VPM CLASSES

GATE SCIENCE
CHEMISTRY
SOLVED SAMPLE PAPER

* DETAILED SOLUTIONS

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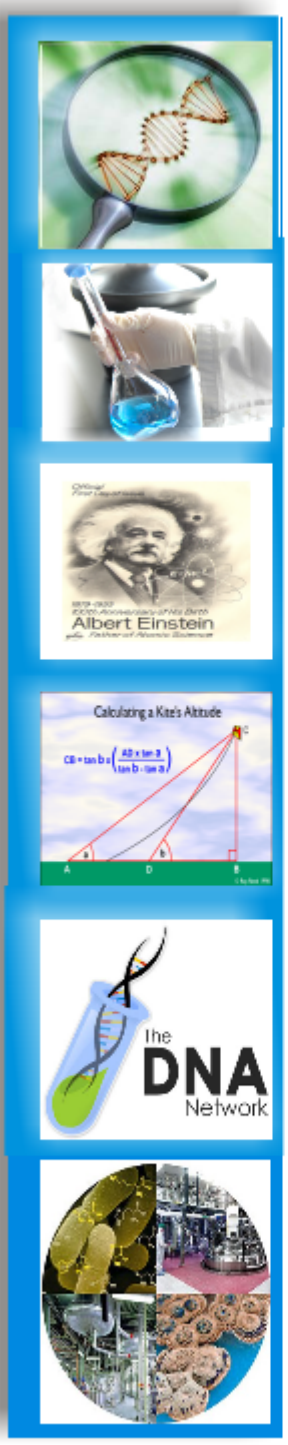

GATE - CHEMISTRY

MOCK TEST PAPER

- 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

VPM CLASSES

For IIT-JAM, JNU, GATE, NET, NIMCET and Other Entrance Exams

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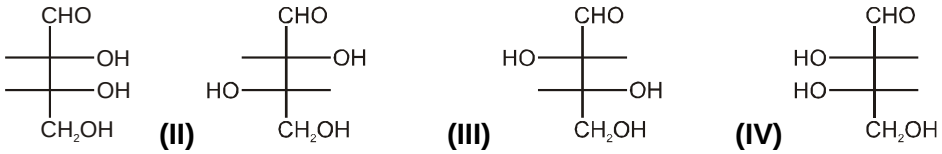
1. For the reaction A + B $\rightarrow X^{\ddagger} \rightarrow$ P, Ea = 20.0 kJ mol^{-1} at 300 K. The enthalpy changes for the formation of the activated complex from the reactants in kJ mol^{-1} is____.

2. For the aldotetroses I-IV, the combination of TRUE statements, among P-T, is



(I) **(II)** **(III)** **(IV)**

P = I and II are diastereomers and II and III are enantiomers

Q = I and IV are mesomers and are optically inactive

R = I and III can be interconverted by a base catalysed isomerisation

S = only I and IV are HIO_4 cleavable

T = I and III are D-sugars and II and IV are L-sugars

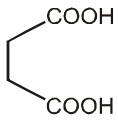
(A) Q, R, T

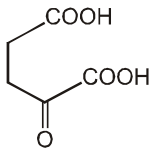
(B) P, R, T

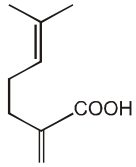
(C) Q, S, T

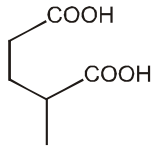
(D) P, Q, S

3. Oxidation of X with chromic acid chiefly gives

(A) 

(B) 

(C) 



(D)

4. Given that $E_0(Fe^{3+}, Fe) = -0.04$ V and $E_0(Fe^{2+}, Fe) = -0.44$ V, the value of $E_0(Fe^{3+}, Fe^{2+})$ is_____.

5. The most **unstable** species among the following is

(A) $Ti(C_2H_5)_4$

(B) $Ti(CH_2Ph)_4$

(C) $Pb(CH_3)_4$

(D) $Pb(C_2H_5)_4$

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 (T_1).

Which of the above statements are correct?

(A) 1 and 2

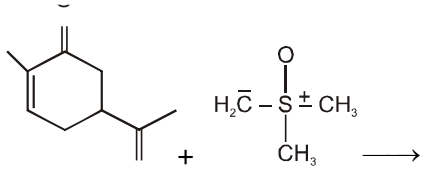
(B) 1 and 3

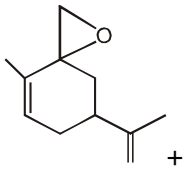
(C) 2 and 3

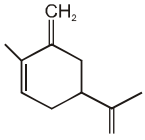
(D) 1, 2 and 3

7. The number of possible geometrical isomers for octahedral $Co(ox)(PMe_3)_2NH_3Cl$ complex is_____.

8. The products formed in the following reaction are



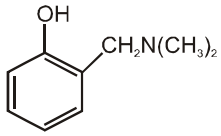
(A)  + DMSO

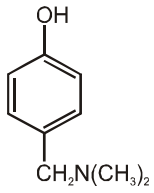
(B)  + $CH_3SO_2CH_3$

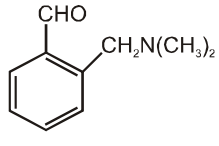
(C) + DMSO

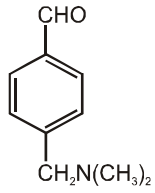
(D) + DMSO

9. Phenol on reaction with formaldehyde and dimethyl amine mainly gives

(A) 

(B) 

(C) 

(D) 

10. The complexes $V(C_6H_6)_2$ and $Cr(C_6H_6)_2$ are both readily oxidized in air to their respective cations. The number of unpaired electrons, respectively, in each are ___ & _____.

11. The electrophilic aromatic substitution proceeds through a

(A) free radical

(B) sigma complex

(C) benzyne

(D) carbene

12. Match the following

I	II
(P) Supporting electrolyte	(1) Overpotential
(Q) $Zn(Hg)_{a=1}$ |$ZnCl_2$ (aq) | $Zn(Hg)_{Q=2}$	(2) Residual current
(R) Inversion temperature	(3) Electrolyteconcentration cell
(S) Entropy of vapourisation	(4) Electrode concentration cell
	(5) Trouton's rule
	(6) Joule-Thomson expansion

(A) P-2, Q-4, R-6, S-5

(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, $Hg_2Cl_2(s) + H_2(g) \rightarrow 2Hg(l) + 2HCl(aq)$, the correct representation of the cell and the thermodynamic properties ΔG, ΔH and ΔS at 298 K respectively, are (given : E_{298} = 0.2684 V and temperature coefficient = 3×10^{-4} VK^{-1})

(A) Pt | H_2(g, 1 atm) | HCl (aq) | Hg_2Cl_2 (s) | Hg (l); $\Delta G = -51.8$ kJ mol^{-1}, $\Delta H = -34.5$ kJ mol^{-1}, $\Delta S = -58$ JK^{-1} mol^{-1}

(B) Pt | H_2(g, 1 atm) | HCl (aq) | Hg_2 Cl_2 (s) | Hg (l); $\Delta G = -25.9$ kJ mol^{-1}, $\Delta H = -34.5$ kJ mol^{-1}, $\Delta S = -29$ JK^{-1} mol^{-1}

(C) Hg(l) | Hg_2 Cl_2 (s) | HCl (aq) | H_2 (g, 1 atm) | Pt; $\Delta G = -51.8$ kJ mol^{-1}, $\Delta H = -69$ kJ mol^{-1}, $\Delta S = -58$ JK^{-1} mol^{-1}

(D) Hg(l) | Hg_2 Cl_2 (s) | HCl (aq) | H_2 (g, 1 atm) | Pt; $\Delta G = 51.8$ kJ mol^{-1}, $\Delta H = 69$ kJ mol^{-1}, $\Delta S = 58$ JK^{-1} 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____ was the percentage extraction.

15. A substance was known to contain 49.06 , 0.02 per cent of a given constituent A. The results obtained 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?

(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 (Z*) for the 1s electron of $_8O$ according to Slater's rules is nearly_____.

17. The formula of the pyrosilicate ion is

(A) SiO_4^{4-}

(B) $Si_2O_7^{6-}$

(C) $Si_3O_9^{6-}$

(D) $Si_6O_{18}^{12-}$

18. The structure of 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.

(A) X_2Y_6

(B) XY_2

(C) X_2Y_3

(D) X_3Y_2

20. The perxenate ion XeO_4^{4-} can be prepared by

(A) Direct reaction of Xe with oxygen

(B) Reaction of XeF_6 with oxygen

(C) Hydrolysis of XeF_6 in acidic medium

(D) Hydrolysis of XeF_6 in basic medium

21. Assuming H_2 and HD molecules having equal lengths, the ratio of the rotational partition functions of these molecules, at temperature above 100K 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) $[Ni(CN)_4]^{2-}$, (ii) $[Mn(CN)_6]^{3-}$ and (iii) $[Cr(CN)_6]^{3-}$ by ^{14}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 V^{3+} ion is

(A) $^3F_2$

(B) $^5D_0$

(C) $^3F_4$

(D) $^2D_{5/2}$

25. Using chlorobenzene as solvent, the reagents needed for an efficient synthesis of borazine are

(A) NH_4Cl and BCl_3

(B) NH_4Cl, BCl_3 and $NaBH_4$

(C) NH_4Cl and $NaBH_4$

(D) NH_3 and BCl_3

26. The basic reaction involved in the synthesis of silicones is

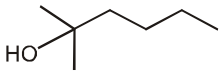
(A) The hydrolysis of trimethyl chlorosilane

(B) The hydrolysis of dimethyl dichlorosilane

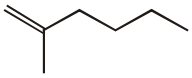
(C) The hydrolysis of ethyl chlorosilane

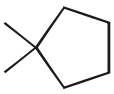
(D) The acid hydrolysis of dimethyl silane

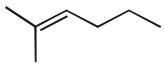
27. The major product obtained upon treatment of compound X with H_2SO_4 at 80ºC is

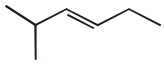


(X)

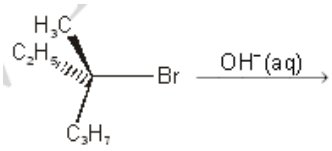
(A) 

(B) 

(C) 

(D) 

28. In the reaction



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

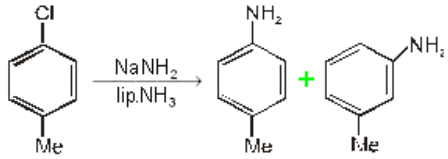
(A) Fluorobenzene; the benzenonium ion intermediate is established by 2p (F), 2p (C) overlap which is most efficient

(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) Iodobenzene; 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 : Br_2 (g) + BF_2(g) $\rightarrow$ 2BrF_3(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_____.

33. For the reaction,

$2Cl\ (g) \rightarrow Cl_2\ (g)$

the thermodynamic properties

(A) ΔG, ΔH and ΔS are positive

(B) ΔG, ΔH and ΔS are negative

(C) ΔG and ΔH are negative and ΔS is positive

(D) ΔG is negative and ΔH and ΔS are positive

34. The standard free energies of formation of H_2S (g) and CdS (s) at 1000 ^oC are –49.0 kJ/mol and –127.2 kJ/mol, respectively. Use these data to predict whether H_2 (g) will reduce CdS (s) to metallic Cd at this temperature

(A) ΔG = –78.2 kJ/mol and H_2 reduces CdS

(B) ΔG = – 39.1 kJ/mol and H_2 reduce CdS

(C) ΔG = 0 kJ/mol and the reaction is at equilibrium

(D) ΔG = +78.2 kJ/mol and the reaction is not feasible

35. The ionic strength of 0.01 M K_2SO_4 is_____.

36. A student recorded a polarogram of 2.0 mM Cd^{2+} solution and forgot to add KCl solution. What type of error do you expect in his results?

(A) Only migration current will be observed

(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 mol^{-1} are 200 s and 50 s respectively. The order of the reaction is_____.

38. The Nernst heat theorem is:

(A) $\lim_{T=0} \frac{d(\Delta F)}{dT} = 0$

(B) $\lim_{T=0} \Delta S = 0$

(C) $\lim_{T=0} \Delta C_p = 0$

(D) $\lim_{T=0} \frac{d(\Delta H)}{dT} = 0$

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

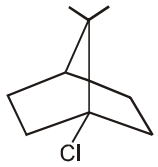
(A) k-electron capture

(B) Positron emission

(C) Proton emission

(D) β emission

41. Which of the following statements about the reactivity of 1-chloroapocamphane (1) towards alcoholic $AgNO_3$ 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

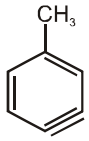
(A) All the isotopes in the series have mass numbers divisible by 4 without any remainder

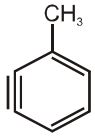
(B) All the isotopes in the series have mass numbers divisible by 4 with a remainder of 2

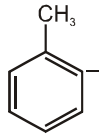
(C) The end product in an isotope of bismuth

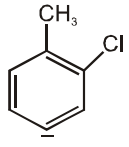
(D) The end product is an isotope of lead

43. *o*-Chlorotoluene reacts with sodamide in liquid ammonia to give *o*-toluidine and m-toluidine. This reaction proceeds through an intermediate

(A) 

(B) 

(C) 

(D) 

44. The decreasing order of reactivity of *meta*-nitrobromobenzene (I); 2, 4, 6-trinitrobromobenzene (II); *para*-nitrobromobenzene (III) and 2, 4-dinitrobromobenzene (IV) towards 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) Fe^{3+} and F

(B) Fe^{3+} and S^{2-}

(C) Ag^{+} and S^{2-}

(D) Ag^{+} and F^{-}

46. If the value of K_0 for the reaction $A_{(g)}$ $B_{(g)}+C_{(g)}$ is 6×10^{-4} mol m^{-3} at 530 K, then the value of K_p(in Nm^{-2}) is

(A) 2.64

(B) 0.64

(C) 2.60×10^{-4}

(D) 1.38×10^{-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

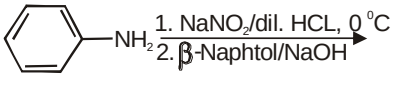
(B) 24 g

(C) 32 g

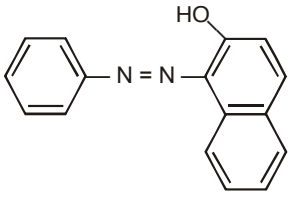
(D) 48 g

COMMON DATA QUESTIONS 48 & 49

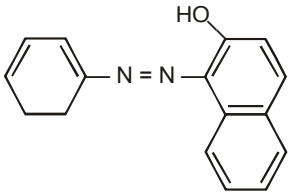
Write the structures of X,Y and Z in the following.

48. 

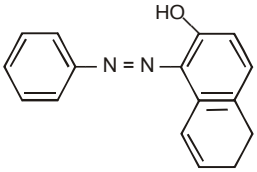
X



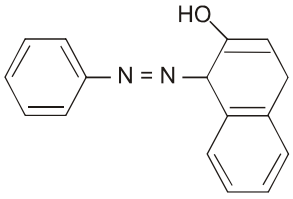
(A) Red-orange coloured dye



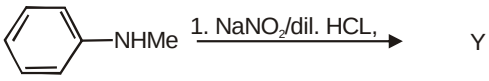
(B) Red-orange coloured dye

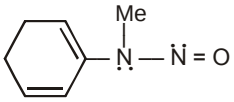


(C) Red-orange coloured dye

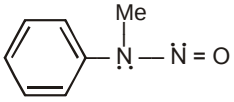


(D)

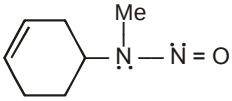
49. 



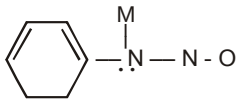
(A) N-Nitrosoamine (oily layer)



(B) N-Nitrosoamine (oily layer)



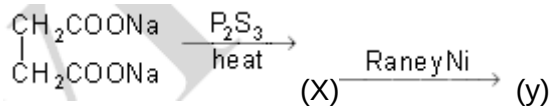
(C) N-Nitrosoamine (oily layer)



(D) N-Nitrosoamine (oily layer)

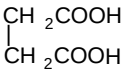
LINKED ANSWER QUESTIONS 50 & 51

Given the following reaction



50. What is the product x in the reaction?

(A) 

(B) 

(C) 

(D) 

51. What is the product y in the reaction?

(A) $CH_3CH_2CH_3CH_5$

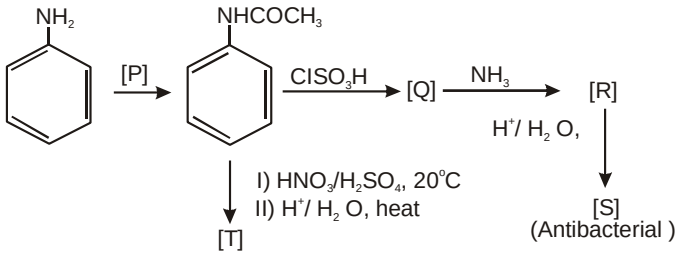
(B) $CH_3CH_2CH_2CH_3$

(C) $CH_3CH_3CH_2CH_3$

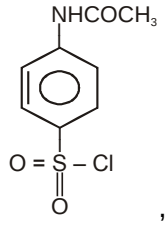
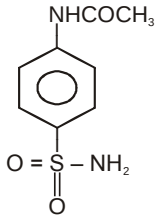
(D) $CH_3CH_2CH_2CH_2$

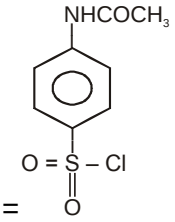
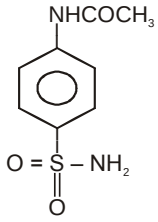
LINKED ANSWER QUESTIONS 52-53

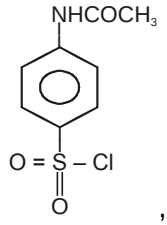
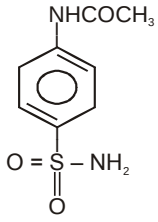
Given the following Reaction

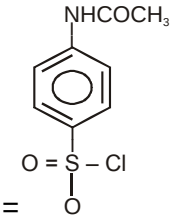
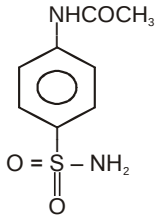


52. What is the product P and Q in the reaction?

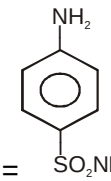
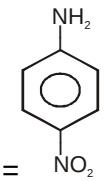
(A) Q =  , R = 

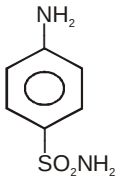
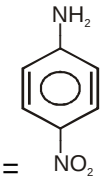
(B) Q =  , R = 

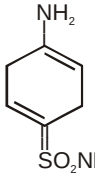
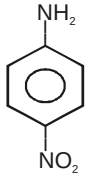
(C) Q =  , R = 

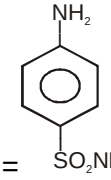
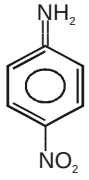
(D) Q =  , R = 

53. What is the product R and S in the reaction?

(A) S =  , T = 

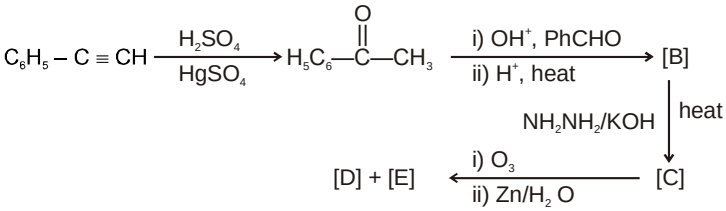
(B) S =  , T = 

(C) S =  , T = 

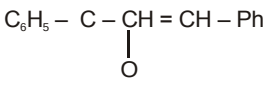
(D) S =  , T = 

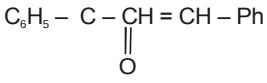
LINKED ANSWER QUESTIONS 54-55

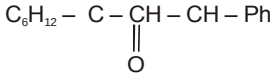
Given the following Reaction

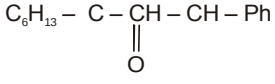


54. What is the product B in the reaction?

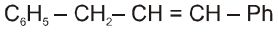
(A) 

(B) 

(C) 

(D) 

55. What is the product C in the reaction?

(A) 

(B) $C_6H_{12} - CH_3 - CH = CH - Ph$

(C) $C_6H_{13} - CH_3 - CH = CH - Ph$

(D) $C_6H_{13} - CH_3 - CH_2 - CH_2 - Ph$

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 Phlegmatic

(A) practical

(B) salivary

(C) dishonest

(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**

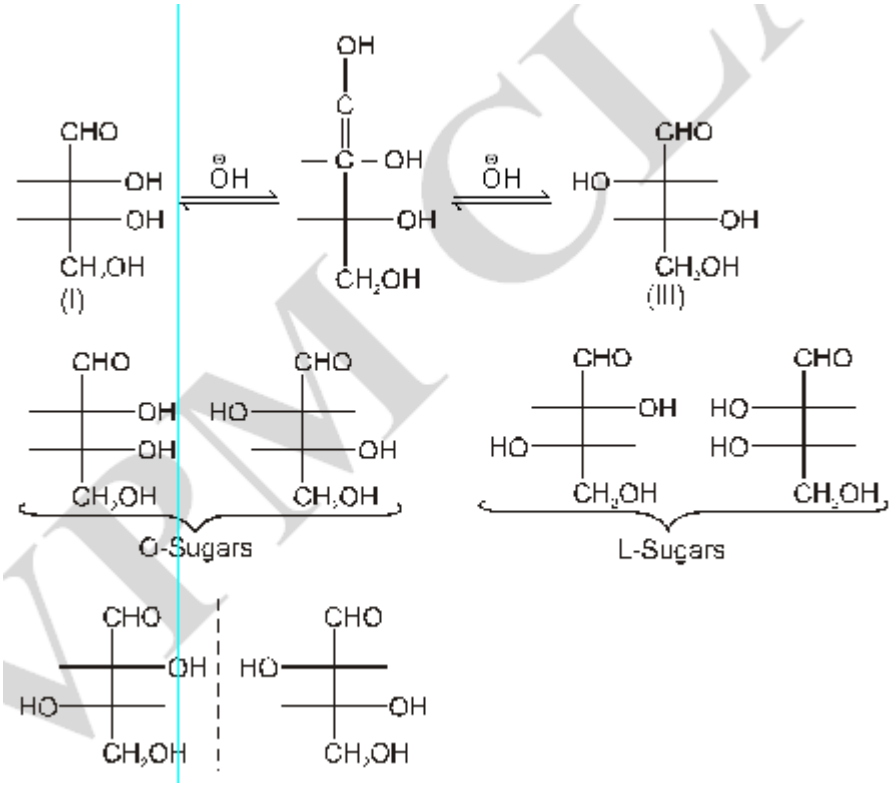
For bimolecular reaction

$$\Delta H = E_a - 2RT = 20.0 - \left(\frac{2 \times 8.314 \times 300}{100}\right) = 20.0 - 4.98 = 15.02 \text{ kJ mol}^{-1}$$

2. (B)

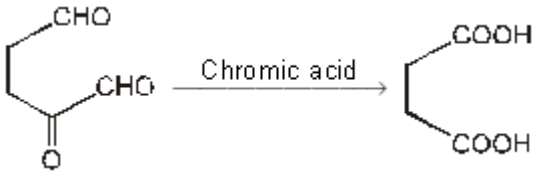
(I) R, R (II) R, S

Both are diastereomers.



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

3.(A)



4.(D) 0.40V

$$Fe^{3+} + 3e^- \rightarrow Fe \quad -0.04V$$
$$-Fe^{2+} + 2e^- \rightarrow Fe \quad -0.44V$$
$$Fe^{3+} + e^- \rightarrow Fe^{2+} \quad +0.4V$$

5.(A) The most unstable species is $Ti(C_2H_5)_4$ because it will polymerize alkenes.

6.(D) (1) Photosynthesis:

$$6CO_2 + 12H_2O \xrightarrow{\text{Light}} C_6H_{12}O_6 + 6H_2O + 6O_2 \text{ (Carbohydrate)}$$

Photosynthesis in plants proceeds with an increase in the energy.

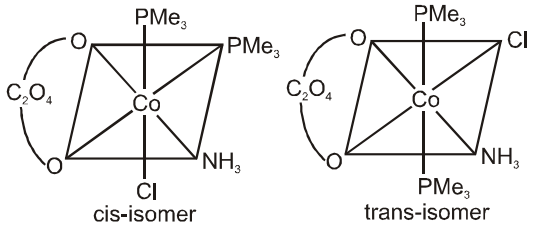
Quantum Yield =

Phosphorescence:

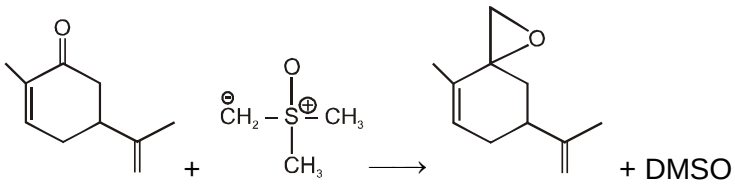
$$T_1 \longrightarrow S_0$$
(Triplet state) (Ground state)

All statements 1, 2 and 3 are correct.

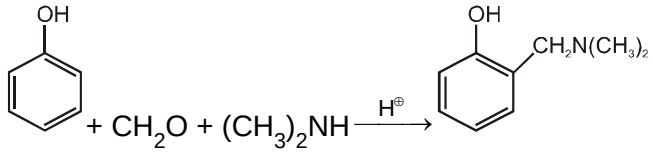
7. **2**



8.(A)



9.(A)

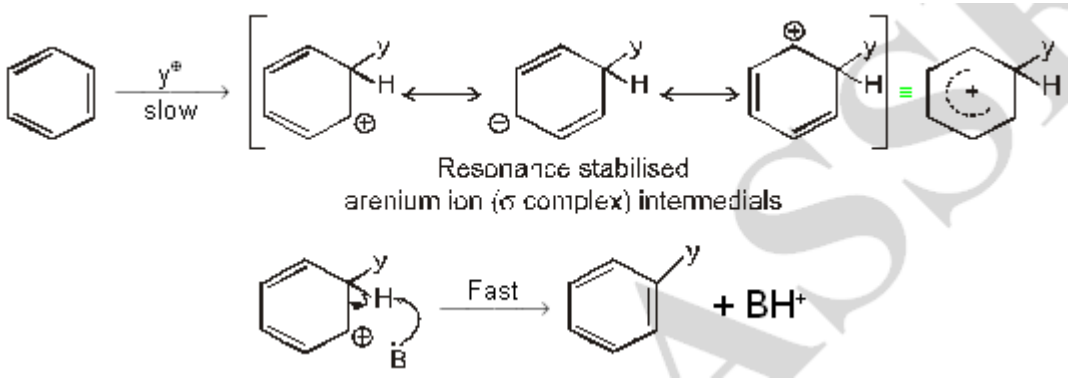


10. **1, 0**

$V(C_6H_6)_2$ — unpaired e^- = 1

$Cr(C_6H_6)_2$ — unpaired e^- = 0

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 σ complex) the leaving group departs in second step. So it is a bimolecular and involves arenium ion (σ complex) intermediate.



12.(A) (P) Supporting electrolyte (2) Residual current

(Q) $Zn(Hg)_{a=1}|ZnCl_2$ (aq) | $Zn(Hg)_{Q=2}$ (4) Electrode concentration cell

(R) Inversion temperature (6) Thomson expansion

(S) Entropy of vaporization (5) Trouton's rule

13.(A) $Hg_2Cl_2 + 2e^-$ $2Hg(l) + 2Cl^-$ (aq)

H_2 $2H^+ + 2e^-$

$\Delta G = -nFE = 2 \times 96500 \times 0.2684 = -51.8$ kJ mol^{-1}

$\Delta S = -nF\left(\frac{\partial E}{\partial T}\right)_T = 2 \times 96500 \times 3 \times 10^{-4} = -57.9$ JK^{-1} mol^{-1}

$\Delta H = -nF\left[E - T\left(\frac{\partial E}{\partial T}\right)_P\right] = -2 \times 96500[0.2684 - 298 \times 3 \times 10^{-4}] = -2 \times 96500 \times 0.179 =$ -34.5 kJ mol^{-1}

14. **99.75%**

Given $D = 999, V_o = 20$ ml, $V_m = 50$ ml

E = x is percentage of extraction

$D = \frac{\left(\frac{V_m}{V_o}\right)E}{100-E} = 999$

$$999 = \frac{\left(\frac{50}{20}\right)x}{100-x} = \frac{2.5x}{100-x}$$

$x = 99.75\%$

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 = $\frac{(49.42 - 49.06)}{49.06} = 0.73\%$

16.(A) 4.55

$Z_{effective} = Z - S$

S = Screening constant

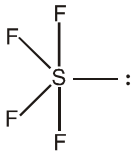
$_8O = \underset{(n-1)}{1s^2}\ \underbrace{2s^2 2p^4}_{n}$

$S = 0.85 \times 2 + 0.35 \times 5 = 1.70 + 1.75 = 3.45$

$Z^* = 8 - 3.45 = 4.55$

17.(B) The formula of the pyrosilicate ion is $Si_2O_7^{6-}$.

18.(C) SF_4 — sp^3d



(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_2Y_3.

20.(D) $2XeF_6 + 16OH^- \longrightarrow XeO_6^{4-} + Xe + 8H_2O + 12F^- + O_2$

The percent ion XeO_6^{4-} can be prepared by hydrolysis of XeF_6 in basic medium.

21.(B) Rotational partition function Fr = $\frac{8\pi^2 IkT}{2h^2}$

$Fr \propto I(\mu r^2)$ given length = const.

T = const.

$Fr \propto \mu$ $\quad \left[\begin{array}{l} \mu_{H_2} = \frac{m_1 m_2}{m_1 + m_2} = \frac{1\times 1}{1+1} = \frac{1}{2} \\ \mu_{HD} = \frac{1\times 2}{1+2} = \frac{2}{3} \end{array}\right.$

$$\frac{Fr_{H_2}}{Fr_{HD}} = \frac{\mu_{H_2}}{\mu_{HD}}$$

$$\frac{Fr_{H_2}}{Fr_{HD}} = \frac{1}{2}\times\frac{3}{2} = \frac{3}{4}$$

22.(D) The order of lability :

$Ni^{+2} > Mn^{+3} > Cr^{+3}$

$d^8 \quad d^4 \quad d^3$

So the order of rate of exchange of cyanide ligand $[Ni(CN)_4]^{2-} > [Mn(CN)_6]^{3-} > [Cr(CN)_6]^{3-}$.

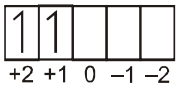
23.(D) Lattice energy depends on the product of the ionic charge

$$\mu \propto (z^+ z^-)$$

(z^+z^-)	(z^+z^-)
LiF	1
MgO	4
LiCl	1
NaCl	1

So MgO has the highest lattice energy.

24.(A) $V^{3+} = 3d^2$



L = 2 + 1 = 3 (F)

$S = \frac{n}{2} = \frac{2}{2} = 1$

Multiplicity = (2S + 1) = (2 × 1 + 1) = 3

A/C to Hund's Rule Smallest J is the most stable if the subshell is less than half filled.

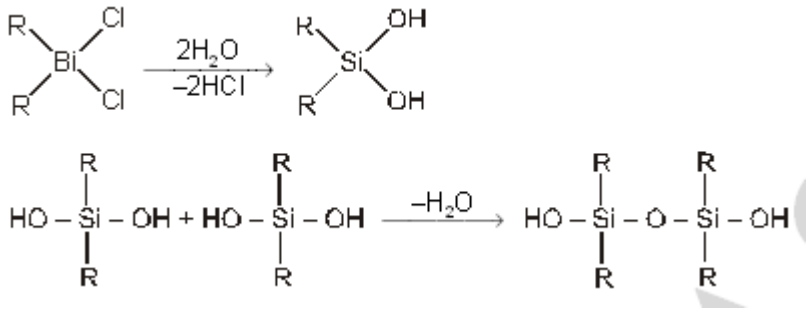
J (smallest value) = L – S = 3 – 1 = 2

So the ground state term symbol

$^{2S+1}L_J = {}^3F_2$

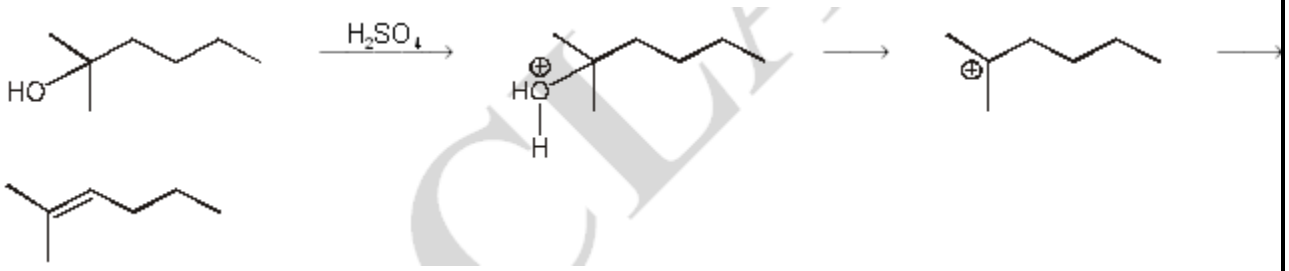
25.(B) $3BCl_3 + 3NH_4Cl \xrightarrow{\Delta} B_3N_3H_3Cl_3 \xrightarrow{NaBH_4} \underset{\text{(Borazine)}}{B_3N_3H_6}$

26.(B)

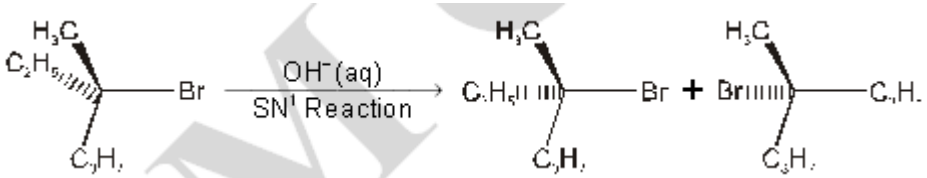


The starting material for the manufacture of silicones are dimethyl dichlorosilane.

27.(C)



28.(D)

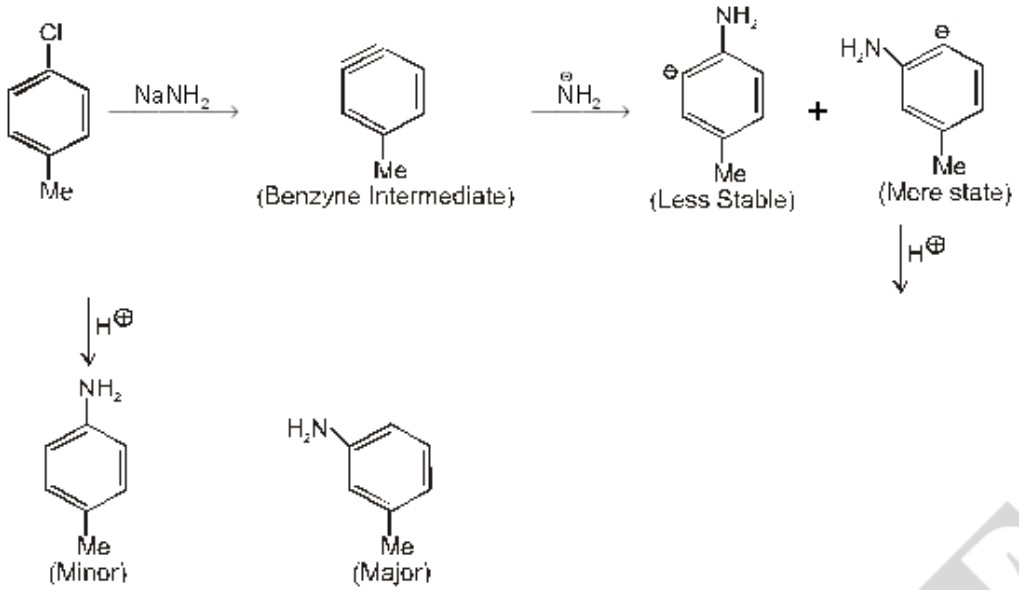


Rate of reaction $\propto$ [Reaction intermediate] so if the concentration of the reactant is doubled the rate of reaction will double.

29.(A) The order of reactivity of various halobenzenes is PhF > PhCl $\approx$ PhBr > PhI.

In fluorobenzene F and C have 2p orbitals which are of comparable size thus there is better overlap resulting in greater +R effect than that of Cl, Br or I.

30.(D)



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.

$$Br_2(g) + BF_2(g) \rightarrow 2BrF_3(g)$$

Initial mole	1	1	0
at equilibrium	(1 – x)	(1 – x)	2x

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

$$P_{Br_2} = \frac{(1-x)}{2} \times P \; ; P_{BrF_3} = \frac{2x}{2} \times P \qquad ; \; P_{BF_2} = \left(\frac{1-x}{2}\right) P$$

$$K_P = \frac{P^2_{BrF_3}}{(P_{Br_2})(P_{BF_2})} = \frac{4x^2P^2}{(1-x)(1-x)P^2} = \frac{4x^2}{(1-x)(1-x)}$$

32.(B) 0.66

At equilibrium

$x_A = 0.5; x_B = 0.5$

A/C to Raoult's law

$P = P_A + P_B = x_A P_A^{o} + x_B P_B^{o}$

$P_A = 0.5 \times 200 = 100$ 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) $2Cl\,(g) \rightarrow Cl_2\,(g)$

$\Delta n = 1 - 2 = -1$

ΔS = –ve, ΔH = –ve, ΔG = –ve

34.(D) $CdS\,(s) + H_2\,(g) \rightarrow H_2S\,(g) + Cd\,(s)$

$\Delta G = \Sigma G_{Products} - \Sigma G_{reactant} = [\Delta G^{o}_{fH_2S(g)} + \Delta G^{o}_{fCd(s)} - (\Delta G^{o}_{fCdS(s)} + \Delta G^{o}_{fH_2(g)})] = [-49 + 0 - (-127.2 + 0)]$

$= 78.2$ kJ/mol

The reaction is not feasible.

35. **0.03**

$I = \frac{1}{2}\,(m_+ z_+^{\,2} + m_- z_-^{\,2})$

Given K_2SO_4

$m_+ = 2 \times 0.01$ M

$m_- = 0.01$ M

$z_+ = +1$

$z_- = -2$

$I = \frac{1}{2}\ [2 \times 0.01 \times (1)^2 + 0.01 \times (2)^2] = \frac{1}{2}\ (0.02 + 0.04) = \frac{1}{2}\ (0.06) = 0.03$

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**

$$\frac{\left(t_{1/2}\right)_1}{\left(t_{1/2}\right)_2} = \left(\frac{a_2}{a_1}\right)^{n-1}$$

$$\ln\frac{\left(t_{1/2}\right)_1}{\left(t_{1/2}\right)_2} = n - 1\ln\left(\frac{a_2}{a_1}\right)$$

$$n = 1 + \frac{\ln\left(t_{1/2}\right)_1 / \ln\left(t_{1/2}\right)_2}{\ln\frac{a_2}{a_1}} = 1 + \frac{\ln 200}{\ln\frac{0.4}{0.1}} + 1 + \frac{\ln 4}{\ln 4} = 1 + 1 = 2$$

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

$$\lim_{T\to 0}\left[\frac{\partial(\Delta H)}{\partial T}\right]_P = 0$$

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

40.(D) $^{11}_{5}B \xrightarrow[\beta \text{ emission}]{-\beta} {}^{11}_{6}C$

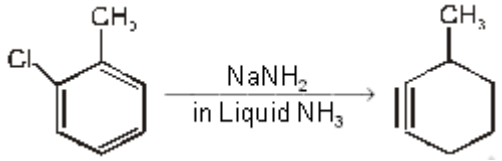
$\frac{n}{p} = \frac{6}{5}$ $\frac{n}{p} = \frac{5}{6}$

$\frac{n}{p}$ Ratio high $\frac{n}{p}$ Ratio low

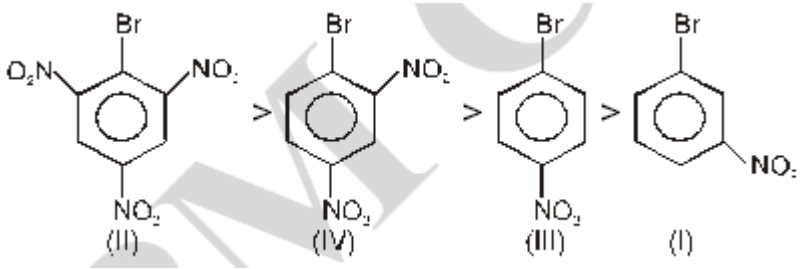
41.(D) Substitutions reactions do not take place at bridgehead carbons due to rigid cage like structure of substrate. So 1-chloroapocamphane does not react with Alcoholic $AgNO_3$.

42.(C) The last member of the Neptunium series is an isotope of bismuth $\left({}^{209}_{83}Bi\right)$ and not an isotope of Lead.

43.(B)



44.(B) The reactivity of substrate for $ArSN^2$ reaction α – R and –I power of the group present at o- and p-position. So the order is



45.(B) Hard acid = 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) $K_c = 6 \times 10^{-4}$ mol m^{-3}, T = 530 K, R = 8.314 JK^{-1} mol^{-1}

$K_p = K_c(RT)^{\Delta n}$

$A_{(g)}$ $B_{(g)} + C_{(g)}$

$\Delta n = 2 - 1 = 1$

$K_p = 6 \times 10^{-4} \times 8.314 \times 530 = 2.64$

47.(C) Half life time $t_{1/2}$ = 3 days

Time for decay T = 12 day

$T = n \times t_{1/2}$

$12 = n \times 3$

$n = 4$

Let the original amount be = N_0

Let the amount left after 4 half life periods = N

Fraction = N/N_0

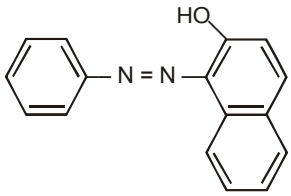
$N = \left(\frac{1}{2}\right)^n N_0$

$\frac{N}{N_0} = \left(\frac{1}{2}\right)^n$

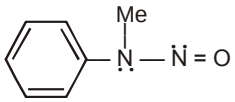
$\frac{2}{N_0} = \left(\frac{1}{2}\right)^4$

$N_0 = 32$ gm

^{24}Na is used to detect the presence of blood clots.

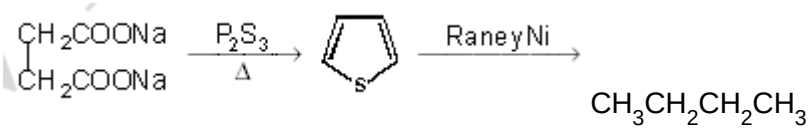


48.(A) X = Red-orange coloured dye

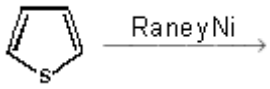


49.(B) Y = N-Nitrosoamine (oily layer)

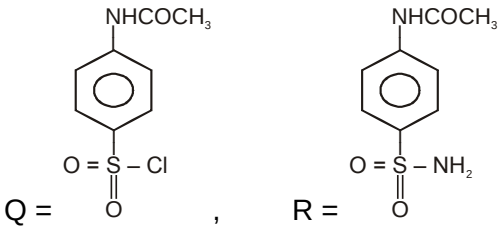
50.(A)



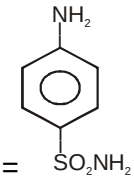
51.(B)



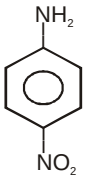
52.(B) P = CH_3COCl or $(CH_3CO)_2O$



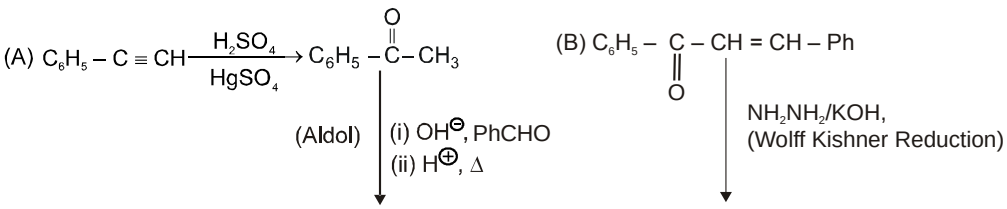
53.(A) S =



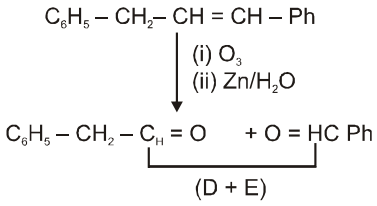
, T =



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

$\therefore$ Total principal = Rs. 1800 for 1 year

Interest = Rs. 90

$\therefore$ Rate of interest $= \frac{90 \times 100}{1800 \times 1} = 5\%$

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

So, $\frac{\text{A did}}{\text{A can}} + \frac{\text{B did}}{\text{B can}} = 1$

$\therefore$ $\frac{35}{60} + \frac{35}{x} = 1$

or $x = 84$ 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.

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 $(671)^2+1 =458330$