ANANDALAYA
PERIODIC TEST - 2
Class: XI

Subject: Chemistry   MM :   70
Date   :   28-09-2022   Time: 3 hours

General Instructions:
1) There are 31 questions in the question paper. All questions are compulsory.
2) Section A – Question no. 1 to 4 are case – based questions having four MCQs or Assertion Reason type or very short answer type based on given passage each carrying 1 Mark.
3) Section B – Question 5 to 18 are MCQs and Assertion Reason type questions carrying 1 mark each.
4) Section C – Question 19 to 23 are short answer questions and carry 2 marks each.
5) Section D – Question 24 to 28 are long answer type [I] questions and carry 3 marks each.
6) Section E – Question 29 to 31 are long answer type [II] questions carrying 5 marks each.
7) There is no overall choice. However, internal choices have been provided
8) Use of calculators not permitted.

SECTION A

1.   Many people have a qualitative idea of what is meant by *concentration.* Anyone who has made instant coffee or lemonade knows that too much powder gives a strongly flavoured, highly concentrated drink, whereas too little results in a dilute solution that may be hard to distinguish from water. In chemistry, the concentration of a solution is the quantity of a **solute** that is contained in a particular quantity of **solvent** or solution. Knowing the concentration of solutes is important in controlling the stoichiometry of reactants for solution reactions. Chemists use many different methods to define concentrations like; Percentage concentrations, Molarity, Molality, Mole fraction, Parts per million etc.

Here, the picture is one of the brands of Rubbing alcohol is displayed. It is nothing but iso propyl alcohol. Which belongs to alcohol series of organic compounds. It has antiseptic property. The concentration in % v/v of it in water is also displayed in the picture. Just being with the picture, answer the following questions.

(i)   Which one the following is the correct interpretation of the concentration displayed here in   (1) this picture?

(A) 70 ml water contains 70 ml alcohol
(B) The molarity of the solution is 0.7 Molar
(C) 30 ml water contains 70 ml Alcohol
(D) The mole fraction of water is 0.7

(ii)   What volume of pure Alcohol is required if 500 ml of such rubbing alcohol solution is to be   (1)
       prepared?
       (A) 530 ml   (B) 700 ml   (C) 300 ml   (D) 350 ml

(iii) If the molarity of displayed rubbing alcohol is M_1 with volume V_1. If the V_2 volume of   (1)
       water is added in to this solution where $V_1 = V_2$, then what will the relation between the new
       Molarity M_2 and initial molarity M_1?
       (A) $M_1 = 2M_2$ (B) $M_2 = 2M_1$ (C) $M_1 = M2/V_1$ (D) $M_2 = M1/V_2$

(iv)   If the alcohol in its aqueous solution is having its mole fraction 0.6. What will be the mole   (1)
       fraction of water? (Density = 1 g/ml, Molecular mass of water is 18 g/mol)
       (A) 0.2   (B) 0.6   (C) 0.1   (D) 0.4

2.   When Schrödinger equation is solved for hydrogen atom, the solution gives the possible
       energy levels the electron can occupy and the corresponding wave function(s) (ψ) of the
       electron associated with each energy level.
       These quantized energy states and corresponding wave functions which are characterized by
       a set of **three quantum numbers** (principal quantum number n, azimuthal quantum number
       l and magnetic quantum number ml) arise as a natural consequence in the solution of the
       Schrödinger equation.
       The fourth quantum number is spin quantum number. An electron spins around its own axis,
       much in a similar way as earth spins around its own axis while revolving around the sun. In
       other words, an electron has, besides charge and mass, intrinsic spin angular quantum
       number. Spin angular momentum of the electron — a vector quantity, can have two
       orientations relative to the chosen axis. These two orientations are distinguished by the spin
       quantum numbers m_s which can take the values of +½ or –½. These are called the two spin
       states of the electron and are normally represented by two arrows, ↑ (spin up) and ↓ (spin
       down).
       The number of electrons to be filled in various orbitals is restricted by the exclusion
       principle. According to this principle: No two electrons in an atom can have the same set of
       four quantum numbers.
       This is just as "It is impossible to have exactly the same kind of people you want around
       you". Somewhere or somewhen they are different than you. They are not going to be just as
       like You. That is why it is said that Accept the person and the situation as they are.
       As the electrons cannot have all four quantum numbers same. Some way they are different.

       Answer the following questions on the basis of the quantum numbers.

(i)   How many electrons can fit in the orbital for which n = 3 and l = 1?   (1)
       (A) 2   (B) 6   (C) 10   (D) 14
(ii)   What will be the total number of radial nodes in 3p orbitals?   (1)
       (A) 3   (B) 2   (C) 1   (D) 0
(iii) For which of the following set of four quantum numbers, an electron will have the highest   (1)
       energy?

	n	l	m_l	m_s
1	4	2	-1	+1/2
2	4	1	0	-1/2
3	4	2	-1	-1/2
4	5	0	0	-1/2

       (A) 1   (B) 2   (C) 3   (D) 4
(iv)   Define: Degenerate orbitals   (1)

3. Modern periodic table arranges the elements in the increasing order of atomic number. It has 18 groups and 7 periods. Atomic numbers are consecutive in a period and increases in group in a pattern. Elements are divided into four blocks, s-block, p-block, d-block and f-block based on their electronic configuration. 78% of elements are metals, about 20 elements are non-metals and few elements like B, Si, Ge, As are metalloids. Metallic character increases down the group but decreases along the period from left to right. The physical and chemical properties vary periodically with their atomic numbers.

Periodic trends are observed in atomic size, ionisation enthalpies, electron gain enthalpies, electronegativity and valence. Oxides of metals are basic, some are amphoteric. Non-metals form acidic oxides, some form neutral oxides. s-block elements are soft, highly reactive, do not show variable oxidation states. p-block elements are metals, non-metals as well as metalloids, show variable oxidation states, exist as solids, liquids and gases. d-block elements are metals, form coloured ions, show variable oxidation states, have high melting and boiling points. Lanthanoids and actinoids are f-block elements, form coloured ions. All actinoids are radioactive.

(i)   Name the elements which belong to d-block but are not transition metals.   (1)
(ii) What are representative elements?   (1)
(iii) Which group elements are most electropositive and why?   (1)
(iv) Mention two possible oxidation states of p – block elements on the basis of their common   (1)
      electronic configuration

4. According to wave mechanics, the atomic orbitals can be expressed by wave functions (ψ 's) which represent the amplitude of the electron waves. These are obtained from the solution of Schrödinger wave equation. However, since it cannot be solved for any system containing more than one electron, molecular orbitals which are one electron wave functions for molecules are difficult to obtain directly from the solution of Schrödinger wave equation. To overcome this problem, an approximate method known as linear combination of atomic orbitals (LCAO) has been adopted. The common diagram is represented below.
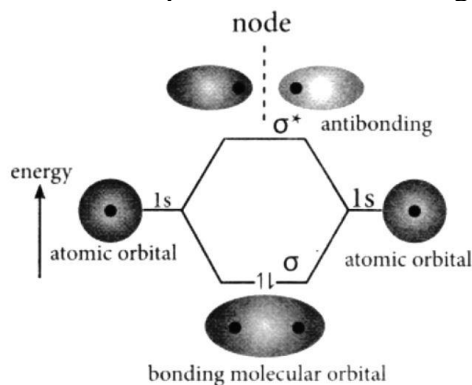
The linear combination of atomic orbitals to form molecular orbitals takes place only if the following conditions are satisfied:
1. The combining atomic orbitals must have the same or nearly the same energy.
2. The combining atomic orbitals must have the same symmetry about the molecular axis.
3. The combining atomic orbitals must overlap to the maximum extent.
Considering the Molecular orbital theory of Homo Nuclear diatomic Molecules, answer the following questions as asked.

(i) Which one of the following would be paramagnetic as per M.O.T?   (1)
     (A) O_2^{-2} (B) N_2 (C) H_2 (D) O_2

(ii) Which of the following molecular orbitals possess minimum energy?   (1)
     (A) $\sigma 2p_z$ (B) $\sigma 1s$ (C) $\sigma 2s^*$ (D) $\pi 2p_x$

(iii) Compare the relative stability of the following species (1)
O_2, O_2^+, O_2^- (Superoxide), O_2^{2-} (peroxide)

(iv) Draw the M.O. diagram for Be_2 molecule with proper labelling. (1)

## SECTION B

5. How many grams of HNO_3 should be dissolved in water to prepare a 500 ml aqueous (1)
solution of 2 M HNO_3? (At. Mass of H = 1u, N = 14u, O = 16u)
(A) 6.3 g   (B) 63 g   (C) 126 g   (D) 12.6 g

6. A hypothetical electromagnetic wave is shown in figure. What will be the wavelength of the (1)
radiation for this?
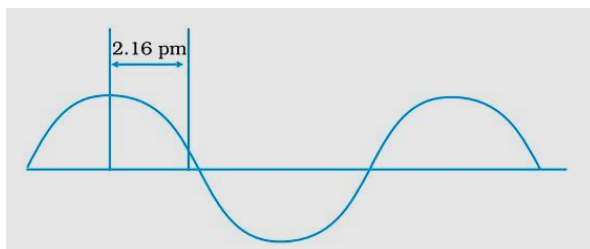
(A) 2.16 pm   (B) 4.32 pm   (C) 43.2 pm   (D) 8.64 pm

7. The quantity of energy absorbed or released by an electron when moving from one orbit to (1)
another is…………
(A) Variable   (B) Discrete   (C) Increases   (D) Decreases

8. What is the energy of an electron of hydrogen atom in the state n = 2? (1)
(A) -2.18×10^{-18} J   (B) 2.18×10^{-18} J   (C) -0.545×10^{-18} J   (D) 0.545×10^{-18} J

9. The number of elements in fifth period of periodic table is: (1)
(A) 8   (B) 32   (C) 18   (D) 14

10. **AlCl₃** is an electron deficient compound but **AlF₃** is not. This is because: (1)

(A) The atomic size of F is smaller than Cl which makes **AlF₃** more covalent.
(B) **AlCl₃** is a covalent compound while **AlF₃** is an ionic compound.
(C) **AlCl₃** exists as dimer but **AlF₃** does not.
(D) Al in **AlCl₃** is sp³ hybrid state but Al in **AlF₃** is in sp² state.

11. Which order is true with reference to size of species? (1)
(A) $Pb < Pb^{2+} < Pb^{4+}$
(B) $Pb^{4+} > Pb^{2+} > Pb$
(C) $Pb > Pb^{2+} > Pb^{4+}$
(D) $Pb^{2+} < Pb < Pb^{4+}$

12. Which element of the followings may have the values of its successive ionisation enthalpies (1)
as follows?
$$\Delta_i H_1 = 740 \text{ kJ mol}^{-1}, \Delta_i H_2 = 1440 \text{ kJ mol}^{-1}, \Delta_i H_3 = 7850 \text{ kJ mol}^{-1}$$
(A) Al   (B) Mg   (C) S   (D) P

13. Which of the following figure is projected incorrectly? (1)

(A) s-block   (B) p-block   (C) f-block   (D) d-block
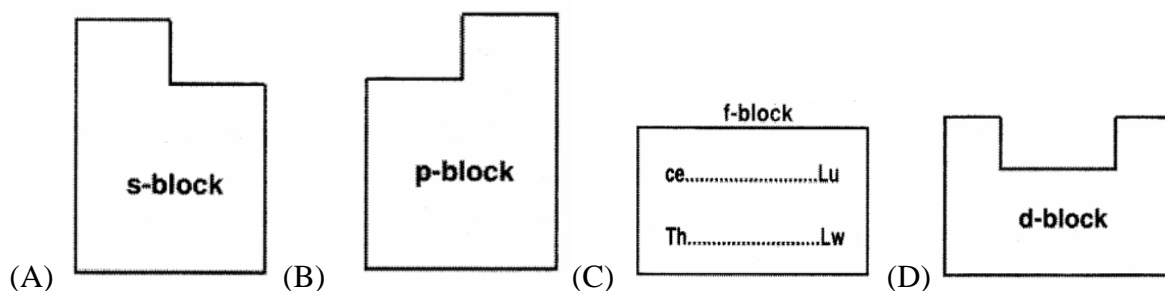
14. Which of the following will not result in the formation of bond?

(A)   (B)   (C)   (D)
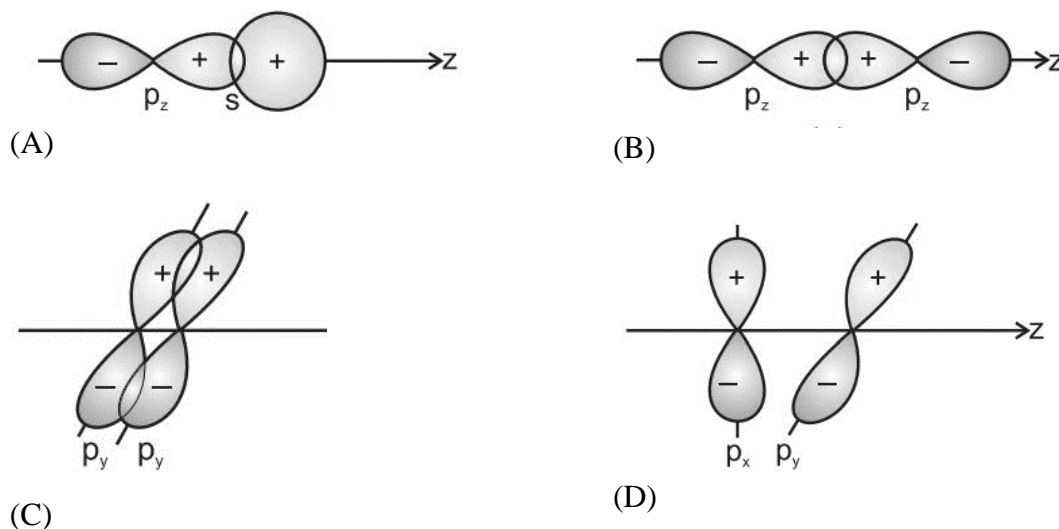
15. Which has strongest H-bond?
(A) H_2O (B) NH_3 (C) HF   (D) H_2S

Q. 16 to Q.18 are Assertion and Reasoning type Questions. Select the appropriate option form below.
(A)   Assertion and reason both are correct and reason is correct explanation of assertion.
(B)   Assertion and reason both are correct statements but reason is not correct explanation of assertion.
(C)   Assertion is correct but reason is wrong statement.
(D)   Assertion is wrong but reason is correct statement.

16. **Assertion**: If one mole of solute dissolved in water then Molarity and Molality of the (1)
solution will have the same value.
Reason: The density of water is 1 g/ml. So, it's volume equals mass.

17. **Assertion**: BF_3 molecule is polar in nature (1)
**Reason**: All the molecules containing polar covalent bonds are not always polar in nature.

18. **Assertion:** Electronegativity of an element is not constant. It is variable. (1)
Reason: As it depends upon the atom to which the desired element attached.

SECTION C – 2 Marks

19. Thomas Edison patented -- first in 1879 and then a year later in 1880 -- and began commercializing his incandescent light bulb. (2)
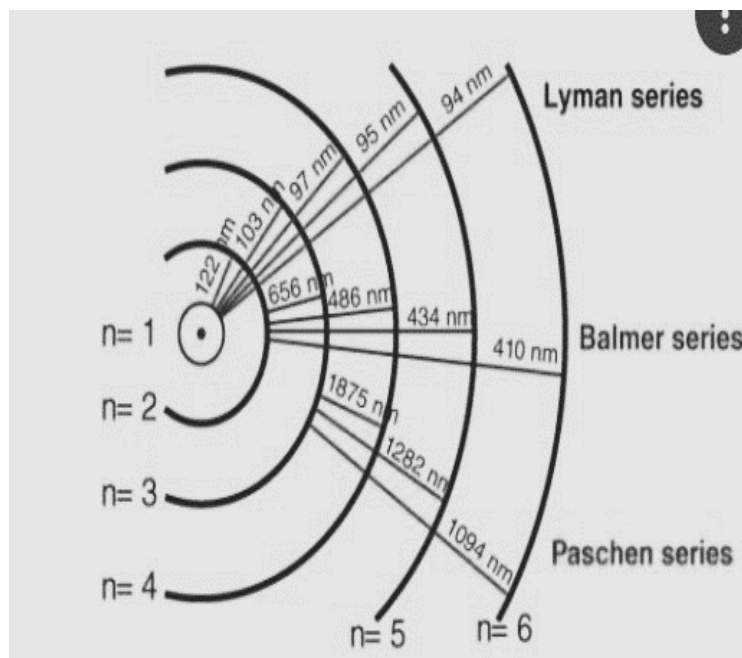
A bulb emits electro-magnetic light of wavelength 400 nm. The capacity of the bulb is 100 watt. Calculate the number of photons emitted per second by the bulb.
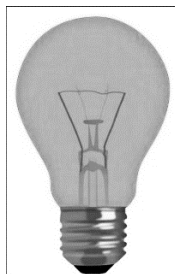
OR

The mass number on an ion is 37, possess one unit of negative charge. If the ion contains 11.1% more neutrons than the electrons, find the symbol of the ion.

20. (2)

Observe the picture and answer the following questions.

a) What will be the total number of spectral lines when electron transit in Paschen series from higher level n = 6?

b) In the spectra of hydrogen, we are getting the light of longest wavelength in lyman series, what will be the excited state n_2 and what will be the ground state n_1?

21. A certain substance is covered with a piece of paper. The mass of piece of paper is 0.02 g and the total mass of a solid substance and the piece of paper is 20.036 g. If the volume of the solid is 2.16 cm^3, calculate the density of the substance up to proper number of significant figures. (2)

22. (a) What will be the volume of O_2 at STP necessary for the combustion of 4-gram methane gas? (2)

(b) What will be the number of moles of NO formed When 1 mole ammonia and 1 mole of O_2 is mixed? (At masses of N = 14u, H = 1u, O = 16u)

$$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(l)$$
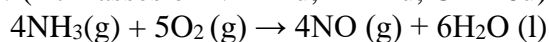
23. How would you explain the fact that the first ionization enthalpy of sodium is lower than that of magnesium but its second ionization enthalpy is higher than that of magnesium? (2)

SECTION D – 3 Marks

24. The density of 3 M solution of NaCl is 1.25 g mL–1. Calculate the molality of the solution. (3)
    (At. Mass of Na = 23u, Cl = 35.5u)

25. (a) Write down the electronic configuration of copper. (3)
    (b) Calculate the radius in picometer of Bohr's fifth orbit for hydrogen atom.
    (c) Out of electron and proton which one will have higher velocity to produce matter wave of the same wave length? Explain how?

    OR

    (a) Table-tennis ball has a mass 10 g and a speed of 90 m/s. If speed can be measured within an accuracy of 4% what will be the uncertainty in speed and position?
    (b) Justify the statement with the help of a suitable example.
       The effect of uncertainty principle is significant only for motion of microscopic particles and is negligible for the macroscopic particles.

26. The threshold frequency ν_0 for a metal is 7.0×10^{14} s^{-1}. Calculate the kinetic energy of an electron emitted when radiation of frequency $\nu = 1.0 \times 10^{15}$ s^{-1} hits the metal. (3)

27. (a) Write the general electronic configuration of p-block elements? (3)
    (b) Assign the position of the clement having outer electronic configuration
    $$(n - 1) \, d^2 \, ns^2 \text{ for } n = 4$$
    (c) Write the name and deduce the atomic number of 4th noble gas.

28. (a) Describe the change in hybridisation (if any) of the Al atom in the following reaction. (3)
    $$AlCl_3 + Cl^- \rightarrow AlCl_4^-$$

    (b) State any one postulate of VSEPR theory.

    OR

    (a) Is there any change in the hybridisation of B and N atoms as a result of the following reaction?
    $$BF_3 + NH_3 \rightarrow F_3 B.NH_3$$
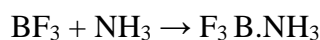
    (b) Out of NaCl and NaBr, which one is more co-valent in Nature?

SECTION E – 5 Marks

29. (a) How many significant figures are present in following expression? (5)
       (i) 0.0025 (ii) 600.0
    (b) Vitamin C is known to contain 1.29×10^{24} hydrogen atoms. Calculate the number of moles of hydrogen atoms. (At. Mass of H = 1u)
    (c) 56 kg of N_2(g) and 10 kg of H_2(g) are mixed to produce NH_3(g). Calculate the number of moles of ammonia gas formed. (Atomic mass/g mol^{-1} N = 14, H = 1)

30. (a) Which of the following would have a move negative electron gain enthalpy? Why?
       F or Cl.
    (b) Arrange the elements N, P, O and S in the order of
       (i) increasing first ionization enthalpy.
       (ii) increasing non-metallic character.
       Give reason for the arrangement assigned.

OR

(a) Addition of an electron to an alkali metal is slightly exothermic whereas addition of an electron to an alkaline earth metal is endothermic. Explain
(b) Mention the co-valency of Al in $[Al\ Cl\ (H_2O)_5]^{2+}$.
(c) What is the atomic number of the element having maximum number of unpaired 2p- electrons?
(d) State reason: Mg^{+2} has smaller size than O^{-2} even both have same number of electrons.

31.   (a) Structures of molecules of two compounds are given below: 5

(I)   (II)
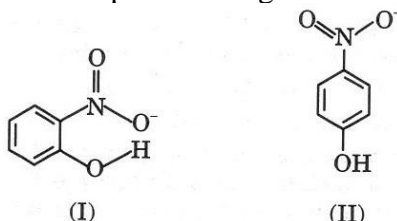
(i) Which of the two compounds will have intermolecular hydrogen bonding?
(ii) Which of the above two compounds will show higher melting point?

(b)
(i) Explain the hybridization present in NH_3 molecule.
(ii) On the basis of Hybridization concept, give one point of similarity and one point of difference between NH_3 and H_2O

OR

(a) Which out of NH_3 and NF_3 has higher dipole moment and why?
(b) What is the
(i) shape of C_2H_2 molecule
(ii) What is the hybridization of Carbon present in this molecule

(c) All the C—O bonds in carbonate ion ($CO_3{}^{2-}$) are equal in length. Explain.