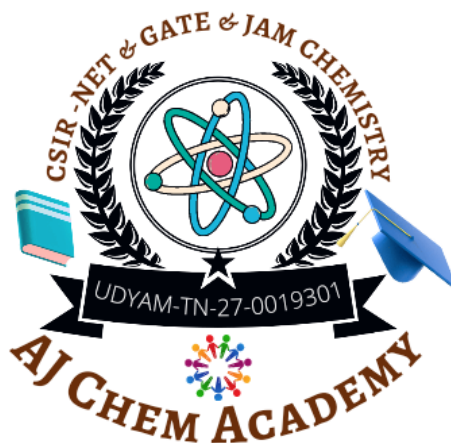


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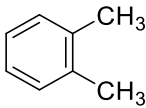
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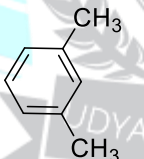


Q.1 – Q.75 MCQ, carry ONE mark each (for each wrong answer: -1).
You are required to Answer All Questions.

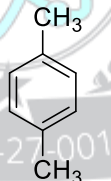
- The correct **DECREASING** order of **aromaticity** is represented by
 - Benzene > Pyridine > Pyrrole > Furan
 - Pyridine > Benzene > Furan > Pyrrole
 - Benzene > Pyrrole > Pyridine > Furan
 - Pyridine > Benzene > Pyrrole > Furan
- The **exceptional stability** of **cyclopropyl methyl cation** is attributed to
 - conjugation between the bent orbitals of the cyclopropyl ring and the vacant p orbital of the cationic carbon
 - +I effect of the cyclopropyl ring
 - conjugation between the bent orbitals of the cyclopropyl ring and the filled p orbital of the cationic carbon
 - ring strain of cyclopropyl group
- The number of **$^1\text{H-NMR}$ signals** of the following compounds respectively



P



Q



R

(a) 6, 6, 4

(b) 3, 3, 3

(c) 3, 4, 3

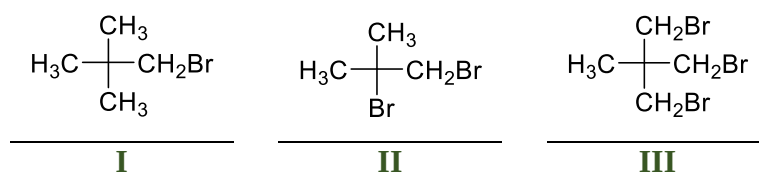
(d) 3, 4, 2
- The structure of $[\text{XeF}_5]^-$ is
 - pentagonal planar
 - square pyramidal
 - trigonal bipyramidal
 - pentagonal pyramidal
- Choose the correct order of **xenon halides stability**:
 - $\text{XeBr}_2 > \text{XeCl}_2 > \text{XeF}_2$
 - $\text{XeF}_2 > \text{XeBr}_2 > \text{XeCl}_2$
 - $\text{XeCl}_2 > \text{XeF}_2 > \text{XeBr}_2$
 - $\text{XeF}_2 > \text{XeCl}_2 > \text{XeBr}_2$
- Calculate the Z_{eff} experienced by the **4s electron for Potassium ($Z = 19$)**
 - 1.00
 - 2.20
 - 1.80
 - 1.40
- The **origin of colour** in **BiI_3 (orange-red)** is due to
 - metal-to-ligand charge transfer process
 - ligand-to-metal charge transfer process
 - d-d transition
 - bismuth in +3 oxidation state
- The **enantiomeric excess (ee)** of a mixture containing **40% R enantiomer** and **60% S enantiomer** is



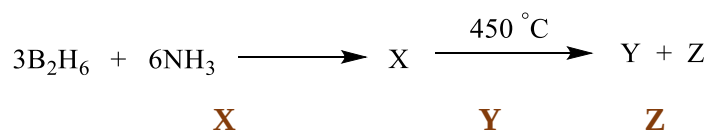
- (a) 60% (b) 40% (c) 20% (d) 50%
9. **Bathochromic shift in UV-Vis spectroscopy refers to**
 (a) shift to longer wavelength (b) shift to shorter wavelength
 (c) blue shift (d) Both b and c
10. **Which of the following relations is true for mixing of two ideal gases?**
 (a) $\Delta H = 0$; $\Delta V > 0$ (b) $\Delta H = 0$; $\Delta S > 0$ (c) $\Delta H = 0$; $\Delta G > 0$ (d) $\Delta H < 0$; $\Delta G < 0$
11. **The unit of rate constant of a reaction $A \rightarrow P$ is s^{-1} . If the half-life of the reaction is found to be 45 mins for initial concentration of A equal to 100 mol L^{-1} , then what will be the half-life when the initial concentration of A is 200 mol L^{-1} ?**
 (a) 90 mins (b) 22.5 mins (c) 45 mins (d) 60 mins
12. **Which of the following spectroscopy techniques is associated with molecular emission?**
 (a) UV-Visible spectroscopy (b) IR spectroscopy
 (c) Fluorescence spectroscopy (d) X-ray diffraction
13. **Read both Statement and Reason, then choose the right option:**
Statement : Reduction in size of lanthanides (M^{3+}) with increasing atomic number.
Reason : Consequence of the poor shielding of the 4f electron so there is a steady increase in effective nuclear charge.
 (a) Both statement and reason are incorrect (b) Statement is incorrect
 (c) Statement and Reason are correctly matched (d) Reason is incorrect
14. **Which of the following single bonds would show the strongest absorption in the IR?**
 (a) C—O (b) C—N (c) C—C (d) C—H
15. **If drops do not collapse under the effect of gravity, it indicates that**
 (a) the pressure inside the drop is greater than outside of the drop
 (b) viscosity of the liquid is large
 (c) the surface tension is low
 (d) the pressure outside the drop is greater than inside of the drop
16. **Which one of the following is not true for a Joule-Thomson expansion process?**
(P) It is iso-enthalpic **(Q)** $\mu_{J,T} = 0$ for the ideal gases
(R) $\frac{\partial T}{\partial P} = \frac{1}{C_p} \left(\frac{\partial H}{\partial P} \right)_P$ **(S)** $\mu_{J,T} > 0$ for all the temperature
 (a) R and S (b) Q and S (c) P and R (d) Q and R



17. How could you distinguish the following compounds by ^1H -NMR?



- (a) Number of signals and Chemical shifts (b) Number of signals and Coupling constants
(c) Chemical shifts and Integration (d) Integration and Coupling constants
18. How many **normal modes of vibration** of **CO₂** molecule is **IR active**?
- (a) 5 (b) 2 (c) 3 (d) 4
19. Which of the following statements is **wrong** about the **valence bond theory**?
- (a) Utilized hybridization concept
(b) Reaction between the ligands and a metal ion with the formation of co-ordinate covalent bonds
(c) Explained magnetic properties of complexes
(d) Support to compute lattice energies of transition metals for d⁶ - d⁹ electronic configuration
20. Read the Statement and pick out the correct option:
- Statement (I) : Metal in low oxidation states are usually strong reducing agents.**
- Statement (II) : To date, no example as an oxidizing agent is known when the metal is in a zero-oxidation state.**
- In the context of the above two statements, which of the following is correct?**
- (a) Statement (I) is wrong (b) Statement (II) is wrong
(c) Both statements are correct (d) Both statements are wrong
21. Complete the following reaction:



- (a) $6\text{H}_3\text{BNH}_3$; $2\text{B}_3\text{N}_3\text{H}_6$; 12N_2
 (b) $6\text{H}_3\text{BNH}_3$; $2\text{B}_3\text{N}_3\text{H}_6$; 12H_2
 (c) $3[\text{BH}_2(\text{NH}_3)_2][\text{BH}_4]$; $2\text{B}_3\text{N}_3\text{H}_6$; 12H_2
 (d) $3[\text{BH}_2(\text{NH}_3)_2][\text{BH}_4]$; $2\text{B}_3\text{N}_3\text{H}_6$; 12N_2
22. The calculated magnetic moment (in Bohr Magnetons) for $[\text{Cr}(\text{OH}_2)_6]^{3+}$ is
- (a) 1.73 (b) 2.83 (c) 3.88 (d) 4.90

23. Match the molecule (P-S) with the most suitable point group (I-IV) in the following list. Choose the correct option from the options given below:

	LIST-I		LIST-II	
(P)		(I)	C_2	
(Q)		(II)	C_i	
(R)		(III)	C_1	
(S)		(IV)	C_s	

	P	Q	R	S
(a)	III ; IV ; II ; I			
(b)	IV ; III ; II ; I			
(c)	II ; IV ; III ; I			
(d)	III ; I ; II ; IV			

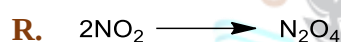
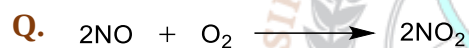
24. The aqueous solution of which of the following compounds is the best conductor of electric current?
 (a) Hydrochloric acid (b) Acetic acid (c) Ammonia (d) Fructose
25. Hybridization of the central carbon of allenes is
 (a) sp^3 (b) sp^2 (c) sd (d) sp
26. The crystal field stabilization energy for a weak field octahedral d^6 complex is
 (a) $0.4 \Delta_o$ (b) $0.6 \Delta_o$ (c) $0.8 \Delta_o$ (d) $2.4 \Delta_o$
27. The major product of hydroboration-oxidation of 1-propene is
 (a) 1,2-dihydroxypropane (b) 2-propanol (c) 1-propanol (d) n-propane
28. From the following coordination complexes the highest conductivity is expected for
 (a) $[Co(NH_3)_6]Cl_3$ (b) $[Co(NH_3)_5Cl]Cl_2$ (c) $[Co(NH_3)_5Br]Br_2$ (d) $cis-[Pt(NH_3)_2Cl_4]$
29. The major product obtained when allyl-o-bromophenyl ether is heated at $200^\circ C$ is
 (a) 6-Allyl-2-bromo-2,4-cyclohexadienone (b) 3-Allyl-6-bromophenol
 (c) 5-Allyl-6-bromophenol (d) 2-Allyl-6-bromophenol
30. A crystal with $a = b = c$ and $\alpha = \beta = \gamma$ is
 (a) trigonal (b) monoclinic (c) orthorhombic (d) tetragonal
31. Based on molecular orbital theory, the highest occupied molecular orbital(s) for B_2 has
 (a) two unpaired electrons with parallel spins
 (b) an empty orbital
 (c) two unpaired electrons with one parallel and another anti-parallel spins

- (d) a paired electron
32. The **wrong** feature about the **organolithium compound, RLi (R = Me, ⁿBu, t-Bu)**, is
- (a) aggregates as various oligomer in solution (b) pyrophoric
(c) should access only under inert atmosphere. (d) moisture insensitive
33. A real **hydrogen-like** wave function is given as $\psi = \frac{1}{4\sqrt{2\pi}} \left(\frac{Z}{a_0}\right)^{5/2} r e^{-Zr/2a_0} \cos\theta$. what are the **principal (n), azimuthal (ℓ), and magnetic (m_l) quantum numbers?**

	n	ℓ	m _l
(a)	1	1	0
(c)	2	1	0

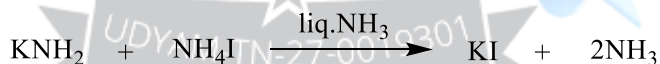
	n	ℓ	m _l
(b)	2	1	1
(d)	1	0	0

34. The following reactions are involving in the **Ostwald process for nitric acid production**. Of these, identify the **exothermic reaction**:



- (a) Q and R
(b) P and R
(c) P and Q
(d) P, Q and R

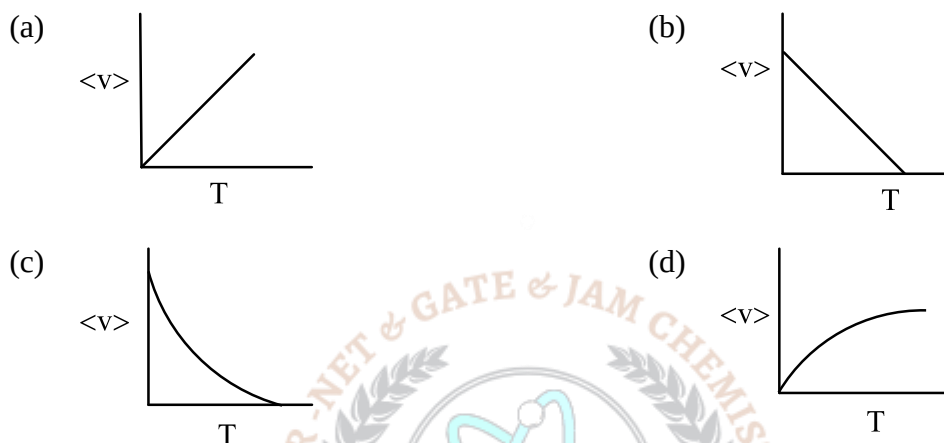
35. The following reaction is an example for



- (a) amphoteric (b) precipitation (c) neutralization (d) solvolysis
36. Reagents used for **Sharpless asymmetric epoxidation** are
- (a) Diethyl tartrate ; $\text{Ti}(\text{O}i\text{-Pr})_3$; t-BuOOH
(b) Diethyl tartrate ; $\text{Ti}(\text{O}i\text{-Pr})_4$; t-BuOH
(c) Diethyl tartrate ; $\text{Ti}(\text{O}i\text{-Pr})_2$; t-BuOOH
(d) Diethyl tartrate ; $\text{Ti}(\text{O}i\text{-Pr})_4$; t-BuOOH
37. The reaction product(s) of **o-bromotoluene** in the presence of **$\text{NaNH}_2/\text{liq. NH}_3$** is/are
- (a) o-Toluidine (b) m-Toluidine (c) Both o- and m-Toluidines (d) Toluene
38. The relationship between the **energy of the transition state** and the **structure** is described by
- (a) Curtin Hammett principle (b) Hammond's postulate
(c) Hammett equation (d) Taft equation
39. The **equilibrium constant (K_p)** is
- (a) independent of temperature (b) independent of pressure

- (c) independent of Gibbs free energy (d) independent of enthalpy

40. Considering the **Maxwell's distribution** of molecules of a gas, which one of the following graphs is a qualitative representation of **average speed of molecules** with **change in absolute temperature**?



41. **Lossen rearrangement** involves the transformation of

- (a) amide to isocyanate (b) activated hydroxamate to isocyanate
(c) acid azide to isocyanate (d) isocyanate to amide

42. Which of the following equations is **not correct**?

- (a) $\left(\frac{\partial T}{\partial V}\right)_S = \left(\frac{\partial P}{\partial S}\right)_V$ (b) $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$ (c) $\left(\frac{\partial S}{\partial P}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_P$ (d) $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$

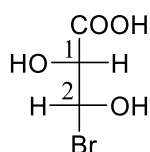
43. Which of the following **iron rods** will undergo **corrosion faster**?

- (a) Iron rod covered with magnesium
(b) A part of iron rod covered with magnesium
(c) Iron rod is galvanized but there is a breaking in the plating
(d) Iron rod is plated with copper, but there is a breaking in the plating

44. Which of the following **carbide on hydrolysis** can produce **methane gas**?

- (a) CaC_2 (b) Al_4C_3 (c) AlC_3 (d) Li_4C_3

45. The configurations (**R,S-notation**) of carbons 1 and 2 of the following compound are

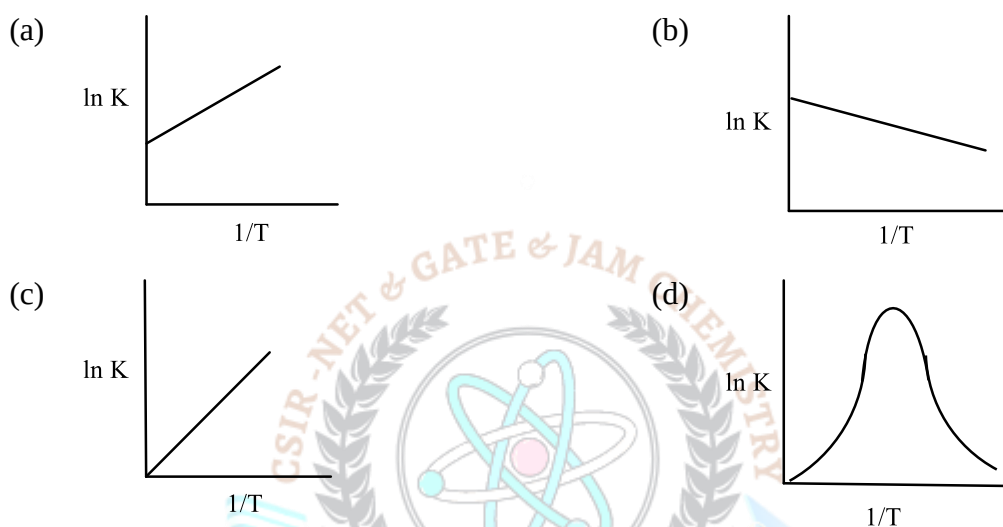


- (a) 1S, 2S (b) 1S, 2R (c) 1R, 2S (d) 1R, 2R

46. Which one of the following is **true** for the **viscosity of a liquid**?

- (a) The viscosity increases with increasing temperature
(b) Viscosity decreases with increasing temperature

- (c) Viscosity remains independent of temperature
 (d) Viscosity first increases with temperature and then decreases after reaching a Critical value
47. From the Arrhenius equation of relation between the rate constant of a reaction and temperature, identify the correct plot among following
 (k is rate constant and T is absolute temperature).



48. The bond length of a homonuclear diatomic molecule can be determined from
 (a) IR spectrum (b) Microwave spectrum
 (c) Rotational Raman spectrum (d) Vibrational Raman spectrum
49. The entropy change in a reversible adiabatic process is
 (a) 0 (b) ∞ (c) $c_v(T_2 - T_1)$ (d) $R \ln \left(\frac{V_1}{V_2} \right)$
50. Which of the following statements is correct?
 (a) Rigid trans-1,2-diols readily react with periodic acid
 (b) Periodic acid cleaves vicinal diols into two aldehydes or two ketones or an aldehyde and a ketone
 (c) Osmium tetroxide is a key reagent in the conversion of alkenes into geminal diols
 (d) Grignard and organolithium reagents react with ethylene oxide to give secondary alcohols
51. The Lambert-Beer law fails at
 (a) Low concentration of solution (b) High concentration of solution
 (c) Monochromatic light (d) High pressure
52. Consider a free particle of mass ' m ' in 1D box of length ' L '. If the length of the box



is extended to 2L, then the difference between the ground state energy before and after expansion of length will be

- (a) $\frac{h^2}{8mL^2}$ (b) $\frac{h^2}{32mL^2}$ (c) $\frac{3h^2}{32mL^2}$ (d) $\frac{h^2}{16mL^2}$

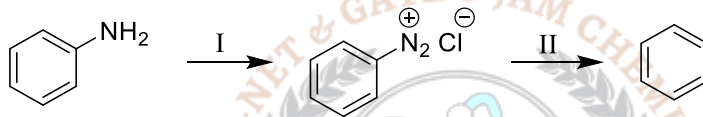
53. Pick out a correct molecule that has **stereochemically inactive lone pair/s** of electron?

- (a) ClF_3 (b) SF_4 (c) $[\text{TeF}_5]^-$ (d) $[\text{SeCl}_6]^{2-}$

54. **Zaitsev product** will not be the major product under **E2 conditions** when

- (a) sterically bulky base is used (b) unhindered base is used
(c) no base is used (d) acidic conditions employed

55. The **reagents** used in the following transformation respectively:



- (a) I. NaNO_3/HCl , II. $\text{H}_3\text{PO}_2/\text{H}_2\text{O}$ (b) I. NaNO_2/HCl , II. $\text{HCl}/\text{H}_2\text{O}$
(c) I. NaNO_2/HCl , II. $\text{H}_3\text{PO}_3/\text{H}_2\text{O}$ (d) I. NaNO_2/HCl , II. $\text{H}_3\text{PO}_2/\text{H}_2\text{O}$

56. A solution is prepared by dissolving solute 'S' in a solvent 'V'. The solution will be called an **ideal-dilute solution** if

- (a) S obeys Raoult's law and V obeys Henry's law
(b) S is an ionic compound and V is a polar solvent
(c) S obeys Henry's law and V obeys Raoult's law
(d) the dissociation constant of S is very low and V is a polar solvent

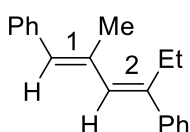
57. What is the **efficiency** of a **Carnot engine** that operates in between **100 °C** and **0 °C**?

- (a) 100.0% (b) 26.8% (c) 78.3% (d) 50.2%

58. What type of defect can arise when a **cation** and an **anion are missing** in the crystal lattice?

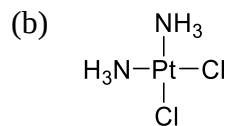
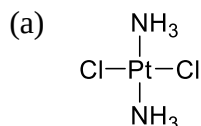
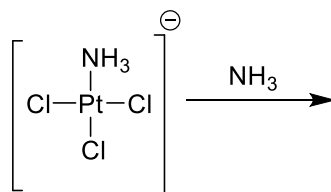
- (a) Dissociation (b) F center (c) Frenkel (d) Schottky

59. **Configuration (E/Z)** of the following molecule is



- (a) 1E, 2E (b) 1Z, 2Z
(c) 1E, 2Z (d) 1Z, 2E

60. **By using the trans effect**, find out the product(s) in the following reaction:



(c) Both a and b in equal amount

(d) “a” is a major and “b” is a minor

61. The **Fermi level** is

- (a) the energy level of the highest occupied orbital in a metal at 273 K
- (b) the energy level of the lowest occupied orbital in a metal at 273 K
- (c) the energy level of the highest occupied orbital in a metal at absolute zero
- (d) the energy level of the lowest occupied orbital in a metal at absolute zero

62. **S_N2 reaction** are correctly defined by the combination of terms

- (a) intermediate and retention of configuration
- (b) intermediate and inversion of configuration
- (c) transition state and retention of configuration
- (d) transition state and inversion of configuration

63. **Silicones** have a wide range of advantageous chemical and physical properties.

The correct statements are

P. Resistant to attack by acids and bases

Q. Readily combustible

R. Remain unchanged on exposure to UV radiation

(a) P and Q

(b) P and R

(c) Q and R

(d) All are correct

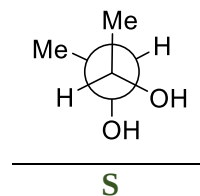
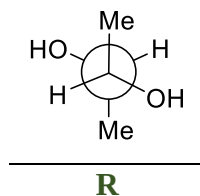
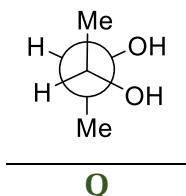
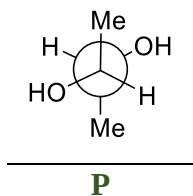
64. **1, 3, 5-Cyclooctatrienyl cation** is

- (a) Aromatic
- (b) Anti-aromatic
- (c) Non-aromatic
- (d) Homoaromatic

65. The correct order of **ionic conductance at infinite dilution** is

- (a) $\text{H}^+ > \text{Li}^+ > \text{Na}^+ > \text{K}^+$
- (b) $\text{K}^+ > \text{Na}^+ > \text{Li}^+ > \text{H}^+$
- (c) $\text{Li}^+ > \text{Na}^+ > \text{K}^+ > \text{H}^+$
- (d) $\text{H}^+ > \text{K}^+ > \text{Na}^+ > \text{Li}^+$

66. Among the following, the **Newmann projections of meso-2, 3-butanediol** are



- (a) P and Q (b) P and R (c) R and S (d) Q and S
67. The reaction between **cis olefin** and **triplet carbene** affords
 (a) cis Cyclopropane (b) trans Cyclopropane
 (c) mixture of cis and trans cyclopropanes (d) trans Olefin
68. Which of the following **metalloenzyme** can **interconvert carbon dioxide to carbonates**?
 (a) Carbonic anhydrase (b) Xanthine oxidase (c) Carboxypeptidase (d) Nitrogenase
69. Find the **incorrect characteristic chemical property of halogen fluorides, XF_3 , XF_5 ($\text{X} = \text{Cl}, \text{Br}, \text{I}$)**.
 (a) Ready to undergo hydrolysis (b) Strong fluorinating agent
 (c) Strong oxidizing agent (d) Can carry out reaction even in aqueous medium
70. Which of the following **DOES NOT** give a **positive test with Fehling's solution**?
 (a) Galactose (b) Maltose (c) Fructose (d) Sucrose
71. Pick out a correct **increasing order of ionization energy** for diatomic molecules.
 (a) $\text{N}_2 < \text{O}_2 < \text{NO}$ (b) $\text{NO} < \text{N}_2 < \text{O}_2$
 (c) $\text{O}_2 < \text{N}_2 < \text{NO}$ (d) $\text{NO} < \text{O}_2 < \text{N}_2$
72. The $t_{1/2}$ of a reaction is **doubled** if the **initial concentration is doubled**. What is the **order of the reaction**?
 (a) Zero-order (b) First-order (c) Second-order (d) Third-order
73. Which of the following wave numbers of **stretching vibration** will have **highest value**?
 (a) $\nu_{\text{C-H}}$ (b) $\nu_{\text{C-C}}$ (c) $\nu_{\text{C=O}}$ (d) $\nu_{\text{C-Br}}$
74. The **reactive species** in the transformation of **phenol into salicylaldehyde** in the presence of **KOH/ CHCl_3** is
 (a) carbocation (b) free radical (c) nitrene (d) carbene
75. The value of **van der waals constants 'a'** for some gases are given here. The **order of liquefaction** of these gases is

Gas	a (L atm mol ⁻²)
N_2	1.390
O_2	1.360
NH_3	4.170
CH_4	2.253

- (a) $\text{N}_2 > \text{O}_2 > \text{NH}_3 > \text{CH}_4$
 (b) $\text{NH}_3 > \text{CH}_4 > \text{N}_2 > \text{O}_2$
 (c) $\text{NH}_3 < \text{CH}_4 < \text{N}_2 < \text{O}_2$
 (d) $\text{N}_2 < \text{O}_2 < \text{NH}_3 < \text{CH}_4$



Answer Key

Q.No	Ans	Q.No	Ans	Q.No	Ans	Q.No	Ans	Q.No	Ans
1.	a	16.	a	31.	a	46.	b	61.	c
2.	a	17.	c	32.	d	47.	b	62.	d
3.	d	18.	c	33.	c	48.	c	63.	b
4.	a	19.	d	34.	d	49.	a	64.	d
5.	d	20.	b	35.	c	50.	b	65.	d
6.	b	21.	c	36.	d	51.	b	66.	b
7.	b	22.	c	37.	c	52.	c	67.	c
8.	c	23.	a	38.	b	53.	d	68.	a
9.	a	24.	a	39.	b	54.	a	69.	d
10.	b	25.	d	40.	d	55.	d	70.	d
11.	c	26.	a	41.	b	56.	c	71.	d
12.	c	27.	c	42.	a	57.	b	72.	a
13.	c	28.	a	43.	d	58.	d	73.	a
14.	a	29.	d	44.	b	59.	a	74.	d
15.	a	30.	a	45.	d	60.	b	75.	b

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