



विद्या सर्वार्थ साधिका

ANANDALAYA
PERIODIC TEST - 2
Class: XI

Subject: Chemistry (043)

Date : 03-10-2023

MM: 70

Time: 3 hours

General Instructions:

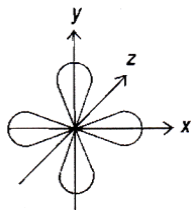
Read the following instructions carefully.

- 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 short answer questions carrying 2 marks 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 log tables and calculators is not allowed.

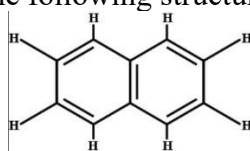
SECTION A

- Which of the following is the best example of law of conservation of mass? (1)
(A) The weight of a piece of platinum is the same before and after heating in air.
(B) When 12 g of carbon is heated in a vacuum there is no change in mass of CO_2 .
(C) A sample of air increases in volume when heated at constant pressure but its mass remains unaltered.
(D) 12 g of carbon combines with 32 g of oxygen to form 44 g of CO_2
- Which of the following has the largest number of atoms? ($\text{Cu} = 63.5\text{u}$) (1)
(A) 0.5 gm atom of Cu (B) 0.635 gm of Cu
(C) 0.25 moles of Cu (D) 1 gm of Cu
- 2.5 liter of 1M NaOH solution is mixed with another 3 liter of 0.5 M NaOH solution. Then the molarity of the regulating solution is _____ (1)
(A) 0.8 M (B) 1.0 M (C) 0.73 M (D) 0.50 M
- Which of the following relation is correct? (1)
(A) picometer < millimeter < nanometer < micrometer
(B) nanometer < picometer < micrometer < millimeter
(C) picometer < nanometer < micrometer < millimeter
(D) millimeter < micrometer < nanometer < picometer
- How many orbitals are associated with $n = 4$? (1)
(A) 16 (B) 15 (C) 8 (D) 18
- Which of the following has maximum number of unpaired electrons? (Atomic No of Fe = 26 u, Co = 27 u) (1)
(A) Fe^{3+} (B) Fe^{2+} (C) Co^{+2} (D) Co^{+3}
- Mention the region of spectrum during transition of electron from $n_2 = 3$ state to $n_1 = 2$ state. (1)
(A) Ultraviolet (B) Visible (C) Infrared (D) Far infrared

8. Bond angle in BeCl_2 and BCl_3 respectively are _____. (1)
 (A) $180^\circ, 120^\circ$ (B) $120^\circ, 180^\circ$
 (C) $90^\circ, 109^\circ 28'$ (D) $90^\circ, 120^\circ$
9. Which orbital is expressed by the following figure? (1)



- (A) d_{xy} (B) d_{z^2} (C) $d_{x^2-y^2}$ (D) d_{xz}
10. Which electronic configuration from the following would be the element of third period? (1)
 (A) $[\text{Ar}]3d^7 4s^2$ (B) $[\text{Ar}] 3s^2 3p^4$ (C) $[\text{Ar}] 3d^1 4s^2$ (D) $[\text{Ar}]3d^3 4s^2$
11. Which of the following show the correct order of decreasing radii of atoms of same element? (1)
 (A) atom > cation > anion (B) anion > cation > atom
 (C) cation > anion > atom (D) anion > atom > cation
12. Number of π bonds and σ bonds in the following structure is– (1)



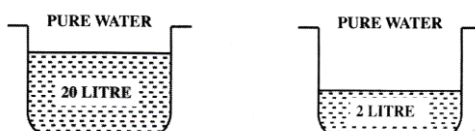
- (A) 6, 19 (B) 4,20 (C) 5,19 (D) 5,20

For question no. 13 to 16, select the most appropriate answer from the options given below:

- (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. **Assertion:** Black body is an ideal body that emits and absorbs radiations of all frequencies. (1)
Reason: The frequency of radiation emitted by the body goes from a higher frequency to lower frequency with an increase in temperature.
14. **Assertion:** SnCl_2 is more co-valent than SnCl_4 . (1)
Reason: Sn^{+4} is more polarising than Sn^{+2}
15. **Assertion:** Cations are generally smaller than a neutral atom (1)
Reason: Z_{eff} is comparatively more and hence the size contracts
16. **Assertion:** There is no place for isotopes in the modern periodic table. (1)
Reason: Isotope have same atomic number but different atomic mass.

SECTION B

17. (a) Will the molarity of pure water be same or different in the following two containers? (2)
 (b) Justify your answer.



18. Although geometries of NH_3 and H_2O molecules are distorted tetrahedral, bond angle in water is less than that of ammonia. Discuss. (2)
19. Calculate the molarity of NaOH in the solution prepared by dissolving its 4 g in enough water to form 250 ml of the solution. (2)
20. What is the number of photons of light with wavelength 4000 pm which provide 1 joule of energy? (2)

OR

Electromagnetic radiation of wavelength 242 nm is just sufficient to ionize the sodium atom. Calculate the ionization energy of sodium in kJ mol^{-1} .

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

SECTION C

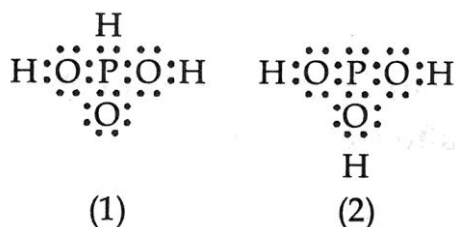
22. 3g of H_2 react with 29g of O_2 to yield H_2O . (3)
- (a) Which one is the limiting reagent?
- (b) Calculate the maximum amount of H_2O that can be formed.
- (c) Calculate the amount of the reactant which remains unreacted.

23. (a) A molecule of O_2 and that of SO_2 travels with the same velocity. What is the ratio of their wavelengths? (Atomic mass of $\text{O} = 16 \text{ u}$ and $\text{S} = 32 \text{ u}$) (3)
- (b) Nickel atom can lose two electrons to form Ni^{2+} ion. The atomic number of nickel is 28. From which orbital can it lose two electrons?

24. (a) The first ionization enthalpy values (in KJ mol^{-1}) of group 13 elements are: (3)
- | | | | | |
|-----|-----|-----|-----|-----|
| B | Al | Ga | In | Tl |
| 801 | 577 | 579 | 558 | 589 |

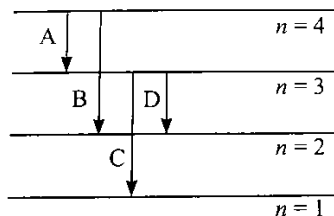
How would you explain this deviation from the general trend?

- (b) Assign the position of the element having outer electronic configuration, $(n - 1) d^2 ns^2$ for $n = 4$. (3)
25. Give reasons: (3)
- (i) IE_1 of sodium is lower than that of magnesium whereas IE_2 of sodium is higher than that of magnesium.
- (ii) Noble gases have positive value of electron gain enthalpy.
26. (a) Define bond-length. (3)
- (b) H_2PO_3 can be represented by structures 1 and 2 shown below. Can these two structures be as the canonical forms of the resonance hybrid representing H_3PO_3 ? If not, give reasons for the same.



27. (a) Although both CO_2 and H_2O are triatomic molecules, the shape of H_2O molecule is bent while that of CO_2 is linear. Explain this on the basis of dipole moment. (3)
- (b) Draw the Lewis dot structure of HNO_3

28. (a) Which of the following transitions will have the shortest wavelength? (3)



- (b) Which of the following colour radiations have the lowest energy?
Red, Green, Blue, Violet

(c) Define: Degenerate orbitals

SECTION D

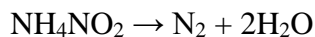
29. The empirical formula can be defined as the simplest ratio of the number of atoms involved in the formation of the compound. The chemical formula of any compound can be defined on the basis of two types of formula which include molecular formulas and empirical formulas. Both the empirical formula and a molecular formula represent the number and the identity of the atom. The molecular formula can be defined as the formula that gives the actual number of atoms involved in the compound. Molar mass is molecular mass expressed in grams. 1 mole of every gas or vapours has volume equal to 22.4 L and has molecule exactly same as Avogadro's number. (4)

Answer the following questions:

- (a) What is the empirical formula of Glucose?

OR

- (a) What is the empirical formula of the first member of Alkyne homologous series?
 (b) A compound has 20% Mg, 26.66% S and 53.33% O, what is the empirical formula of the compound? [Mg = 24u, S = 32u, O = 16u]
 (c) What is the volume of N₂ gas liberated at STP by heating 6.4g of NH₄NO₂? [N=14u, O=16u]



30. 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. (4)

Let us apply this method to the homonuclear diatomic hydrogen molecule. Consider the hydrogen molecule consisting of two atoms A and B. Each hydrogen atom in the ground state has one electron in 1s orbital. The atomic orbitals of these atoms may be represented by the wave functions ψ_A and ψ_B .

Mathematically, the formation of molecular orbitals may be described by the linear combination of atomic orbitals that can take place by addition and by subtraction of wave functions of individual atomic orbitals.

The molecular orbital σ formed by the addition of atomic orbitals is called the bonding molecular orbital while the molecular orbital σ^* formed by the subtraction of atomic orbital is called antibonding molecular orbital.

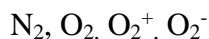
Answer the following questions:

- (a) Why is O₂⁻ paramagnetic in nature?

OR

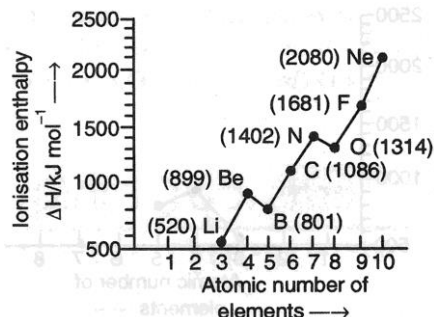
- (a) Write the M.O. configuration of F₂ molecule.
 (b) Depict the change in stability during the ionization of Nitrogen and Oxygen as shown below:
 (i) N₂ → N₂⁺ + e⁻
 (ii) O₂ → O₂⁺ + e⁻

- (c) Considering Molecular orbital theory, arrange the following species in increasing order of their bond order.



SECTION E

31. (a) Explain the deviation in ionization enthalpy of some elements from the general trend by using the figure given below. (5)



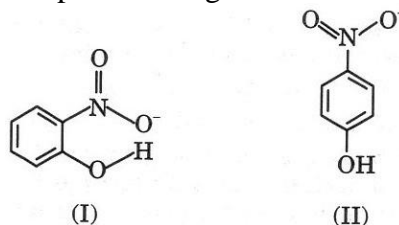
- (b) Nitrogen has positive electron gain enthalpy. Explain
 (c) Answer the following in short.
 (i) Which one has less negative electron gain enthalpy, F or Cl? Why?
 (ii) Which one is more metallic, N or K? Why?
32. (a) Which out of NH_3 and NF_3 has higher dipole moment and why? (5)
 (b) Describe the change in hybridisation (if any) of the Al atom in the following reaction.

$$\text{AlCl}_3 + \text{Cl}^- \rightarrow \text{AlCl}_4^-$$

 (c) Draw the schematic diagram of positive overlapping between s and P_z orbital.

OR

- (a) What is the shape of BrF_5 ?
 (b) Structures of molecules of two compounds are given below:



- (i) Which of the two compounds will have intermolecular hydrogen bonding and which compound is expected to show intramolecular hydrogen bonding?
 (ii) Which of the above compounds will form hydrogen bond with water easily and be more soluble in it?
 (c) Draw the diagram to represent resonance in Ozone molecule.
33. (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? (5)
 (b) Define: Threshold frequency
 (c) Wavelengths of different radiations are given below.
 (i) 300nm (ii) 300μm (iii) 3nm (iv) 30Å

OR

- (a) 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 line associated with the transition in Balmer series when the electron moves to $n=4$ orbit. ($R_H = 109677 \text{ cm}^{-1}$)
 (b) Define: Work function
 (c) What will be the value of radial nodes and angular nodes in 3p orbital?