

There are total of 65 questions in this paper which are of multiple choice type or numerical answer type.
Questions Q. 1 - Q. 25 carry 1 mark each. Questions Q. 26 Q. 55 carry 2 marks each. The 2 marks questions include two pairs of common data questions and two pairs of linked answer questions depends on the answer to the first question of the pair. If the first question in the linked pair is wrongly answered or is not attempted, then the answer to the second question in the pair will not be evaluated.

- Questions Q. 56- Q. 65 belong to General Aptitude (GA) section and carry a total of 15 marks. Questions Q. 56 Q. 60 carry 1 mark each, and questions Q. 61 - Q. 65 carry 2 marks each.

There will be negative marking of $1 / 3$ marks for each wrong answer for 1 mark questions. For all 2 marks questions $2 / 3$ marks will be deducted for each wrong answer. However, in the case of the linked answer question pair, there will be negative marks only for wrong answer to the first question and no negative marks for wrong answer to the second question. There is no negative marking for questions of numerical answer type.

TIME : 3 HOURS
MAX. MARKS :
100


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1. For the reaction $\mathrm{A}+\mathrm{B} \rightleftharpoons \mathrm{X}^{+} \rightarrow \mathrm{P}, \mathrm{Ea}=20.0 \mathrm{~kJ} \mathrm{~mol}^{-1}$ at 300 K . The enthalpy change for the formation of the activated complex from the reactants in $\mathrm{kJ} \mathrm{mol}^{-1}$ is $\qquad$ .
2. For the aldotetroses I-IV, the combination of TRUE statements, among P-T, is

(II)

(III)

(IV)

$\mathrm{P}=\mathrm{I}$ and II are diastereomers and II and III are enantiomers
Q $=1$ and IV are mesomers and are optically inactive
$R=I$ and III can be interconverted by a base catalysed isomerisation
$\mathrm{S}=$ only I and IV are $\mathrm{HIO}_{4}$ cleavable
T = I and III are D-sugars and II and IV are L-sugars
(A) Q, R, T
(B) P, R, T
(C) Q, S, T
(D) P, Q, S
3. Oxidation of X with chromic acid chiefly gives


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(C)

(D)

4. Given that $\mathrm{E}_{0}\left(\mathrm{Fe}^{3+}, \mathrm{Fe}\right)=-0.04 \mathrm{~V}$ and $\mathrm{E}_{0}\left(\mathrm{Fe}^{2+}, \mathrm{Fe}\right)=-0.44 \mathrm{~V}$, the value of $\mathrm{E}_{0}\left(\mathrm{Fe}^{3+}, \mathrm{Fe}^{2+}\right)$ is $\qquad$ .
5. The most unstable species among the following is
(A) $\mathrm{Ti}\left(\mathrm{C}_{2} \mathrm{H}_{5}\right)_{4}$
(B) $\mathrm{Ti}\left(\mathrm{CH}_{2} \mathrm{Ph}\right)_{4}$
(C) $\mathrm{Pb}\left(\mathrm{CH}_{3}\right)_{4}$
(D) $\mathrm{Pb}\left(\mathrm{C}_{2} \mathrm{H}_{5}\right)_{4}$
6. Consider the following statements:

1. Photosynthesis in plants proceeds with an increase in the energy.
2. Quantum yield is defined as the number of molecules reacted or formed per einstein of light absorbed.
3. Phosphorescence occurs from the lowest vibrational level of triplet state $\left(T_{1}\right)$.

Which of the above statements are correct?
(A) 1 and 2
(B) 1 and 3
(C) 2 and 3

C L A S S E 5

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(D) 1, 2 and 3
7. The number of possible geometrical isomers for octahedral $\mathrm{Co}(\mathrm{ox})\left(\mathrm{PMe}_{3}\right)_{2} \mathrm{NH}_{3} \mathrm{Cl}$ complex is $\qquad$ .
8. The products formed in the following reaction are

(A)

(B)

(C) + DMSO
(D) + DMSO
9. Phenol on reaction with formaldehyde and dimethyl amine mainly gives


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(C)

(D)

10. The complexes $\mathrm{V}\left(\mathrm{C}_{6} \mathrm{H}_{6}\right)_{2}$ and $\mathrm{Cr}\left(\mathrm{C}_{6} \mathrm{H}_{6}\right)_{2}$ are both readily oxidized in air to their respective cations. The number of unpaired electrons, respectively, in each are $\qquad$ \& .
11. The electrophilic aromatic substitution proceeds through a
(A) free radical
(B) sigma complex
(C) benzyne
(D) carbene
12. Match the following

## I

(P) Supporting electrolyte
(Q) $\mathrm{Zn}(\mathrm{Hg})$
${ }_{1} \mathrm{ZnCl}_{2}(\mathrm{aq})$ $\mid \mathrm{Zn}(\mathrm{Hg})_{Q=2}$
(R) inversion temperature
(S) Entropy of vapourisation

(1) Overpotential
(2) Residual current
(3) Electrolyteconcentration cell
(4) Electrode concentration cell
(5) Trouton's rule
(6) Joule-Thomson expansion
(A) P-2, Q-4, R-6, S-5

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(B) P-2, Q-4, R-3, S-6
(C) P-1, Q-4, R-6, S-3
(D) P-1, Q-3, R-6, S-5
13. For the reaction, $\mathrm{Hg}_{2} \mathrm{Cl}_{2}(\mathrm{~s})+\mathrm{H}_{2}(\mathrm{~g}) 2 \mathrm{Hg}(\mathrm{l})+2 \mathrm{HCl}(\mathrm{aq})$, the correct representation of the cell and the thermodynamic properties $\square \mathrm{G}, \square \mathrm{H}$ and $\square \mathrm{S}$ at 298 K respectively, are (given : $\mathrm{E}_{298}=$ 0.2684 V and temperature coefficient $=3 \times 10^{-4} \mathrm{VK}^{-1}$ )
(A) Pt $\left|\mathrm{H}_{2}(\mathrm{~g}, 1 \mathrm{~atm})\right| \mathrm{HCl}(\mathrm{aq})\left|\mathrm{Hg}_{2} \mathrm{Cl}_{2}(\mathrm{~s})\right| \mathrm{Hg}(\mathrm{I}) ; \square \mathrm{G}=51.8 \mathrm{~kJ} \mathrm{~mol}^{-1}, \mathrm{H}=-34.5 \mathrm{~kJ}$ $\mathrm{mol}^{-1}, \square \mathrm{~S}=-58 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$
(B) $\mathrm{Pt}\left|\mathrm{H}_{2}(\mathrm{~g}, 1 \mathrm{~atm})\right| \mathrm{HCl}(\mathrm{aq})\left|\mathrm{Hg}_{2} \mathrm{Cl}_{2}(\mathrm{~s})\right| \mathrm{Hg}(\mathrm{I}) ; \mathrm{G}=-25.9 \mathrm{~kJ} \mathrm{~mol}^{-1}, \square \mathrm{H}=-34.5 \mathrm{~kJ}$ $\mathrm{mol}^{-1}, \square \mathrm{~S}=-29 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$
(C) $\mathrm{Hg}(\mathrm{I})\left|\mathrm{Hg}_{2} \mathrm{Cl}_{2}(\mathrm{~s})\right| \mathrm{HCl}(\mathrm{aq})\left|\mathrm{H}_{2}(\mathrm{~g}, 1 \mathrm{~atm})\right| \mathrm{P}, \square \mathrm{G}=-51.8 \mathrm{~kJ} \mathrm{~mol}^{-1}, \square \mathrm{H}=-69 \mathrm{~kJ} \mathrm{~mol}^{-}$ ${ }^{1}, \square \mathrm{~S}=-58 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$
(D) $\mathrm{Hg}(\mathrm{I})\left|\mathrm{Hg}_{2} \mathrm{Cl}_{2}(\mathrm{~s})\right| \mathrm{HCl}(\mathrm{aq}) \mid \mathrm{H}_{2}(\mathrm{~g}, 1$ atm $) \mid \mathrm{Pt} ; \square \mathrm{G}=51.8 \mathrm{~kJ} \mathrm{~mol}^{-1}, \square \mathrm{H}=69 \mathrm{~kJ} \mathrm{~mol}^{-1}$, $\square \mathrm{S}=58 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$
14. In the extraction of cerium IV with 2-thenoyl trifluoro acetone in benzene the distribution ratio was 999, if the volume of organic phase was 20 ml and that of aqueous phase 50 ml , then $\qquad$ was the percentage extraction.
15. A substance was known to contain $49.06,0.02$ per cent of a given constituent A. The results oblained by two observers using the same substance and the same general technique were:
Observer (1) - 49.01; 49.21; 49.08
Observer (2) — 49.40; 49.44; 49.42
Calculate relative mean error in both the observations respectively?

C L A S S E 5
(A) $0.08 \%, 0.73 \%$
(B) $0.73 \%, 0.08 \%$
(C) $0.65 \%, 0.81 \%$
(D) $0.81 \%, 0.65 \%$
16. The effective nuclear charge $\left(Z^{*}\right)$ for the $1 s$ electron of ${ }_{8} \mathrm{O}$ according to Slater's rules is nearly $\qquad$ -.
17. The formula of the pyrosilicate ion is
(A) $\mathrm{SiO}_{4}{ }^{4-}$
(B) $\mathrm{Si}_{2} \mathrm{O}_{7}{ }^{6-}$
(C) $\mathrm{Si}_{3} \mathrm{O}_{9}{ }^{6-}$
(D) $\mathrm{Si}_{6} \mathrm{O}_{18}{ }^{12-}$
18. The structure of $\mathrm{SF}_{4}$ is
(A) Octahedral
(B) Tetrahedral
(C) Trigonal bipyramidal
(D) Square planar
19. An atom $X$ has three valence electrons and atom $Y$ has six valence electrons. The compound formed between them will have the formula.
(B) $\mathrm{XY}_{2}$
(C) $X_{2} Y_{3}$

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(D) $\mathrm{X}_{3} \mathrm{Y}_{2}$
20. The perxenate ion $\mathrm{XeO}_{4}^{4-}$ can be prepared by
(A) Direct reaction of Xe with oxygen
(B) Reaction of $\mathrm{XeF}_{6}$ with oxygen
(C) Hydrolysis of $\mathrm{XeF}_{6}$ in acidic medium
(D) Hydrolysis of $\mathrm{XeF}_{6}$ in basic medium
21. Assuming $\mathrm{H}_{2}$ and HD molecules having equal lengths, the ratio of the rotational partition functions of these molecules, at temperature above 100 K is
(A) $\frac{3}{8}$
(B) $\frac{3}{4}$
(C) $\frac{1}{2}$
(D) $\frac{2}{3}$
22. The rate of exchange of cyanide ligands in the complexes (i) $\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2-}$, (ii) $\left[\mathrm{Mn}(\mathrm{CN})_{6}\right]^{3-}$ and (iii) $\left[\mathrm{Cr}(\mathrm{CN})_{6}\right]^{3-}$ by ${ }^{14} \mathrm{CN}$ follow the order
(A) (ii) $>$ (i) $>$ (iii)
(B) (iii) $>$ (i) $>$ (ii)
(C) (i) $>$ (iii) $>$ (ii)
(D) (i) $>$ (ii) $>$ (iii)
23. Among the following isostructural compounds, identify the compound which has the highest lattice energy
(A) LiF
(B) LiCl
(C) NaCl
(D) MgO
24. The ground state of $\mathrm{V}^{3+}$ ion is
(A) ${ }^{3} F_{2}$
(B) ${ }^{5} D_{0}$
(C) ${ }^{3} F_{4}$
(D) ${ }^{2} D_{5 / 2}$
25. Using chlorobenzene as solvent, the reagents needed for an efficient synthesis of borazine are
(A) $\mathrm{NH}_{4} \mathrm{Cl}$ and $\mathrm{BCl}_{3}$
(B) $\mathrm{NH}_{4} \mathrm{Cl}, \mathrm{BCl}_{3}$ and $\mathrm{NaBH}_{4}$
(C) $\mathrm{NH}_{4} \mathrm{Cl}$ and $\mathrm{NaBH}_{4}$
(D) $\mathrm{NH}_{3}$ and $\mathrm{BCl}_{3}$
26. The basic reaction involved in the synthesis of silicones is
(A) The hydrolysis of trimethyl chlorosilane
(B) The hydrolysis of dimethyl dichlorosilane
(C) The hydrolysis of ethyl chlorosilane
(D) The acid hydrolysis of dimethyl silane
27. The major product obtained upon treatment of compound $X$ with $\mathrm{H}_{2} \mathrm{SO}_{4}$ at $80^{\circ} \mathrm{C}$ is

(X)
(A)

(B)

(C)

(D)

28. In the reaction
 $\mathrm{OH}^{-}(\mathrm{aq})$
if the concentration of both the reactions is doubled, then the rate of the reaction will
(A) Remain unchanged
(B) Quadruple
(C) Reduce to one fourth
(D) Double
29. Among the halobenzenes, the one that undergoes electrophilic aromatic substitution most readily and the reason for its higher reactivity are
(A) Fluorobenzene; the benzenonium ion intermediate is established by $2 p$ ( $F$ ), $2 p$ (C) overlap which is most efficient
(B) Chlorobenzene; very high electron affinity of chlorine considerably lowers the energy of activation of the reaction
(C) Bromobenzene; high polarizing power of the halogen atom helps in effective stabilization of the benzenonium ion intermediate
(D) lodobenzene; iodine atom has the lowest electronegativity and hence electron density of the phenyl ring is least disturbed
30.


The above reaction is an example of
(A) Nucleophilic substitution of addition-elimination mechanism
(B) Electrophilic substitution by addition-elimination mechanism
(C) Radical substitution reaction
(D) Nucleophilic substitution involving benzyne intermediate
31. For the reaction: $\mathrm{Br}_{2}(\mathrm{~g})+\mathrm{BF}_{2}(\mathrm{~g}) \rightarrow 2 \mathrm{BrF}_{3}(\mathrm{~g})$, the equilibrium constant at 2000 K and 1.0 bar is 5.25 . When the pressure is increased by 8 -fold, the equilibrium constant
(A) Increases by a factor of 1.86
(B) Decreases by a factor of 1.86
(C) Remains same

## (D) Increases by a factor of 8

32. The vapour pressure of pure components 'A' and 'B' are 200 torr and 100 torr respectively. Assuming a solution of these components obeys Raoult's law, the mole fraction of component ' $A$ ' in vapour phase in equilibrium with a solution containing equimoles of ' $A$ ' and ' $B$ ' is $\qquad$ .
33. For the reaction,
$2 \mathrm{Cl}(\mathrm{g}) \rightarrow \mathrm{Cl}_{2}(\mathrm{~g})$
the thermodynamic properties
(A) $\square \mathrm{G}, \square \mathrm{H}$ and $\square \mathrm{S}$ are positive
(B) $\square \mathrm{G}, \square \mathrm{H}$ and $\square \mathrm{S}$ are negative
(C) $\square \mathrm{G}$ and $\square \mathrm{H}$ are negative and $\square \mathrm{S}$ is positive
(D) $\square \mathrm{G}$ is negative and $\square \mathrm{H}$ and $\square \mathrm{S}$ afe positive
34. The standard free energies of formation of $\mathrm{H}_{2} \mathrm{~S}(\mathrm{~g})$ and $\mathrm{CdS}(\mathrm{s})$ at $1000{ }^{\circ} \mathrm{C}$ are $-49.0 \mathrm{~kJ} / \mathrm{mol}$ and $-127.2 \mathrm{~kJ} / \mathrm{mol}$, respectively. Use these data to predict whether $\mathrm{H}_{2}(\mathrm{~g})$ will reduce CdS (s) to metallic Cd at this temperature
(A) $\square \mathrm{G}=-78.2 \mathrm{~kJ} / \mathrm{mol}$ and $\mathrm{H}_{2}$ reduces CdS
(B) $\square \mathrm{G}=-39.1 \mathrm{~kJ} / \mathrm{mol}$ and $\mathrm{H}_{2}$ reduce CdS
(C) $a=0 \mathrm{~kJ} / \mathrm{mol}$ and the reaction is at equilibrium
(D) $G=+78.2 \mathrm{~kJ} / \mathrm{mol}$ and the reaction is not feasible
35. The ionic strength of $0.01 \mathrm{M} \mathrm{K}_{2} \mathrm{SO}_{4}$ is $\qquad$ .
36. A student recorded a polarogram of $2.0 \mathrm{mM} \mathrm{Cd}^{2+}$ solution and forgot to add KCI solution. What type of error do you expect in his results?
(A) Only migration current will be observed

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(B) Only diffusion current will be observed
(C) Both migration current as well as diffusion current will be observed
(D) Both catalytic current as well as diffusion current will be observed
37. The half-life time for a reaction at initial concentrations of 0.1 and $0.4 \mathrm{~mol}^{-1}$ are 200 s and 50 $s$ respectively. The order of the reaction is $\qquad$ .
38. The Nernst heat theorem is:
(A) $\lim _{T=0} \frac{d(\Delta F)}{d T}=0$
(B) $\lim _{T=0} \Delta S=0$
(C) $\lim _{T=0} \Delta C_{p}=0$
(D) $\lim _{T=0} \frac{d(\Delta H)}{d T}=0$
39. Fast breeder reactors use
(A) No moderator
(B) Graphite as moderator
(C) Heavy water as moderator
(D) Uranium as fuel
40. A nucleus with a high $N / P$ ratio undergoes spontaneous
(A) $k$-electron capture
(B) Positron emission
(C) Proton emission
(D) $\square$ emission
41. Which of the following statements about the reactivity of 1-chloroapocamphane (1) towards alcoholic $\mathrm{AgNO}_{3}$ is true?

(1)
(A) Reacts by SN1 mechanism
(B) Reacts by SN2 mechanism
(C) Reacts by SN3 mechanism
(D) Does not react
42. Neptunium series is different from other radio-active series in that
(A) All the isotopes in the series have mass numbers divisible by 4 without any remainder
(B) All the isotopes in the series have mass numbers divisible by 4 with a remainder of 2
(C) The end product in an isotope of bismuth
(D) The end product is an isotope of lead
43. $o$-Chlorotoluene reacts with sodamide in liquid ammonia to give $o$-toluidine and $m$-toluidine. This reaction proceeds through an intermediate
(B)


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(C)

(D)

44. The decreasing order of reactivity of meta-nitrobromobenzene (I); 2, 4, 6trinitrobromobenzene (II); para-nitrobromobenzene (III) and 2, 4-dinitrobromobenzene (IV) towards $\mathrm{OH}^{-}$ions is
(A) I $>$ II $>$ III $>$ IV
(B) II $>$ IV $>$ III $>$ I
(C) IV $>$ II $>$ III $>$ I
(D) II $>$ IV $>$ I $>$ III
45. Which of the following represents a set of hard acid and soft base respectively?
(A) $\mathrm{Fe}^{3+}$ and F
(B) $\mathrm{Fe}^{3+}$ and $\mathrm{S}^{2-}$
(C) $\mathrm{Ag}^{+}$and $\mathrm{S}^{2-}$
(D) $\mathrm{Ag}^{+}$and $\mathrm{F}^{-}$
46. If the value of $\mathrm{K}_{0}$ for the reaction $\mathrm{A}_{(\mathrm{g})} \mathrm{B}_{(\mathrm{g})}+\mathrm{C}_{(\mathrm{g})}$ is $6 \times 10^{-4} \mathrm{~mol} \mathrm{~m}^{-3}$ at 530 K , then the value of $K_{p}\left(\right.$ in $\left.\mathrm{Nm}^{-2}\right)$ is
(A) 2.64
(B) 0.64
(C) $2.60 \times 10^{-4}$

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(D) $1.38 \times 10^{-5}$
47. A radioactive isotope having a half-life of 3 days we received after 12 days. It was found that there were only 2 g of the isotope in the container. The initial weight of the isotope was
(A) 12 g
(B) 24 g
(C) 32 g
(D) 48 g

## COMMON DATA QUESTIONS 48 \& 49

Write the structures of $X, Y$ and $Z$ in the following.
48.
 x

(A)


(B) Red-orange coloured dye

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(C)

Red-orange coloured dye
(D)

49.


(A) N-Nitrosoamine (oily layer)

(B)

N-Nitrosoamine (oily layer)
(C)

C)

N-Nitrosoamine (oily layer)

LINKED ANSWER QUESTIONS 50 \& 51
Given the following reaction


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50. What is the product $x$ in the reaction?
(A)


$$
\begin{aligned}
& \mathrm{CH}{ }_{2} \mathrm{COOH} \\
& \mathrm{CH}_{2} \mathrm{COOH}
\end{aligned}
$$

(B)
(C)

(D)

51. What is the product $y$ in the reaction?
(A) $\mathrm{CH}_{3} \mathrm{CH}_{2} \mathrm{CH}_{3} \mathrm{CH}_{5}$
(B) $\mathrm{CH}_{3} \mathrm{CH}_{2} \mathrm{CH}_{2} \mathrm{CH}_{3}$
(C) $\mathrm{CH}_{3} \mathrm{CH}_{3} \mathrm{CH}_{2} \mathrm{CH}_{3}$
(D) $\mathrm{CH}_{3} \mathrm{CH}_{2} \mathrm{CH}_{2} \mathrm{CH}_{2}$

## LINKED ANSWER QUESTIONS 52-53

Given the following Reaction


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52. What is the product $P$ and $Q$ in the reaction?
(A)


(B)


(C)

(D)


53. What is the product $R$ and $S$ in the reaction?
(A)
 $\mathrm{T}=$


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(B) $\mathrm{S}=$

$\mathrm{T}=$

(C)


(D)
 $T=$


## LINKED ANSWER QUESTIONS 54-55

Given the following Reaction

54. What is the product $B$ in the reaction?


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(D)

55. What is the product $C$ in the reaction?
(A) $\mathrm{C}_{6} \mathrm{H}_{5}-\mathrm{CH}_{2}-\mathrm{CH}=\mathrm{CH}-\mathrm{Ph}$
(B) $\mathrm{C}_{6} \mathrm{H}_{12}-\mathrm{CH}_{3}-\mathrm{CH}=\mathrm{CH}-\mathrm{Ph}$
(C) $\mathrm{C}_{6} \mathrm{H}_{13}-\mathrm{CH}_{3}-\mathrm{CH}=\mathrm{CH}-\mathrm{Ph}$
(D) $\mathrm{C}_{6} \mathrm{H}_{13}-\mathrm{CH}_{3}-\mathrm{CH}_{2}-\mathrm{CH}_{2}-\mathrm{Ph}$
56. A lent Rs. 600 to $B$ for 2 years and rs. 150 to $C$ for 4 years and received altogether from both Rs. 90 as interest. Find the rate of interest, simple interest being calculated.
(A) $5 \%$
(B) $16 \%$
(C) $6 \%$
(D) $4.5 \%$
57. $A$ and $B$ together can complete a piece of work in 35 days while $A$ alone can complete the same work in 60 days. In how many days, B alone will be able to complete the same work?
(A) 84 days
(B) 83 days
(C) 85 days
(D) 90 days
58. Synonym of Phlégmatic
(A) practical
(B) salivary
(C) dishonest

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(D) calm
59. Synonym of Ponderous
(A) contemplative
(B) moist
(C) erect
(D) bulky
60. Atom : Microscope
(A) tape : microphone
(B) planet : telescope
(C) person : microcosm
(D) receiver : telephone
61. Chronic : Acute
(A) symphony : ditty
(B) constant : sudden
(C) ailing : mortal
(D) timely: belated
62. Synonym of Vernacular
(A) Ingrained
(B) incorrigible
(C) perfect
(D) pious
63. Synonym of Pastime
(A) employment
(B) amusement
(C) hobby
(D) enjoy
64. $210,195,175,150,120$
(A) 90
(B) 75
(C) 80
(D) 85
65. 2, 5, 26, 677
(A) 17803
(B) 13576
(C) 458329
(D) 458330

## ANSWER KEY

| Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Answer | 15 | B | A | D | A | D | 2 | A | A | 1,0 | B | A | A | 99.75\% | A | A | B | C | C | D |
| Question | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| Answer | B | D | D | A | B | B | C | D | A | D | C | B | B | D | 0.03 | C | 2 | D | A | D |
| Question | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
| Answer | D | C | B | B | B | A | C | A | B | A | B | B | A | B | A | A | A | D | D | B |
| Question | 61 | 62 | 63 | 64 | 65 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Answer | B | A | A | D | D |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

## HINTS AND SOLUTIONS

1. 15

For bimolecular reaction

(I) R, R
(II) $R, S$

Both are diastereomers.

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Both are mirror images to each other. So (II) \& (III) are enantiomers.
3.(A)

4.(D)

5.(A) The most unstable species is $\mathrm{Ti}\left(\mathrm{C}_{2} \mathrm{H}_{5}\right)_{4}$ because it will polymerize alkenes.
6.(D) (1) Photosynthesis :

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Photosynthesis in plants proceeds with an increase in the energy.
Quantum Yield =
Phosphorescence:
$\underset{\text { (Triplet state) }}{\mathrm{T}_{1}} \longrightarrow \underset{\text { (Ground state) }}{\mathrm{S}_{0}}$

All statements 1, 2 and 3 are correct.
7. 2




trans-isomer

8.(A)

10.
$\mathrm{V}\left(\mathrm{C}_{6} \mathrm{H}_{6}\right)_{2}$ - unpaired $\mathrm{e}^{-}=1$
$\mathrm{Cr}\left(\mathrm{C}_{6} \mathrm{H}_{6}\right)_{2}$ - unpaired $\mathrm{e}^{-}=0$

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11.(B) In electrophilic aromatic substitution reaction ,the electrophile attacks the substrate in the first step to give a carbocation (known as arenium ion or $\square$ complex) the leaving group departs in second step. So it is a bimolecular and involves arenium ion ( $\square$ complex) intermediate.


12.(A) (P) Supporting electrolyte
(2) Residual current
(Q) $\mathrm{Zn}(\mathrm{Hg})_{\mathrm{a}=1}\left|\mathrm{ZnCl}_{2}(\mathrm{aq})\right| \mathrm{Zn}(\mathrm{Hg})_{Q=2}$
(4) Electrode concentration cell
(R) Inversion temperature
(6) Thomson expansion
(S) Entropy of vaporization
(5) Trouton's rule
13.(A) $\mathrm{Hg}_{2} \mathrm{Cl}_{2}+2 \mathrm{e}^{-} 2 \mathrm{Hg}(1)+2 \mathrm{Cl}^{-}(\mathrm{aq})$

$$
\mathrm{H}_{2} 2 \mathrm{H}^{+}+2 \mathrm{e}^{-}
$$


$H=-n F\left[E-T\left(\frac{\partial E}{\partial T}\right)_{P}\right]=-2 \times 96500\left[0.2684-298 \times 3 \times 10^{-4}\right]=-2 \times 96500 \times 0.179=-$ $34.5 \mathrm{~kJ} \mathrm{~mol}^{-1}$
14. $99.75 \%$

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Given $\quad D=999, V_{o}=20 \mathrm{ml}, \quad \mathrm{V}_{\mathrm{m}}=50 \mathrm{ml}$
$E=x$ is percentage of extraction
$\left(\frac{V_{m}}{V_{o}}\right) E$
$\mathrm{D}=\overline{\overline{100-E}}=999$
$999=\frac{\left(\frac{50}{20}\right) x}{100-x}=\frac{2.5 x}{100-x}$
$x=99.75 \%$
15.(A) Observation (1), Mean $=49.10 \%$

Relative Mean error $=\frac{(49.10-49.06)}{49.06}=0.08 \%$
Observation (2),
Mean $=49.42 \%$
Relative Mean error $\left.=\frac{(49.42-49.06)}{49.06}=0.73 \%\right)$
16.(A) 4.55
$Z_{\text {effective }}=Z-S$
S = Screening constant

$S=0.85 \times 2+0.35 \times 5=1.70+1.75=3.45$
$Z^{*}=8-3.45=4.55$
17.(B) The formula of the pyrosilicate ion is $\mathrm{Si}_{2} \mathrm{O}_{7}^{6-}$.
18.(C) $\mathrm{SF}_{4}-\mathrm{sp}^{3} \mathrm{~d}$

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(Trigonal bipyramidal)
19.(C) Atom $X$ has three valence electrons and hence it has a valency of 3 while atom $Y$ has six valence electrons, it has a valency of 2 . Thus the formula of the compound is $X_{2} Y_{3}$.
20.(D) $2 \mathrm{XeF}_{6}+16 \mathrm{OH}^{-} \longrightarrow \mathrm{XeO}_{6}{ }^{4-}+\mathrm{Xe}+8 \mathrm{H}_{2} \mathrm{O}+12 \mathrm{~F}^{-}+\mathrm{O}_{2}$

The percent ion $\mathrm{XeO}_{6}{ }^{4-}$ can be prepared by hydrolysis of $\mathrm{XeF}_{6}$ in basic medium.
21.(B) Rotational partition function $\mathrm{Fr}=\frac{8 \pi^{2} \mathrm{IkT}}{2 \mathrm{~h}^{2}}$
$\operatorname{Fr} \square \mathrm{I}\left(\square \mathrm{r}^{2}\right)$ given length $=$ const.

$$
\mathrm{T}=\text { const. }
$$

$\mathrm{Fr} \square \square$


$$
\left[\begin{array}{l}
\mu_{\mathrm{H}_{2}}=\frac{m_{1} m_{2}}{m_{1}+m_{2}}=\frac{1 \times 1}{1+1}=\frac{1}{2} \\
\mu_{\mathrm{HD}}=\frac{1 \times 2}{1+2}=\frac{2}{3}
\end{array}\right.
$$

$$
\frac{\mathrm{Fr}_{\mathrm{H}_{2}}}{\mathrm{Fr}_{\mathrm{HD}}}=\frac{\mu_{\mathrm{H}_{2}}}{\mu_{\mathrm{HD}}}
$$

22.(D) The order of lability:
$\mathrm{Ni}^{+2}>\mathrm{Mn}^{+3}>\mathrm{Cr}^{+3}$
$d^{8} \quad d^{4} \quad d^{3}$
So the order of rate of exchange of cyanide ligand $\left[\mathrm{Ni}(\mathrm{CN})_{4}\right]^{2-}>\left[\mathrm{Mn}(\mathrm{CN})_{6}\right]^{3-}>\left[\mathrm{Cr}(\mathrm{CN})_{6}\right]^{3-}$.
23.(D) Lattice energy depends on the product of the ionic charge

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$$
\mu \propto\left(z^{+} z^{-}\right)
$$

$\left(z^{+} z^{-}\right)$

| LiF | 1 |
| :--- | :--- |
| MgO | 4 |
| LiCl | 1 |
| NaCl | 1 |

So MgO has the highest lattice energy.
24.(A) $\quad V^{3+}=3 d^{2}$

$L=2+1=3(F)$
$S=\frac{n}{2}=\frac{2}{2}=1$
Multiplicity $=(2 S+1)=(2 \times 1+1)=3$
A/C to Hund's Rule'smallest Jis the most stable if the subshell is less than half filled.
J (smallest value) $=\mathrm{L}-\mathrm{S}=3-1=2$
So the ground state term symbol

25.(B)

26.(B)

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The starting material for the manufacture of silicones are dimethyl dichlorosilane.
27.(C)


28.(D)


Rate of reaction [Reaction intermediate] so if the concentration of the reactant is doubled the rate of reaction will double.
29.(A) The order of reactivity of various halobenzenes is $\mathrm{PhF}>\mathrm{PhCl} \square \mathrm{PhBr}>\mathrm{Phl}$.

In fluorobenzene $F$ and $C$ have $2 p$ orbitals which are of comparable size thus there is better overlap resulting in greater +R effect than that of $\mathrm{Cl}, \mathrm{Br}$ or I .
30.(D)

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This reaction is an example of nucleophilic substitution involving benzyne intermediate.
31.(C) The equilibrium constant does not/depend on the pressure so the equilibrium constant remain same.

|  | $\mathrm{Br}_{2}(\mathrm{~g})+\mathrm{BF}_{2}(\mathrm{~g}) \rightarrow 2 \mathrm{BrF}_{3}(\mathrm{~g})$ |  |
| :--- | :---: | :---: |
| Initial mole | 1 | 0 |
| at equilibrium | $(1-\mathrm{x})$ | $(1-\mathrm{x})$ |
| $2 x$ |  |  |

Total no. of moles at equilibrium $=(1-x)+(1-x)+2 x=2$

$K_{P}=\frac{P_{\mathrm{B}_{\mathrm{B}} \mathrm{F}_{3}}^{2}}{\left(\mathrm{P}_{\mathrm{Br}_{2}}\right)\left(\mathrm{P}_{\mathrm{BF}_{2}}\right)}=\frac{4 x^{2} \mathrm{P}^{2}}{(1-x)(1-x) \mathrm{P}^{2}}=\frac{4 x^{2}}{(1-x)(1-x)}$
32.(B) 0.66

At equilibrium

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$\mathrm{X}_{\mathrm{A}}=0.5 ; \mathrm{x}_{\mathrm{B}}=0.5$
A/C to Raoult's law
$P=P_{A}+P_{B}=x_{A} P_{A}{ }^{\circ}+x_{B} P_{B}{ }^{\circ}$
$P_{A}=0.5 \times 200=100$ Torr
$P_{B}=0.5 \times 100=50$ Torr
$P=100+50=150$ Torr
$x_{A}$ vapour $=\frac{P_{A}}{P}=\frac{100}{150}=\frac{2}{3}=0.66$
33.(B) $\quad 2 \mathrm{Cl}(\mathrm{g}) \rightarrow \mathrm{Cl}_{2}(\mathrm{~g})$
$\square \mathrm{n}=1-2=-1$
$\square \mathrm{S}=-\mathrm{ve}, \quad \quad \square \mathrm{H}=-\mathrm{ve}$,
34.(D) $\mathrm{CdS}(\mathrm{s})+\mathrm{H}_{2}(\mathrm{~g}) \rightarrow \mathrm{H}_{2} \mathrm{~S}(\mathrm{~g})+\mathrm{Od}(\mathrm{s})$
$\square \mathrm{G}=\Sigma \mathrm{G}_{\text {Products }}-\Sigma \mathrm{G}_{\text {reactant }}=\left[\Delta \mathrm{G}_{\mathrm{H}_{2} S(9)}^{\circ}+\Delta \mathrm{G}_{\mathrm{iccotfs})}^{\circ}-\left(\Delta \mathrm{G}_{\mathrm{icdos}(\mathrm{s})}^{\circ}+\Delta \mathrm{G}_{\mathrm{H}_{2}(9)}^{\circ}\right)\right]=[-49+0-(-127.2+0)]$
$=78.2 \mathrm{~kJ} / \mathrm{mol}$
The reaction is not feasible.
35. 0.03


Given $\mathrm{K}_{2} \mathrm{SO}_{4}$
$\mathrm{m}_{+}=2 \times 0.01 \mathrm{M}$
$\mathrm{m}_{-}=0.01 \mathrm{M}$
$z_{+}=+1$

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$$
\begin{aligned}
& z_{-}=-2 \\
& I=\frac{1}{2}\left[2 \times 0.01 \times(1)^{2}+0.01 \times(2)^{2}\right]=\frac{1}{2}(0.02+0.04)=\frac{1}{2}(0.06)=0.03
\end{aligned}
$$

36.(C) The migration current can be practically eliminated if an indifferent electrolyte is added to the solution in a concentration so large that its ions carry essentially all the current if we forgot to add KCl solution then both migration current as well as diffusion current will be observed.
37. 2

38.(D) $A / C$ to the Nernst heat theorem

39.(A) Fast breeder reactors require the use of fast neutrons; no moderator is needed.
40.(D)

$$
\begin{array}{ll}
{ }_{5}^{11} B \xrightarrow{\beta \text { emission }}{ }_{6}^{11} \mathrm{C} & \\
\frac{\mathrm{n}}{\mathrm{p}}=\frac{6}{5} & \frac{\mathrm{n}}{\mathrm{p}}=\frac{5}{6}
\end{array}
$$

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41.(D) Substitutions reactions do not take place at bridgehead carbons due to rigid cage like structure of substrate. So 1-chloroapocamphane does not react with Alcoholic $\mathrm{AgNO}_{3}$.
42.(C) The last member of the Neptunium series is an isotope of bismuth ${ }_{88}^{209}$ Bi $)$ and not an isotope of Lead.
43.(B)

44.(B) The reactivity of substrate for $\mathrm{ArSN}^{2}$ reaction - R and -1 power of the group present at o and $p$-position. So the order is

45.(B) $\quad$ Hard acid $=\mathrm{Fe}^{3+}$

## Soft base $=S^{2}$

Hard Acid: A hard acid like a hard base is difficult to polarize. A cationic hard acid generally has a small size and high positive charge.

Soft Base: Soft lewis base are those in which the donar atoms are easily polarised and have low electronegativity.
46.(A) $\mathrm{K}_{\mathrm{c}}=6 \times 10^{-4} \mathrm{~mol} \mathrm{~m}^{-3}, \mathrm{~T}=530 \mathrm{~K}, \mathrm{R}=8.314 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$

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$K_{p}=K_{c}(R T)^{n}$
$\mathrm{A}_{(\mathrm{g})} \mathrm{B}_{(\mathrm{g})}+\mathrm{C}_{(\mathrm{g})}$
$\square \mathrm{n}=2-1=1$
$\mathrm{K}_{\mathrm{p}}=6 \times 10^{-4} \times 8.314 \times 530=2.64$
47.(C) Half life time $t_{1 / 2}=3$ days

Time for decay $\mathrm{T}=12$ day
$\mathrm{T}=\mathrm{n} \times \mathrm{t}_{1 / 2}$
$12=n \times 3$
$\mathrm{n}=4$
Let the original amount be $=\mathrm{N}_{0}$
Let the amount left after 4 half life periods = N
Fraction $=\mathrm{N} / \mathrm{N}_{0}$
$N=\left(\frac{1}{2}\right)^{n} N_{0}$
$\frac{\mathrm{N}}{\mathrm{N}_{0}}=\left(\frac{1}{2}\right)^{\mathrm{n}}$
$\mathrm{N}_{0}=32 \mathrm{gm}$
${ }^{24} \mathrm{Na}$ is used to detect the presence of blood clots.

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48.(A) $X=$ Red-orange coloured dye

49.(B) $\mathrm{Y}=$ N-Nitrosoamine (oily layer)
50.(A)

51.(B)

52.(B) $\mathrm{P}=\mathrm{CH}_{3} \mathrm{COCl}$ or $\left(\mathrm{CH}_{3} \mathrm{CO}\right)_{2} \mathrm{O}$

53.(A) $\mathrm{S}=\mathrm{SO}_{马} \mathrm{NH}_{2}$,

$$
\mathrm{T}=
$$



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(A)

(Aldol)
(i) $\mathrm{OH}^{\ominus}, \mathrm{PhCHO}$
(ii) $H^{\oplus}, \Delta$
(B)

(Wolff Kishner Reduction)
54.(B)
55.(A)

56.(A)

Rs. 600 for 2 years = Rs. 1200 for 1 year
and
Rs. 150 for 4 years = Rs. 600 for 1 year
Total principal = Rs. 1800 for 1 year

57.(A) A and B did the work for 35 days to complete it. A can complete the work in 60 days.

So,

$$
\begin{aligned}
& \frac{A \text { did }}{A \text { can }}+\frac{B \text { did }}{B \text { can }}=1 \\
& \frac{35}{60}+\frac{35}{x}=1
\end{aligned}
$$


$x=84$ days.
58.(D) Synonym of Phlegmatic is calm
59.(D) Synonym of Ponderous is bulky
60.(B) One needs a microscope to see an atom. One needs a telescope to see a planet.
61.(B) Chronic continues over a long period of time. Constant continues over a long period of time, sudden is short-lived.

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62.(A) The synonym Vernacular means "Being or characteristic of or appropriate to everyday language" is ingrained.
63.(A) Synonym of pastime is employment. Meaning of Pastime is a diversion that occupies one's time and thoughts.
64.(D) Pattern is $210-195=15$

195-175=20
175-150=25
$150-120=30$
so the missing number is $120-35=85$
65.(D) Pattern is $(2)^{2}+1=5$
$(5)^{2}+1=26$
$(26)^{2}+1=671$
So the missing number is $(671)^{2}+1=458330$

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