Subject – Chemistry

: 3 Hours

General Instructions :

(a) All questions are compulsory.

(b) Marks of each question are indicated against it.

(c) Question number 1 to 5 are very short answer type questions, carrying 1 mark each. Answer these in one word or about one sentence each.

(d) Question number 6 to 10 are short answer type questions, carrying 2 marks each. Answer these in about 30 words each.

(e) Question number 11 to 22 are also short answer type questions, carrying 3 marks each. Answer these in about 40 words each.

(f) Question number 23 is value based question of 4 marks.

(g) Question number 24 to 26 are long answer type questions, carrying 5 marks each. Answer these in about 70 words each.

(h) There is no overall choice. However, an internal choice has been provided in one question of 1 mark, one question of 2 marks, one question of 3 marks and all three questions of 5 marks weightage. Attempt only one of the choices in such questions.

(i) Use log tables, if necessary. Use of calculators is not permitted.

How many electrons in an atom may have the following quantum numbers : (½+½)

(a) $n = 4, \ell = 2, m_s = +\frac{1}{2}$

(b) $n = 4, m_s = -\frac{1}{2}$

(½+

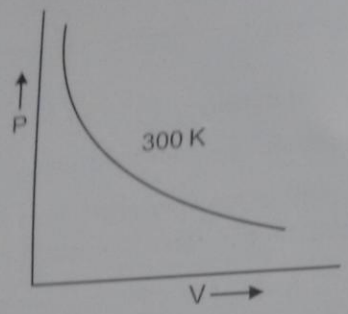
Write the names of the elements :

(a) Belonging to 3^{rd} period and 17^{th} group.

(b) Third noble gas.

Arrange H_2O, NH_3 and CH_4 in decreasing order of bond angle.

4. Which law is demonstrated in the following graph ? Also, state the law. (½+½)



5. How many π and σ bonds are present in CH_3COOH ? (½+½)

OR

Define hybridisation. (1)

6. Calculate the mass of CO_2 which contains the same number of molecules as are contained in 40 g of oxygen. (2)

7. Arrange the following in decreasing order of property indicated : (1+1=2)

(a) Electronegativity : F, Cℓ, Br

(b) Atomic Size : Na^+, Mg^{2+}, $Aℓ^{3+}$

8. Why NF_3 is pyramidal while BF_3 is triangular planar, though both are tetratomic molecules ? (2)

9. On a ship sailing in Pacific Ocean where temperature is 23.4 °C, a balloon is filled with 2 L air. What will be the volume of the balloon when the ship reaches Indian Ocean, where temperature is 26.1 °C ?

OR

1 mol of N_2 and 3 mol of H_2 are present in a container of volume 10 dm^3 at 298 K. What is the total pressure of the mixture ? (2)

What is disproportionation reaction ? Explain with an example. (1+1)

(a) Give electronic configuration of Na^+ ion. Give the spin value of valence electron

(b) Calculate molarity of KI if the density of 20 % (mass/mass) aqueous KI solution is 1.202 g/mL. (Atomic mass of K = 39; I = 127). (1+2)

e electron energy in hydrogen atom is given by $E_n = \left(\frac{-2.18 \times 10^{-18}}{n^2}\right) J\ atom^{-1}$

Calculate the energy required to remove an electron completely from n = 2 orbit. What is the longest wavelength of light in cm that can be used to cause this transition ? (3)

(1+1+1)

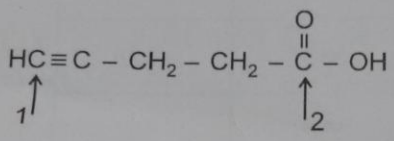
13. Explain :

(a) Radius of Na^+ is less than that of Na.

(b) Ionisation enthalpy decreases down the group.

(c) 4^{th} period has eighteen and not 8 elements.

14. (a) State the hybridization of carbon atoms numbered 1 and 2.



(b) What is Intramolecular hydrogen bonding ? Give an example.

(c) Calculate formal charge on any one of the oxygen atom in NO_3^- ion. (1+1+1)

For real gases, the relation between p, V and T is given by van der Waals equation, where 'a' and 'b' are van der Waals constants, 'nb' is approximately equal to total volume of the molecules of a gas. 'a' is the measure of magnitude of intermolecular attraction.

(a) Arrange the following gases in the increasing order of 'b'. Give reason.

O_2, CO_2, H_2, He

b) Arrange the following gases in the decreasing order of magnitude of 'a'. Give reason.

CH_4, O_2, H_2

Show resonance for NO_2. (3)

lain why : (1+1+1)

Atomic spectra is discontinuous.

Dual nature of matter is significant only for microscopic bodies.

Cu has exceptional electronic configuration [Ar] $3d^{10}4s^1$.

17. Define electron gain enthalpy. Which of the following pairs have higher negative electron gain enthalpy and why? (1+1+1)

(a) F or Cl

(b) O or O^-

OR

The first and second Ionization enthalpies (in $kJ\,mol^{-1}$) and electron gain enthalpies of few elements are given below :

	$\Delta_{IE1}H$	$\Delta_{IE2}H$	$\Delta_{eg}H$
P	419	3051	– 48
Q	1681	3374	– 328
R	2372	5251	48

Which of the above element is likely to be a (a) Metal (b) Non-metal (c) Noble Gas ? (1+1+1)

(a) Using VSEPR theory, predict the shape of :

(i) PCl_5 (ii) SF_4

(iii) ClF_3

(b) Discuss the structure of C_2H_4 using phenomenon of hybridisation. (1½+1½)

(a) Calculate the oxidation number of S in Na_2SO_4.

(b) Can a displacement reaction be a redox reaction? Illustrate with the help of an example.

(c) Justify the following as redox reaction.

$$2K + F_2 \longrightarrow 2K^+F^-$$

(1+1+1)

) What is the difference between the symbol l and L?

Define Photoelectric Effect.

State Hund's rule of maximum multiplicity. Explain by taking the example of nitrogen.

(1+1+1)

(a) Differentiate between sigma and pi-bonds.

(b) What is bond order between C and C in Ethyne?

(c) Which has higher ionic character : ClF_3 or LiF?

Balance the following chemical equations : (1+1+1)

(a) $H_2O_2 + Fe^{2+} \longrightarrow Fe^{3+} + H_2O$ (Acidic medium) (1½+1½)

(b) $MnO_4^- + I^- \longrightarrow MnO_2 + I_2$ (Basic medium)

Rohit takes an open pan to cook vegetables and pulses at a hill station while Sohan cooks pulses and vegetables in pressure cooker at the same place. The gas cylinder of Rohit lasts for only 15 days whereas Sohan uses one gas cylinder per month.

(a) Who will cook vegetables and pulses faster and why?

(b) What is reason for delay in cooking by Rohit?

(c) What value is possessed by Sohan?

(d) Why does Sohan need only one gas cylinder per month and not two like Rohit? (1+1+1+1)

(a) How do the energies of 3s, 3p and 3d orbitals differ in Hydrogen atom and Sodium atom?

(b) How many nodes and nodal planes are present in 4f orbital?

(c) Calculate the uncertainty in the position of an electron if uncertainty in its velocity is 0.001%. (Mass of electron = 9.1×10^{-31} kg; velocity of electron = 300 ms^{-1}) (1+1+3)

OR

Explain the limitations of Bohr's model.

What are the frequency and wavelength of a spectral line during an electron transition from n = 3 state to n = 1 state in a hydrogen atom? ($h = 6.6 \times 10^{-34}$ Js, $c = 3 \times 10^8$ ms^{-1}, $R_H = 109678$ cm^{-1}) (2+3)

Draw MOT diagram of N_2 molecule. Calculate bond order, magnetic behaviour and the type of bonds formed. Arrange the following in the order indicated :

N_2, N_2^+, N_2^-, N_2^{2-} (Increasing Bond dissociation enthalpy)

Which out of NH_3 and NF_3 has a higher dipole moment and why? (3+2)

OR

(a) What is the total number of electrons in NO_3^- and NH_4^+ ?

(b) Why is melting point of MgO (2800 °C) higher than that of BaO (1920 °C) ?

(c) How is molecular orbital different from atomic orbital ? (2+1+2)

(a) Define Limiting Reagent.

(b) Give the volume in cm^3 occupied by one mole of oxygen at STP.

(c) How much magnesium sulphide can be obtained from 2 g of magnesium and 2 g sulphur by the reaction, $Mg + S \longrightarrow MgS$? Identify Limiting Reagent. Calculate the amount of one of the reactants which remains unreacted. (Mg = 24; S = 32) (1+1+3

OR

a) Are 0.5 mole of NaOH and 0.5 M of NaOH solution same ?

b) State Law of Multiple proportion.

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. A volume of 10 L (measured at STP) of this welding gas is found to weigh 11.6 g. Calculate (a) empirical formula (b) molar mass of the gas, and (c) molecular formula. (1+1+

16gms
23