B.SC CHEMISTRY
First Semester
Chemistry (Major)
(BSC- 106)

Duration: 3Hrs. **Full Marks: 70**

Part-A (Objective) =20
Part-B (Descriptive) =50

(PART-B: Descriptive)

Duration: 2 hrs. 40 mins. **Marks: 50**

Answer any *four* from *Question no.* 2 to 8
***Question no.* 1 is compulsory.**

1. (a) Define root mean square (RMS) and most probable velocity of gas molecules? Explain how most probable velocities vary with temperature. 2+3

   (b)State Pauli's exclusion principle with examples. 2

   (c)State de Broglie principle and prove that $\lambda = \frac{h}{mv}$ 3

2. Write the postulates of kinetic theory of gases. Derive an expression for the pressure of an ideal gas by means of the kinetic theory of gases. Show that the total kinetic energy of the molecules in one mole of an ideal gas is equal to $\frac{3}{2}RT$. Calculate the kinetic energy of two moles of N_2 at 27°C (R= 8.314 $JK^{-1}mol^{-1}$). 2+4+2+2=10

3. (a) A glass capillary of diameter 0.1 cm is dipped in water. Calculate the level of the water that rises in the capillary if surface tension of water =72.75dyne cm^{-1}, density = 0.9984 gcm^{-3}. 3

   (b)Explain the following terms 3

   (i) Fluidity

   (ii) Surface tension

   (c) Define viscosity of fluids and write its unit. How does the temperature affect the viscosity of a liquid? 4

4. (a) What are the four quantum numbers? Explain the significance of four quantum numbers. **5**

(b) A cricket ball weighing 100 g is to be located within 0.1 Å. What is the uncertainty in its velocity? Comment on your result. **3**

(c) Explain Hund's rule of maximum multiplicity using examples **2**

5. (a) Suggests four similar reactions which justify diagonal relationship between Beryllium and Aluminium. **4**

(b) Explain the following reactions on the basis of electronegativity difference with hybridization of Nitrogen **3**

$RNH_2 + H_2O \rightarrow RNH_3^+ + OH^-$

$C_5H_5N + H_2O \rightarrow C_5H_5NH^+ + OH^-$

$RC{\equiv}N + H_2O \rightarrow$ no reaction

(c) On the basis of electronic configuration explain why- **3**

(i) Sulfur has lower electron affinity than Chlorine.

(ii) Sulfur has lower Ionization potential than phosphorous.

(iii) Boron has lower Ionization Potential than Beryllium.

6. (i) Draw the orbital structure of the molecule, $H_3C-\ddot{N}H_2$. Evaluate the hybridisation of C and N atoms; mention the bond angle and the geometry of the molecule. **3**

(ii) Define resonance. What do you mean by resonance energy? Draw resonance structures for any one of the following molecule/ion **1+1+2=4**

(a) 

(b) 

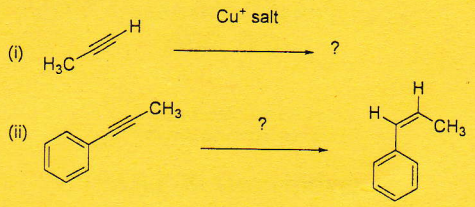
(iii) Explain the terms (any two) **1.5×2=3**

(a) Inductive effect. (b) Intra-molecular Hydrogen bonding.

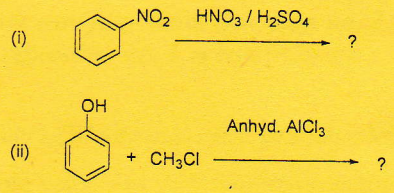
(c) carbocations.

7. (a) Benzene contains three double bonds, however its experimental bond length is found in between single and double bond length. Explain why? 3

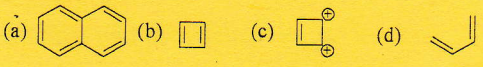
(b) Complete the following reaction- 2



(c) Write the product of the following reaction- 3



(d) Identify compound based on aromatic, antiaromatic and non-aromatic character 2



8. (i) Write the product of the following. 3

a) $C_2H_5I + 2H \xrightarrow{Zn/HCl}$?

b) $CH_3I + HI \xrightarrow{\text{Red P, 420 K}}$?

(ii) Write the mechanism of Wurtz reaction. 3

(iii) In which category category the following reactions belong: 4

(a) $NH_4CNO \xrightarrow{heat} NH_2CONH_2$

(b) $CH_3Br + KOH\,(aq) \longrightarrow CH_3OH + KBr$

(c) $CH3CHO + HCN \longrightarrow CH_3CH(CN)\text{-}OH$

(d) $CH_3CH_2Br + KOH \longrightarrow CH_2{=}CH_2 + H_2O$

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B SC CHEMISTRY
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Chemistry (Major)
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Duration: 20 minutes **Marks – 20**

(PART A - Objective Type)

I. Choose the correct answer: **1×20=20**

1. Which of the following statements is incorrect

   a.The pressure exerted by the vapour in equilibrium with the liquid at affixed temperature is called vapour pressure.

   b.the vapour pressure increases with rise in temperature

   c.at equilibrium, liquid $\rightleftharpoons$ vapour

   d.at equilibrium, the rate of evaporation is not equal to rate of condensation

2. The dimension in which coefficient of viscosity is expressed are

   a.Mass X length X time^{-1} b.Mass X length^{-1} X time^{-1}

   c.Mass X length^{-1} X time d.Mass^{-1} X length^{-1} X time^{-1}

3. With rise in temperature, the surface tension of the liquid

   a.Increases b.Decreases

   c.Remains the same d.None of the above

4. The expressions for the root mean square and most probable velocities are respectively,-

   a. $\sqrt{\frac{2RT}{M}}, \sqrt{\frac{3RT}{M}}$ b. $\sqrt{\frac{3RT}{M}}, \sqrt{\frac{2RT}{M}}$

   c. $\sqrt{\frac{8RT}{M}}, \sqrt{\frac{2RT}{M}}$ d. $\sqrt{\frac{8RT}{\pi M}}, \sqrt{\frac{3RT}{M}}$

5 The correct ratio is

a. $\langle C^2 \rangle^{1/2} : \langle C \rangle : C_p :: \sqrt{3} : \frac{\sqrt{8}}{\pi} : \sqrt{2}$, b. $\langle C^2 \rangle^{1/2} : \langle C \rangle : C_p :: \sqrt{2} : \frac{\sqrt{8}}{\pi} : \sqrt{3}$,

c. $\langle C^2 \rangle^{1/2} : \langle C \rangle : C_p :: \sqrt{8} : \frac{\sqrt{3}}{\pi} : \sqrt{2}$, d. $\langle C^2 \rangle^{1/2} : \langle C \rangle : C_p :: \sqrt{3} : \frac{\sqrt{2}}{\pi} : \sqrt{8}$

6. The mathematical expression for Heisenberg's Uncertainty principle is

a. $\Delta x \times \Delta P_x \leq \frac{h}{4\pi}$ b. $\Delta x \times \Delta P_x \geq \frac{h}{4\pi}$

c. $\Delta x \times \Delta V_x \geq \frac{h}{4\pi}$ d. None of the above

7 The relationship for de Broglie equation is

a. $\lambda = \frac{h}{m}$, b. $\lambda = \frac{h}{p}$, c. $v = \frac{c}{\lambda}$, d. $\lambda = \frac{h}{v}$

8. The order of increasing energy for the orbital-

a. $3s < 3p < 4s < 3d$, b. $3s < 3p < 4s < 3d$,

c.$3s < 4s < 3p < 3d$ d. $3p < 3s < 3d < 4s$

9. In which of the following orbital Hund's rule is not applicable-

a. p-orbital b. d-orbital c. f-orbital d. s-orbital

10. The position of Platinum (78) in the periodic table is-

a. Group 8^{th} and period 6^{th} b. Group 9^{th} and period 6^{th}

c. Group 10^{th} and period 6^{th} d. Group 10^{th} and period 5^{th}

11. If Nb and Ta belong to the group 5^{th} and period 5^{th} and 6^{th} respectively, the covalent radii of Nb will be –

a. greater than covalent radii of Ta b. less than covalent radii of Ta

c. equal to covalent radii of Ta d. twice the covalent radii of Ta

12. The effective nuclear charge of 3d electron in Nickel is-

a. 7.55 b. 4.05 c. 5.05 d. 8.55

13. Hybridisation of C in CH_3 is

a. sp^3 b. sp^2 c. sp d. d^2sp^3

14. Which of these molecules, CCl_4, $CHCl_3$, CO_2, H_2O, will have dipole moment, $\mu=0$

a. $CHCl_3$ & CO_2, b. CCl_4 only

c. CCl_4 & CO_2 d. $CHCl_3$ & H_2O,

15. Which of the following molecule will have the highest boiling point

a. C_4H_{10} b. $C_3H_7NH_2$ c. C_3H_7OH d. CH_3-O-C_2H_5

16. The IAPAC name of the following compound is CH_3-CH=CH-CCH –

a. Pent-3-en-1 yne b. Pent-2-ene-1,4-diyne,

c.Oct-6-ene-1,4-diyne, d. None of the above

17. When Grignard reagent (CH3MgBr) reacts with H2O, the major product is

a. CH_4, b.C_2H_6, c.Mg(OH)Br, d. ROH

18. Which of the following statement about carbocation is not correct?

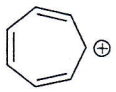
a. Bridgehead carbocation is stable because of their non-plannerity

b. A carbocation would be stable if and only if it is planner.

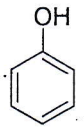
c. Possibility of resonance can increase the stability of carbocation

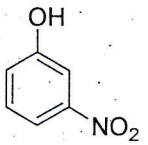
d. In carbocation the carbon atom is sp^2 hybridized

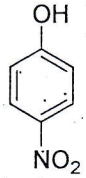
19. Among the following compound which one is not aromatic-?

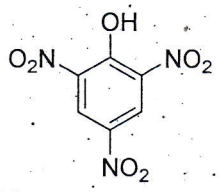
(a)  (b)  (c).  (d) All of these

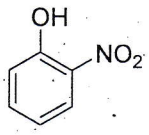
20: The product of the following transformation is-



(a) 

(b) 

(c) 

(d) 

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