

8/2014

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| ROLL<br>NUMBER |  |  |  |  |
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| SET | A |
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**INDIAN SCHOOL MUSCAT  
HALF YEARLY EXAMINATION 2022  
CHEMISTRY (043)**



CLASS : XI  
DATE: 28/11/2022

TIME ALLOTTED : 3 HRS.  
MAXIMUM MARKS: 70

GENERAL INSTRUCTIONS:

- a) There are 35 questions in this question paper with internal choice.
- b) SECTION A consists of 18 multiple-choice questions carrying 1 mark each.
- c) SECTION B consists of 7 very short answer questions carrying 2 marks each.
- d) SECTION C consists of 5 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.
- h) Physical constants:  $h = 6.626 \times 10^{-34}$  Js,  $m_e = 9.1 \times 10^{-31}$  kg
- i) Use log tables and calculators is not allowed

**SECTION A**

1. What would be the IUPAC name for the element with atomic number 120? 1
  - (a) Unnilbium
  - (b) Ununbium
  - (c) Unnilunium
  - (d) Unbinilium
  
2. The HF is a liquid at room temperature because of 1
  - (a) low polarizability
  - (b) Intramolecular hydrogen bonding
  - (c) Low molar mass
  - (d) Intermolecular hydrogen bonding
  
3. What will be the molality of the solution containing 18.25g of HCl gas (molar mass 36.5 g/mol) dissolved in 500 g of water? 1
  - (a) 0.1 m
  - (b) 0.5 m
  - (c) 1 m
  - (d) 2 m



4.  $\Psi^2 = 0$  represents 1  
 (a) angular wave function (b) s orbital  
 (c) node (d) p orbital
5. The valence shell electronic configuration of the element with most negative electron gain enthalpy is 1  
 (a)  $2s^2 2p^5$  (b)  $3s^2 3p^5$   
 (c)  $4s^2 4p^5$  (d)  $5s^2 4p^5$
6. The number of atoms of Sulphur present in 0.1 mole of  $S_8$  molecule is 1  
 (a)  $6.022 \times 10^{23}$  (b)  $4.8176 \times 10^{22}$   
 (c)  $4.8176 \times 10^{23}$  (d)  $6.022 \times 10^{22}$
7. The number of radial nodes possible for 3d orbital is 1  
 (a) 3 (b) 0 (c) 1 (d) 2
8. What is the geometry of the molecule, if the central atom has three bond pairs and one lone pair of electrons? 1  
 (a) Trigonal planar (b) Trigonal pyramidal  
 (c) See saw (d) Tetrahedral
9. Which of the following elements has the highest electronegativity? 1  
 (a) F (b) Cl (c) Br (d) I
10. When 200 L of nitrogen gas is heated with 300 L of hydrogen gas in a closed container, the volume of ammonia produced in L is 1  
 (a) 200 (b) 300 (c) 400 (d) 500
11. The correct electronic configuration of chromium atom ( $Z = 24$ ) is: 1  
 (a)  $[Ar] 3d^5 4s^1$  (b)  $[Ar] 3d^4 4s^2$   
 (c)  $[Ar] 3d^6 4s^0$  (d)  $[Ar] 4s^1 3d^5$

12. The solution of A and B are 0.1 and 0.2 molar respectively. If 100 ml of A are mixed with 25 ml of B, then the molarity of the final solution is 1
- (a) 0.15 M (b) 0.18 M  
(c) 0.12 M (d) 0.30 M
13. Which one of the following combinations of atomic orbitals does not form sigma molecular orbital? 1
- (a) 1s and 1s (b) 2p<sub>y</sub> and 2p<sub>y</sub> (c) 2p<sub>z</sub> and 2p<sub>z</sub> (d) 2s and 2s
14. Which of the following pairs of d- orbitals will have electron density along the molecular axis? 1
- (a) d<sub>z</sub><sup>2</sup>, d<sub>xz</sub> (b) d<sub>xz</sub>, d<sub>yz</sub>  
(c) d<sub>z</sub><sup>2</sup>, d<sub>x</sub><sup>2</sup>-y<sup>2</sup> (d) d<sub>zy</sub>, d<sub>x</sub><sup>2</sup>-y<sup>2</sup>

**In the following questions (Q. No 15 to 18) consist of two statements – Assertion (A) and Reason (R). Choose the correct answer out of the following choices.**

(A) Assertion and reason both are correct and reason is the correct explanation for assertion.

(B) Assertion and reason both are correct but reason is not the correct explanation for assertion.

(C) Assertion is correct but reason is wrong.

(D) Assertion is wrong but reason is correct.

(E) Both assertion and reason are wrong.

15. **Assertion:** 2 mol of NaOH and 2 M of NaOH are same. 1  
**Reason:** The number of molecules of NaOH are same in both.
16. **Assertion:** Angular momentum of an electron in an atom is quantized. 1  
**Reason:** In an atom only, those orbits are permitted in which angular moment of an electron is integral multiple of (h/2π).
17. **Assertion:** Atomic radius in general decreases along a period. 1  
**Reason:** Alkali metals have the largest atomic radii and noble gases have the smallest atomic radii.

18. **Assertion:**  $\text{NF}_3$  is more polar than  $\text{NH}_3$ . 1  
**Reason:** Both  $\text{NF}_3$  and  $\text{NH}_3$  have trigonal pyramidal geometry.

### SECTION B

19. Calculate the number of moles of  $\text{HCl}$  and also the number of molecules of  $\text{HCl}$  in 100 ml of 0.001 M  $\text{HCl}$  solution. 2
20. (i) Out of 4s and 3d orbitals, which has higher energy and why? 2  
(ii) State Heisenberg's uncertainty principle?

### OR

- (a) What is the radius for the second orbit of  $\text{He}^+$  ion?  
(b) State Pauli Exclusion principle.
21. Using molecular orbital theory, write the electronic configuration of  $\text{O}_2$  molecule. Calculate its bond order and predict its magnetic behaviour. 2
22. (i) Why is dipole moment of  $\text{HF}$  higher than that of  $\text{HCl}$ ? 2  
(ii) Draw the resonance structures of  $\text{CO}_3^{2-}$
23. (a) Among  $\text{Li}$ ,  $\text{Na}$ ,  $\text{K}$ ,  $\text{Rb}$ ,  $\text{Cs}$  which element has the lowest ionization energy? Why? 2  
(b) Assign the position of the element having atomic number 27

### OR

Give reason for the following

- (i) Noble gases have large positive electron gain enthalpies.  
(ii) Ionization enthalpy of nitrogen is greater than that of oxygen.
24. Calculate the molality of an aqueous solution whose mole fraction is 0.32 2
25. (i) Lithium shows anomalous behaviour. Why? 2  
(ii) Give any two anomalous property of lithium.

### SECTION C

26. (i) Electrons are emitted with zero velocity from a metal surface when it is exposed to radiation of wavelength  $6800 \text{ \AA}$ . Calculate threshold frequency ( $\nu_0$ ) and work function ( $W_0$ ) of the metal. 3
27. (a) Draw the Lewis dot structure for  $\text{NO}_2^-$  3  
(b) Which one of the following has greatest covalent character? Why?  
KCl, NaCl,  $\text{MgCl}_2$ ,  $\text{CaCl}_2$   
(c) Define bond length.

#### OR

- (i) Out of  $\sigma$  and  $\pi$  bonds, which one is stronger bond and why?  
(ii) Which one of the following has greatest covalent character? Why?  
 $\text{MgCl}_2$ ,  $\text{CaCl}_2$ ,  $\text{AlCl}_3$ ,  $\text{GaCl}_3$   
(iii) Define bond angle.
28. Calculate the uncertainty in the position of an electron if its velocity is measured within the accuracy of 0.001% 3  
( $h = 6.626 \times 10^{-34} \text{ Js}$ ,  $m_e = 9.1 \times 10^{-31} \text{ kg}$ , Velocity of electron =  $300 \text{ ms}^{-1}$ )
29. An organic compound on analysis gave the following percentage composition C = 57.8%, H = 3.6% and the rest is oxygen. Find out the molecular formula of the compound. 3  
(Molar mass =  $166 \text{ g/mol}$ ) (RAM of C=12u, O=16u, H=1u)

#### OR

- Calculate the molarity of 500 mL of an aqueous solution containing 60 g of methyl alcohol ( $\text{CH}_3\text{OH}$ ). (RAM of C=12u, O=16u, H=1u)
30. How many electrons in an atom may have the following quantum numbers? 3  
(i)  $n = 4$ ,  $l = 3$ ,  $s = -\frac{1}{2}$   
(ii)  $n = 3$ ,  $l = 2$   
(iii)  $n = 4$ ,  $ml = 0$

### SECTION D

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

31. The emission spectrum of hydrogen atom has been divided into number of spectral series with wavelength given by Rydberg formula. These observed spectral line is due to electron making transition between two energy levels in atom. When energy is supplied electrons get excited and when these excited electrons transit to ground level they emit electromagnetic energy of specific frequency. This emitted energy can be recorded by a spectrograph giving rise to spectrum. Of all elements hydrogen has the simplest line spectrum. Line spectrum become complex for heavier atoms. 4
- (i) What are Lyman series in hydrogen spectrum?
- (ii) Calculate the wavenumber for the longest wavelength Lyman transition in hydrogen spectrum.
- (iii) Show that the circumference of the Bohr orbit of hydrogen atom is an integral multiple of the de-Broglie wavelength associated with electron moving around the orbit.

### OR

- (iii) Using Bohr's equation calculate the enthalpy required for the process.



32. When two atoms come close to each other, there is overlapping of atomic orbitals. The formation of covalent bond depends upon the overlapping of atomic orbitals. The covalent bonds are classified into two types depending upon the types overlapping – sigma bond and pi bond. Pauling introduced the concept of hybridization. Unlike pure orbitals, hybrid orbitals are used in bond formation. There are various type of hybridization involving s, p and d orbitals. Hybridization indicates the geometry of the molecule. 4
- (i) Define hybridization
- (ii) Predict the hybridization in  $\text{BrF}_5$  molecule and the shape of the hybridised orbitals
- (iii) Draw orbital overlap diagram for  $\text{H}_2\text{O}$

### OR

- (iii) Write any two conditions for the formation of molecular orbitals

## SECTION E

The following questions are long answer type and carry 5 marks each.

Two questions have an internal choice.

33. (a) Explain the periodic trend in ionisation enthalpy. 5  
(b) Out of fluorine and chlorine which one has more negative electron gain enthalpy? Why?  
(c) What are isoelectronic species? Give two examples of species which are isoelectronic with  $\text{Ca}^{2+}$ .
34. a) Explain the formation of ethene molecule on the basis of hybridization giving emphasis on 5  
(i) Energy level diagram (ii) Orbital overlap diagram (iii) Nature and shape of the hybridised orbitals  
b) On the basis of VSEPR theory predict the shape of  
(i)  $\text{XeF}_4$  (ii)  $\text{BrF}_3$

OR

- a) Explain the formation of hydrogen molecule using valence bond theory  
b) On the basis of VSEPR theory predict the shape of  
(i)  $\text{XeO}_4$  (ii)  $\text{IF}_4^-$
35. (i) Define black body. 5  
(ii) Find the energy of a photon which has wavelength  $0.50 \text{ \AA}$ .  
(iii) Draw the shapes of  $3d_{xy}$  and  $3d_{x^2-y^2}$  orbitals.  
(iv) Write the quantum numbers for the valence electron in potassium.

OR

- (a) Define Hund's rule.  
(b) Give the significance of magnetic quantum number  
(c) How many electron waves are possible in the fourth orbit of hydrogen atom?  
(d) Two particles A and B are in motion. If the momentum of A is half of that of B and if the wavelength of A is  $4.5 \times 10^2 \text{ nm}$ , what is the wavelength of B?

\*\*\*\*END OF THE QUESTION PAPER\*\*\*\*





9/2/21

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| SET | B |
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**INDIAN SCHOOL MUSCAT  
HALF YEARLY EXAMINATION 2022  
CHEMISTRY (043)**



CLASS : XI  
DATE:

TIME ALLOTTED : 3 HRS.  
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GENERAL INSTRUCTIONS:

- a) There are 35 questions in this question paper with internal choice.
- b) SECTION A consists of 18 multiple-choice questions carrying 1 mark each.
- c) SECTION B consists of 7 very short answer questions carrying 2 marks each.
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- 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.
- h) Physical constants:  $h = 6.626 \times 10^{-34}$  Js,  $m_e = 9.1 \times 10^{-31}$  kg
- i) Use log tables and calculators is not allowed

**SECTION A**

1. Paschen series of hydrogen spectrum is under which part of electromagnetic spectrum? 1  
 (a) Visible                      (b) IR                      (c) UV                      (d) Microwave
  
2. The rule that is violated in the ground state electronic configuration [Ar] 3d<sup>6</sup> is 1  
 (a) Pauli Exclusion principle                      (b) Hund's rule of maximum multiplicity  
 (c) Octet rule                      (d) Aufbau principle
  
3. The intramolecular hydrogen bond is present in 1  
 (a) Phenol                      (b) o-nitrophenol  
 (b) p-nitrophenol                      (c) p-cresol

4. If the concentration of glucose ( $C_6H_{12}O_6$ ) in blood is  $0.9 \text{ g L}^{-1}$ , what is the molarity of glucose in blood? (molar mass of glucose is  $180 \text{ g/mol}$ ) 1  
(a) 5 M (b) 50 M  
(c) 0.005 M (d) 0.5 M
5. The atomic number of an element is 20. How many electrons have  $l = 1$  in this? 1  
(a) 2 (b) 12 (c) 4 (d) 8
6. Identify the T- shaped molecule in the following 1  
(a)  $H_2O$  (b)  $BF_3$  (c)  $ClF_3$  (d)  $SF_4$
7. The number of angular nodes possible in 4d orbital is 1  
(a) 3 (b) 0 (c) 1 (d) 2
8. s and p block elements are collectively called as 1  
(a) Alkaline earth metals (b) Inner transition elements  
(c) Representative elements (d) Transition elements
9. The molarity of a solution obtained by mixing 750 ml of 0.5 M HCl with 250 ml of 2 M HCl will be 1  
(a) 0.975M (b) 0.875M  
(c) 1M (d) 1.75M
10. Which of the following is dependent on temperature? 1  
(a) Molality (b) Molarity  
(c) Mole fraction (d) Mass percentage
11. The valence shell electronic configuration of the element with most negative electron gain enthalpy is 1  
(a)  $2s^2 2p^5$  (b)  $3s^2 3p^5$   
(c)  $4s^2 4p^5$  (d)  $5s^2 4p^5$

12. Transuranium elements belong to 1  
(a) s block (b) p block (c) d block (d) f block
13. The element with highest electronegativity belongs to 1  
(a) period 2 and group 17 (b) period 3 and Group 7  
(c) period 3 and Group 17 (d) period 2 and Group 1
14. The number of atoms in 0.1 mole of triatomic gas is \_\_\_\_\_ 1  
(a)  $1.800 \times 10^{22}$  (b)  $6.026 \times 10^{22}$   
(c)  $1.806 \times 10^{23}$  (d)  $3.600 \times 10^{22}$

In the following questions (Q. No 15 to 18) consist of two statements – Assertion (A) and Reason (R). Choose the correct answer out of the following choices.

- (a) Assertion and reason both are correct and reason is the correct explanation for assertion.  
(b) Assertion and reason both are correct but reason is not the correct explanation for assertion.  
(c) Assertion is correct but reason is wrong.  
(d) Assertion is wrong but reason is correct.  
(e) Both assertion and reason are wrong.
15. **Assertion:** Angular momentum of an electron in an atom is quantized. 1  
**Reason:** In an atom only, those orbits are permitted in which angular moment of an electron is integral multiple of  $(h/2\pi)$ .
16. Assertion:  $\text{NF}_3$  is more polar than  $\text{BF}_3$  1  
Reason: Both have similar geometry
17. Assertion: Heizenberg's uncertainty principle is not applicable for microscopic bodies. 1  
Reason: Microscopic bodies have wave nature.
18. **Assertion:** 2 mol of NaOH and 2 M of NaOH are same. 1  
**Reason:** The number of molecules of NaOH are same in both.

## SECTION B

19. (i) Define limiting reagent  
(ii) When 200 L of nitrogen gas is heated with 300 L of hydrogen gas in a closed container, what volume of ammonia gas is produced?
20. (i) Write the electronic configuration of  $\text{Cu}^{2+}$  ion. (Atomic number of Cu = 29) 2  
(ii) Define photo electric effect.

### OR

- (a) Calculate the energy associated with first orbit of  $\text{Li}^{2+}$ .  
(b) Define Stark effect.
21. Using molecular orbital theory, write the electronic configuration of  $\text{N}_2$  molecule. Calculate its bond order and predict its magnetic behaviour. 2
22. (i) Explain why  $\text{NH}_3$  is more polar than  $\text{NF}_3$  2  
(ii) Draw the resonance structure of  $\text{NO}_3^-$
23. (a) Among Li, Na, K, Rb, Cs which element has lowest ionization energy? Why? 2  
(b) Assign the position of the element having atomic number 27

### OR

Give reason for the following

- (i) Noble gases have large positive electron gain enthalpies.  
(ii) Ionization enthalpy of nitrogen is greater than that of oxygen.
24. Calculate the molality of an aqueous solution whose mole fraction is 0.32 2
25. (a) Define van der Waal's radius. 2  
(b) Arrange the following in the increasing order of their oxidising power  
F, Cl, O, N

## SECTION C

26. Calculate the kinetic energy of moving electron which has a wavelength of 4.8 pm. 3  
( $h = 6.626 \times 10^{-34}$  Js,  $m_e = 9.1 \times 10^{-31}$  kg)

27. (a) Draw the Lewis dot structure for  $\text{NO}_2^-$  3  
(b) Which one of the following has greatest covalent character? Why?  
KCl, NaCl,  $\text{MgCl}_2$ ,  $\text{CaCl}_2$   
(c) Define bond length.

OR

- (i) Out of  $\sigma$  and  $\pi$  bonds, which one is stronger bond and why?  
(ii) Which one of the following has greatest covalent character? Why?  
 $\text{MgCl}_2$ ,  $\text{CaCl}_2$ ,  $\text{AlCl}_3$ ,  $\text{GaCl}_3$   
(iii) Define bond angle.
28. Calculate the uncertainty in the position of an electron if its velocity is measured within the 3  
accuracy of 0.001%  
( $h = 6.626 \times 10^{-34} \text{ Js}$ ,  $m_e = 9.1 \times 10^{-31} \text{ kg}$ , Velocity of electron =  $300 \text{ ms}^{-1}$ )
29. An organic compound on analysis gave the following percentage composition C = 57.8%, 3  
H = 3.6% and the rest is oxygen. Find out the molecular formula of the compound.  
(Molar mass =  $166 \text{ g/mol}$ ) (RAM of C=12u, O=16u, H=1u)

OR

Calculate the molarity of 500 mL of an aqueous solution containing 60 g of methyl alcohol ( $\text{CH}_3\text{OH}$ ). (RAM of C=12u, O=16u, H=1u)

30. How many electrons in an atom may have the following quantum numbers? 3  
(i)  $n = 5, l = 2, s = -\frac{1}{2}$   
(ii)  $n = 4, l = 3$   
(iii)  $n = 4, m_l = 0$

#### SECTION D

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

31. The emission spectrum of hydrogen atom has been divided into number of spectral series with 4  
wavelength given by Rydberg formula. These observed spectral line is due to electron making transition between two energy levels in atom. When energy is supplied electrons get excited and when these excited electrons transit to ground level they emit electromagnetic energy of

specific frequency. This emitted energy can be recorded by a spectrograph giving rise to spectrum. Of all elements hydrogen has the simplest line spectrum. Line spectrum become complex for heavier atoms.

- (i) What are Balmer series in hydrogen spectrum?
- (ii) Calculate the wavenumber for longest wavelength Balmer transition in hydrogen spectrum.
- (iii) Show that the circumference of the Bohr orbit of hydrogen atom is an integral multiple of the de-Broglie wavelength associated with electron moving around the orbit.

**OR**

- (iii) Using Bohr's equation calculate the enthalpy required for the process.



32. When two atoms come close to each other, there is overlapping of atomic orbitals. The formation of covalent bond depends upon the overlapping of atomic orbitals. The covalent bonds are classified into two types depending upon the types overlapping – sigma bond and pi bond. Pauling introduced the concept of hybridization. Unlike pure orbitals, hybrid orbitals are used in bond formation. There are various type of hybridization involving s, p and d orbitals. Hybridization indicates the geometry of the molecule. 4

- (i) Define hybridization
- (ii) Predict the hybridization in  $\text{BrF}_5$  molecule and the shape of the hybridised orbitals
- (iii) Draw orbital overlap diagram for  $\text{H}_2\text{O}$

**OR**

- (iii) Write any two conditions for the formation of molecular orbitals

### SECTION E

The following questions are long answer type and carry 5 marks each.

Two questions have an internal choice.

33. (a) Explain the periodic trend in electronegativity. 5
- (b) Out of fluorine and chlorine which one has more negative electron gain enthalpy? Why?
- (c) What are isoelectronic species? Give two examples of species which are isoelectronic with  $\text{Mg}^{2+}$ .

34. a) Explain the formation of ethyne molecule on the basis of hybridization giving emphasis on (i) Energy level diagram (ii) Orbital overlap diagram (iii) Nature and shape of the hybridised orbitals 5
- b) On the basis of VSEPR theory predict the shape of (i)  $\text{XeF}_4$  (ii)  $\text{BrF}_3$

**OR**

- a) Explain the formation of hydrogen molecule using valence bond theory
- b) On the basis of VSEPR theory predict the shape of (i)  $\text{XeO}_4$  (ii)  $\text{IF}_4^-$

35. (i) Define black body. 5
- (ii) Find the energy of a photon which has wavelength  $0.50 \text{ \AA}$ .
- (iii) Draw the shapes of  $3d_{xy}$  and  $3d_{x^2-y^2}$  orbitals.
- (iv) Write the quantum numbers for the valence electron in sodium

**OR**

- (a) Define Aufbau principle.
- (b) Give the significance of principal quantum number
- (c) How many electron waves are possible in the fourth orbit of hydrogen atom?
- (d) Two particles A and B are in motion. If the momentum of A is half of that of B and if the wavelength of A is  $4.5 \times 10^2 \text{ nm}$ , what is the wavelength of B?

**\*\*\*\*END OF THE QUESTION PAPER\*\*\*\***





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| SET | C |
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**INDIAN SCHOOL MUSCAT  
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- a) There are 35 questions in this question paper with internal choice.
- b) SECTION A consists of 18 multiple-choice questions carrying 1 mark each.
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- f) SECTION E consists of 3 long answer questions carrying 5 marks each.
- g) All questions are compulsory.
- h) Physical constants:  $h = 6.626 \times 10^{-34}$  Js,  $m_e = 9.1 \times 10^{-31}$  kg
- i) Use log tables and calculators is not allowed

**SECTION A**

1. What would be the IUPAC name for the element with atomic number 118? 1
  - (a) Ununseptium
  - (b) Ununhexium
  - (c) Unniloctium
  - (d) Ununoctium
  
2. Lyman series of hydrogen spectrum is under which part of electromagnetic spectrum? 1
  - (a) Visible
  - (b) IR
  - (c) UV
  - (d) Microwave
  
3.  $\Psi^2 = 0$  represents 1
  - (a) angular wave function
  - (b) s orbital
  - (c) node
  - (d) p orbital
  
4. The rule that is violated in the ground state electronic configuration [Ar] 3d<sup>6</sup> is 1
  - (a) Pauli Exclusion principle
  - (b) Hund's rule of maximum multiplicity
  - (c) Octet rule
  - (d) Aufbau principle

5. The valence shell electronic configuration of the element with most negative electron gain enthalpy is 1  
(a)  $2s^2 2p^5$  (b)  $3s^2 3p^5$   
(c)  $4s^2 4p^5$  (d)  $5s^2 4p^5$
6. The number of atoms of Sulphur present in 0.1 mole of  $S_8$  molecule is. 1  
(a)  $6.022 \times 10^{23}$  (b)  $4.8176 \times 10^{22}$   
(c)  $4.8176 \times 10^{23}$  (d)  $6.022 \times 10^{22}$
7. The number of radial nodes possible for 3d orbital is 1  
(a) 3 (b) 0 (c) 1 (d) 2
8. What is the geometry of the molecule, if the central atom has three bond pairs and one lone pair of electrons? 1  
(a) Trigonal planar (b) Trigonal pyramidal  
(c) See saw (d) Tetrahedral
9. The element with highest electronegativity belongs to 1  
(a) period 2 and group 17 (b) period 3 and Group 7  
(c) period 3 and Group 17 (d) period 2 and Group 1
10. When 200 L of nitrogen gas is heated with 300 L of hydrogen gas in a closed container, the volume of ammonia produced in L is 1  
(a) 200 (b) 300 (c) 400 (d) 500
11. The correct electronic configuration of chromium atom ( $Z = 24$ ) is: 1  
(a)  $[Ar] 3d^5 4s^1$  (b)  $[Ar] 3d^4 4s^2$   
(c)  $[Ar] 3d^6 4s^0$  (d)  $[Ar] 4s^1 3d^5$
12. The solution of A and B are 0.1 and 0.2 molar respectively. If 100 ml of A are mixed with 25 ml of B, then the molarity of the final solution is 1  
(a) 0.15 M (b) 0.18 M  
(c) 0.12 M (d) 0.30 M

13. Which one of the following combinations of atomic orbitals does not form sigma molecular orbital? 1  
 (a)  $1s$  and  $1s$  (b)  $2p_y$  and  $2p_y$  (c)  $2p_z$  and  $2p_z$  (d)  $2s$  and  $2s$
14. Which of the following pairs of d- orbitals will have electron density along the molecular axis? 1  
 (a)  $d_z^2$ ,  $d_{xz}$  (b)  $d_{xz}$ ,  $d_{yz}$   
 (c)  $d_z^2$ ,  $d_x^2 - y^2$  (d)  $d_{zy}$ ,  $d_x^2 - y^2$

**In the following questions (Q. No 15 to 18) consist of two statements – Assertion (A) and Reason (R). Choose the correct answer out of the following choices.**

- (A) Assertion and reason both are correct and reason is the correct explanation for assertion.  
 (B) Assertion and reason both are correct but reason is not the correct explanation for assertion.  
 (C) Assertion is correct but reason is wrong.  
 (D) Assertion is wrong but reason is correct.  
 (E) Both assertion and reason are wrong.
15. **Assertion:** 2 mol of NaOH and 2 M of NaOH are same. 1  
**Reason:** The number of molecules of NaOH are same in both.
16. **Assertion:**  $\text{NF}_3$  is more polar than  $\text{NH}_3$ . 1  
**Reason:** Both  $\text{NF}_3$  and  $\text{NH}_3$  have trigonal pyramidal geometry.
17. **Assertion:** Atomic radius in general decreases along a period. 1  
**Reason:** Alkali metals have the largest atomic radii and noble gases have the smallest atomic radii.
18. **Assertion:** Angular momentum of an electron in an atom is quantized. 1  
**Reason:** In an atom only, those orbits are permitted in which angular moment of an electron is integral multiple of  $(h/2\pi)$ .

### SECTION B

19. Calculate the number of moles of HCl and also the number of molecules of HCl in 100 ml of 0.001 M HCl solution. 2
20. (i) Out of 6s and 4f orbitals, which has higher energy and why? 2  
(ii) State Heisenberg's uncertainty principle?

### OR

- (a) What is the radius of the second orbit of  $\text{He}^+$  ion?  
(b) State Pauli Exclusion principle.
21. Using molecular orbital theory, write the electronic configuration of  $\text{O}_2$  molecule. Calculate its bond order and predict its magnetic behaviour. 2
22. (i) Why is dipole moment of HF higher than that of HCl? 2  
(ii) Draw the resonance structure of  $\text{CO}_3^{2-}$
23. (a) Among Li, Na, K, Rb, Cs which element has the lowest ionization energy? Why? 2  
(b) Assign the position of the element having atomic number 27.

### OR

Give reason for the following

- (i) Noble gases have large positive electron gain enthalpies.  
(ii) Ionization enthalpy of nitrogen is greater than that of oxygen.
24. Calculate the molality of an aqueous solution whose mole fraction is 0.32 2
25. (i) Lithium shows anomalous behaviour. Why? 2  
(ii) Give any two anomalous properties of lithium.

### SECTION C

26. Calculate the kinetic energy of moving electron which has a wavelength of 4.8 pm. 3  
( $h = 6.626 \times 10^{-34}$  Js,  $m_e = 9.1 \times 10^{-31}$  kg)
27. (a) Draw the Lewis dot structure for  $\text{NO}_2^-$  3

KCl, NaCl, MgCl<sub>2</sub>, CaCl<sub>2</sub>

(c) Define bond length.

**OR**

(i) Out of  $\sigma$  and  $\pi$  bonds, which one is stronger bond and why?

(ii) Which one of the following has greatest covalent character? Why?

MgCl<sub>2</sub>, CaCl<sub>2</sub>, AlCl<sub>3</sub>, GaCl<sub>3</sub>

(iii) Define bond angle.

28. Calculate the uncertainty in the position of an electron if its velocity is measured within the accuracy of 0.001% 3

( $h = 6.626 \times 10^{-34}$  Js,  $m_e = 9.1 \times 10^{-31}$  kg Velocity of electron =  $300 \text{ ms}^{-1}$ )

29. An organic compound on analysis gave the following percentage composition C = 57.8%, H = 3.6% and the rest is oxygen. Find out the molecular formula of the compound. 3

(Molar mass = 166 g/mol) (RAM of C=12u, O=16u, H=1u)

**OR**

Calculate the molarity of 500 mL of an aqueous solution containing 60 g of methyl alcohol (CH<sub>3</sub>OH). (RAM of C=12u, O=16u, H=1u)

30. How many electrons in an atom may have the following quantum numbers? 3

(i)  $n = 4, l = 3, s = -\frac{1}{2}$

(ii)  $n = 3, l = 2$

(iii)  $n = 4, m_l = 0$

#### SECTION D

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

31. The emission spectrum of hydrogen atom has been divided into number of spectral series with wavelength given by Rydberg formula. These observed spectral line is due to electron making transition between two energy levels in atom. When energy is supplied electrons get excited and when these excited electrons transit to ground level they emit electromagnetic energy of specific frequency. This emitted energy can be recorded by a spectrograph giving rise to 4

spectrum. Of all elements hydrogen has the simplest line spectrum. Line spectrum become complex for heavier atoms.

(i) What are Lyman series in hydrogen spectrum?

(ii) Calculate the wavenumber for longest wavelength Lyman transition in hydrogen spectrum.

(iii) Show that the circumference of the Bohr orbit of hydrogen atom is an integral multiple of the de-Broglie wavelength associated with electron moving around the orbit.

**OR**

(iii) Using Bohr's equation calculate the enthalpy required for the process.



32. When two atoms come close to each other, there is overlapping of atomic orbitals. The formation of covalent bond depends upon the overlapping of atomic orbitals. The covalent bonds are classified into two types depending upon the types overlapping – sigma bond and pi bond. Pauling introduced the concept of hybridization. Unlike pure orbitals, hybrid orbitals are used in bond formation. There are various type of hybridization involving s, p and d orbitals. Hybridization indicates the geometry of the molecule. 4

(i) Define hybridization

(ii) Predict the hybridization in  $\text{BrF}_5$  molecule and the shape of the hybridised orbitals

(iii) Draw orbital overlap diagram for  $\text{H}_2\text{O}$

**OR**

(iii) Write any two conditions for the formation of molecular orbitals

### SECTION E

The following questions are long answer type and carry 5 marks each.

Two questions have an internal choice.

33. (a) Explain the periodic trend in electronegativity. 5
- (b) Out of fluorine and chlorine which one has more negative electron gain enthalpy? Why?
- (c) What are isoelectronic species? Give two examples of species which are isoelectronic with  $\text{Ca}^{2+}$ .

34. a) Explain the formation of ethene molecule on the basis of hybridization giving emphasis on (i) Energy level diagram (ii) Orbital overlap diagram (iii) Nature and shape of the hybridised orbitals 5
- b) On the basis of VSEPR theory predict the shape of (i)  $\text{XeF}_4$  (ii)  $\text{BrF}_3$

**OR**

- a) Explain the formation of hydrogen molecule using valence bond theory
- b) On the basis of VSEPR theory predict the shape of (i)  $\text{XeO}_4$  (ii)  $\text{IF}_4^-$

35. (i) Define black body. 5
- (ii) Find the energy of a photon which has wavelength  $0.50 \text{ \AA}$ .
- (iii) Draw the shapes of  $3d_{xy}$  and  $3d_{x^2-y^2}$  orbitals.
- (iv) Write the quantum numbers for the valence electron in potassium.

**OR**

- (a) Define Hund's rule.
- (b) Give the significance of azimuthal quantum number
- (c) How many electron waves are possible in the fourth orbit of hydrogen atom?
- (d) Two particles A and B are in motion. If the momentum of A is half of that of B and if the wavelength of A is  $4.5 \times 10^2 \text{ nm}$ , what is the wavelength of B?

**\*\*\*\*END OF THE QUESTION PAPER\*\*\*\***

