INDIAN SCHOOL AL WADI AL KABIR

FIRST ASSESSMENT (2023 - 24)

Class: XI | Sub: CHEMISTRY (043) | Max Marks: 70

Date:17.09.2023 | Set - 1 | 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.

(h) Use of log tables and calculators is not allowed.

SECTION A

The following questions are multiple -choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

1. Helium has a higher first ionization enthalpy than hydrogen because of:

a) the larger size of helium

b) greater nuclear charge in helium

c) more electrons in helium

d) helium is monoatomic whereas hydrogen is diatomic

2. Which of the following equations represents the first ionisation enthalpy of calcium?

a) $Ca^{+}(s) \rightarrow Ca^{2+}(s) + e^{-}$

b) $Ca(s) \rightarrow Ca^{+}(s) + e^{-}$

c) $Ca^{+}(g) \rightarrow Ca^{2+}(g) + e^{-}$

d) $Ca(g) \rightarrow Ca^{+}(g) + e^{-}$

3. How many atoms are there in 6 g of water?

a) 3.011×10^{23} b) 6.022×10^{23}

c) 9.033×10^{23} d) 1.204×10^{24}

4. The mass percentage of carbon in Ethane (C_2H_6) is ……

a) 24 % b) 33.3 %

c) 40 % d) 80 %

5. Carbon monoxide reacts with oxygen to form carbon dioxide.

$$2CO(g) + O_2(g) \rightarrow 2CO_2(g)$$

100 ml of carbon monoxide is mixed with 75 ml of oxygen. What is the total volume of the gaseous mixture when the reaction is complete?

a) 125 ml b) 100 ml

c) 175 ml d) 350 ml

6. *f* sub-shell can accommodate a maximum of …… electrons and it contains ……. orbitals.

a) 10, 5 b) 6, 3

c) 14, 7 d) 20, 10

7. How many electrons in an atom can have the following quantum numbers?

$n = 3$, $l = 1$, $m_s = -1$

a) 5 b) 3

c) 1 d) 7

8. Find the number of unpaired electrons present in an atom of chlorine.

a) 5 b) 3

c) 1 d) 2

9. Which of these molecules is polar?

a) BF_3 b) PF_5

c) CCl_4 d) OF_2

10. Octet rule does not explain the formation of one of the following molecules. Identify the molecule.

a) CO b) H_2O

c) SF_6 d) NH_3

11. What is the formal charge on nitrogen in nitrate ion, NO_3^-?

a) -1 b) +1

c) 0 d) -2

12. CO and NO^+ are isoelectronic. Identify the bond order of NO^+

a) 3 b) 2

c) 1 d) 1.5

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

Assertion (A): According to MOT, bond order of C_2 is two.

Reason (R): C_2 does not contain any unpaired electrons.

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.

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

Assertion (A): Ionization enthalpy increases on moving down the group.

Reason (R): On moving down the group, outermost electrons are less attracted by the nucleus due to increase in shielding effect.

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.

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

Assertion (A): First electron gain enthalpy of F is less negative than that of Cl.

Reason (R): In fluorine, the newly added electron goes to the smaller second shell and suffers significant electron-electron repulsion.

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.

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

Assertion (A): 5d orbitals have lower energy than 6s.

Reason (R): The lower the value of n + *l* for an orbital, the lower is its energy.

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.

SECTION B

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

17. Calculate the mass of a photon with wavelength 3.3 pm.

(Given, planks constant = 6.6×10^{-34} Js)

18. State: a) Heisenberg's uncertainty principle.

b) Hund's rule of maximum multiplicity.

19. A compound contains 58.54% carbon, 7.32% hydrogen and 34.14% nitrogen. Its molecular mass is 82 u. Identify the empirical and molecular formulae.

OR

a) Calculate the molarity of NaOH in the solution prepared by dissolving its 8 g in enough water to form 800 mL of the solution. (Na = 23u, O = 16u, H = 1u))

b) Does Molarity depend on temperature? Explain.

20. a) Write the general outer electronic configuration of '*f*' block elements.

b) Write the IUPAC name and symbol of the element with atomic number 108.

21. Draw the resonance structures and resonance hybrid of CO_3^{2-} ion.

SECTION C

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

22. Describe the conditions for the combination of atomic orbitals to form molecular orbitals.

23. Draw the Lewis representation of:

a) NO_2^- b) CN^- c) O_3

Mention the charge on each atom.

24. Differentiate between covalent radius and van der Waals radius with the help of a diagram.

25. a) State Aufbau principle.

b) Identify all the four quantum numbers of $4d^{8}$

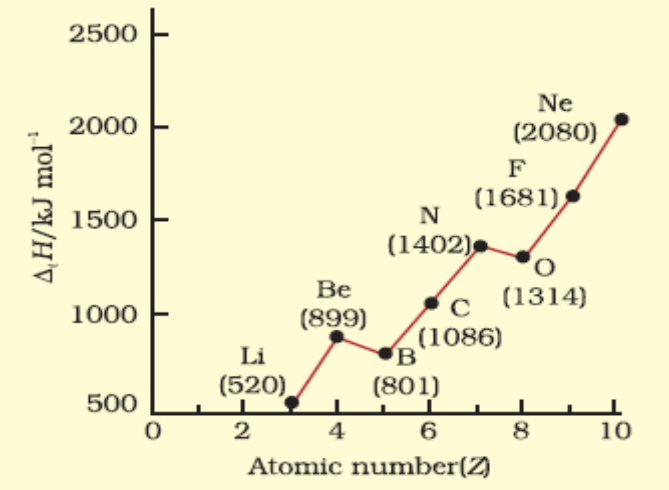
OR

a) Draw Boundary surface diagrams of:

i) p_x ii) d_{z^2}

b) Write the sub-shell electronic configuration of Cr. (Atomic number of Cr is 24).

26. First ionization enthalpies ($\Delta_i H$) of elements of the second period are given below. Write a note on the general trend and exceptional cases.



27. The density of 3 M solution of NaOH is 1.42 g mL^{-1}. Calculate the molality of the solution.

28. a) State Gay Lussac's Law of gaseous volumes.

b) Calculate the number of atoms in each of the following:

i) 8 moles of oxygen gas

ii) 8 g of oxygen gas

SECTION D

The following questions are case -based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.

29. Many a time, reactions are carried out with the amounts of reactants that are different than the amounts as required by a balanced chemical reaction. In such situations, one reactant is in more amount than the amount required by balanced chemical reaction. The reactant which is present in the least amount gets consumed after sometime and after that further reaction does not take place whatever be the amount of the other reactant.

In a given reaction, 13.8g of sodium is mixed with 14.2 g of chlorine to produce sodium chloride. (Na = 23u, Cl = 35.5u)

$2\ Na + Cl_2 \rightarrow 2\ NaCl$

Answer the following questions:

a) Identify the limiting reagent.

b) Calculate the mass of NaCl produced in the above reaction.

c) Calculate the mass of the excess reactant remaining at the end of the reaction.

OR

c) In another reaction, 48 g of carbon is reacted with 64 g of oxygen to form a single product so that there is no limiting reagent. Predict whether CO or CO_2 is produced in this reaction. Explain your answer.

30. A quantitative measure of the tendency of an element to lose electron is given by its Ionization Enthalpy. It represents the energy required to remove an electron from an isolated gaseous atom (X) in its ground state. The ionization enthalpy is expressed in units of kJ mol^{-1}. The second ionization enthalpy is defined as the energy required to remove the second most loosely bound electron

The first ($\Delta_i H_1$), second ($\Delta_i H_2$) and third ($\Delta_i H_3$) ionization enthalpies (in kJ mol^{-1}) and electron gain enthalpy of a few elements are given below:

Elements	$\Delta_i H_1$	$\Delta_i H_2$	$\Delta_i H_3$	$\Delta_{eg}H$
I	735	1440	7733	-57
II	495	4562	6910	-53
III	2080	3952	6122	+116
IV	590	1150	4912	-54
V	1681	3374	6050	-328

Answer the following questions:

Which of the above elements is likely to be?

a) an inert gas.

b) the metal which can form an ionic halide of the formula MX. (X=halogen)

c) the more reactive group two metal. Explain your answer.

OR

c) Name the element having the highest first ionisation enthalpy in the modern periodic table. Write an equation to represent the second ionisation of this element.

SECTION E

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

31. Attempt **any five** of the following:

a) Electron gain enthalpy of oxygen is less negative than that of sulphur. Why?

b) What are Transuranium Elements?

c) Write any two characteristics of transition elements.

d) K^+ is smaller than K. Give reason.

e) Arrange the following in the increasing order of size.

Na^+, F^-, O^{2-}, Mg^{2+}

f) What are Representative elements? Give an example

g) $[AlF_6]^{3-}$ is known but $[BF_6]^{3-}$ is unknown. Why?

32. a) Calculate the energy associated with the 4^{th} orbit of He^+. What is the radius of this orbit?

b) Indicate the number of unpaired electrons in:

i) S^{2-} ii) Co^{2+}

c) Which atom is indicated by the following configuration, [Ne] $3s^2\ 3p^5$?

OR

a) Calculate the amount of energy released during an electronic transition from n = 3 state to the n = 2 state in the hydrogen atom?

b) Calculate the angular nodes and radial nodes present in 3*d* subshell.

c) How many electrons in an atom can have the following quantum numbers?

i) n = 4, m_s = + ½ ii) n = 3, l = 2, m_s = - ½

33. a) Explain the Hybridisation in SF_6. Predict its shape and bond angle.

b) Using MOT, predict the bond order and magnetic behaviour of:

i) B_2 ii) F_2

c) What is Intramolecular hydrogen bond? Give an example.

OR

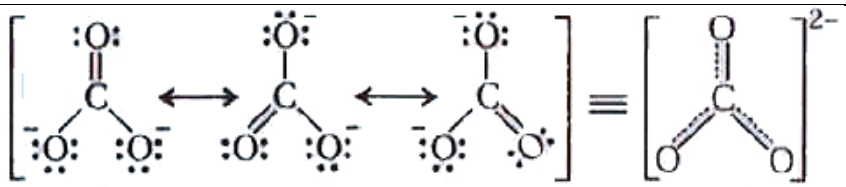
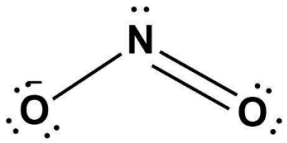
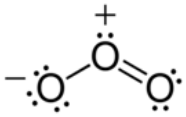
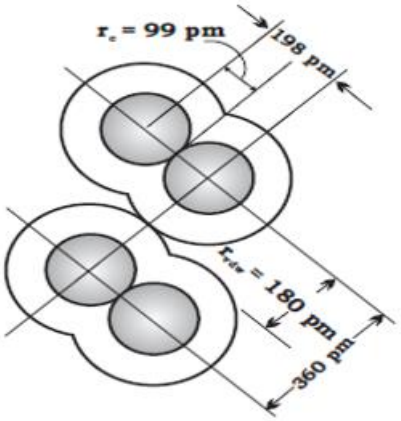
a) Explain the Hybridisation in $BeCl_2$. Predict its shape and bond angle.

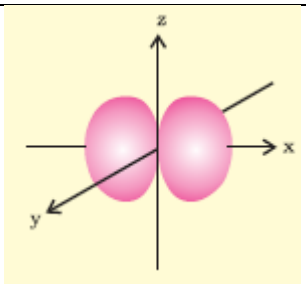
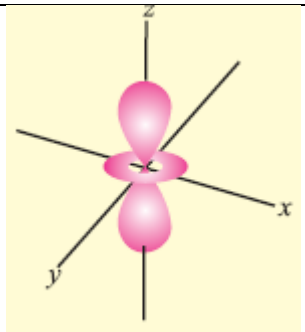
b) Complete the following table:

COMPOUND	SHAPE	BOND ANGLE
H_2O		
NH_3		
BCl_3		

ANSWER KEY

1.	b) greater nuclear charge in helium	**1**
2.	d) $Ca(g) \rightarrow Ca^{+}(g) + e^{-}$	**1**
3.	b) 6.022×10^{23}	**1**
4.	d) 80 %	**1**
5.	a) 125 ml	**1**
6.	c) 14, 7	**1**
7.	b) 3	**1**
8.	c) 1	**1**
9.	d) OF_2	**1**
10.	c) SF_6	**1**
11.	b) +1	**1**
12.	a) 3	**1**
13.	b) Both A and R are true but R is not the correct explanation of A.	**1**
14.	d) A is false but R is true	**1**
15.	a) Both A and R are true and R is the correct explanation of A	**1**
16.	d) A is false but R is true.	**1**
17.	$m = \frac{h}{\lambda v}$ $= \frac{6.6 \times 10^{-34}\ Js}{3.3 \times 10^{-12}\ m \times 3 \times 10^{8}\ ms^{-1}}$ $= 0.66 \times 10^{-30}$ kg or 6.6×10^{-31} kg	½ ½ **1**
18.	a) It is impossible to determine simultaneously, the exact position and exact momentum (or velocity) of an electron. b) Pairing of electrons does not take place until all the orbitals are singly occupied.	**1** **1**
19.	Empirical formula is C_2H_3N Molecular formula is $C_4H_6N_2$ **OR** a) $\text{Molarity (M)} = \frac{\text{No. of moles of solute}}{\text{Volume of solution in litres}}$ = 0.2 mol / 0.8 L = 0.25 $molL^{-1}$	**1** **1** ½ ½

	b) Yes, Molarity depends upon temperature as volume changes with temperature.	**1**
20.	a) $(n-2)f^{1-14}\ (n-1)d^{0-1}\ ns^2$ b) Unniloctium (Uno)	**1** **1**
21.		**2**
22.	• The combining atomic orbitals must have the same or nearly the same energy. • The combining atomic orbitals must have the same symmetry about the molecular axis. • The combining atomic orbitals must overlap to the maximum extent.	**1** **1** **1**
23.	a)  b)  c) 	**1** **1** **1**
24.	**Covalent radius** is half of the distance between the centre of nucleus of two similar atoms joined by a covalent bond in the same molecule. **van der Waals radius** is half of the distance between the centre of nucleus two similar atoms in separate molecules. 	**1** **1** **1**
25.	a) In the ground state of the atoms, the orbitals are filled in order of their increasing energies. b) n = 4, l = 2, m_l = 0, m_s = - ½ **OR**	**1** **2**

	a) i)  ii)  b) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^5$	**2** **1**
26.	• Across the period, ionization energy increases. • Reason • The first ionization enthalpy of boron is slightly less than that of beryllium. • Reason • The first ionization enthalpy of oxygen is slightly less than that of Nitrogen. • Reason	½ ½ ½ ½ ½ ½
27.	Molality = $\frac{Molarity \times 1000}{(density \times 1000) - (Molarity \times Molar\ mass\ of\ solute)}$ Molality = 2.3 mol kg^{-1}	**1** **2**
28.	a) When gases combine or are produced in a chemical reaction, they do so in a simple ratio by volume provided all gases are at same temperature and pressure. b) i) Number of atoms = 8 x 6.022 x 10^{23} x 2 = 96.352 x 10^{23} ii) Number of atoms = 0.25 x 6.022 x 10^{23} x 2 = 3.011 x 10^{23}	**1** **1** **1**
29.	a) Chlorine b) 23.4 g c) Number of moles of unreacted Na = 0.2 mol Mass of unreacted sodium = 4.6 g **OR** c) CO Mole ratio between carbon and oxygen is 2:1	**1** **1** **1** **1** **1** **1**
30.	a) Element III b) Element II c) Element IV Compared to element I, element IV has lower first I.E. Also, element IV has less negative EGE.	**1** **1** **1** **1**

	OR	
	c) Helium	**1**
	$He^{+}(g) \rightarrow He^{2+}(g) + e^{-}$	**1**
31.	a) This is because when an electron is added to O, the added electron goes to the smaller second shell and suffers significant electron-electron repulsion. For S, the electron is added to the larger third shell.	**1**
	b) The elements after uranium in the modern periodic table are called Transuranium Elements.	**1**
	c) Transition elements form coloured ions, exhibit variable oxidation states, paramagnetic, form complexes and often used as catalysts. (*Any two*).	**½ + ½**
	d) K^{+} has fewer electrons than K, while its nuclear charge remains the same.	**1**
	e) $Mg^{2+} < Na^{+} < F^{-} < O^{2-}$	**1**
	f) s block and p block elements are collectively known as Representative elements. Any one example.	**½ + ½**
	g) $[BF_6]^{3-}$ is unknown due to the absence of d orbitals. $[AlF_6]^{3-}$ is known as Al can expand its covalency beyond 4 due to the availability of d orbitals.	**1**
32.	a) $E_n = -2.18 \times 10^{-18}\left(\frac{Z^2}{n^2}\right)\text{J}$	**½**
	Z = 2, n = 4 E_n = - 0.545 x 10^{-18} J	**1**
	$r_n = \frac{52.9(n^2)}{Z}\text{pm}$	**½**
	= 423.2 pm	**1**
	b) i) 0 ii) 3	**½ + ½**
	c) Cl	**1**
	OR	
	a) $\Delta E = R_H\left(\frac{1}{n_i^2} - \frac{1}{n_f^2}\right) = 2.18 \times 10^{-18}\text{J}\left(\frac{1}{n_i^2} - \frac{1}{n_f^2}\right)$	**1**
	= - 0.302 x 10^{-18} J	**1**
	b) Angular nodes, l = 2	**½**
	Radial nodes, n-l-1 = 3-2-1 = 0	**½**
	c) i) 16	**1**

	ii) 5	**1**
33.	a) sp^3d^2 hybridisation - Explanation	**1**
	Shape: Octahedral	½
	Bond angle: 90^0	½
	b) i) Bond order is 1	½
	Magnetic behaviour – Paramagnetic	½
	ii) Bond order is 1	½
	Magnetic behaviour – Diamagnetic	½
	c) Hydrogen bond within the molecule.	½
	2-Nitrophenol.	½
	OR	
	a) Hybridisation in $BeCl_2$ is sp - Explanation	**1**
	Shape is Linear and bond angle is 180^0	½ + ½
	b)	

COMPOUND	SHAPE	BOND ANGLE	
H_2O	Bent	104.5^0	**1**
NH_3	Trigonal pyramidal	107^0	**1**
BCl_3	Trigonal planar	120^0	**1**