JAM - 2025

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JAM - 2025

(Q1-10) MCQ carry ONE mark each (for each wrong answer: – 1/3).

1. **Maximum value of the function $f(r) = r^2e^{-r}$, when $0 < r < \infty$ is**

(a) $4e^{-2}$ (b) e^{-1} (c) $2e^{-\sqrt{2}}$ (d) $4e^{-\sqrt{2}}$

2. **Consider 10 balls each having different colors including a blue ball. If 6 balls are selected randomly, the probability of the blue ball being selected is**

(a) 0.3 (b) 0.4 (c) 0.6 (d) 0.8

3. **Sulfide ores are concentrated by**

(a) froth floatation (b) smelting (c) roasting (d) reduction

4. **Crystal system with the unit cell parameters $a = b \neq c$ and $\alpha = \beta = \gamma = 90°$ is**

(a) monoclinic (b) orthorhombic (c) tetragonal (d) hexagonal

5. **The correct trend of acidity of the ions is**

(a) $[Fe(H_2O)_6]^{2+} > [Fe(H_2O)_6]^{3+} > [Al(H_2O)_6]^{3+}$

(b) $[Al(H_2O)_6]^{3+} > [Fe(H_2O)_6]^{3+} > [Fe(H_2O)_6]^{2+}$

(c) $[Fe(H_2O)_6]^{2+} > [Al(H_2O)_6]^{3+} > [Fe(H_2O)_6]^{3+}$

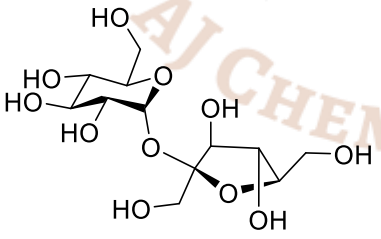
(d) $[Fe(H_2O)_6]^{3+} > [Fe(H_2O)_6]^{2+} > [Al(H_2O)_6]^{3+}$

6. **Dissolution of SbF_5 in BrF_3 produces**

(a) BrF_5 and SbF_3 (b) BrF and SbF_7 (c) $[BrF_2]^+[SbF_6]^-$ (d) $[SbF_4]^+[BrF_4]^-$

7. **The molecular structure of table sugar is**

(a)



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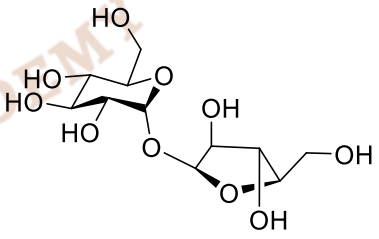

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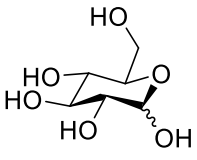
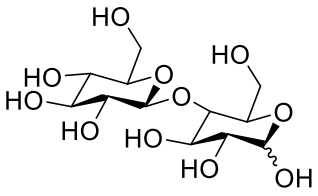


(d)



8. **The product formed when (R)-2-bromopropionic acid is treated with low concentration of hydroxide ion is**

(a) Predominantly of S configuration (b) Predominantly of R configuration

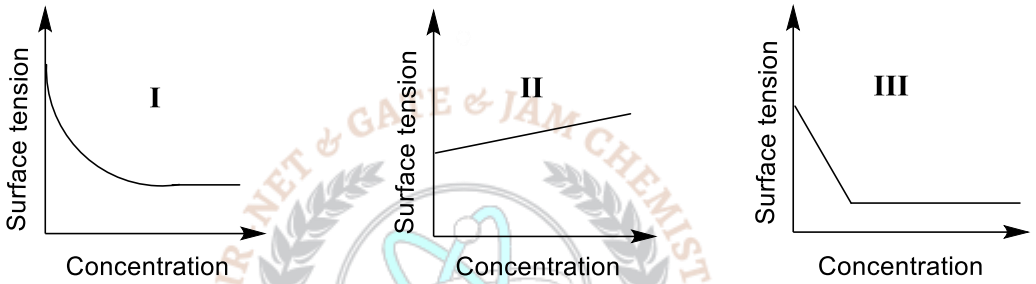
(c) a racemic mixture (d) achiral

9. **A system having Hamiltonian $\hat{H}$ follows the eigen value equation $\hat{H}\Psi_n = E_n\Psi_n$, with**

$E_n = \left(n + \frac{1}{2}\right)$. If the state of the system is prepared as, $\Psi = N(\Psi_1 + \Psi_2 + \Psi_3 - \Psi_4 - \Psi_5)$, where N is the normalization constant, then the expectation value of energy is

(a) -0.5 (b) -2.5 (c) 3.5 (d) 17.5

10. The figures (I, II, III) given below schematically represent variation of surface tension of three different aqueous solutions with increasing concentration of each of the solutes (surfactant, sodium chloride and n-propanol). Match the figures with appropriate solutes and choose the correct option.



	I		II		III
(a)	surfactant	;	sodium chloride	;	n-propanol
(b)	sodium chloride	;	n-propanol	;	surfactant
(c)	surfactant	;	n-propanol	;	sodium chloride
(d)	n-propanol	;	sodium chloride	;	surfactant

(Q.11-30) MCQ carry TWO marks each (for each wrong answer: – 2/3).

11. The correct option for x which satisfies the following equation is

$$\begin{bmatrix} x & 2 & 3 \\ 4 & x & 6 \\ x & 8 & 9 \end{bmatrix} = \begin{bmatrix} 102 & 18 & 36 \\ 1 & 3 & 4 \\ 17 & 3 & 6 \end{bmatrix}$$

(a) $3 \pm \sqrt{5}$ (b) $\frac{3 \pm \sqrt{5}}{2}$ (c) $2(3 \pm \sqrt{5})$ (d) $3 \pm 2\sqrt{5}$

12. The type of carboxypeptidase metalloenzyme and the metal ion present in it, respectively, are

(a) hydrolase and Zn(II) (b) isomerase and Zn(II)

(c) hydrolase and Cu(II) (d) isomerase and Cu(II)

13. The biomolecule that does NOT contain iron is

(a) cytochromes (b) hemocyanin (c) hydrogenase (d) hemerythrin

14. Hydrolysis of P_4O_{10} produces a compound R, which on heating above 320 °C yields

a compound S. The compounds R and S, respectively, are

(a) H_3PO_4 and $(HPO_3)_n$ (b) H_3PO_3 and $(HPO_3)_n$

(c) H_3PO_4 and $H_4P_2O_7$ (d) H_3PO_3 and $H_4P_2O_7$

15. Ion-dipole interactions vary with distance (r) as

(a) $1/r$ (b) $1/r^2$ (c) $1/r^4$ (d) $1/r^6$

16. In the following transformation, the number of α and β particles emitted, respectively, are

$$^{223}_{88}Ra \longrightarrow {}^{207}_{82}Pb$$

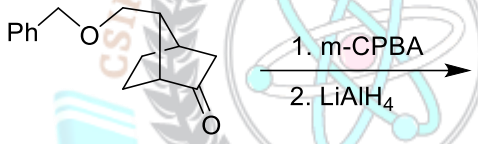
(a) 4, 2 (b) 4, 3 (c) 2, 4 (d) 3, 4

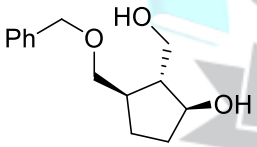
17. Wilkinson's catalyst contains

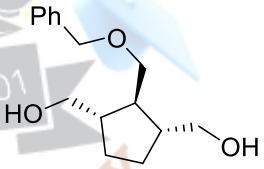
(a) ruthenium(I) in square planar geometry (b) ruthenium(I) in tetrahedral geometry

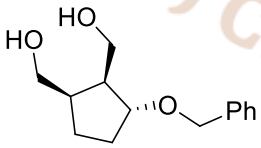
(c) rhodium(I) in square planar geometry (d) rhodium(I) in tetrahedral geometry

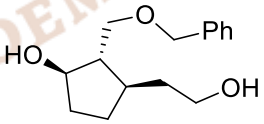
18. The major product of the following transformation is



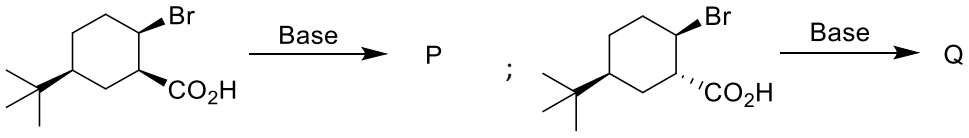
(a) 

(b) 

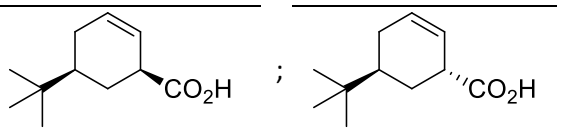
(c) 

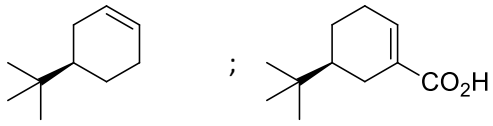
(d) 

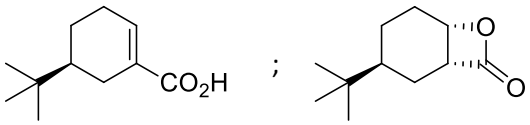
19. The major products P and Q of the following transformations are

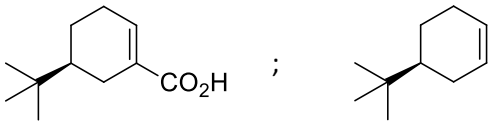


P **Q**

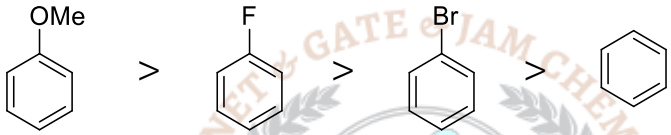
(a) 

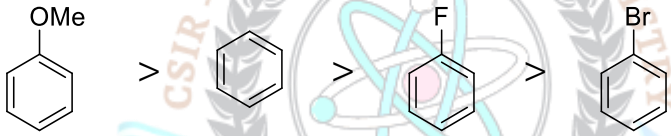
(b) 

(c) 

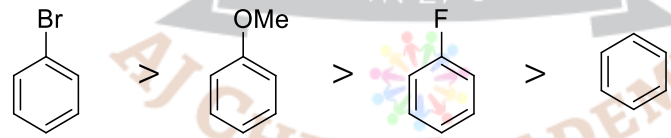
(d) 

20. The correct order of the rate of mononitration using conc.H_2SO_4/conc. HNO_3 at room temperature is

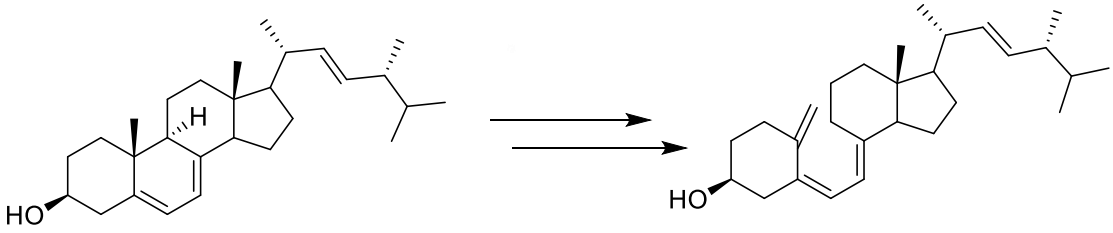
(a) 

(b) 

(c) 

(d) 

21. Pericyclic reactions involved in the synthesis of Vitamin D_2 from Ergosterol are



Ergosterol **Vitamin D_2**

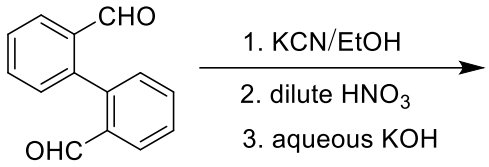
(a) 6π electrocyclic ring opening followed by [1,7] sigmatropic shift

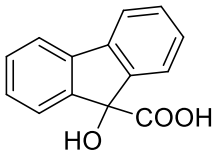
(b) [1,5] sigmatropic shift followed by 6π electrocyclic ring opening

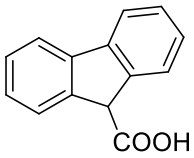
(c) [3,3] sigmatropic rearrangement followed by [1,7] sigmatropic shift

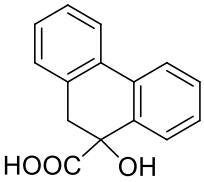
(d) 4π electrocyclization followed by 6π electrocyclic ring opening

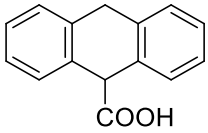
22. The major product in the following reaction sequence is



(a) 

(b) 

(c) 

(d) 

23. **An organic compound $P(C_8H_{16})$ produces a meso compound upon oxidation with OsO_4/NMO. The compound P is [Where, NMO = N-methylmorpholine N-oxide]**

(a) (E)-4-octene (b) (Z)-4-octene (c) (E)-3-octene (d) (Z)-3-octene

24. **The correct order of the dipole moment among the following is**

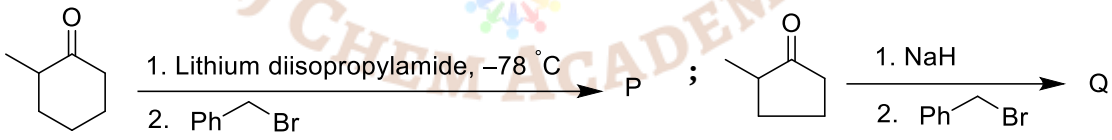
(a) fluoromethane > methanol > chloromethane > dimethylether

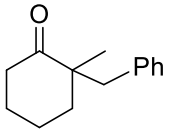
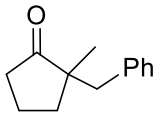
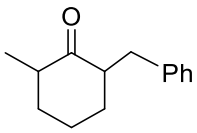
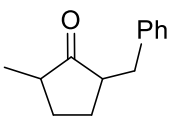
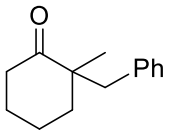
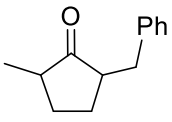
(b) fluoromethane > chloromethane > methanol > dimethylether

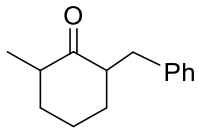
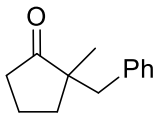
(c) chloromethane > fluoromethane > methanol > dimethylether

(d) chloromethane > fluoromethane > dimethylether > methanol

25. **The major products P and Q of the following reactions are**



	P		Q
(a)		and	
(b)		and	
(c)		and	

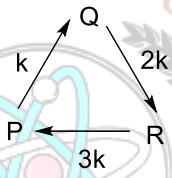
(d)  and 

26. **A vessel contains 1 mol of gas X and 2 mol of gas Y at 2 bar and 25 ℃. The gas mixture is compressed such that the final pressure becomes 3 bar without any change in temperature. Considering ideal gas behaviour, the change in Gibbs free energy (in kJ) during the compression is closest to**

[Given: Gas constant, $R = 8.314\ J\ mol^{-1}K^{-1}$]

(a) 1 (b) 3 (c) 6 (d) 9

27. **The substances, P, Q and R undergo chemical reactions according to the scheme given below.**



At time $t = 0$, the $[P] = 0.11$ M. Considering them to be first order reactions, the concentration of Q (in M) at equilibrium is

(a) 0.06 (b) 0.03 (c) 0.02 (d) 0.05

28. **For van der Waals gases, at the critical point, $\frac{dP}{dV_m} = 0$ and**

(a) $\frac{d^2P}{dV_m^2} = 0$ (b) $\frac{d^2P}{dV_m^2} < 0$ (c) $\frac{d^2P}{dV_m^2} > 0$ (d) $\frac{d^2P}{dV_m^2}$ diverges

29. **The set of asymmetric top molecules is**

(a) CH_3CN, CH_3OH, H_2CO (b) H_2CO, H_2O, CH_3CN

(c) H_2O, CH_3CN, CH_3OH (d) CH_3OH, H_2O, H_2CO

30. **Consider Langmuir adsorption of a gas on a uniform solid surface having N number of surface sites. The free and adsorbed gas molecules are in dynamic equilibrium. If the fractional surface coverage is θ, the rate of adsorption of the gas is proportional to**

(a) $N\theta$ (b) $N(1-\theta)$ (c) $N\left(\frac{\theta}{1-\theta}\right)$ (d) $N\left(\frac{1}{1-\theta}\right)$

(Q31-40) MSQ carry TWO marks each (no negative marks).

31. **According to VSEPR theory, the set(s) of species having trigonal bipyramidal geometry is (are)**

(a) PCl_5 and SF_4 (b) ClF_3 and I_3^- (c) PCl_5 and $Sb(Ph)_5$ (d) ClF_3 and BrF_5

32. **In alkaline medium, which of the following metal ion(s) form(s) red precipitate/ coloration with dimethylglyoxime?**

(a) Ni(II) (b) Bi(III) (c) Zn(II) (d) Fe(II)

33. **The correct statement(s) about the octahedral Mn-complex with spin only magnetic moment of approximately 6.0 μ_B is(are)**

(a) possible oxidation state of Mn in the complex is +4

(b) possible oxidation state of Mn in the complex is +2

(c) ligands associated with the complex is strong field ligand

(d) ligands associated with the complex is weak field ligand

34. **For $[Mn(CO)_6]^+$ and $[V(CO)_6]^-$ complexes, the correct statement(s) is(are)**

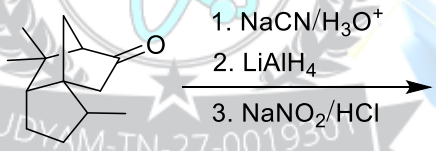
(a) stretching frequency of the CO is higher in the Mn-complex

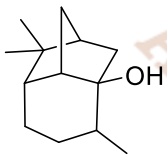
(b) metal-carbonyl bond is stronger in the V-complex

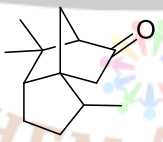
(c) Mn-complex does not obey 18 e^- rule

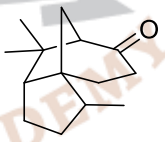
(d) V-complex obeys 18 e^- rule

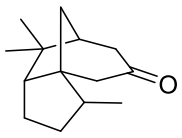
35. **The product in the following transformation is(are)**



(a) 

(b) 

(c) 

(d) 

36. **The set(s), in which all the compounds yield achiral products upon treatment with $CH_3MgBr/ether$ followed by hydrolysis with dilute mineral acid, is(are)**

(a) 3,4-epoxyhexane, cyclohexanone and butanone

(b) ethyl propionate, phenylacetyl chloride and cyclohexanone

(c) butanone, ethylpropionate and cyclohexanone

(d) ethyl phenyl ketone, 3,4-epoxyhexane, and phenylacetyl chloride

37. **The reaction(s) that will yield cyclic product is(are)**

(a) (E)-2-hexene with CH_2I_2/Zn-Cu

(b) 2-butanone with ethyl-2-chloropropionate with NaOEt/EtOH

(c) hexane-2,5-dione with ammonia

(d) cyclohexane-1,2-diol with $NaIO_4$

38. **The correct statement(s) among the following is(are)**

(a) In natural nucleic acids, the nucleosides are linked through phosphodiester bonds

(b) Natural nucleic acids have sulphur containing heterocyclic bases

(c) The isoelectric point of arginine is higher than that of isoleucine

(d) The molecular weight of guanine is higher than that of cytosine

39. **Among the following, the correct condition(s) for spontaneity is(are)**

(a) $(\Delta G_{sys})_{P,T} < 0$ (b) $(\Delta A_{sys})_{V,T} < 0$ (c) $(\Delta H_{sys})_{P,S} < 0$ (d) $(\Delta G_{sys})_{V,P} < 0$

40. **Correct statement(s) with respect to defects in solids is(are)**

(a) In Schottky defect, atoms move from interior lattice sites to surface lattice sites

(b) Equilibrium concentration of defects remain unchanged with change in temperature

(c) A perfect solid is thermodynamically less stable than the solid with defects

(d) Common point defects in pure alkali halides are Frenkel-type

(Q 41-50) NAT carry ONE mark each (no negative marks).

41. $\int_0^\infty xe^{-x}dx =$ _____. **(round off to the nearest integer)**

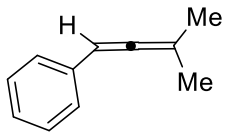
42. **Consider $\vec{C} = \vec{A} \times \vec{B}$, Where $\vec{A} = 3\hat{i} - 2\hat{j} + 5\hat{k}$ and $\vec{B}$, a unit vector in xy-plane, makes an angle of $37°$ with the x-axis. Projection of $\vec{C}$ on the x-axis is _____.**

(round off to one decimal place)

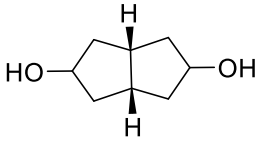
43. **A yellow compound X is produced after the reaction of $K_2[Ni(CN)_4]$ with excess of $K/liq.NH_3$ at -33 °C. The oxidation state of Ni in the compound X is _____.**

44. **Number of spin allowed transition(s) possible for d^2 octahedral configuration is ___**

45. **Number of ^{1}H-NMR signals observed for the following compound is _____.**



46. **The number of stereoisomers possible for the following compound is _____.**



47. **An electron at rest is accelerated through 10 kV potential. The de Broglie wavelength (in Å) of the electron is _____.** **(round off to three decimal places)**

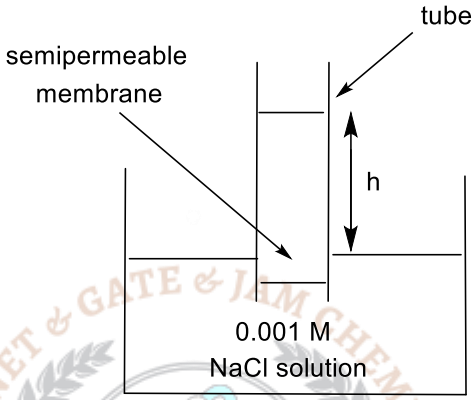
[Given: Mass of an electron, $m_e = 9.11 \times 10^{-31}$ kg;

Planck's constant (h) $= 6.63 \times 10^{-31}$ J s;

$1\ eV = 1.6 \times 10^{-19}\ J$]

48. A tube fitted with a semipermeable membrane is dipped into $0.001\ M$ NaCl solution at $300\ K$ as shown in the figure. Assume density of the solvent and solution are same. At equilibrium, the height of the liquid column, h (in cm) is ____.

(round off to one decimal place)



[Given: Acceleration due to gravity, $g = 9.8\ ms^{-2}$,
density of solution $(\rho) = 1\ kg\ dm^{-3}$,
gas constant, $R = 8.314\ J\ mol^{-1}K^{-1}$]

49. The resonance frequency of ^{1}H nuclei is 300 MHz in an NMR spectrometer. If the spectrometer is operated at 12 T magnetic field, the resonance frequency (in MHz) of the same ^{1}H nuclei is ____. (round off to one decimal place)

[Given: Nuclear magneton $(\beta_N) = 5.05 \times 10^{27} JT^{-1}$,
Nuclear g factor (g_N) for $^{1}H = 5.586$,
Planck's constant $(h) = 6.63 \times 10^{-34}\ J\ s$]

50. The first rotational absorption of $^{12}C^{16}O$ molecule is observed at $3.84\ cm^{-1}$. If an isotopic substitution is made with ^{18}O in the molecule, the frequency (in cm^{-1}) of first rotational absorption is ____. (round off to two decimal places)

(Q 51-60) NAT carry TWO marks each (no negative marks).

51. If $y + xe^{y} = \sin x + \tan x$, then the value of $\frac{dy}{dx}$ at $x = 0$ is ____.

(round off to the nearest integer)

52. Consider the following matrices P and Q.

$$P = \begin{pmatrix} 1 & 2 & 0 & 0 & 0 \\ 3 & 4 & 0 & 0 & 0 \\ 0 & 0 & 5 & 0 & 0 \\ 0 & 0 & 0 & 6 & 7 \\ 0 & 0 & 0 & 8 & 9 \end{pmatrix} \text{ and } Q = \begin{pmatrix} 10 & 11 & 0 & 0 & 0 \\ 12 & 13 & 0 & 0 & 0 \\ 0 & 0 & 4 & 0 & 0 \\ 0 & 0 & 0 & 15 & 16 \\ 0 & 0 & 0 & 17 & 18 \end{pmatrix}$$

If $R = PQ$, sum of the diagonal elements of R is _____.

53. The number of species among the following, having bond order of three is _____.

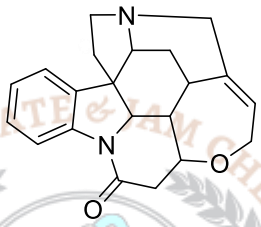
$$N_2, F_2, NO^+, O_2^-, N_2^+, CO, O_2, O_2^{2-}$$

54. 1.84 g of a mixture of $CaCO_3$ and $MgCO_3$ is heated till no further weight loss. The weight of the residue is 0.96 g. The % composition of $CaCO_3$ in the mixture is _____

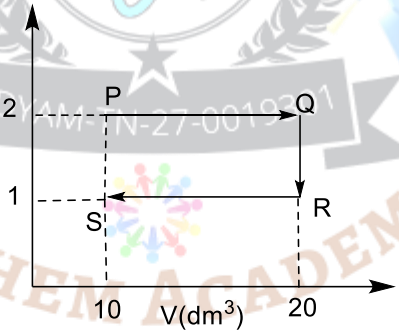
(round off to two decimal places)

[Given: Atomic weight of Ca = 40; Mg = 24; C = 12; O = 16]

55. The number of chiral carbon centers in the following molecule is _____.



56. One mole of a monoatomic ideal gas starting from state P, goes through Q and R to state S, as shown in the figure. Total change in entropy (in JK^{-1}) during this process is _____. (round off to two decimal places)



(Not to scale)

[Given: Gas constant, $R = 8.314\ J\ mol^{-1}\ K^{-1}$]

57. In one second, 95 moles of He gas particles are hitting a wall of a cubic container of volume $1\ dm^3$. If the average velocity component of the particles perpandicular to the wall is $1000\ m\ s^{-1}$, then the pressure of the gas in the container is $X \times 10^5\ N\ m^{-2}$. The value of X is _____. (round off to two decimal places)

[Given: Avagadro's number, $N_A = 6.02 \times 10^{23}$, mass of He = $4\ g\ mol^{-1}$]

58. Solubility of $PbCO_3$ in a buffer of pH 5 is $X \times 10^{-4}$. The value of X is _____.

(round off to one decimal place)

[K_{sp} of $PbCO_3 = 1.5 \times 10^{-13}$; for H_2CO_3, $K_{a1} = 4.2 \times 10^{-7}$, $K_{a2} = 4.8 \times 10^{-11}$]

59. The molar conductivity of a 0.02 M weak acid HA is 3.2 mS m^2mol^{-1} at 298 K.

The pK_a of HA is _____. (round off to one decimal place)

[Given: Limiting molar conductivity of HA $= 39$ mS m^2mol^{-1} at 298 K]

60. A cell is constructed by $Cl_2/Cl^-_{(aq)}$ and a standard hydrogen electrode half-cells.

The standard potential of the complete cell is 1.38 V and $\left(\frac{\partial E^\circ}{\partial T}\right)_P = -1.24$ mVK^{-1}.

The $\Delta S^\circ_{reaction}$ (in J $K^{-1}mol^{-1}$) for the following cell reaction is _____.

$$H_{2(g)} + Cl_{2(g)} \longrightarrow 2H^+_{(aq)} + 2Cl^-_{(aq)}$$

[Given: Faraday constant $(F) = 96480$ C mol^{-1}] (round off to one decimal place)

Answer Key

Q.No	Ans
1.	a
2.	c
3.	a
4.	c
5.	b
6.	c
7.	a
8.	b
9.	c
10.	d
11.	a
12.	a
13.	b
14.	a

Q.No	Ans
21.	a
22.	a
23.	b
24.	c
25.	d
26.	b
27.	b
28.	a
29.	d
30.	b
31.	a, b or a, b, c
32.	a, d
33.	b, d
34.	a, b, d

Q.No	Ans
41.	1
42.	−3.2 to −3.0
43.	0
44.	3
45.	5
46.	3
47.	0.115 to 0.130
48.	*
49.	509.0 to 512.0
50.	3.64 to 3.66
51.	1
52.	638
53.	3
54.	53.00 to 56.00

15.	b
16.	a
17.	c
18.	d
19.	d
20.	b

35.	c, d
36.	b, c
37.	a, b, c
38.	a, c, d
39.	a, b, c
40.	a, c

55.	6
56.	−8.80 to −8.50
57.	0.74 to 0.78
58.	8.0 to 9.5
59.	3.6 to 3.9
60.	−240.0 to −238.0

Q. 1 – 10	1 Mark (MCQ)
Q. 41– 50	1 Mark (NAT)

Q. 11 – 30	2 Marks (MCQ)
Q. 51 – 60	2 Marks (NAT)

Q. 31 – 40	2 Marks (MSQ)