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The Mother's International School  
Mid-Term Examination (2024-25)  
Class: XI  
Subject: Chemistry  
Date: 9.9.2024

TIME: 3 HOURS

MM:70

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

- 1 Which one will have maximum numbers of water molecules? 1
- a) 18 molecules of water
  - b) 1.8 grams of water
  - c) 18 grams of water
  - d) 18 moles of water
- 2 The de Broglie wavelength for particles having same kinetic energy is 1
- a) Independent of its velocity
  - b) Directly proportional to its velocity
  - c) Inversely proportional to its velocity
  - d) Unpredictable
- 3 Which of the following has the maximum number of unpaired electrons? 1
- a)  $Mg^{2+}$
  - b)  $V^{3+}$
  - c)  $Ti^{3+}$
  - d)  $Fe^{2+}$
- 4 The number of sigma and pi bonds in nitrogen is
- a) 1,2
  - b) 2,1
  - c) 1,1
  - d) 2,2

- 5 The following quantum number are possible for how many orbitals?  
 $n = 3, l = 2, m = +2$   
a) 1  
b) 2  
c) 3  
d) 4 1
- 6 Which of the following angle corresponds to  $sp^2$  hybridisation?  
a)  $90^\circ$   
b)  $120^\circ$   
c)  $180^\circ$   
d)  $109^\circ$  1
- 7 The electrons distribute themselves to retain similar spins as far as possible in a set of degenerate orbitals. This statement relates to  
a) Pauli's Exclusion Principle  
b) Hund's Rule  
c) Law of degeneration  
d) Aufbau Principle 1
- 8 The element with the highest first ionization enthalpy is  
a) boron  
b) carbon  
c) nitrogen  
d) oxygen 1
- 9 Which of the following statements is true for chloride ion and potassium ion, which are iso electronic?  
a) They have same size  
b) chloride ion is bigger than potassium ion  
c) Potassium ion is bigger than chloride ion  
d) Size of an ion depends on the other cation or anion present 1
- 10 The geometry and the type of hybrid orbital present about the central atom in  $BF_3$  is  
a) linear,  $sp$   
b) trigonal planar,  $sp^2$   
c) tetrahedral,  $sp^3$   
d) pyramidal,  $sp^3$  1
- 11 Which of the following is **not** correct?  
a)  $\Delta G$  is zero for a reversible reaction  
b)  $\Delta G$  is positive for a spontaneous reaction  
c)  $\Delta G$  is negative for a spontaneous reaction  
d)  $\Delta G$  is positive for a non-spontaneous reaction 1
- 12 The molecule which has zero dipole moment is  
a)  $CH_4$   
b)  $BF_3$   
c)  $NF_3$   
d)  $CO$  1

In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- Assertion and reason both are true, reason is correct explanation of assertion.
- Assertion and reason both are true, but reason is not the correct explanation of assertion.
- Assertion is true, reason is false.
- Assertion is false, reason is true.

- 13 Assertion: Combustion of all organic compounds is an exothermic reaction. Reason: The enthalpies of all elements in their standard state are zero. 1
- 14 Assertion: Water has a bond angle less than ammonia Reason: This is due to lp-bp repulsion. 1
- 15 Assertion: Enthalpy of formation of  $H_2O(l)$  is greater than that of  $H_2O(g)$ . Reason: Enthalpy change is negative for condensation reaction. 1
- 16 Assertion: An orbital cannot have more than 2 electrons and their spin must be opposite. Reason: No two electrons in an atom can have same set of all four quantum numbers. 1

### SECTION B

- 17 a) State Heisenberg's Uncertainty Principle 2  
 b) The uncertainties in the velocity of two particles A and B are 0.05 and 0.02  $ms^{-1}$  respectively. The mass of B is five times to that of A. What is the ratio of uncertainties in their positions? 2
- 18 a) What are stationary states? 2  
 b) What are Zeeman and Stark Effect? 2
- 19 Derive the relationship between  $\Delta H$  and  $\Delta U$ . 2  
 What are extensive property and intensive properties? 2
- 20 Compare the structure of  $NCl_3$  and  $PCl_3$ . 2
- 21 Calculate the enthalpy change for the following addition reaction. 2  
 $C_2H_4(g) + HBr(g) \rightarrow C_2H_5Br(g)$   
 Bond Enthalpy Data (in kJ/mol)  
 C-H +414, H-Br +362, C-C +346, C=C +602, C-Br +285 respectively

### SECTION C

- 22 Define ionisation enthalpy. Discuss the factors affecting ionisation enthalpy of the elements and its trends in the periodic table. 3
- 23 a) Define mole fraction 1+2  
 b) Dissolving 120 g of urea (Molar mass of urea =  $60 g mol^{-1}$ ) in 1000 g of water gave a solution of density 1.15 g/mL. Calculate the molarity and molality of the solution.
- 24 a) 30g of Magnesium and 30 g of oxygen are reacted, then what does the residual mixture contain? ans 50g of magnesium oxide and 10 g of oxygen 1.5x2  
 b) Chlorine is prepared in the laboratory according to the reaction.

$4 \text{HCl (aq)} + \text{MnO}_2 \text{ (s)} \longrightarrow 2 \text{H}_2\text{O (l)} + \text{MnCl}_2 \text{ (aq)} + \text{Cl}_2 \text{ (g)}$  How many grams of HCl react with 5.0 g of manganese dioxide? (Atomic mass of Mn = 55 u)

1+2

- 25 a) Draw the shapes of  $3d_{z^2}$  and  $3d_{x^2-y^2}$  orbitals  
b) Write all quantum numbers associated with 4f and  $3p_x$  orbitals

3

- 26 The enthalpy of combustion of methane, graphite and dihydrogen at 298 K are  $-890.3 \text{ kJ mol}^{-1}$ ,  $-393.5 \text{ kJ mol}^{-1}$  and  $-285.8 \text{ kJ mol}^{-1}$  respectively. Calculate enthalpy of formation of methane gas.

3

- 27 a) Explain Lanthanoid contraction.  
b) State Fajan's rule.

3

- 28 a) Compare the bond angle of methane and ammonia. Give reason.  
b) Draw the diagram of ethene and explain the hybridisation.

#### SECTION D

- 29 Thermodynamics involve energy changes in chemical reactions and other processes. Internal energy is total energy stored in a substance. We can specify absolute value of volume but not the absolute value of internal energy. We can measure only change in internal energy ( $\Delta U$ ). Work done on the system is taken as positive and work done by the system is taken as negative. Heat ( $q$ ) absorbed by the system is +ve and heat given out by system is negative.

- a) What is enthalpy of neutralisation? When does it have a fixed value?  
b) What is the mathematical expression of first law.  
c) Which has more entropy  $1 \text{ mol H}_2\text{O(l)}$  at  $25^\circ\text{C}$  or  $1 \text{ mol H}_2\text{O(l)}$  at  $35^\circ\text{C}$ ?

2  
1  
1

- 30 Read the passage given below and answer the following questions:  
In the periodic table electronegativity increases from left to right in a period and decreases from top to bottom in a group. The non-metallic character of an element is directly related to the electronegativity while the metallic character is inversely related to it.

- a) The element with maximum electronegativity belongs to  
(i) Period-1, Group-18  
(ii) Period-2, Group-17  
(iii) Period-3, Group-17  
(iv) Period-2, Group-1.

1

- b) Which of the following groups contains metals, non-metals as well as metalloids?  
(i) Group-1  
(ii) Group-17  
(iii) Group-14  
(iv) Group-2.

1

- c) The least, metallic element of group-13 is  
(i) Aluminium  
(ii) Boron  
(iii) Gallium

(iv) Indium.

- d) The electronegativity increases with
  - (i) decrease in nuclear charge
  - (ii) increase in atomic mass
  - (iii) decrease in atomic size
  - (iv) increase in atomic number.

**SECTION E**

- 31 a) Give two differences between sigma and pi bond 2+3  
 b) Explain the hybridisation, geometry and shape of water and ammonium ion.
- 32 a) Define empirical Formula and molecular formula 2+1+2  
 b) Give one example each of a molecule in which empirical formula and molecular formula is (i) Same (ii) Different.  
 c) A compound contains 4.07 % hydrogen, 24.27 % carbon and 71.65 % chlorine. Its molar mass is 98.96 g. What are its empirical and molecular formulas?
- 33 a) The wave number of first line of Balmer series of hydrogen is  $15200 \text{ cm}^{-1}$ . What is the wave number of the first Balmer line of  $\text{Li}^{2+}$  ion? 1.5  
 b) Write 2 differences between absorption and emission spectrum 2  
 c) What transition in the hydrogen spectrum would have the same wavelength as the Balmer transition  $n = 4$  to  $n = 2$  in the  $\text{He}^+$  spectrum? Ans  $n = 2$  to  $n = 1$  1.5

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