

J.B. Academy, Ayodhya
Half Yearly Examination 2023-24
Sub:Chemistry, Class - XI

Max Mark: 70

Time: 3 Hours

General Instructions:

Read the following instructions carefully.

- (a) There are 33 questions in this question paper with internal choices.
 - (b) Section-A consists of 16 multiple-choice questions carrying 1 mark each.
 - (c) Section-B consists of 5 short answer questions carrying 2 mark each.
 - (d) Section-C consists of 7 short answer questions carrying 3 mark each.
 - (e) Section-D consists of 2 case- based questions carrying 4 mark each.
 - (f) Section-E consists of 3 long answer questions carrying 5 mark each.
 - (g) All questions are compulsory.
 - (h) Use of log table and calculator is not allowed.
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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. Which of the following pairs of gases contains the same number of molecules?

- (a) 16 g of O₂ and 14 g of N₂
- (b) 6 g of O₂ and 22 g of CO₂
- (c) 28 g of N₂ and 22 g of CO₂
- (d) 32 g of CO₂ and 32 g of N₂

2. The mass of an atom of carbon is _____.

- (a) 1g
- (b) 1.99×10^{-23} g
- (c) 1/12 g
- (d) 1.99×10^{23} g

3. The number of significant figures in 6.02×10^{23} is _____.

- (a) 23
- (b) 3
- (c) 4
- (d) 26

4. Formation of CO and CO₂ illustrates the law of _____.

- (a) Law of conservation of mass
- (b) Law of Reciprocal proportion
- (c) Law of Constant Proportion
- (d) Law of Multiple Proportion

5. Which of the following is not permissible?

- (a) $n=4, l=3, m=0$
- (b) $n=4, l=2, m=1$
- (c) $n=4, l=4, m=1$
- (d) $n=4, l=0, m=0$

6. An atom have d^8 configuration. The maximum number of electrons in the same spin is

- (a) 5
- (b) 3
- (c) 8
- (d) 2

7. The total no of orbital for $(n+l)=4$ is

- (a) 4
- (b) 16
- (c) 32
- (d) 9

8. The uncertainty in measuring speed of a particle is zero. Uncertainty in measuring its position will be

- (a) zero (b) $h/4\pi$ (c) $h/4\pi m$ (d) infinite

9. The orbital angular momentum of a 4p electron will be

- (a) $4 \cdot h/4\pi$ (b) $\sqrt{2} \cdot h/2\pi$ (c) $\sqrt{6} \cdot h/4\pi$ (d) $\sqrt{2} \cdot h/4\pi$

10. The nuclei of elements X, Y and Z have same number of protons, but different number of neutrons.

According to Mendeleev periodic table, the element X, Y and Z

- (a) belong to same group and period (b) Belong to different group and different period
(c) belong to same group and different period (d) are isotopes, which do not have different position.

11. The increasing order of electron affinity of the electronic configuration of element is:

- (I) $3s^2, 3p^5$ (II) $2s^2, 2p^3$
(III) $2s^2, 2p^5$ (IV) $3s^1$
(a) $II < IV < III < I$ (b) $I < II < III < IV$
(c) $I < III < II < IV$ (d) $IV < III < II < I$

12. Second ionization potential of Li, Be and B is in the order:

- (a) $Li > Be > B$ (b) $Li > B > Be$ (c) $Be > Li > B$ (d) $B > Be > Li$

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

Assertion (A): The empirical mass of ethene is half of its molecular mass.

Reason (R): The empirical formula represents the simplest whole-number ratio of various atoms present in a compound.

- (i) Both A and R are true and R is the correct explanation of A.
(ii) A is true but R is false.
(iii) A is false but R is true.
(iv) Both A and R are false.

14. Assertion (A): Black body is an ideal body that emits and absorbs radiation of all frequencies.

Reason (R): The frequency of radiation emitted by a body goes from a lower frequency to a higher frequency with an increase in temperature.

1. Both A and R are true and R is the correct explanation of A.
2. Both A and R are true but R is not the explanation of A
3. A is true and R is false;
4. Both A and R are false.

15. Assertion (A): Boron has a smaller first ionisation enthalpy than beryllium.

Reason (R): The penetration of a 2s electron to the nucleus is more than the 2p electron hence 2p electron is more shielded by the inner core of electrons than the 2s electrons.

- (i) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
(ii) Assertion is correct statement but reason is wrong statement.
(iii) Assertion and reason both are correct statements and reason is correct explanation for assertion.
(iv) Assertion and reason both are wrong statements.

16. Assertion (A): Sodium chloride formed by the action of chlorine gas on sodium metal is a stable compound.

Reason ©: This is because sodium and chloride ions acquire octet in sodium chloride formation.

- (i) A and R both are correct, and R is the correct explanation of A.
- (ii) A and R both are correct, but R is not the correct explanation of A.
- (iii) A is true but R is false.
- (iv) A and R both are false

SECTION – B

This section contains 5 questions with internal choice in one question. The following questions are very short answer type contain only 2 marks each.

17. Predict the shapes of the following molecules on the basis of hybridization. BCl_3 , CH_4 , CO_2 , NH_3

Or

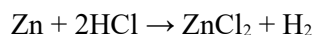
Write Lewis structure of the following compounds and show a formal charge on each atom. HNO_2 , NO_2 , H_2SO_4

18. Calculate the mass percent of calcium, phosphorus and oxygen in calcium phosphate $\text{Ca}_3(\text{PO}_4)_2$

19. Nitrogen has positive electron gain enthalpy whereas oxygen has negative. However, oxygen has lower ionization enthalpy than nitrogen. Explain.

20. First member of each group of representative elements (i.e., s and p-block elements) shows anomalous behavior. Illustrate with two examples.

21. Hydrogen gas is prepared in the laboratory by reacting dilute HCl with granulated zinc. The following reaction takes place.



Calculate the volume of hydrogen gas liberated at STP when 32.65 g of zinc reacts with HCl. 1 mol of a gas occupies 22.7 L volume at STP; atomic mass of Zn = 65.3 u.

SECTION – C

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

22. Match the following:

(i) 88 g of CO_2	(a) 0.25 mol
(ii) 6.022×10^{23} molecules of H_2O	(b) 2 mol
(iii) 5.6 litres of O, at STP	©1 mol
(iv) 96 g of O	(d) 6.022×10^{23} molecules
(v) 1 mol of any gas	(e) 3 mol

23. A vessel contains 1.6 g of dioxygen at STP (273.15K, 1 atm pressure). The gas is now transferred to another vessel at a constant temperature, where pressure becomes half of the original pressure. Calculate
- volume of the new vessel.
 - number of molecules of dioxygen.

24. The Balmer series in the hydrogen spectrum corresponds to the transition from $n_1 = 2$ to $n_2 = 3, 4, \dots$. This series lies in the visible region. Calculate the wave number of the line associated with the transition in the Balmer series when the electron moves to $n = 4$ orbit. ($R_H = 109677 \text{ cm}^{-1}$)

25. Calculate the energy and frequency of the radiation emitted when an electron jumps from $n = 3$ to $n = 2$ in a hydrogen atom.

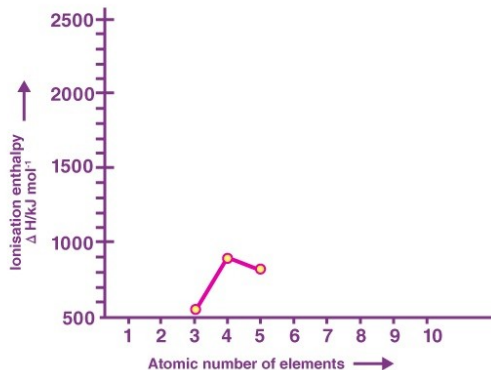
Or

Threshold frequency, ν_0 is the minimum frequency that a photon must possess to eject an electron from a metal. It is different for different metals. When a photon of frequency $1.0 \times 10^{15} \text{ s}^{-1}$ was allowed to hit a metal surface, an electron having $1.988 \times 10^{-19} \text{ J}$ of kinetic energy was emitted. Calculate the threshold frequency of this metal. Show that an electron will not be emitted if a photon with a wavelength equal to 600 nm hits the metal surface.

26. Ionization enthalpies of elements of second period are given below:

Ionization enthalpy/ kcal mol^{-1} : 520, 899, 801, 1086, 1402, 1314, 1681, 2080.

Match the correct enthalpy with the elements and complete the graph given in Fig. Also, write symbols of elements with their atomic number.



27. (a) The mass of an electron is m , charge is e and it is accelerated from rest through a potential difference of V volts. The velocity acquired by electron will be?

(b) The energy of an electron moving in n^{th} Bohr's orbit of an element is given by $E_n = -13.6Z^2/n^2 \text{ eV/atom}$. The graph $V/S \ Z^2$ will be?

28. Write postulate and drawback of Valance Bond Theory.

SECTION - D

The following questions are case-based questions. Read the passage carefully and answer the questions that follow. 4(1+1+2)

29. Electron moves around the nucleus in circular orbitals in fixed energy paths. As far as electron moves in these orbits neither energy is absorbed nor liberated. But when electron move from lower energy level to higher energy level energy is absorbed while when it comes back from higher energy level to lower energy level energy is liberated in the form of photon & a spectral line is formed. Corresponding to different

possible transitions different lines are formed which form the particular serieses viz. lyman, balmer, paschen, bracket, pfund, Humphery etc. Suppose e⁻ in hydrogen atom is present in 10th excited state, then answer the following questions based on paragraph:

(i) If electron present in 10th excited state liberate one visible quanta then next quanta liberated will correspond to following transition –

- (A) $10 \rightarrow 2$ (B) $11 \rightarrow 2$ (C) $11 \rightarrow 1$ (D) $2 \rightarrow 1$

(ii) Total number of spectral lines which can be obtained during the transition to ground level –

- (A) 45 (B) 55 (C) 66 (D) 36

(iii) Minimum value of wavelength that can be obtained during the transition – (Where R is Rydberg constant.)

- (A) $121/120R$ (B) $11/10R$ (C) $100/99R$ (D) $10/9R$

30. The identity of a substance is defined not only by the types of atoms or ions it contains, but by the quantity of each type of atom or ion. The experimental approach required the introduction of a new unit for number of substances, the mole, which remains indispensable in modern chemical science. The mole is an amount unit similar to familiar units like pair, dozen, gross, etc. It provides a specific measure of the number of atoms or molecules in a bulk sample of matter. A mole is defined as the amount of substance containing the same number of discrete entities (atoms, molecules, ions, etc.) as the number of atoms in a sample of pure ^{12}C weighing exactly 12g. One Latin connotation for the word “mole” is “large mass” or “bulk,” which is consistent with its use as the name for this unit. The mole provides a link between an easily measured macroscopic property, bulk mass, and an extremely important fundamental property, number of atoms, molecules and so forth. The number of entities composing a mole has been experimentally determined to be $6.02214179 \times 10^{23}$. $6.02214179 \times 10^{23}$, a fundamental constant named Avogadro’s number (NA) or the Avogadro constant in honor of Italian scientist Amedeo Avogadro. This constant is properly reported with an explicit unit of “per mole,” a conveniently rounded version being $6.022 \times 10^{23}/\text{mol}$. Consistent with its definition as an amount unit, 1 mole of any element contains the same number of atoms as 1 mole of any other element. The masses of 1 mole of different elements, however, are different, since the masses of the individual atoms are drastically different. The molar mass of an element (or compound) is the mass in grams of 1 mole of that substance, a property expressed in units of grams per mole (g/mol).

The following questions are multiple choice questions. Choose the most appropriate answer:

(i) A sample of copper sulphate pentahydrate contains 8.64 g of oxygen. How many grams of C is present in the sample?

- (a) 0.952g (b) 3.816g (c) 3.782g (d) 8.64g

(ii) A gas mixture contains 50% helium and 50% methane by volume. What is the percent by weight of methane in the mixture?

- (a) 19.97% (b) 20.05% (c) 50 (d) 80.03%

Or

The mass of oxygen gas which occupies 5.6 litres at STP could be

- (a) gram atomic mass of oxygen (b) one fourth of the gram atomic mass of oxygen
(c) double the gram atomic mass of oxygen (d) half of the gram atomic mass of oxygen

(iii) The number of moles of oxygen in 1L of air containing 21% oxygen by volume, in standard conditions is

(a) 0.186 mol

(b) 0.21 mol

(c) 2.10 mol

(d) 0.0093 mol

SECTION - E

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

31. Threshold frequency, ν_0 is the minimum frequency that a photon must possess to eject an electron from a metal. It is different for different metals. When a photon of frequency $1.0 \times 10^{15} \text{ s}^{-1}$ was allowed to hit a metal surface, an electron having $1.988 \times 10^{-19} \text{ J}$ of kinetic energy was emitted. Calculate the threshold frequency of this metal. Show that an electron will not be emitted if a photon with a wavelength equal to 600 nm hits the metal surface.

Or

What is the photoelectric effect? State the result of a photoelectric effect experiment that could not be explained on the basis of laws of classical physics. Explain this effect on the basis of quantum theory of electromagnetic radiation.

32. Write the drawbacks in Mendeleev's periodic table that led to its modification.

Or

Discuss and compare the trend in ionization enthalpy of the elements of group 1 with those of group 17 elements.

33. Discuss the concept of hybridization. What are its different types in a carbon atom?

Or

Describe the valence bond theory of covalent bond formation by taking an example of hydrogen. How can you interpret energy changes taking place in the formation of dihydrogen?

----- ALL THE BEST -----