MM 70

Time: 3 Hours

General Instructions:

Read the following instructions carefully.

a) There are 33 questions in this question paper. All questions are compulsory.

b) Section A: Q. No. 1 to 16 are multiple choice type questions carry 1 mark each.

c) Section B: Q. No. 17 to 21 are short answer questions and carry 2 marks each.

d) Section C: Q. No. 22 to 28 are short answer questions and carry 3 marks each.

e) Section D: Q. No. 29 to 30 are case based questions carrying 4 marks each.

f) Section E : Q. No. 31 to 33 are long answer questions carrying 5 marks each.

g) There is no overall choice. However, internal choices have been provided.

SECTION A

1. The number of significant figures in 0.00551 are_____

   (a) 5   (b) 3

   (c) 2   (d) 26

2. The number of moles present in 6 gms of carbon is:

   (a) 0.5   (b) 5

   (c) 1   (d) 3

3. Which of the following pairs of gases contains the same number of molecules?

   (a) 16 g of O_2 & 14 g of N_2 (b) 6 g of O_2 & 22 g of CO

   (c) 28 g of N_2 & 22 g of CO_2 (d) 32 g of CO & 32g of N

4. The electronic configuration of copper (Z=29) is

   (a) [Ne] $3s^2$ $3p^6$ $3d^9$ $4s^2$ (b) [Ne] $3s^2$ $3p^6$ $3d^{10}$ $4s^1$

   (c) [Ne] $3s^2$ $3p^6$ $3d^1$ $4s^2$ (d) [Ne] $3s^2$ $3p^6$ $4s^2$ $4p^1$

5. Which of the following is not permissible?

   (a) n= 4, l = 3, m = 0   (b) n= 4, l = 2, m= 1

   (c) n= 1, l = 2, m = 1   (d) n= 1, l = 0, m = 0

6. The elements with atomic numbers 12, 20, 38, 56, 88 are all

   (a) Halogens   (b) noble gases

   (c) alkali earth metals   (d) transition metals

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7. The smallest ion among the following is

   (a) N^{3-} (b) F   (c) O^{2-} (d) None of the above

8. Which one of them is the strongest?

   (a) Ionic bond   (b) Covalent bond

   (c) Metallic Bond   (d) Van der Waals force

9. The amount of the heat released when 20 ml of 0.5 M NaOH is mixed with 100 ml of 0.1 M

   HCl is x kJ. The heat of neutralization is

   (a) $-100 \times$ kJ/mol   (b) $-50 \times$ kJ/mol   (c) $100 \times$ KJ/mol   (d) $50 \times$ kJ/mol

10. Maximum bond angle is present in case of

   (a) BBr_3 (b) BCl_3

   (c) BF_3 (d) Same in all

11. Which of the following pairs represents isobars?

   (a) $^3He_2$ and $^4He_2$ (b) ^{24}Mg and $^?Mg$

   (c) $^{40}K_{19}$ and $^{40}Ca_{20}$ (d) $^{39}K_{19}$ and $^?K$

12. Weakest Hydrogen bond is shown by

   (a) Ammonia   (b) Water

   (c) Hydrogen fluoride   (d) Hydrogen chloride

In the following questions (Q. No. 13- 16) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

   a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

   b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

   c) Assertion is correct statement but reason is wrong statement.

   d) Assertion is wrong statement but reason is correct statement.

13. **Assertion** : The empirical mass of ethene is half of its molecular mass.
    Reason : The empirical formula represents the simplest whole number ratio of various atoms present in a compound.

14. **Assertion** : The lesser the lattice enthalpy more stable is the ionic compound.
    Reason : The lattice enthalpy is greater, for ions of highest charge and smaller radii.

15. **Assertion** : The bond order of helium is always zero.
    Reason : The number of electrons in bonding molecular orbital and antibonding molecular orbital is equal.

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

SECTION B

17. (a) State Black body radiation.

                                                                              (1+1)

(b) Make an electromagnetic spectrum of different radiations .

18. Using s, p, d, f notations, describe the orbital with following quantum numbers:
    (a) n=1,l=0   (b) n = 3, l =1   (c) n =2, l=0   (d) n=4, l =3   (0.5x2)

19. (a) Find the group number and period number of element having atomic number 52.
    (b) The reactivity of halogens decrease down the group but of alkali metals increases
        down the group. Why?   (1+1)
                    OR
    Discuss the concept of hybridization.
                                                                                          (2)

20. Calculate the amount of water produced by the combustion of 16 g of methane.
                                                                                          (2)

21. Consider the following species: N^{3-}, O^{2-}, F^-, Na^+, Mg^{2+}, Al^{3+}.
(1+1)
    (a) What is common in them and what is that called?
    (b) Arrange them in order of decreasing radii.

SECTION C

22. (a) Calculate the mole fraction of the solute in a 1.00 molal aqueous solution.
    (b) How many moles of Lead (II) chloride will be formed from a reaction between 6.5 g of
        PbO and 3.2 g of HCl?   (1.5+1.5)

23. Yellow light emitted from a sodium lamp has a wavelength of 580 nm. Calculate the frequency
    and wave number of yellow light.   (3)

24. Write the electronic configuration and indicate the number of unpaired electrons in
    (a) S (b) Cu (c) Fe .   (1+1+1)

25. Draw the energy level diagram of F_2. Find the bond order.   (3)
                    OR
    Draw the energy level diagram of O_2. Find the bond order

26. (a) Explain why cations are smaller and anions are larger in radii than their parent atoms.
    (b) Explain why ionisation enthalpy of nitrogen is more than that of oxygen.
    (c) The electron gain enthalpy of Cl (Z = 17)is more negative than that of Fluorine (Z=9)
                                                                                          (1+1+1)

27. A crystalline salt when heated becomes anhydrous and loses 51.2 % of its weight. The anhydrous
    salt on analysis gave the following percentage composition Mg = 20.0%, S = 26.6%, O = 53.33%
    Calculate the molecular formula of the anhydrous salt and the crystalline salt. Molecular weight of
    anhydrous salt is 120.
                                                                                          (3)

28. What is the wavelength of the light emitted when the electron in a hydrogen atom undergoes transition from the energy level with n = 5 to energy level n = 1? (3)

SECTION- D

29. The capacities of shells with a given principal quantum number are fixed by the rules governing the permitted values of the quantum numbers and the Pauli Exclusion Principle. The permitted values of the quantum numbers are :

Principal quantum number	n	1 to ∞
Azimuthal quantum number	l	0 to n−1
Magnetic quantum number	m_l	−l to +l,
Spin quantum number	m_s	−½ or +½

The Pauli Exclusion Principle states that no two electrons in the same atom may have the same values of all four quantum numbers. It follows that, for a given value of n, there are $2n^2$ different sets of values for the quantum numbers, because l may have the values 0, 1, . . ., n−1, and for each value of l there are 2l+1 values of m and for each set of values of l and m there are just two choices for m_s.

1. What will be the maximum possible number of electrons having m_s = −1/2 for n=5?

2. What is the maximum number of electrons having n = 3 and l = 1?

3. How many sub-shells are associated with n = 4?

4. What is the total number of orbitals associated with the principal quantum number n = 3? (

    OR

The maximum number of electrons with l = 3 is

30. The Lattice Enthalpy of an ionic solid is defined as the energy required to completely separate one mole of a solid ionic compound into gaseous constituent ions. For example, the lattice enthalpy of NaCl is 788 kJ mol^{-1}. This means that 788 kJ of energy is required to separate one mole of solid NaCl into one mole of $Na^+(g)$ and one mole of Cl^- (g) to an infinite distance. Bond length is defined as the equilibrium distance between the nuclei of two bonded atoms in a molecule. Bond lengths are measured by spectroscopic, X-ray diffraction and electron-diffraction techniques. The covalent radius is measured approximately as the radius of an atom's core which is in contact with the core of an adjacent atom in a bonded situation. The Vander waals radius represents the overall size of the atom which includes its valence shell in a nonbonded situation.

1. Name the geometry involved in sp^3d hybridization.

2. Write the shape of AB_2E_3 type molecule.

3. What is the shape and hybrization of BF_3?

4. What is the shape and geometry of water?

    OR

Calculate the number of bond pair and lone pair in N of NO_3^-

4

SECTION E

31. The reaction $2C + O_2 \longrightarrow 2CO$ is carried out by taking 24.0 g of carbon and 96.0 g of O_2. Find out.

(a) Which reactant is left in excess?
(b) How much of it is left?
(c) How many grams of the other reactant should be taken so that nothing is left at the end of the reaction ?

$(1+2+2)$

OR

(a) What is the concentration of sugar ($C_{12}H_{22}O_{11}$) in mol L^{-1} if its 20 g are dissolved in enough water to make a final volume up to 2L?

$(2+3)$

(b) In three moles of ethane (C_2H_6), calculate the following:

(i) Number of moles of carbon atoms.
(ii) Number of moles of hydrogen atom
(iii) Number of molecules of ethane

$(3+2)$

32. (a) Draw orbital diagrams of the C_2H_4 and C_2H_2 molecules.
    (b) What is the total number of sigma and pi bonds in the following molecules?
       (i) hexanoic acid (ii) 2,3 dimethylpentane

OR

(a) Discuss the shape of the following molecules using the VSEPR model
   $BeCl_2$, BCl_3, $SiCl_4$, AsF_5, H_2S, PH_3

$(3+2)$

(b) Which out of NH_3 and NF_3 has higher dipole moment and why?

33. (a) Consider the element N, P, O and S and arrange them is order of:

(3)

(i) increasing 1st Ionisation Enthalpy.
(ii) increasing negative electron gain enthalpy.
(iii) increasing non-metallic character

(b) What is the trend of electronegativity in a group and period?

(2)

OR

(a) In what ways Bohr's model is better than Rutherford's model (with diagram).

(2)

(b) Draw the conclusions given by Bohr 's model?

(3)