (b) Molecular mass (c) Formula mass

10 A compound contains 4.07 % hydrogen, 24.27 % carbon and 71.65 % chlorine. Its molar mass is 98.96 g. What are its empirical and molecular formulas?

11 Dinitrogen and dihydrogen react with each other to produce ammonia according to the following chemical equation:

$$N_2(g) + H_2(g) \rightarrow 2NH_3(g)$$

(i) Calculate the mass of ammonia produced if 2.00×10^3 g dinitrogen reacts with 1.00×10^3 g of dihydrogen.

(ii) Will any of the two reactants remain unreacted?

12 A welding fuel gas contains carbon and hydrogen only. Burning a small sample of it in oxygen gives 3.38 g carbon dioxide, 0.690 g of water and no other products. Calculate the empirical formula.

13 A compound made up of two elements A and B has A= 70 %, B = 30 %. Their relative number of moles in the compound are 1.25 and 1.88. calculate

a. Atomic masses of the elements A and B.

b. Molecular formula of the compound, if its molecular mass is found to be 160.

14 An organic compound on analysis produced following results C = 41 %, H = 5.75 %, N = 6.08 % and rest is oxygen, find empirical formula?

15 Calculate molarity of 58 % HBr by mass if the density of the solution is 1.26 g/cm^3?

16 A white powder has the following composition by mass Na = 36.5%, S = 25.4%, O = 38. 1% Calculate the simplest formula. (Na = 23, S = 32, O = 16)

17 500 cm^3 of 0.2M Na_2SO_4 solution is added to 250 cm^3 of 0.3 M $AgNO_3$ solution resulting in the formation of white precipitate. How many moles of Ag_2SO_4 will be precipitated? Which is the limiting agent?

18 How many atoms and gram atoms are contained in 20g of Ca? (mass of Ca = 40)

19 Find out the volume of the following at N.T.P.

a) $3.01 X 10^2$ molecules of NH_3 b) 1.4 g of N_2

20 Calculate amount of CO_2 formed when 20g of $CaCO_3$ reacts with 20g of HCl.

21 An acid (molecular mass 104 u) contains 34.6% Carbon, 3.85% H and the rest Oxygen. Calculate the molecular formula of the acid. (C=12, H=1, O=16)

22 Differentiate between molality and molarity?

23 Calculate the number of water molecules in a drop of water weighing 0.05g.

24 300 mL of 0.3 M NaCl solution is added to $100cm^3$ of 0.5M $AgNO_3$ solution. How many moles of AgCl are formed?

Topic: Structure of atom

Answer the following:

1. Fill in the blanks-

   1. Cathode rays are produced when high voltage is applied across a gas under ………..

   2. Neutrons was discovered by------------------------------

   4. Emission spectra are obtained when an electron jumps from …………..energy levels to ………………………………….....levels.

   5. The light radiations with discrete quantities of energies are called -------------

2. Calculate the number of photons of light with wavelength of 400 nm that can produce 2J of energy. (Ans:4.02 X 10^{18} photons)

3. The minimum energy required for the photo emission of electron from the surface of a metal is $4.95X10^{-19}$ J. Find the kinetic energy of most energetic photoelectrons when the metal is irradiated with radiation of wavelength of 3000 A˚ (Ans:$1.67X10^{-19}$J)

4. What observations led Rutherford to conclude that:

   i) Most of the space inside the atom is hollow.

   ii) The central part of the atom is positively charged.

   iii) Volume occupied by the nucleus is very small as compared to the volume occupied by the atom.

   iv) Almost the entire mass of the atom is concentrated inside the nucleus.

5. Calculate the wavelength of the radiation emitted when an electron in a hydrogen atom makes a transition from fourth to second energy level. (Ans: 486.3nm)

6. If the velocity of the electron in Bohr's first orbit is 2. 19 X 10^6 m/s. Calculate the de-Broglie wavelength associated with it. (Ans: 332pm)

7. Calculate the uncertainty in position of a dust particle with mass equal to 1mg, if uncertainty in its velocity is 5.5 X 10^{-20} m/s. (Ans: 9.6X10^{-10} m)

8. Calculate the product of uncertainty in position and velocity for an electron of mass 9.1 X 10^{-31} Kg (Ans: 5.8X10^{-5} m^2S^{-1})

9. What is the maximum number of electrons that can be accommodated

   In the shell with n=3

   In the subshell with l =3

   In an orbital with m=+3

10. Which of the following orbitals are not possible: 2d, 4f, 4g, and 6g.

11. Which of the following are iso electronic species Na^+, Mg^{2+}, K^+, Ca^{2+}, S^{2-}, Ar

12. Write the electronic configuration of Fe^{2+} and Fe^{3+} ions. Which of these have more number of unpaired electrons. Which is more stable? (Z of Iron is 26)

13. An element has 8 electrons in 4d subshell. Show the distribution of 8 electrons in d-orbital of the element in rectangular boxes.

14. How many electrons in an atom of Neon (Z=10) has clockwise spin?

15. Why 3d subshell has higher energy than 4s subshell in a multi electron atom.

16. What is the lowest value of "n" that allows "g" orbitals to exist.

17. Give the number of electrons in the species in H_2^+, H_2 and O_2^+

18. Determine the quantum number of 19th electron of Cr (Z= 24), 21st electron of Sc and 7th electron of Nitrogen.

19. How many electrons in atom have the following Quantum numbers. n = 3, l = 0

20. Distinguish between an Emission spectrum and an Absorption spectrum.

21. (a) Give no. of electrons in the species H_2^+ and O_2^-.

(b) Using s,p,d notation describe the following orbitals:

(i) n = 3, l = 1, m = 0? (ii) n = 1, l =0

22. Calculate the total number of electrons present in one mole of methane.

23. How much energy is required to ionize H atom if the electron occupies n = 5 orbit? Compare your answer with the ionization enthalpy of Hydrogen (energy required to remove the electron from n = 1 orbit)

24. What is the difference between orbit and orbital.

25. Chlorophyll present in green leaves of plants absorbs light at 4.620×10^{14} Hz. Calculate the wavelength of radiation in nanometer. Which part of the electromagnetic spectrum does it belong to?

26. The mass of an electron is 9.1×10^{-31} kg. If its K.E. is 3.0×10^{-25} J, calculate its wavelength. (Ans: 8965 A˚)

27. In photo electric experiment, irradiation of a metal with light of frequency $5 \times 10^{20}\ S^{-1}$ yields electrons with a maximum kinetic energy 6.63×10^{-14} J. Calculate the threshold frequency of the metal. (Ans: $4 \times 10^{20}\ S^{-1}$)

28. Derive de- Broglie relationship by using Einstein relation $E = mc^2$ and Planck's relationship E = hv.

Topic: Classification of elements and periodicity in properties

Answer the following:

1. What is the general outer electronic configuration of f – block elements?
2. Why do Na and K have similar properties?
3. Arrange the following elements in the increasing order of metallic character :

   Si, Be, Mg, Na, P.
4. Why are elements at the extreme left and extreme right the most reactive?
5. Why does electronegativity value increases across a period and decreases down period?
6. Why does the ionization enthalpy gradually decrease in a group?
7. The atomic radius of elements decreases along the period but Neon has highest size among III period element? Why
8. Which of the following require highest ionization enthalpy?

   m (g) --- m^+ (g) $m^+{}_{(g)}$ --- m^{2+} (g)
9. A and B belong to the same group of the periodic table. A has higher atomic size. Which one will have larger atomic mass?
10. Explain the following:

    (a) cation is smaller than the parent atom

    (b) anion is bigger than the parent atom
11. Nitrogen has more IE than oxygen even though oxygen has smaller size than nitrogen. Explain the observation.
12. Using electronic configuration explain why halogens are highly reactive.

13. A B C D and E have following electronic configurations

    A - $1s^2\ 2s^2\ 2p^1$

    B - $1s^2\ 2s^2\ 2P^6\ 3s^2\ 3P^1$

    C - $1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^3$

    D - $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3P^5$

    E - $1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^6\ 4S^2$

    (a)Which elements belong to the same group?

    (b) Which elements belong to the same period?

    (c) Which element is a metal?

14. Explain the terms:

    a) screening effect   b) Metallic character

15. How would you explain the fact that the first ionization enthalpy of sodium is lower than that of magnesium but its second ionization enthalpy is more than that of Magnesium?

16. Give reason for the following:

    (a)Electron gain enthalpy of noble gas is almost zero.

    (b) Na and Mg^+ have same number of electrons but removal of electron from Mg^+ requires more energy.

17. Would you expect the first ionization enthalpies for two isotopes of the same element to be same or different? Justify your answer.

18. Consider the following species:

    N^{3-}, O^{2-}, F^-, Na^+, Mg^{2+} and Al^{3+}

    (a) What is common in them?

    (b)Arrange them in the order of increasing ionic radii?

19. Explain why alkali metals have low ionization energy? Which element will have lowest $I.E_1$ in this group?

20. Which has the largest ionic radii Na^+, Mg^{2+} or Al^{3+}? Why?

21 Which has the smallest ionic radii F^-, Cl^-, S^{2-} ?

22. Out of F & Cl which one has higher negative electronic gain enthalpy? Why?

23. Out of Na & Mg which one has the higher second ionization energy? Why?

24. Explain why Be has higher ionization enthalpy than B?

25. Among the elements of third period, Na to Ar, pick out the element,

    a) With highest first ionization enthalpy.

    b) With largest atomic radius.

    c) That is most reactive non metal

    d) That is most reactive metal.

26. Consider elements N,P,O,S. Arrange them in the order of

    (a) increasing first ionization energy

    b) increasing negative electron gain enthalpy

    e) increasing non metallic character.

27. An atom of an element contains 29 electrons and 35 neutrons. Deduce:

    (a) number of protons

    (b) electronic configuration

    (c) number of paired electrons

    (d) number of unpaired electrons

Topic: Chemical bonding and molecular structure

Answer the following:

1. Draw electron dot structures for the following :

   (a)Carbonate (b)ethylene (c) Carbon dioxide

2. What is responsible for the mono atomic state of noble gases?
3. Define Hydrogen bond. Which is more liquefiable NH_3 of PH_3? Why?
4. Why are bonding molecular orbitals more stable than antibonding molecular orbitals?
5. He_2 does not exist. Explain in terms of Molecular orbital theory.
6. NH_3 has higher boiling point than PH_3. Give reason.
7. In H_2O, H_2S, H_2Se, H_2Te, the bond angle decreases though all have the same bent shape. Why?
8. Draw Molecular orbital Diagram for O_2 and compare it with O_2^-.
9. Using VSEPR theory predict the shapes of H_2S, $BeCl_2$, PH_3, SiF_4, PF_5, BCl_3, SF_4, XeF_4.
10. Give reason for the following-

    i) CO_2 is linear whereas SO_2 is bent shaped.

    ii)$BeCl_2$ is linear whereas $SnCl_2$ angular molecule.

    iii) Axial bonds are longer than equatorial bonds in PCl_5.

11. Which one of the following has the highest bond order? N_2, N_2^+ or N_2^-. Explain with the help of MOT.
12. What is the total number of sigma and pi bonds in the following molecules?

(a)C_2H_2 (b)C_2H_4 (c) $CH_3-CH_2-CH_2-CH=CH_2$

13. BF_3 is non polar where as NF_3 is polar. Why?
14. Which will be more polar NH_3 of NF_3? Give reason.
15. The oxygen carbon bonds in CO_3^{2-} ion have same bond length. Why?
16. Explain formation of $CH_2 = CH_2$ and C_2H_2 molecule using concept of hybridization.
17. H_2O has higher boiling point than H_2S. Why?
18. Distinguish between sigma & pi bonds.
19. Why CCl_4 does not give white precipitate with silver nitrate?
20. Which of the following has maximum angle? Why?

    H_2O, CO_2, NH_3, CH_4
21. What is the shape of NH_4^+?
22. Both HF and H_2O are associated through hydrogen bonding yet boiling point of HF is lower than that of H_2O. Why?
23. Although geometries of NH_3 and H_2O molecules are distorted tetrahedral bond angles in water is less than that of NH_3? Discuss?
24. Explain why BeH_2 molecule has zero dipole moment although Be-H bonds are polar?
25. Which out of CH_3F and CH_3Cl has higher dipole moment and why?
26. Which hybrid orbitals are used by carbon atoms in the following:

    (a)CH_3-CH_3 (b)$CH_3-CH=CH_2$ (c)CH_3-CH_2-OH (d) CH_3CHO
27. Out of N_2 and O_2 molecules, which has greater bond dissociation enthalpy and why?
28. The two O-O bond distances in ozone molecule are equal. Justify.
29. H_2^+ and H_2^- ions have same bond order but H_2^+ ions are more stable than H_2^-. Give reason.
30. What is meant by H–bonds? Explain by giving example.
31. Draw Lewis structures of : NH_3, BF_3 H_2SO_4, PH_3, F_2, CO_2, H_2S, $SiCl_4$

32. Account for the fact that carbon- carbon bond length in ethene is 134 pm where as in ethane it is 154 pm. And in Benzene it is 139 pm.
33. Calculate number of sigma and pi bonds in the compound $CH_3 – CH_2 - CH_2 - CH = CH_2$
34. What is responsible for the mono atomic state of noble gases?

Topic: States of matter

Answer the following:

1. Why Helium is used in balloons in place of hydrogen?
2. At what temperature the volume of a gas is supposed to be zero?
3. What is the molar volume at 0˚C and 1 bar pressure?
4. What is the effect of increase of temperature on surface tension and viscosity in a liquid?
5. Why vegetables are cooked with difficulty at hill station?
6. At a particular temperature, why vapour pressure of acetone is less than of ether?
7. Why liquids diffuse slowly as compared to gases?
8. Calculate temperature of 4.0 moles of gas occupying 5 dm^3 volume at 3.32 bar. (R= 0.083 bar $dm^3\ k^{-1}\ mol^{-1}$)
9. 34.05 ml of phosphorus vapours weight 0.0625g at 543˚C and 1 bar pressure what is molar mass of phosphorous?
10. A mixture of dihydrogen and dinitrogen at 1 bar pressure contains 20% by weight of H_2. Calculate partial pressure of H_2.
11. What will be minimum pressure required for compressing 500 dm^3 of air at 1 bar to 200 dm^3 at 30˚ C?
12. What is units of ‘a’ and ‘b’ which are Vander Waal’s constant?
13. Why does sharp edge becomes smooth on heating up to melting point?

14. Critical temperature of ammonia and carbon dioxide are 405.5K and 304.10K respectively. Which of these gases will liquefy first when you start cooling from 500K to their critical temperature?
15. Why are aerated water bottles kept under water during summer?
16. Liquid ammonia bottle is cooled before opening the seal. Why?
17. The tyre of automobile is inflated to lesser pressure in summer than in winter. Why?
18. Why is glycerol more viscous than water?
19. Why do real gases deviate from the ideal behavior? What are the conditions under which real gases show ideal behavior?
20. A sample of Helium has a volume of 500 cm^3 at 373K. Calculate the temperature at which the volume become 260 cm^3 keeping pressure constant.
21. What will be the pressure of gaseous mixture when 0.5 L of H_2 at 0.8 bar and 2.0 L of oxygen at 0.7 bar are introduced in a 1L vessel at 27^0C?
22. A sample of N_2 gas has volume of 1.00 L at a pressure of 0.50 atm at 40^0C. Calculate the pressure if the gas is compressed to 0.225 cm^3 at -6^0C.
23. In terms of Charle's law, explain why -273 ^0C is the lowest temperature.
24. Density of a gas is found to be 5.46 g/dm^3 at 27^0C at 2 bar pressure. What will be its density at STP?
25. What do you mean by ideal gas and real gas? Why do real gases deviate from ideal behaviors?
26. Explain the physical significance of Van der Wall's parameters.
27. Using van der Walls gas equation, calculate the pressure exerted by 8.5 g of NH_3 contained in 0.5 L vessel at 300K. For ammonia, a = 4.0 atm L^2mol^{-2}, b=0.036 L mol^{-1}

28. Which property of liquid is responsible for the spherical shape of liquid drops?

29. Define Coefficient of Viscosity. What are the units of Coefficient of viscosity?

30. Calculate the total no. of electrons present in 1.4 g of Nitrogen gas.

Topic: Thermodynamics

Answer the following:

1. Predict the sign of ΔS for the following reactions.
   $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$
2. What is Gibb's Helmholtz equation?
3. In a process, 701 J heat is absorbed and 394 J work is done by system. What is change in Internal energy for process?
4. Given:
   $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$, $\Delta_r H^0 = -92.4$ KJ mol^{-1}.
   What is the standard enthalpy of formation of $NH_3(g)$.
5. Predict the entropy change in-
   (i) A liquid crystallizes into solid
   (ii) Temperature of a crystallize solid raised from OK to 115K
6. Under what condition, the heat evolved/absorbed in a reaction is equal to its free energy change?
7. Calculate the enthalpy of formation of acetic acid if its enthalpy of combustion of ethanoic acid is –867 kJ mol^{-1}. The enthalpy of formation of carbon dioxide and water are –393.5 kJ mol^{-1} and -285.9 $kJmol^{-1}$ respectively.

8. Calculate the maximum work done when 0.75 mol of an ideal gas expands isothermally and reversibly at 27^0C from a volume of 15 L to 25L.

9. Calculate the enthalpy of formation of ethyl alcohol from the following data(App)

(1) $C_2H_5OH_{(l)} + 3O_{2(g)}$-------→ $2CO_{2(g)} + 3H_2O_{(l)}$ Δ_rH° = -1368 kJ

(2) $C_{(s)} + O_{2(g)}$--------------------→ $CO_{2(g)}$ Δ_fH° = -393.5kJ

(3) $H_{2(g)}$ + ½ O_2---------------→ $H_2O_{(l)}$ Δ_fH° = - 286.0kJ

5. When is the entropy of a perfectly crystalline solid zero?

6. What happens to the internal energy of the system if :

(a) Work is done on the system?

(b) Work is done by the system?

7. In a process, 701 J of heat is absorbed by a system and 394 J of work is done by the system.

(a)What is the change in internal energy for the process?

(b) Calculate the internal energy change when the system absorbs 5 KJ of heat and 1KJ of work

8. Enthalpies of formation of CO (g), CO_2 (g), N_2O (g) and N_2O_4 (g) are -110, -393, 81 and 9.7 KJ/mol respectively. Find the value of Δ_rH for the reaction;

N_2O_4 (g) + 3 CO (g) --------→N_2O (g) + 3CO_2 (g)

10 The reaction of cyanamide, NH_2CN (s), with Dioxygen was carried out in a bomb calorimeter, and ΔU was found to be -742.7 KJ/mol at 298K. Calculate Enthalpy change for the reaction at 298K

NH_2CN(s) + 3/2O_2 (g) --------→N_2 (g) + CO_2(g) +H_2O(l)

11 The enthalpy of combustion of methane, graphite and dihydrogen at 298 K are –890.3 kJ mol^{-1}, –393.5 kJ mol^{-1} and –285.8 kJ mol^{-1} respectively. Calculate the Enthalpy of formation of CH_4 (g).

12 Calculate the bond enthalpy of Cl-Cl bond from the following data:

$CH_4(g) + Cl_2(g) \dashrightarrow CH_3Cl(l) + HCl(l)$ [ΔH = -100.3 KJ/mol]

Given, bond enthalpies of C-H, C-Cl and H-Cl bonds are 413, 326 and 431 KJ/mol respectively.

13 Predict in which of the following, entropy increases/decreases:

(i) A liquid crystallizes into a solid.

(ii) Temperature of a crystalline solid is raised from 0 K to 115 K.

(iii) $2NaHCO_3(s) \rightarrow Na_2CO_3(s) + CO_2(g) + H_2O(g)$

(iv) $H_2(g) \rightarrow 2H(g)$

14 A swimmer coming out of a pool is covered with a film of water weighing about 18g. How much heat must be supplied to evaporate this water at 298 K? Calculate the internal energy of vaporization at 100 ˚C. Given $\Delta_{vap}H^{\circ}$ of water at 373K = 40.66kJ/mol Ans. = 36.56 kJ/mol

15 The combustion of 1 mol of benzene takes place at 298K and 1 atm. After combustion $CO_2(g)$ and $H_2O(l)$ are formed and 3267KJ of heat is liberated .calculate the standard enthalpy of formation of benzene. Given: $\Delta f\ H^0\ (H_2O)$ = -286 KJ/mol , $\Delta\ H^0\ (CO_2)$ = -393 KJ/mol

16 The net enthalpy change of a reaction is the amount of energy required to break all the bonds in reactant molecules minus amount of energy required to form all the bonds in the product molecules. What will be the enthalpy change for the following reaction:

$H_2(g) + Br_2(g) \dashrightarrow 2HBr(g)$

Given that bond energy of H_2, Br_2 and HBr is 435 kJ mol^{-1}, 192 kJ mol^{-1} and 368 kJ mol^{-1} respectively

17. Predict the sign of ΔS for the following reactions:

$CaCO_3(s) + CO_2(g)$ ----Heat -- → $CaO(s) + CO_2(g)$

18. Give relationship between ΔH and ΔU for a reaction in gaseous state.
19. The equilibrium constant for a reaction is 10. What will be the value of ΔG°?

    ($R = 8.314\ JK^{-1}mol^{-1}$, $T = 300K$)
20. For the reaction:

    $2\ Cl\ (g) \rightarrow Cl_2\ (g)$, What are the signs of ΔH and ΔS?

Topic: Equilibrium

Answer the following:

1. What are the limitations of Arrhenius Concept of Acids and Bases?
2. Mention the factors that affect equilibrium constant.
3. Explain Bronsted and Lowry Concept. How it is better than Arrhenius?
4. State the formula of conjugate base of each of the following acids :-

   (i) H_3O^+ (ii) HSO_4^- (iii) H_3PO_4 (iv) $CH_3NH_3^+$
5. Write conjugate acids of H_2O & NH_3.
6. What are Buffer solutions?
7. Write K_c for the gaseous reaction: $N_2 + 3H_2 \rightleftharpoons 2NH_3$
8. Out of H_2O & H_3O^+ which is stronger acid?
9. Explain Lewis acids and bases with suitable examples.
10. Water is amphoteric in nature. Explain.
11. Why is ammonia termed as a base though it does not contain OH^- ions?
12. Describe the effect of :

    a) addition of H_2 b) addition of CH_3OH

    c) removal of CO d) removal of CH_3OH on the equilibrium of the reaction:

    $2H_2(g) + CO(g) \rightleftharpoons CH_3OH\ (g)$

13. Which concept can explain the acidic character of CO_2?
14. At 298K, the pH of a lemon piece is 2.32. Calculate its (H_3O^+] and [OH^-].
15. The solubility of AgCl in water 298K is 1.06 x 10^{-5} mole per liter. Calculate its solubility product at this temp.
16. Define solubility Product, write solubility product expression of $Zr_3(PO_4)_4$.
17. Ionic product of water is 2.7x 10^{-14} at 310K. What is the pH of neutral water at this temperature?
18. Calculate the pH of a sample of soft drink whose H_3O^+ ion concentration is 3.8X10^{-3} M.
19. Why is the Entropy of a substance taken as zero at 0K? Calculate the standard free energy change for the reaction:

    $N_2(g) + 3H_2(g) \rightleftarrows 2NH_3(g)$ at 298K

    The value of the equilibrium constant for the above reaction is 6.6 x 10^5 (R= 8.314 J K^{-1} mol^{-1})
20. Equilibrium is dynamic in nature. Explain.
21. In the manufacture of ammonia as

    $3H_2(g) + N_2(g) \rightleftarrows 2NH_3(g)$

    Work out the conditions for the maximum yield of ammonia by using Le- Chatlier principle.
22. Explain why pure solids and liquids are ignored while writing the equilibrium constant expression?
23. Equilibrium constant K_c for the reaction:

    $N_2(g) + 3H_2(g) \rightleftarrows 2NH_3(g)$ at 500K is 0.061.

    At particular time analysis shows that composition of the reaction mixture is 3.0 mol L^{-1} N_2, 2.0 mol L^{-1} H_2 and 0.5 mol L^{-1} NH_3. Is the reaction at equilibrium? If not in which direction does the reaction tend to proceed to reach equilibrium?

24. How does the value of equilibrium constant predict the extent of reaction?

25. Write the expression for equilibrium constant for the following reaction:

$CaCO_3$ (s) $\rightleftarrows$ CaO(s) + CO_2(g)

26. For the equilibrium, $2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$ the value of the equilibrium constant, K_c is 3.75×10^{-6} at 1069 K. Calculate the K_p for the reaction at this temperature?

Hydrolysis of sucrose gives, Sucrose + H_2O →Glucose + Fructose

Equilibrium constant K_c for the reaction is 2×10^{13} at 300K. Calculate ΔG^0 at 300K.

27. The values of K_{sp} of two sparingly soluble salts $Ni(OH)_2$ and AgCN are 2.0×10^{15} and 6×10^{-17} respectively. Which salt is more soluble? Explain.

28. At 473 K, equilibrium constant *Kc* for decomposition of phosphorus pentachloride, PCl_5 is 8.3×10^{-3}. If decomposition is depicted as:

PCl_5 (g) $\rightleftharpoons$ PCl_3 (g) + Cl_2 (g) $\Delta_r H^0 = 124.0$ kJ mol^{-1}

a) Write an expression for K_c for the reaction.

b) What is the value of K_c for the reverse reaction at the same temperature?

c)what would be the effect on K_c if

(i) more PCl_5 is added   (ii) pressure is increased

(iii) Temperature is increased?

29. Dihydrogen gas is obtained from natural gas by partial oxidation with steam as per following endothermic reaction:

CH_4 (g) + H_2O (g) $\rightleftharpoons$ CO (g) + $3H_2$ (g)

(a) Write as expression for K_p for the above reaction.

(b) How will the values of K_p and composition of equilibrium mixture be affected by:

(i) increasing the pressure

(ii) increasing the temperature

(iii) using a catalyst?

30. The value of K_c for the reaction $2A \rightleftharpoons B + C$ is 2×10^{-3}. At a given time, the composition of reaction mixture is [A] = [B] = [C] = 3×10^{-4} M. In which direction the reaction will proceed?

31. The solubility product constant of Ag_2CrO_4 and AgBr are 1.1×10^{-12} and 5.0×10^{-13} respectively. Calculate the ratio of the molarities of their saturated solutions.

32. A tank is full of water. Water is coming in as well as going out at the same rate. What will happen to the level of water in the Tank? What name can be given to such a state?

Topic: Redox reactions

Answer the following:

1 Identify the oxidizing and reducing agents in the following reactions:

(a) $H_2S + Cl_2 \rightarrow 2HCl + S$

(b) $Zn + 2H^+ \rightarrow Zn^{2+} + H_2$

(c) $3Fe_3O_4 + 8Al \rightarrow 9Fe + 4Al_2O_3$

(d) $Fe + H_2SO_4 \rightarrow FeSO_4 + H_2$

(e) $MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$

2. Define oxidation and reduction in terms of oxidation number.

3. Calculate the oxidation numbers of the underlined elements the following compounds:

(a) $\underline{S_2}O_7^{2-}$ (b) $H_2\underline{S}O_3$ (c) $\underline{C}H_3OH$ (d) $H\underline{C}OOH$ (e) $\underline{Cl}O_3^-$

4. Define disproportionate reaction and give example. Analyze your statement.

5. Explain the construction and working of Galvanic cell with the help of neat diagram.

6. Explain the functions of salt bridge.

7. Why is it not possible to find electrode potential of single electrode?

8. Write a note on Standard hydrogen electrode or Normal hydrogen electrode.

9. Balance the following ionic equations:

   (a) $Cu + NO_3^- \rightarrow NO_2 + Cu^{2+}$ (in acidic medium)

   (b) $MnO_4^- + Fe^{2+} \rightarrow Mn^{2+} + Fe^{3+}$ (in acidic medium)

   (c) $Cr_2O_7^{2-} + C_2H_4O \rightarrow C_2H_4O_2 + Cr^{3+}$ (in acidic medium)

   (d) $Zn + NO_3^- \rightarrow Zn^{2+} + NH_4^+$ (in basic medium)

   (e) $MnO_4^- + I^- \rightarrow MnO_2 + I_2$ (in basic medium)

   (f) $Cr(OH)_3 + IO_3^- \rightarrow I^- + CrO_4^{2-}$ (in basic medium)

   (g) $Cr_2O_7^{2-} + Fe^{2+} \rightarrow Cr^{3+} + Fe^{3+} + H_2O$ (in acidic medium)

   (h) $MnO_4^- + SO_2 \rightarrow Mn^{2+} + HSO_4^-$ (in acidic medium)

   (i) $Cr_2O_7^{2-} + SO_2 \rightarrow Cr^{3+} + SO_4^{2-}$ (in acidic medium)

10. Define Redox couple and electrode potential

11. Differentiate between oxidation state and valency.

12. Define electrochemical series and explain the applications of electrochemical series.

13. Give any two application of redox reaction.

14. Arrange the following metals in order of increasing reducing power.

    $K^+/K = -2.93$ V, $Ag^+/Ag = 0.80$ V, $Mg^{2+}/Mg = -2.37$V

15. Is it possible to store $CuSO_4$ solution in Zn vessel? Give reason to support your answer.

16. Is rusting of iron an electrochemical phenomenon? How? Explain.

17. We spend crore of Rupees and even thousands of lives every year due to corrosion. How can be preventing it. Explain.

18. Write the skeleton equations for the following chemical reactions and balance them:

(a)Chloride ions reduce manganese dioxide to manganese (II) ions in acidic medium and itself get oxidized to chlorine gas.

(b) Nitrate ions in acidic medium oxidize magnesium to Mg^{2+} ions but itself gets reduced to Nitrogen (I) oxide.

(c) Zinc reacts with conc. Nitric acid to produce zinc nitrate, nitrogen dioxide and water.

Topic: Hydrogen and s block elements

Answer the following:

1. Describe position of hydrogen in the periodic table.
2. Name the isotopes of hydrogen and calculate the number of neutrons in each.
3. How is hydrogen gas produced in the laboratory?
4. What is syngas? What is coal gasification?
5. Describe with equation water gas shift reaction of production of hydrogen.
6. Define the term hydride. What are the different types of hydrides? What are their characteristic properties?
7. Why does ice float on water? Explain with the structure of ice.
8. Explain hydrolysis reaction and amphoteric nature of water.
9. How is permanent and temporary hardness of water removed?
   Draw the structure of Hydrogen peroxide.
10. How is hydrogen peroxide prepared industrially and in the lab?

11. Give one reaction in which hydrogen peroxide acts as oxidizing agent and one in which it acts as reducing agent.
12. Why are halides of beryllium polymeric?
13. Arrange the alkaline earth metal carbonates in the decreasing order of thermal stability.
14. Name the compound which can be obtained by Solvay's process.
15. How does the basic character of hydroxides of alkali metals vary down the group?
16. Which out of $MgSO_4$ or $BaSO_4$ is more soluble in water?
17. Which elements of alkaline earth metals family do not give characteristic flame colouration?

18 Complete the following reactions:

(i) $Mg(NO_3)_2$ -----Heat ----→

(ii) LiOH -----Heat ----→

(iii) $Na_2O + H_2O \rightarrow$

(iv) $Na + O_2 \rightarrow$

19. Which out of Li and Na has greater value for the following properties:
(i) Hydration enthalpy
(ii) Stability of hydride
(iii) Stability of carbonate
(iv) Basic character of hydroxide
20. Why are alkali metals not found in nature?
21. Why are lithium salts commonly hydrated and those of the other alkali ions usually anhydrous?
22. Beryllium and magnesium do not give colour to flame whereas other alkaline earth metals do so why?
23. Alkali metals are soft and have low melting points. Why?

24. When an alkali metal dissolves in liquid ammonia the solution can acquire different colours. Explain the reasons for this type of colour change.
25. In what ways lithium shows similarities to magnesium in its chemical behaviour?
26. Discuss the various reactions that occur in the Solvay process.
27. What happen when
    (i) magnesium is burnt in air
    (ii) quick lime is heated with silica
    (iii) chlorine reacts with slaked lime
    (iv) calcium nitrate is heated?
    (v) Sodium metal is dropped in water?
    (vi) Sodium metal is heated in free supply of air?
    (vii) Sodium peroxide dissolves in water?
28. Why are potassium and cesium, rather than lithium used in photoelectric cells?
29. Why is Li_2CO_3 decomposed at a lower temperature whereas Na_2CO_3 at higher temperature?
30. Explain why can alkali and alkaline earth metals not be obtained by chemical reduction methods?
31. Explain the significance of sodium, potassium, magnesium and calcium in biological fluids.
32. Potassium carbonate cannot be prepared by Solvay process. Why?
33. The hydroxides and carbonates of sodium and potassium are easily soluble in water while the corresponding salts of magnesium and calcium are sparingly soluble in water. Explain.
34. Why is LiF almost insoluble in water whereas LiCl soluble not only in water but also in acetone?

35. Explain the following:

(a) Lithium forms predominantly covalent compounds.

(b) Li^+ ions are heavily hydrated.

(c) different metals give different colours to flame

36. Draw the structure of (i) $BeCl_2$ (vapour) (ii) $BeCl_2$ (solid).

37. Arrange the following in decreasing order of the property mentioned:

(a) Li^+, K^+, Rb^+ (ionic mobility)

(b) BeO, MgO, CaO, (Enthalpy of formation)

(c) Be, Mg, Ca (metallic radius)

Topic: p Block elements

Answer the following:

1. How can you explain the higher stability of BCl_3 as compared to $TlCl_3$.

2. Give reasons: (a)Graphite is used as lubricant

(b)Diamond is used as an abrasive.

(c)Aluminum oxide is amphoteric in nature.

3. Gallium has higher ionization energy than Aluminum. Why?

4. Explain the following and write the chemical equations for (c) and (d)

(a)Lower oxidation states are ionic while higher are covalent.

(b)$PbCl_4$ is known but PbI_4 is unknown. Why?

(c)What is action of water on $SnCl_4$?

(d)$SnCl_2$ is a solid but $SnCl_4$ is a liquid.

5. How is $SnCl_2$ prepared? What happens when it is mixed with aqueous ferrous sulphate?

6. CO_2 is a gas whereas SiO_2 is a solid. Why?

7. Boric acid contains three OH groups and is expected to behave as a protic acid. But it acts as a Lewis acid. What could be the reason?

8. Boron is unable to form $[BF_6]^{3-}$ ion .Explain.

9. Why does boron trifluoride behave as Lewis acid?

10. What happens when:

    (a) borax is heated strongly

    (b)boric acid is added to water

    (c) Aluminium is treated with dilute NaOH

    (d)BF_3 is reacted with NH_3

    (e) $NaBH_4$ reacts with iodine

11. Explain the following:

    (a)$[SiF_6]^{2-}$ is known whereas $[SiCl_6]^{2-}$ is not known.

    (b) $PbCl_4$ is a powerful oxidizing agent.

    (c)$SnCl_2$ acts as reducing agent.

    (d) Carbon forms covalent compounds while lead forms ionic compounds.

    (e) Aluminium alloys are used to make aircraft body.

    (f) C and Si are always tetravalent but Ge, Sn, Pb show divalency.

    (g) Boron and aluminium tend to form covalent compounds.

12. What are fullerenes? How are they prepared?

13. Why is boron used in nuclear reactions?

14. Which oxide of carbon is regarded as anhydride of carbonic acid.

15. How is excessive content of CO_2 responsible for global warming?

16. Describe two similarities and two dissimilarities between B and Al.

17 A certain salt X, gives the following results:

(i)Its aqueous solution is alkaline to litmus.

(ii) It swells up to a glassy material Y on strong heating.

(iii) When conc.H_2SO_4 is added to a hot solution of X, white crystal of an acid Z separates out.

Identify X, Y and Z.

18. Explain the structure of Diboranes.

<u>Topic: Organic Chemistry: Some Basic Principles and Techniques</u>

Answer the following:

1. Write the hybridized state of C atoms in the following: $CH_2 = CH - C \equiv N$
2. Explain Inductive effect with example.
3. Explain why $(CH_3)_3C^+$ is more stable than $CH_3CH_2^+$.
4. Give the number of Sigma and pi bonds in the following molecules:

   a) CH_3NO_2 b)$HCONHCH_3$ c) $HC \equiv CCH = CHCH_3$ d) $CH_2 = C = CHCH_3$
5. Write the condensed and bond line formula of 2,2,4-Trimethylpentane.
6. Define Isomerism. Explain position Isomerism and Functional Isomerism with examples.
7. Write a short note on Resonance effect .
8. Explain Hyperconjugation effect. How does Hyperconjugation explain the stability of alkenes?
9. Define the terms Electrophiles and Nucleophiles. Give examples.

10. Tertiary Carbocation is more stable than secondary carbocation. Justify

11. Draw cyclic and acyclic isomers of C_3H_6O.

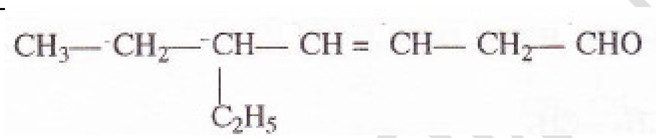
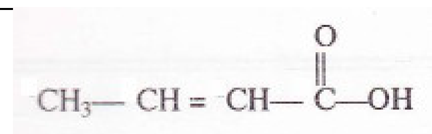
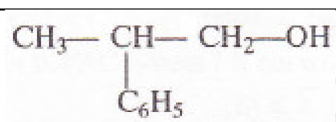
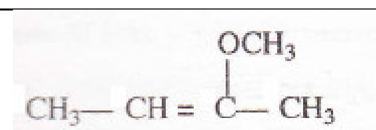
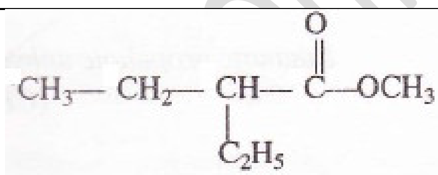
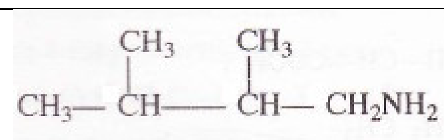
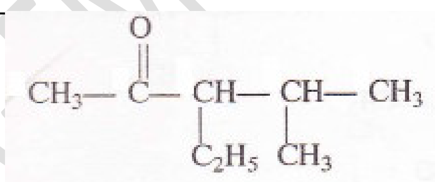
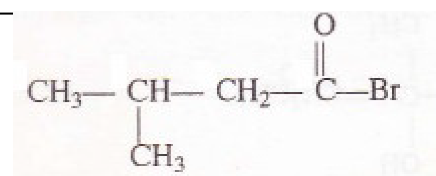
12. Differentiate between + I effect and – I effect.

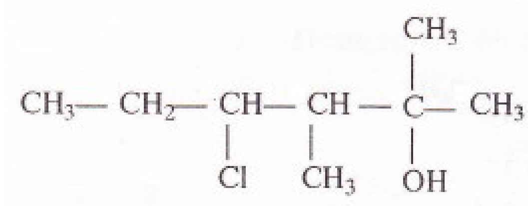
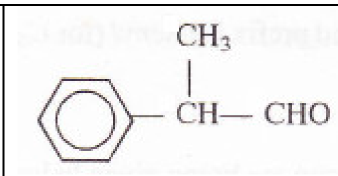
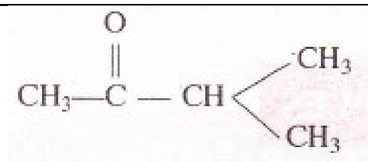
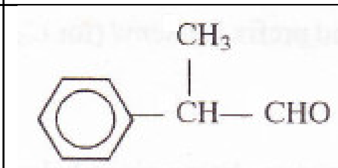
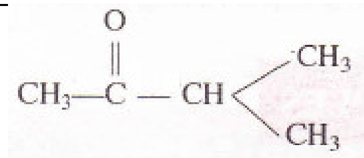
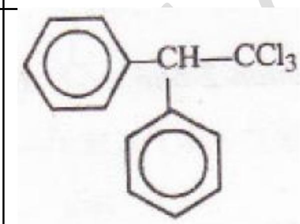
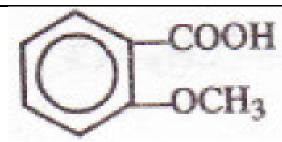
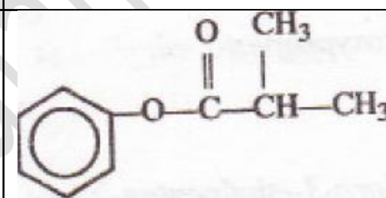
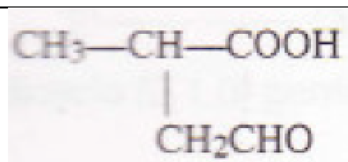
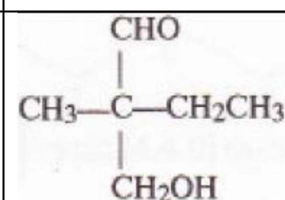
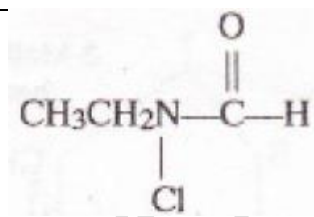
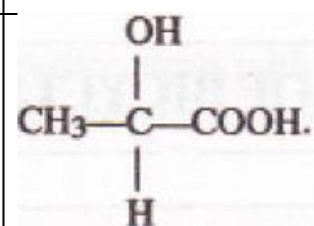
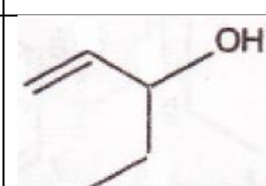
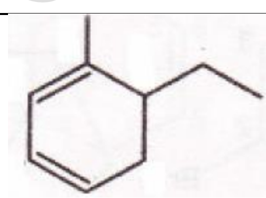
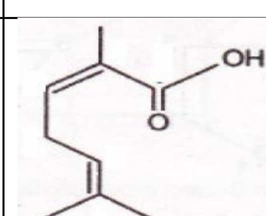
13. Draw the structural formula of :

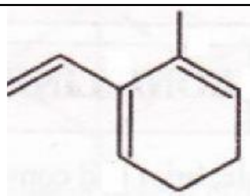
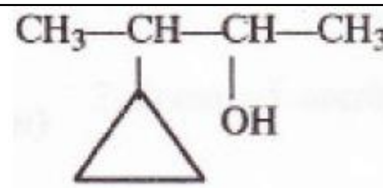
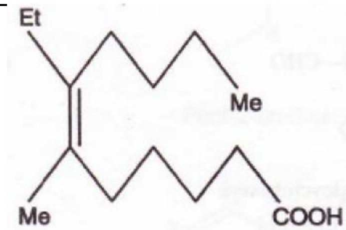
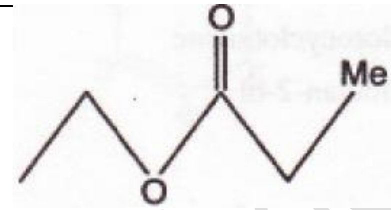
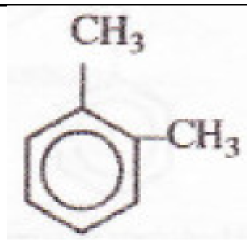
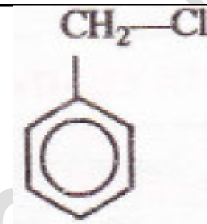
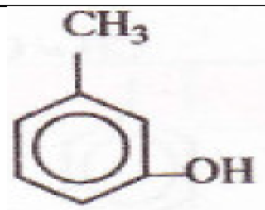
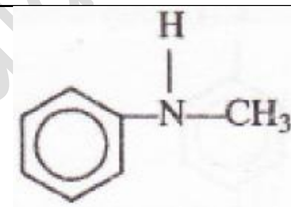
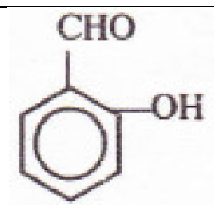
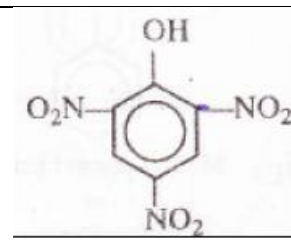
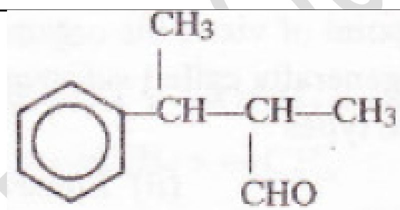
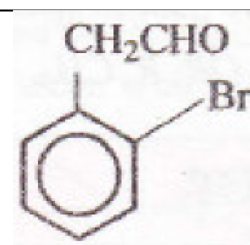
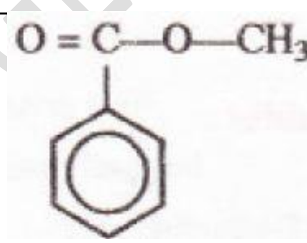
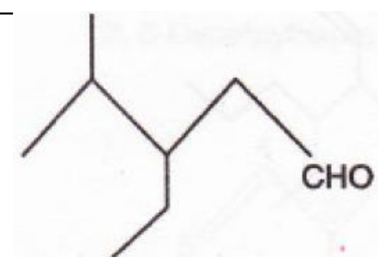
(a)2, 3 – dimethyl butane	(b) 3-methylhexanoic acid
(c) 2,5-dimethyl hexane	(d) Isobutyl alcohol
(e)3-ethyl-2, 2 dimethyl pentane.	(f) Hex-3-enoic acid
(g) 2-chloro-2-methylbutan-1-ol	(h)4-aminopentanal
(i) neo- pentyl bromide	(j) Sec – Butyl alcohol
(k) tert – Butyl bromide	(l) Benzyl chloride

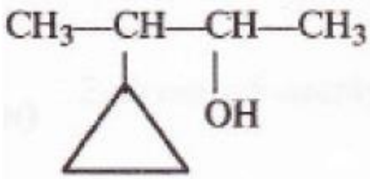
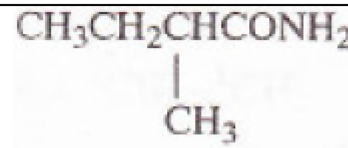
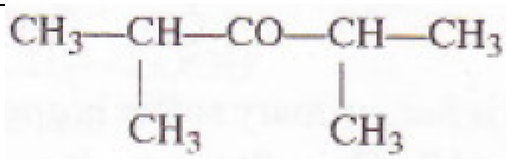
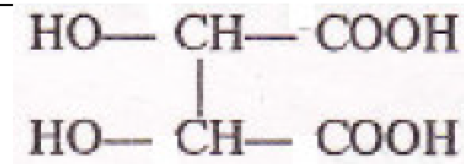
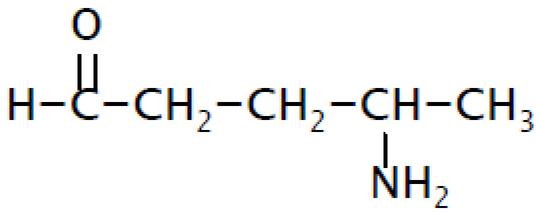
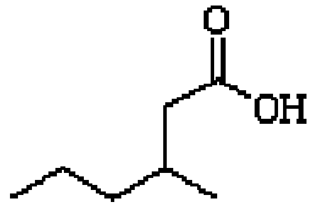
14. **NOMENCLATURE PRACTICE:**

Write the IUPAC names of following compounds:

(a)		**(b)**	
(c)		**(d)**	
(e)		**(f)**	
(g)		**(h)**	

(i)		(j)	
(k)		(l)	
(m)		(n)	
(o)		(p)	
(q)		(r)	
(s)		(t)	
(u)		(v)	
(w)		(x)	

(y)		**(z)**	
(aa)		**(ab)**	
(ac)		**(ad)**	
(ae)		**(af)**	
(ag)		**(ah)**	
(ai)		**(aj)**	
(ak)		**(ak)**	

(al)		(am)	
(an)		(ao)	
(ap)		(aq)	

Topic: Hydrocarbons

Answer the following:

1. Arrange the following in the increasing order of C-C bond length: C_2H_6 C_2H_4 C_2H_2
2. Out of ethylene and acetylene which is more acidic and why?
3. Arrange the following in order of decreasing reactivity towards alkanes:

   HBr, HI, HF, HCl,
4. Write chemical equations for combustion reaction of (i) Butane (ii) Toluene
5. What are the necessary conditions for any system to be aromatic?
6. What effect does branching of an alkane chain has on its boiling point?
7. How would you convert the following compounds into benzene?

   (i) Ethyne (ii) Ethene
8. Write the name of all the possible isomers of $C_2H_2Cl_2$ and indicate which of them is non-polar.
9. Although benzene is highly unsaturated, it does not undergo addition reactions, why?
10. What are alkanes? Why are they called paraffins?
11. How can ethene be prepared from (i) ethanol (ii) ethyl bromide?
12. What is Wurtz reaction? How can it be used to prepare butane?

13. An alkene ‘A’ contains three C – C, eight C – H σ bonds and one C – C π bond. ‘A’ on ozonolysis gives two moles of an aldehyde of molar mass 44 u. Deduce IUPAC name of ‘A’.

14. Addition of HBr to propene yields 2-Bromopropane, while in the presence of benzoyl peroxide, the same reaction yields 1-bromopropane. Explain and give mechanism

15. Write is the structure of the alkene which on reductive ozonolysis gives Butanone and Ethanal

16. Explain why alkanes are insoluble in water.

17. Staggered conformers are more stable than eclipsed conformations. Explain.

18. Which isomer of but-2-ene will have more (a) boiling point (b) melting point

19. Write mechanism of
    a) chlorination of methane
    b) Addition of HBr to propene
    c) Addition of HBr to Propene in presence of peroxide.
    d) Kolbe's electrolysis
    e) Nitration of benzene

20. Name the chloride of pentane which on dehydrohalogenation produces one alkene as the product.

21. What are the products of ozonolysis of 2,2-Dimethyl but- 2- ene? Explain with the mechanism.

22. Write the IUPAC names of the compounds formed by the ozonolysis of Pent – 2- ene and 2-ethylbut-1-ene.

23. Propanal and pentan-3-one are the ozonolysis products of an alkene? What is the structural formula of the alkene?

24. Draw the Cis-Trans isomers for the following compounds. If no cis/trans isomers write NONE: (a) 2-Bromo-2-pentene (b)3-Heptene (c) 4-Methyl-2-pentene (d)1,1-Dibromo-1-butene (e)2-Butenoic acid ($CH_3CH=CHCOOH$)

25. Why peroxide effect is only applicable to the addition of HBr and not to the addition of HCl, HF and HI?

26. Why halogens are ortho and para directive in nature?

27. Complete the following conversions:

a) Acetic acid to Methane

b) Acetic acid to Ethane

c) Sodium propanoate to Ethane

d) Acetylene to Ethane

e) Benzene to m-Nitro toluene

f) Ethyl bromide to Ethane

g) Ethyl bromide to Ethene

h) Ethene to Ethyne

i) Ethyne to Tetrabromo ethane

j) Propene to 2-Bromo propane

k) Ethyl alcohol to Ethane

l) Ethyl alcohol to Ethene

m) But-2-ene to Acetaldehyde

n) Ethane to Butane

o) Propene to 2,3-dimethyl butane

p) Benzene to Ethyl benzene

q) Benzene to Benzene sulphonic acid

r) Propyne to Acetone

s) Ethyne to Butyne

t) Ethyne to 1,2-Dibromo ethane

u) Ethyne to Toluene

v) Propene to Propan-2-ol

w) Propene to Propane

x) Propyne to Propane

y) Benzene to acetophenone

z) Benzoic acid to Benzene

aa) Benzene to m-Nitro toluene

ab) Benzene to P-Nitro toluene

ac) Benzene to m- chloro acetophenone

ad) Benzene to m- chloro acetophenone

Topic: <u>Environmental Chemistry</u>

Answer the following:

1. What is the name of the compound formed when CO combines with blood?
2. Which main gases are responsible for damage in ozone layer?
3. Name the acids which are responsible for acid rain?
4. List out the gases which are considered as major source of air pollution?
5. What is the full form of PAN?
6. Give the examples of insecticides?
7. Which gas is mainly responsible for BHOPAL gas tragedy?
8. What should be the tolerable limit of F^- ions in drinking water?
9. What is 'acid rain'? How is it harmful to the environment?
10. What do you mean by Green House effect? What is the role of CO_2 in the greenhouse effect?
11. Which gases are responsible for greenhouse effect? List some of them.
12. What is smog? How is classical smog different from photochemical smog?
13. What are the reactions involved for ozone layer depletion in the stratosphere?
14. What is the full form of BOD and COD?
15. What are viable and non-viable particulates?
16. What is B.H.C? Give its IUPAC name?

17. What is meant by PCBs?
18. What do you understand by- (i) Mist (ii) Smoke (iii) Fumes
19. Define the term pesticides? What are three categories of pesticides?
20. What do you mean by ozone hole? What are its consequences?
21. What are harmful effects of photochemical smog and how can be they controlled?
22. Give three examples in which green chemistry has been applied.