

M.Sc. 3rd Semester Examination-2022-23

CHEMISTRY

Course ID : 31455

Course Code : CHEM305EID

Course Title : Advanced General Chemistry

Time : 2 Hours

Full Marks : 40

The figures in the right hand margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

1. Answer **any five** questions : 2×5=10

(a) Which of the following elements will possess the highest electron affinity? Explain.

As, O, S, Se

(b) Calculate the wavelength (in nanometer) associated with a proton moving at $1.0 \times 10^3 \text{ ms}^{-1}$ (Mass of proton = $1.67 \times 10^{-27} \text{ kg}$ and $h = 6.63 \times 10^{-34} \text{ Js}$).

(c) Draw the hyper-conjugative forms of propene.

(Turn Over)

1. The first part of the question is to determine the value of $\frac{1}{\sqrt{2}}$.

2. The second part of the question is to determine the value of $\frac{1}{\sqrt{2}}$ when $\theta = 45^\circ$.

3. The third part of the question is to determine the value of $\frac{1}{\sqrt{2}}$ when $\theta = 135^\circ$.

4. The fourth part of the question is to determine the value of $\frac{1}{\sqrt{2}}$ when $\theta = 225^\circ$.

5. The fifth part of the question is to determine the value of $\frac{1}{\sqrt{2}}$ when $\theta = 315^\circ$.

6. The sixth part of the question is to determine the value of $\frac{1}{\sqrt{2}}$ when $\theta = 405^\circ$.

$$\frac{1}{\sqrt{2}} = \frac{1}{\sqrt{2}} \quad \frac{1}{\sqrt{2}} = \frac{1}{\sqrt{2}}$$

7. The seventh part of the question is to determine the value of $\frac{1}{\sqrt{2}}$ when $\theta = 505^\circ$.

8. The eighth part of the question is to determine the value of $\frac{1}{\sqrt{2}}$ when $\theta = 605^\circ$.

- (d) Cyclopropylmethyl cation is more stable than benzyl cation. – Explain.
- (e) What is Carbene ? Give example of a singlet carbene.
- (f) Write down the expression for the fraction of molecules having velocity c to $c+1$ from Maxwell's kinetic theory and explain each parameter.
- (g) Calculate the average speed of nitrogen molecules at 600K temperature.

2. Answer **any four** of the followings : $5 \times 4 = 20$

- (a) (i) What is diagonal relationship ? Give one example.
- (ii) Calculate radius of the second Bohr's orbit for hydrogen atom. (Planck's constant, $h = 6.626 \times 10^{-34}$ Js; Mass of electron = 9.1091×10^{-31} kg; Charge of electron $e = 1.60210 \times 10^{-19}$ C) $3+2$
- (b) Write down two defects of Sommerfeld atomic model. Write down the time independent 3-dimensional Schrödinger's equation. $2+3$
- (c) (i) Draw orbital picture of ethylene. Mention the hybridization and bond angle.

(ii) Draw the resonance contributors of methoxy benzene (C_6H_5OMe). $3+2$

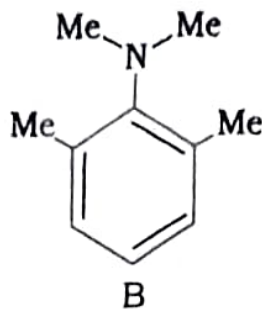
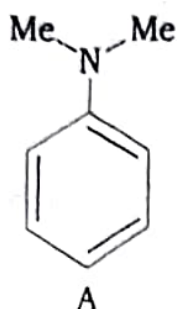
- (d) Give two examples of generation of benzyne. Reaction of singlet carbene with *cis*-2-butene is stereospecific but for triplet carbene the reaction is nonstereospecific. – Explain. $2+3$
- (e) Using the definition of gamma (Γ) function, find out the value of $\Gamma(1/2)$. 5
- (f) Derive the expression for the average speed for the gas molecules from kinetic theory of gases. 5

3. Answer **any one** of the followings : $10 \times 1 = 10$

- (a) (i) Calculate the electronegativity of chlorine from the following dissociation energy

$$E_{H-H} = 104 \text{ K cal mol}^{-1}; E_{Cl-Cl} = 36 \text{ K cal mol}^{-1}; \\ E_{H-Cl} = 134 \text{ K cal mol}^{-1}$$

- (ii) Calculation of screening constant and effective nuclear charge of 4s and 3d electron of Zn (atomic number = 30)
- (iii) Explain why C-N bond length of compound (A) is shorter than C-N bond length of compound (B) ?

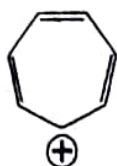


(iv) Which compound is aromatic among the three.

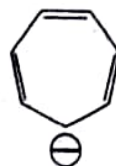
Explain



Cycloheptatriene



Cycloheptatrienyl cation



Cycloheptatrienyl anion

2+3+2+3

(b) (i) Calculate the difference between root mean square speed and average speed for an ideal gas exhibiting Maxwellian distribution of molecular speeds, given the molar mass is 2.0 gm mol^{-1} , density is 0.089 gm L^{-1} and the pressure is 1.0 atm .

(ii) Define classical and non-classical carbocation with suitable examples. Give two pathways to synthesize carbocation.

5+[(1.5+1.5)+2]