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CUMULATIVE EXAMINATION (2023-24)
CLASS-XI
SUBJECT – CHEMISTRY (043)

MM: 70

Time: 03 Hours

General Instructions:

Read the following instructions carefully.

- *There are 33 questions in this question paper with internal choice.*
- *Section A consists of 16 multiple choice questions carrying 1 mark each.*
- *Section B consists of 5 very short answer questions carrying 2 mark each.*
- *Section C consists of 7 short answer questions carrying 3 marks each.*
- *Section D consists of 2 case based questions carrying 4 marks each.*
- *Section E consists of 3 long answer questions carrying 5 marks each.*
- *All questions are compulsory.*
- *Use of calculators is not permitted.*

SECTION A

The following questions are multiple choice questions with one correct answer. Each question carries one mark. There is no internal choice in this section.

1. If the concentration of glucose ($C_6H_{12}O_6$) in blood is 0.9 g L^{-1} , what will be the molarity of glucose in blood?
 - (i) 5 M
 - (ii) 50 M
 - (iii) 0.005 M
 - (iv) 0.5 M
2. What will be the molality of the solution containing 18.25 g of HCl gas in 500 g of water?
 - (i) 0.1 m
 - (ii) 1 M
 - (iii) 0.5 m
 - (iv) 1 m
3. The number of radial nodes for 3p orbital is _____.
 - (i) 3
 - (ii) 4
 - (iii) 2
 - (iv) 1

4. Total number of orbitals associated with third shell will be _____.
- (i) 2
 - (ii) 4
 - (iii) 9
 - (iv) 3
5. The first ionization enthalpies of Na, Mg, Al and Si are in the order:
- (i) $\text{Na} < \text{Mg} > \text{Al} < \text{Si}$
 - (ii) $\text{Na} > \text{Mg} > \text{Al} > \text{Si}$
 - (iii) $\text{Na} < \text{Mg} < \text{Al} < \text{Si}$
 - (iv) $\text{Na} > \text{Mg} > \text{Al} < \text{Si}$
6. The correct order of amount of energy released in electron gain (electron gain enthalpy) for halogens is:
- (i) $\text{F} > \text{Cl} > \text{Br} > \text{I}$
 - (ii) $\text{F} < \text{Cl} < \text{Br} < \text{I}$
 - (iii) $\text{F} < \text{Cl} > \text{Br} > \text{I}$
 - (iv) $\text{F} < \text{Cl} < \text{Br} < \text{I}$
7. Which of the following statements is not true?
- (i) Elements of a group exhibit similar chemical behavior.
 - (ii) Elements of a group have same distribution of electrons.
 - (iii) The elements in a vertical column of periodic table constitute a group.
 - (iv) Elements of a group have same number of shells.
8. Which of the following is a d block element?
- (i) Carbon
 - (ii) Chromium
 - (iii) Lithium
 - (iv) Strontium
9. Which molecule/ion out of the following does not contain unpaired electrons?
- (i) N_2^+
 - (ii) O_2
 - (iii) O_2^{2-}
 - (iv) B_2

10. Geometry of BF_3 is-

- (i) square planar
- (ii) trigonal planar
- (iii) tetrahedral
- (iv) linear

11. Choose the correct option for free expansion of an ideal gas under adiabatic condition from the following.

- (i) $q = 0, \Delta T \neq 0, w = 0$
- (ii) $q \neq 0, \Delta T = 0, w = 0$
- (iii) $q = 0, \Delta T = 0, w = 0$
- (iv) $q = 0, \Delta T < 0, w \neq 0$

12. Which of the following is not correct?

- (i) ΔG is zero for a reversible reaction
- (ii) ΔG is positive for a spontaneous reaction
- (iii) ΔG is negative for a spontaneous reaction
- (iv) ΔG is positive for a non-spontaneous reaction

13. Given below are two statements labelled as Assertion (A) and Reason (R).

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.

Select the most appropriate answers from the options given below.

- i. Both A and R are true and R is correct explanation of A.
- ii. Both A and R are true but R is not the correct explanation of A.
- iii. A is true but R is false.
- iv. A is false but R is true.

14. Given below are two statements labelled as Assertion (A) and Reason (R).

Assertion: For $l=2$, the minimum value of principal quantum number is $n=3$.

Reason: The value of 'l' cannot be greater than 'n'.

Select the most appropriate answers from the options given below.

- i. Both A and R are true and R is correct explanation of A.
- ii. Both A and R are true but R is not the correct explanation of A.
- iii. A is true but R is false.
- iv. A is false but R is true.

15. Given below are two statements labelled as Assertion (A) and Reason (R).

Assertion: A carbon- carbon double bond has shorter bond length than carbon-carbon single bond.

Reason: Bond length decreases with increase in number of bonds between the bonded atoms.

Select the most appropriate answers from the options given below.

- i. Both A and R are true and R is correct explanation of A.
- ii. Both A and R are true but R is not the correct explanation of A.
- iii. A is true but R is false.
- iv. A is false but R is true.

16. Given below are two statements labeled as Assertion (A) and Reason (R).

Assertion: The entropy of a purely crystalline substance approaches zero as the temperature approaches absolute zero.

Reason: At absolute zero, there is perfect order in the crystal.

Select the most appropriate answers from the options given below.

- i. Both A and R are true and R is correct explanation of A.
- ii. Both A and R are true but R is not the correct explanation of A.
- iii. A is true but R is false.
- iv. A is false but R is true.

SECTION B

This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry two marks each.

17. Define molarity. How much NaOH will be required to prepare 0.2 M solution of NaOH in 250 ml of water?

18. Explain why the electron gain enthalpy of fluorine is less negative than that of chlorine.

19. Among the elements B, Al, C and Si,

(i) Which element has the highest first ionization enthalpy?

(ii) Which element has the most metallic character?

20. Differentiate between extensive and intensive properties.

OR

The enthalpy of atomization for the reaction $\text{CH}_4(\text{g}) \rightarrow \text{C}(\text{g}) + 4\text{H}(\text{g})$ is 1665 KJ/mol. What is the bond energy of C-H bond?

21. One mole of acetone requires less heat to vaporize than 1 mole of water. Which of the two liquids has a higher enthalpy of vaporization?

OR

Derive the following relationship $\Delta H = \Delta U + \Delta n_g RT$

SECTION C

This section contains 7 questions with internal choice in one question. The following questions are short answer type questions and carry 3 marks each.

22. Which reactant is in limiting reagent when 35.0g of hydrogen is reacted with 276g of oxygen to form water?
23. Calculate the mass per cent of different elements present in sodium sulphate (Na_2SO_4).
(Na=23g, S=32g, O=16g)
24. What are the frequency and wavelength of photon emitted during a transition from $n=5$ to $n=2$ in hydrogen atom?

OR

- (i) Draw the shapes of s, p, d, f orbitals.
- (ii) Write down the valence shell electronic configuration of-
- a) Cu (Atom no.=29) b) Cr^{3+} ion (Atom no.= 24)
25. (i) First ionization enthalpy of sodium is lower than that of magnesium but its second ionization enthalpy is higher than that of magnesium. Explain.
- (ii) Nitrogen has positive electron gain enthalpy whereas oxygen has negative electron gain enthalpy. Explain.
26. The equilibrium constant for a reaction is 10. What will be the value of standard Gibb's free energy change? ($R=8.314 \text{ JK}^{-1}\text{mol}^{-1}$, $T= 300 \text{ K}$)
27. Predict the geometry and hybridization of the following molecules.
 CH_4 , CO_2 , NH_3
28. Use periodic table to answer the following questions:
- (i) Identify the element with five electrons in the outer subshell.
- (ii) Identify the element that would tend to lose two electrons.
- (iii) Identify the element that would tend to gain two electrons.

SECTION D

The following questions are case-based questions. Each question has an internal choice and carries 4 (1+1+1+1) marks each. Read the passage carefully and answer the questions that follow.

29. During chemical bonding, when the atoms come closer to each other, the attraction takes place between them, and the potential energy of the system keeps on decreasing till a particular distance at which the potential energy is minimum. If the atoms come closer, repulsion starts, and again, the potential energy of the system begins to increase.
- At equilibrium distance, the atoms keep on vibrating about their mean position. The equilibrium distance between the centres of the nuclei of the two bonded atoms is called its bond length. It is expressed in terms of an angstrom (A^0) or picometer (pm). It is determined experimentally by x-ray diffraction or electron diffraction method, or spectroscopic method. The bond length in

chemical bonding is the sum of the ionic radii in an ionic compound. In a covalent compound, it is the sum of its covalent radii. For a covalent molecule AB, the bond length is given by $d = r_a + r_b$

Answer the following questions-

(i) Covalent bonds are directional bonds while ionic bonds are non-directional. Comment.

OR

Ethyne molecule is a linear molecule. Comment.

(ii) Give the relationship between bond length and bond order.

(iii) Arrange the following bonds in order of increasing ionic character giving reason.

N – H, F – H, C – H and O – H

(iv) Define Bond length with example?

30. The particle nature of light posed a dilemma for scientists. On the one hand, it could explain the black body radiation and photoelectric effect satisfactorily but on the other hand, it was not consistent with the known wave nature of light which could account for the phenomena of interference and diffraction. The only way to resolve the dilemma was to accept the idea that light possesses both particle and wave-like properties, i.e., light has dual behavior. Depending on the experiment, we find that light behaves either as a wave or as a stream of particles. Whenever radiation interacts with matter, it displays particle like properties in contrast to the wavelike properties (interference and diffraction), which it exhibits when it propagates. This concept was totally alien to the way the scientists thought about matter and radiation and it took them a long time to become convinced of its validity.

Answer the following questions-

(i) As per the photoelectric effect which thoroughly propagated the particle nature of light, what would happen if we increase the intensity of light falling on the metal surface?

(ii) Why is the wavelength of a large particle like tennis ball is not visible?

(iii) According to de Broglie, the matter should exhibit dual behaviour, that is, both particle and wave like properties. However, a cricket ball of mass 100 g does not move like a wave when it is thrown by a bowler at a speed of 100 km/h. Calculate the wavelength of the ball .

(iv) Explain why a cricket ball does not show wave nature?

SECTION E

The following questions are long answer questions. All questions have an internal choice and carry 5 marks each.

31. Mention the criteria for spontaneity of a reaction. Give the mathematical expression for change in entropy of a reversible process. Find out in which of the following processes entropy increases/decreases giving suitable reason-

- (i) Temperature of a crystalline solid is raised from 0K to 110K
- (ii) A liquid undergoes crystallization into solid.
- (iii) $\text{Cl}_2(\text{g}) \rightarrow 2\text{Cl}(\text{g})$

OR

(i) Define (a) Molar enthalpy of vaporization (b) Lattice enthalpy

(ii) What is standard enthalpy of formation? For a reaction- $\text{N}_2(\text{g}) + 3\text{H}_2 \rightarrow 2\text{NH}_3(\text{g})$, $\Delta_r H^\circ = -98 \text{ kJ/mol}$. Find out the standard enthalpy of formation of NH_3 .

32.(i) What are the important features of Bohr atomic model of atom? Explain in detail.

(ii) Find out the radius and Energy of Bohr second orbit of He^+ .

OR

(i) Using s, p, d, f notations, describe the orbitals associated with the following quantum numbers (a) $n=2, l=1$ (b) $n=4, l=0$ (c) $n=5, l=3$ (d) $n=3, l=2$

(ii) Write following principles-(a) Aufbau's principle (b) Pauli's exclusion principle

(c) Hund's rule of maximum multiplicity

33. (i) Give reasons for the following:

(a) Why NH_3 has more dipole moment than NF_3 .

(b) Water molecule has bent structure whereas carbon dioxide molecule is linear.

(ii) What is resonance energy? Show all the resonating structures of ozone.

(iii) Draw the Lewis dot structures of H_2SO_4 and PCl_5 .

OR

i. All the C-O bonds in carbonate ion (CO_3^{2-}) ion are equal in length. Explain the statement drawing all the resonating structures of carbonate ion.

ii. What is meant by the term average bond enthalpy? Why is there a difference in bond enthalpy of O-H bond in ethanol ($\text{C}_2\text{H}_5\text{OH}$) and water?