



विद्या सर्वार्थ साधिका

ANANDALAYA  
PERIODIC TEST - 2  
Class: XI

Subject: Chemistry (043)

Date : 30-09-2024

MM: 70

Time: 3 hours

**General Instructions:**

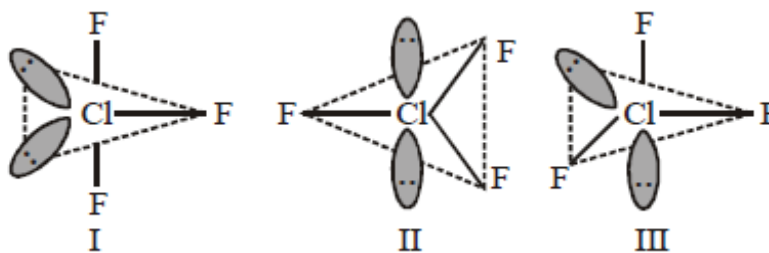
Read the following instructions carefully.

- (a) There are 33 questions in this question paper with internal choice.
- (b) SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
- (c) SECTION B consists of 5 short answer questions carrying 2 marks each.
- (d) SECTION C consists of 7 short answer questions carrying 3 marks each.
- (e) SECTION D consists of 2 case-based questions carrying 4 marks each.
- (f) SECTION E consists of 3 long answer questions carrying 5 marks each.
- (g) All questions are compulsory. Use of log tables and calculators is not allowed.

**SECTION A**

1. What is the mass of 1.5 mL solution in correct significant figures, if the density of the solution is  $3.12 \text{ g mL}^{-1}$ ? (1)  
(A) 4.7 g (B)  $4680 \times 10^{-3} \text{ g}$  (C) 4.680 g (D) 46.80 g
2. 10 g of hydrogen and 64 grams of oxygen were allowed to react. What is the amount of water formed in this reaction? (1)  
(A) 4 mol (B) 2 mol (C) 3 mol (D) 1 mol
3. The empirical formula of this compound is  $\text{CH}_2$ . One mole of this compound weighs 42 grams. What is its molecular formula? (1)  
(A)  $\text{C}_3\text{H}_6$  (B)  $\text{CH}_2$  (C)  $\text{C}_3\text{H}_8$  (D)  $\text{C}_2\text{H}_2$
4. Volume of water need to be added with 10 mL of 10 M  $\text{HNO}_3$  to get 0.1 M  $\text{HNO}_3$  is \_\_\_\_\_. (1)  
(A) 990 mL (B) 10 mL (C) 1000 mL (D) 1010 mL
5. The Heisenberg uncertainty principle will be most significant for which of the following objects? (1)  
(A) Object A of mass  $9.11 \times 10^{-30} \text{ kg}$  (B) Object B of mass  $9.11 \times 10^{-28} \text{ g}$   
(C) Object C of mass  $9.11 \times 10^{-24} \text{ mg}$  (D) Object D of mass  $9.11 \times 10^{-28} \text{ kg}$
6. The third line of the Balmer series in the emission spectrum of the hydrogen atom is due to the transition from the \_\_\_\_\_. (1)  
(A) fourth Bohr orbit to the first Bohr orbit (B) fifth Bohr orbit to the second Bohr orbit  
(C) sixth Bohr orbit to the third Bohr orbit (D) seventh Bohr orbit to the third Bohr orbit
7. The deBroglie wavelength of a car of mass 1000 kg and velocity 36 km/hr is \_\_\_\_\_. (1)  
(A)  $6.626 \times 10^{-38} \text{ m}$  (B)  $6.626 \times 10^{-30} \text{ m}$  (C)  $6.626 \times 10^{-34} \text{ m}$  (D)  $6.626 \times 10^{-31} \text{ m}$
8. Which pair of compounds have odd number of electrons in the group NO, CO,  $\text{ClO}_2$ ,  $\text{N}_2\text{O}_5$ ,  $\text{SO}_2$ ,  $\text{O}_3$ ? (1)  
(A) NO,  $\text{ClO}_2$  (B) CO,  $\text{SO}_2$  (C)  $\text{SO}_2$ ,  $\text{O}_3$  (D) None of these

9. Arrange the following in increasing order of covalent character: (1)  
 (i) NaCl (ii) RbCl (iii) MgCl<sub>2</sub> (iv) AlCl<sub>3</sub>  
 (A) (ii), (i), (iii), (iv) (B) (i), (ii), (iii), (iv) (C) (iv), (ii), (i), (iii) (D) (iii), (i), (ii), (iv)
10. Which set of four quantum numbers corresponds to an electron in a 4p orbital? (1)  
 (A)  $n = 4, l = 1, m_l = 0, m_s = 1$  (B)  $n = 4, l = 3, m_l = 3, m_s = -1$   
 (C)  $n = 4, l = 2, m_l = 0, m_s = 1$  (D)  $n = 4, l = 4, m_l = 3, m_s = -1$
11. Which species is diamagnetic? (1)  
 (A) Cr<sup>2+</sup> (Atomic no = 24) (B) Zn (atomic no = 30)  
 (C) Mn (atomic no = 25) (D) C (atomic no = 6)
12. Which of the following structures is most stable? Choose the correct option. (1)



- (A) only I (B) only II (C) only III (D) all the three have same stability

Select the most appropriate answer for the Assertion (A) and reason (R) from the options given below for questions 13-16.

- (A) Both A and R are true and R is the correct explanation of A  
 (B) Both A and R are true but R is not the correct explanation of A.  
 (C) A is true but R is false.  
 (D) A is false but R is true.

13. (A): Cu<sup>+</sup> is less stable than Cu<sup>2+</sup> but Fe<sup>3+</sup> is more stable than Fe<sup>2+</sup>. (1)  
 (R): Half-filled and completely filled subshells are more stable.
14. (A): IF<sub>7</sub> has sp<sup>3</sup>d<sup>3</sup> hybridization (1)  
 (R): It has octahedral structure
15. (A): Metallic character decreases and non-metallic character increases on moving from left to right in a period. (1)  
 (R): It is due to increase in ionisation enthalpy and decrease in electron gain enthalpy, when one moves from left to right in a period.
16. (A): The metallic radius of Na is 1.86 Å and the ionic radius of Na<sup>+</sup> is lesser than 1.86 Å (1)  
 (R): Ions are always smaller in size than the corresponding elements.

## SECTION B

17. The density of water at room temperature is 0.1 g/mL. How many drops of water are there in a drop of water if its volume is 0.05 mL (2)
18. What is the total number of sigma and pi bonds in the molecules (a) C<sub>2</sub>H<sub>2</sub> and (b) C<sub>2</sub>H<sub>4</sub> ? (2)
19. 500 mL of CO<sub>2</sub> molecules contain 6 × 10<sup>23</sup> molecules. How many molecules of NH<sub>3</sub> will be present in 2500 mL of NH<sub>3</sub> at the same temperature and pressure? (2)
20. A nitrogen gas laser pulse with a wavelength of 337 nm contains 3.83 mJ of energy. How many photons does it contain? (2)

OR

The energy required to dislodge electrons from sodium metal via the photoelectric effect is 275 kJ/mol. What wavelength in nm of light has sufficient energy per photon to dislodge an electron from the surface of sodium?

21. Write the electronic configuration of chromium and copper and account for its exceptional configuration. (2)

### SECTION C

22. Zinc metal reacts with dilute HCl to liberate hydrogen gas. What volume of hydrogen gas liberated at STP when 32.65 g of zinc reacts with HCl? 1 mole of a gas occupies 22.7 L volume at STP, atomic mass of Zn = 63.5 u. (3)
23. (a) What is the main difference between electromagnetic wave theory and Planck's quantum theory? (3)  
(b) State Hund's rule.  
(c) Bohr's orbits are called stationary orbits or states. Comment.
24. (a) Explain why atomic radius decreases as we move to the right across a period for main-group elements but not for transition elements. (3)  
(b) Both vanadium (atomic no. 23) and its  $3^+$  ions are paramagnetic. Use electron configurations to explain this statement.
25. (a) The electron affinity (electron gain enthalpy) of sodium is lower than that of lithium, while the electron affinity of chlorine is higher than that of fluorine. Suggest an explanation for this observation. (3)  
(b) Arrange this isoelectronic series in order of decreasing radius:  $F^-$ , Ne,  $O^{2-}$ ,  $Mg^{2+}$ ,  $Na^+$ .
26. (a) Predict the geometry and bond angles of  $PCl_3$ . (3)  
(b) Predict the geometry about each interior atom in methanol  $CH_3OH$   
(c) Determine if  $CF_4$  is polar or non-polar.
27. In  $N_2O$ , nitrogen is the central atom and the oxygen atom is terminal. In  $OF_2$ , however, oxygen is the central atom. Use formal charges to explain why? (3)
28. Determine the wavelength of light emitted when an electron in a hydrogen atom makes a transition from an orbital in  $n = 6$  to an orbital in  $n = 5$ . (3)

### SECTION D

29. Solving Chemical Problems: Learning to solve problems is one of the most important skills you will acquire in this course. Many of the problems you will solve can be thought of as unit conversion problems, where you are given one or more quantities and asked to convert them into different units. To solve any problem, you need to assess the information given in the problem and devise a way to get to the information asked for. In other words, you must: (4)

- Identify the starting point (the given information).
- Identify the end point (what you must find).
- Devise a way to get from the starting point to the end point using what is given as well as what you already know or can look up.

(We call this the conceptual plan.) In graphic form, we can represent this progression as

Given -----? Conceptual Plan -----? Find

While no problem-solving procedure is applicable to all problems, the following four-step procedures can be helpful in working through many of the numerical problems you will encounter.

**SORT:** Begin by sorting the information in the problem into Given and Find.

**STRATEGIZE:** Devise a conceptual plan for the problem. Begin with the given quantity and symbolize each conversion step with an arrow. Below each arrow, write the appropriate conversion factor for that step. Focus on the units.

**SOLVE:** Follow the conceptual plan. Begin with the given quantity and its units. Multiply by the appropriate conversion factor(s), cancelling units, to arrive at the find quantity.

**CHECK:** Check your answer. Are the units correct? Does the answer make sense?

Answer the following questions based on conversion of units?

- (a) Convert 1.76 yards to centimetres. ( $1.094 \text{ yd} = 1 \text{ m}$ ) (1)  
(b) Convert 1.8 quarts to cubic centimetres. ( $1.057 \text{ qt} = 1 \text{ L}$ ) (1)

- (c) Calculate the displacement (the total volume of the cylinders through which the pistons move) of a 5.70-L automobile engine in cubic inches. (2)

**OR**

- (c) The mass of fuel in a jet must be calculated before each flight to ensure that the jet is not too heavy to fly. A 747 is fuelled with 173,231 L of jet fuel. If the density of the fuel is  $0.768 \text{ g/cm}^3$ , what is the mass of the fuel in kilograms? (2)

30. An ionic compound has 3-D crystal lattice in which positive and negative charges are equal. (4)  
The crystal lattice is stabilised by enthalpy of lattice formation, bond length, bond angle, bond enthalpy, bond order and bond polarity have significant effect on properties of compounds. All the properties of certain compounds cannot be explained by a single structure, more than one structure of a compound to explain its property are called resonating structures.  
Dipole moment depends upon polarity and shapes of molecules. Shapes of molecules can be determined by VSEPR theory as well as hybridisation  $sp$ ,  $sp^2$ ,  $sp^3$ ,  $sp^3d$ ,  $sp^3d^2$  are linear, trigonal planar, tetrahedral, trigonal bipyramidal and octahedral geometry respectively. Hydrogen bond is formed between hydrogen and F, O, N. Intramolecular H-bonding is within the molecules which is weaker than intermolecular H-bonding, between the molecules.

Answer the following questions:

- (a) (i) Why does  $\text{CO}_2$  have zero dipole moment? (2)  
(ii) Why are sigma bonds stronger than pi bonds?

**OR**

- (a) (i) What is hybridisation of 'S' in  $\text{SF}_6$  and its shape? (2)  
(ii) Arrange  $\text{NaCl}$ ,  $\text{NaBr}$ ,  $\text{NaF}$ ,  $\text{NaI}$  in increasing order of ionic character.  
(b) Why is the bond angle in  $\text{H}_2\text{O}$  more than  $\text{H}_2\text{S}$ ? (1)  
(c) Why is o-nitrophenol steam volatile, p-nitrophenol is not? (1)

### SECTION E

31. Answer the following: (5)  
(a) Electronegativity of elements increases on moving from left to right in the periodic table. Give reason.  
(b) Ionisation enthalpy decreases in a group from top to bottom. Why?  
(c) Arrange the elements N, P, O and S in the increasing order of-  
(i) first ionisation enthalpy. (ii) non-metallic character.  
Give reason for the arrangement assigned.
32. (a) Draw an MO energy diagram and determine the bond order for the  $\text{N}_2^-$  ion. Do you expect the bond in the  $\text{N}_2^-$  ion to be stronger or weaker than the bond in the  $\text{N}_2$  molecule? Is  $\text{N}_2^-$  diamagnetic or paramagnetic? (5)  
(b) Write the hybridization and shape for  $\text{XeF}_4$ .

**OR**

- (a) Apply valence bond theory to write a hybridization and bonding scheme (shape) for ethene,  $\text{H}_2\text{C}=\text{CH}_2$ .  
(b) Compare the relative stabilities of following species on the basis of molecular orbital theory and arrange them in increasing order of their stabilities.  $\text{O}_2$ ,  $\text{O}_2^+$ ,  $\text{O}_2^-$ ,  $\text{O}_2^{2-}$
33. (a) How did the photoelectric effect lead Einstein to propose that light is quantized? (5)  
(b) How did the Bohr model account for the emission spectra of atoms?  
(c) What are the possible values of the angular momentum quantum number ' $l$ '? What does the angular momentum quantum number determine?

**OR**

- (a) Explain Heisenberg's uncertainty principle.  
(b) Why does the uncertainty principle make it impossible to predict a trajectory for the electron?  
(c) What are the possible values of the magnetic quantum number ' $m_l$ '? What does the magnetic quantum number determine?