

Q

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- Which one of the following is the correct formula for the lowest-energy eigenfunction for a particle in a one-dimensional box having infinite barriers at $x = -L/2$ and $L/2$?
 (A) $\sqrt{\frac{2}{L}} \sin\left(\frac{\pi x}{L}\right)$
 (B) $\sqrt{\frac{2}{L}} \cos\left(\frac{\pi x}{L}\right)$
 (C) $\sqrt{\frac{2}{L}} \exp\left(\frac{i\pi x}{L}\right)$
 (D) $\sqrt{\frac{2}{L}} \exp\left(\frac{-i\pi x}{L}\right)$
- For a single particle-in-a-ring system having energy $9h^2/8\pi^2I$ we can say that the angular momentum, when measured, will equal:
 (A) $3h/2\pi$
 (B) $\sqrt{12}h/2\pi$
 (C) either $3h/2\pi$ or $-3h/2\pi$
 (D) zero
- A molecule in a gas undergoes about 1.0×10^9 collisions in each second. Suppose that one collision in 10 is effective in deactivating the molecule rotationally. The width (in hertz) of rotational transitions in the molecule will be:
 (A) 1.59 MHz
 (B) 15.9 MHz
 (C) 159 MHz
 (D) None of the above
- The rotational structure in the Raman spectrum of carbon dioxide (CO_2), is offset from the wavenumber of the incident radiation by 2.3622 cm^{-1} , 5.5118 cm^{-1} , 8.6614 cm^{-1} , The rotational constant of carbon dioxide is:
 (A) 0.3937 cm^{-1}
 (B) 0.5906 cm^{-1}
 (C) 1.1811 cm^{-1}
 (D) 2.3622 cm^{-1}
- In a given cell, solution I transmits 42.0 per cent and solution II 85.0 per cent of radiation having a certain wavelength. What is the transmittance at the same wavelength of a solution made by mixing 35.0 cm^3 of solution I and 55.0 cm^3 of solution II, if no reaction occurs?
 (A) 64.6 %
 (B) 68.3 %
 (C) 35.7 %
 (D) 44.7 %

$D = \frac{D_1 V_1 + D_2 V_2}{V_1 + V_2}$
- $\Delta H_{\text{vap}} = 30 \text{ kJ mol}^{-1}$ and $\Delta S_{\text{vap}} = 75 \text{ J mol}^{-1} \text{ K}^{-1}$. Find temperature of vapour, at one atmosphere:
 (A) 250 K
 (B) 298 K
 (C) 350 K
 (D) 400 K

$\Delta G = \Delta H - T \Delta S = 0$
- 0.1 mole of CH_3NH_2 ($K_b = 5 \times 10^{-4} \text{ M}$) is mixed with 0.08 mole of HCl and diluted to one litre. What will be the H^+ concentration in the solution?
 (A) $8 \times 10^{-2} \text{ M}$
 (B) $8 \times 10^{-11} \text{ M}$
 (C) $1.6 \times 10^{-11} \text{ M}$
 (D) $8 \times 10^{-5} \text{ M}$

$(\text{pH}) = 11.1$
- The pH of a salt of weak acid with weak base is given by the expression if K_w , K_a and K_b are the dissociation constants of water, weak acid and weak base respectively:
 (A) $\text{pH} = \frac{1}{2} (\text{p}K_w + \text{p}K_a + \text{p}K_b)$
 (B) $\text{pH} = \frac{1}{2} (\text{p}K_w - \text{p}K_a - \text{p}K_b)$
 (C) $\text{pH} = \frac{1}{2} (\text{p}K_w + \text{p}K_a - \text{p}K_b)$
 (D) $\text{pH} = \frac{1}{2} (\text{p}K_a + \text{p}K_b - \text{p}K_w)$

$\text{pH} = \frac{1}{2} \left(\frac{\text{p}K_w}{14} + \frac{\text{p}K_a}{14} - \frac{\text{p}K_b}{14} \right)$
- Nicotinic acid ($K_a = 1.4 \times 10^{-5} \text{ M}$) is represented by HNic . The % dissociation in a solution will be if it contained 0.1 mole of nicotinic acid per litre of solution:
 (A) 1.673
 (B) 4
 (C) 6.673
 (D) 10

$\frac{1.4 \times 10^{-5}}{0.1} = 1.4 \times 10^{-4}$
 $\alpha = \frac{1.4 \times 10^{-4}}{1.4 \times 10^{-4}} = 1$
 $\alpha = 100\%$

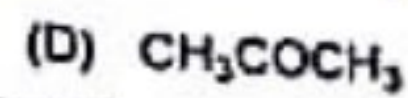
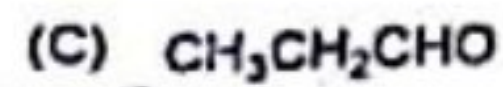
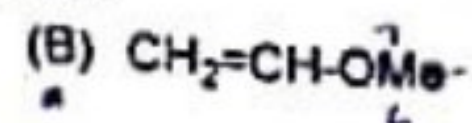
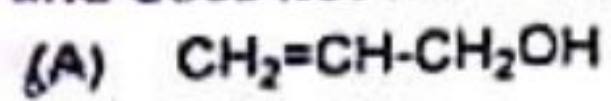
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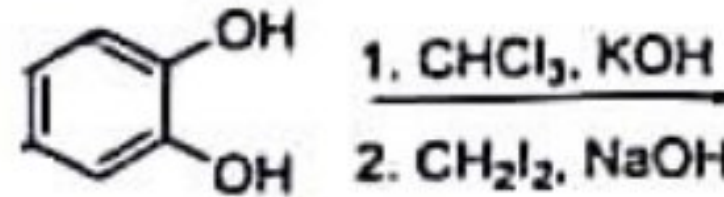
$1.4 \times 10^{-5} \times 0.1$
 $\frac{1.4 \times 10^{-5}}{1.4 \times 10^{-4}}$
 1.4×10^{-4}

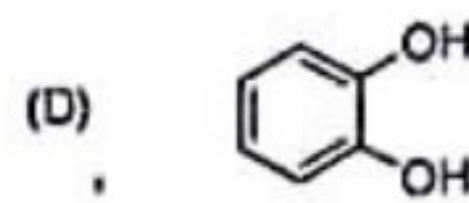
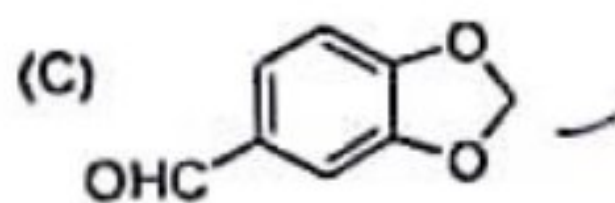
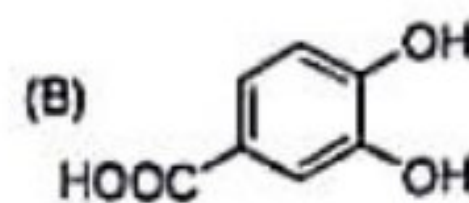
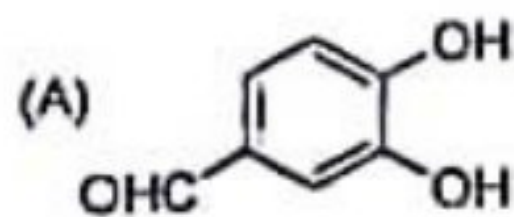
11.8×10^{-4}
 $\frac{11.8 \times 10^{-4}}{1.4 \times 10^{-4}}$
 8.43
 $\alpha = 8.43$
 $\alpha = 843\%$

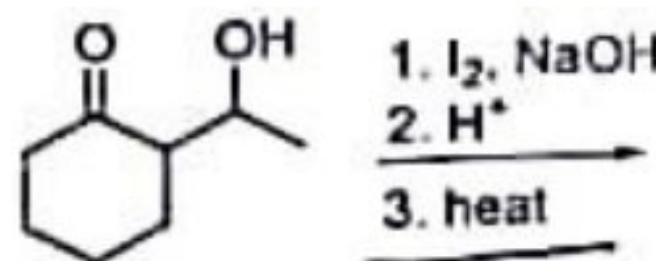
10. Molar heat capacity of water in equilibrium with ice at constant pressure is
 (A) 0
 (C) $40.45 \text{ kJ K}^{-1} \text{ mol}^{-1}$
 (B) ∞
 (D) $75.48 \text{ kJ K}^{-1} \text{ mol}^{-1}$
11. Spontaneous adsorption of a gas on solid surface is an exothermic process because
 (A) ΔH increases for system
 (C) ΔS decreases for gas
 (B) ΔS increases for gas
 (D) ΔG increases for gas
12. The solubility of the sparingly soluble salt (L_xM_y) is 'S'. The solubility product (K_{sp}) of this salt is:
 (A) S^{xy}
 (C) $x^x y^y S^{xy}$
 (B) S^{x+y}
 (D) $x^x y^y S^{x+y}$
13. An azeotropic mixture is a:
 (A) constant vapour pressure mixture
 (C) constant temperature mixture
 (B) constant volume mixture
 (D) constant boiling mixture
14. Tyndall effect exhibited by colloidal particles is characteristic of:
 (A) Kinetic property
 (C) Magnetic property
 (B) Optical property
 (D) Electrical property
15. When equal volumes of following solutions are mixed, precipitation of AgCl ($K_{sp} = 1.8 \times 10^{-10} \text{ M}^2$) will occur only with:
 (A) $10^{-4} \text{ M } [\text{Ag}^+]$, $10^{-4} \text{ M } [\text{Cl}^-]$
 (C) $10^{-6} \text{ M } [\text{Ag}^+]$, $10^{-6} \text{ M } [\text{Cl}^-]$
 (B) $10^{-5} \text{ M } [\text{Ag}^+]$, $10^{-5} \text{ M } [\text{Cl}^-]$
 (D) $10^{-10} \text{ M } [\text{Ag}^+]$, $10^{-10} \text{ M } [\text{Cl}^-]$
16. The enthalpy and entropy change for a chemical reaction are $-2.5 \times 10^3 \text{ cal}$ and 7.4 cal deg^{-1} respectively. Predict the nature of the reaction at 298K.
 (A) Reversible
 (C) Spontaneous
 (B) Irreversible
 (D) Non-spontaneous
17. Which one of the following solution will have the highest boiling point?
 (A) 1% NaCl in water
 (C) 1% glucose in water
 (B) 1% CaCl_2 in water
 (D) 1% sucrose in water
18. Which of the following reaction is called as 'Clemmensen reduction'?
 (A) Reduction of acyl halide with $\text{H}_2/\text{Pd}/\text{BaSO}_4$
 (B) Reduction of ester with $\text{Na}/\text{C}_2\text{H}_5\text{OH}$
 (C) Reduction of anhydride with LiAlH_4
 (D) Reduction of carbonyl compounds with $\text{Na}/\text{Hg}/\text{HCl}$

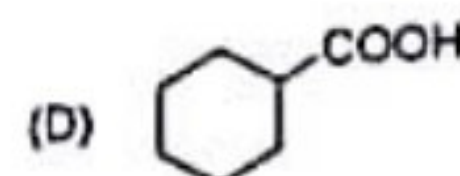
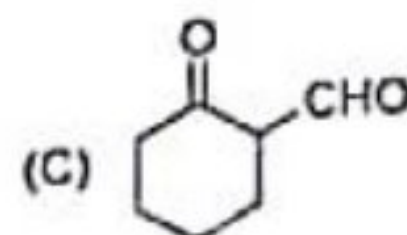
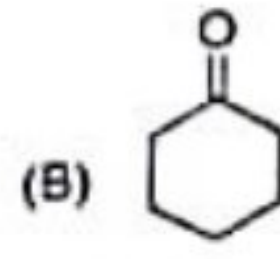
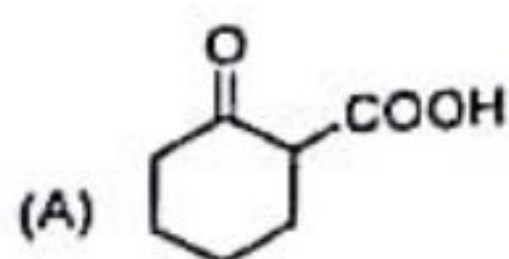
19. An organic compound C_3H_6O does not give a precipitate with 2,4-dinitrophenyl hydrazine reagent and does not react with sodium metal. It could be:



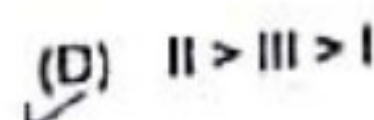
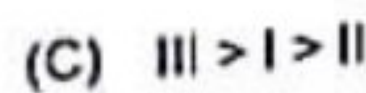
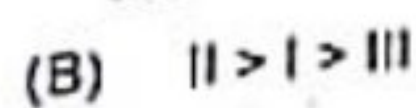
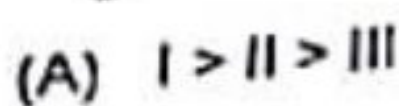
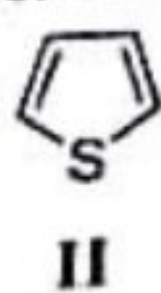
20.  P. Here 'P' is



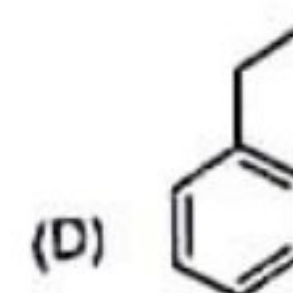
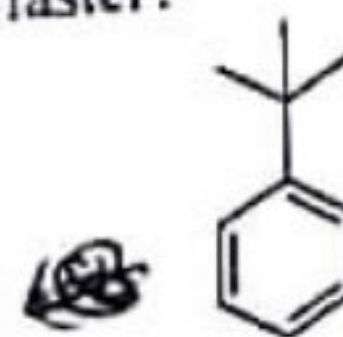
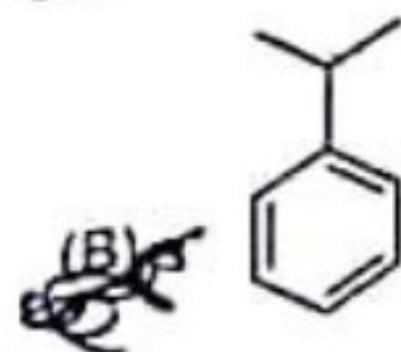
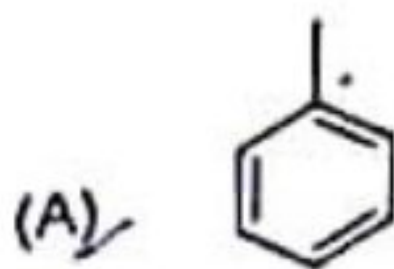
21.  P. Here 'P' is



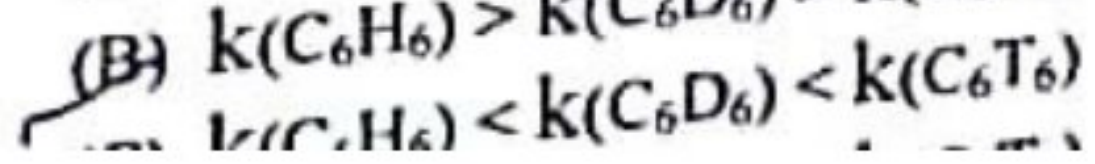
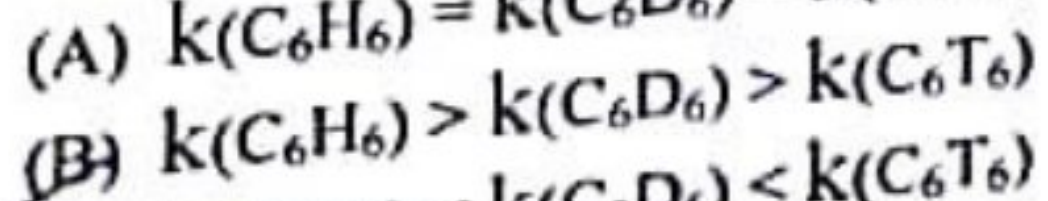
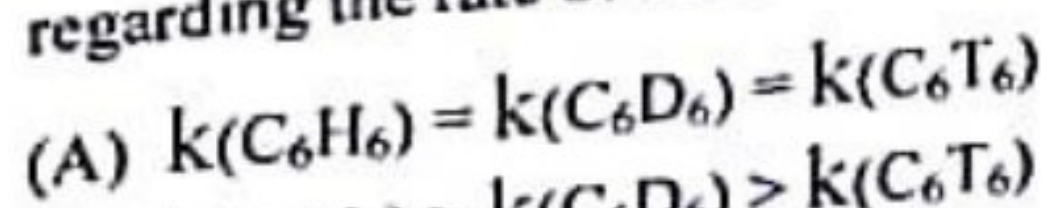
22. Correct order of aromatic character for the given compounds is:



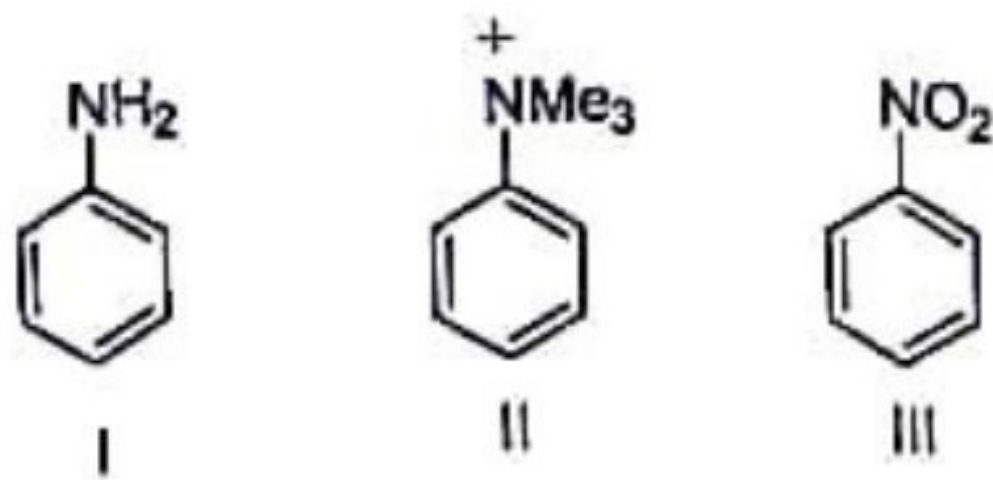
23. Which of the following will undergo nitration faster?



24. For the electrophilic substitution reaction involving sulfonation, which of the following sequence regarding the rate of reaction is true?



25. Which of the following will give Friedel-Crafts reaction?



- (A) Only I (B) I and III (C) all of these (D) none of these

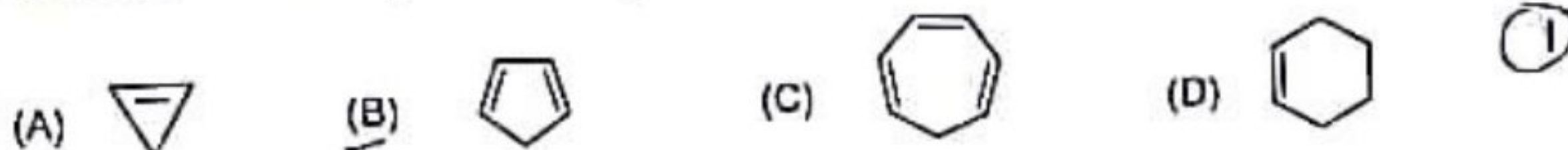
26. The most basic compound among the following is:

- (A) Benzylamine (B) Aniline (C) *p*-Nitroaniline (D) Acetanilide

27. Nitrobenzene can be prepared from benzene by using a mixture of conc. HNO_3 and conc. H_2SO_4 . In the nitrating mixture HNO_3 acts as.

- (A) Acid (B) Base (C) Catalyst (D) Reducing agent

28. The most acidic compound among the following is:



29. The type of isomerism observed in urea molecule is:

- (A) Chain (B) Position (C) Geometrical (D) Functional

30. Number of possible 3D-isomers of glucose are:

- (A) 4 (B) 10 (C) 16 (D) 32

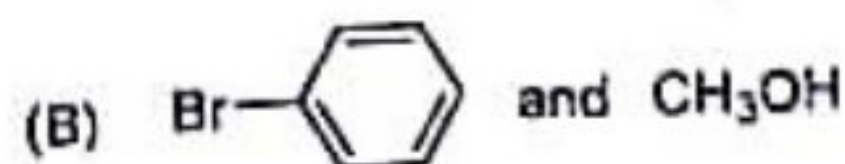
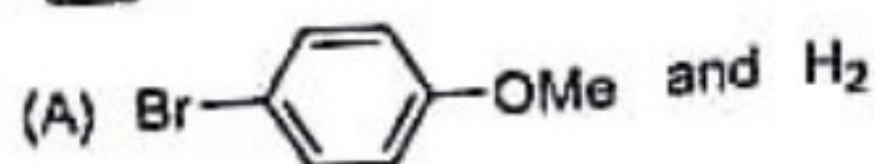
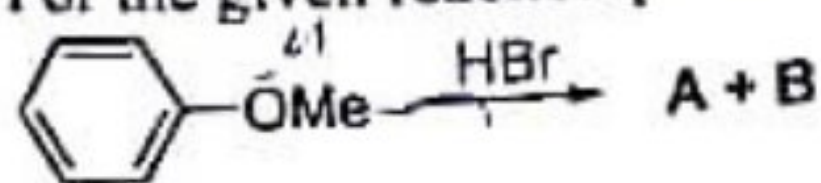
31. Which of the following compounds is optically active?

- (A) 1-Bromobutane (B) 1-Bromo-2-methylpropane (C) 2-Bromobutane (D) 2-Bromo-2-methylpropane

32. When cyclohexane is poured in water, it floats, because:

- (A) Cyclohexane is in 'boat' form (B) Cyclohexane is less dense than water (C) Cyclohexane is in 'chair' form (D) Cyclohexane is in 'crown' form

33. For the given reaction products A and B are, respectively:



34. Mutarotation involves:

- (A) Racemisation (C) Diastereomerisation

- (B) Conformational inversion (D) Optical resolution

35. How many isomers are there of octahedral $[\text{CrCl}_2(\text{OH}_2)_4]^+$ and octahedral $[\text{CoCl}_2(\text{en})_2]^+$?
 (A) 2 for $[\text{CrCl}_2(\text{OH}_2)_4]^+$; 2 for $[\text{CoCl}_2(\text{en})_2]^+$
 (B) 2 for $[\text{CrCl}_2(\text{OH}_2)_4]^+$; 3 for $[\text{CoCl}_2(\text{en})_2]^+$
 (C) 3 for $[\text{CrCl}_2(\text{OH}_2)_4]^+$; 3 for $[\text{CoCl}_2(\text{en})_2]^+$
 (D) 3 for $[\text{CrCl}_2(\text{OH}_2)_4]^+$; 2 for $[\text{CoCl}_2(\text{en})_2]^+$ ①
36. For which pair of complexes is the order of values of Δ_{oct} correct?
 (A) $[\text{Fe}(\text{CN})_6]^{4-} > [\text{Fe}(\text{CN})_6]^{3-}$
 (B) $[\text{Rh}(\text{NH}_3)_6]^{3+} > [\text{Co}(\text{NH}_3)_6]^{3+}$ ①
 (C) $[\text{Cr}(\text{OH}_2)_6]^{2+} > [\text{Cr}(\text{OH}_2)_6]^{3+}$
 (D) $[\text{CrF}_6]^{3-} > [\text{Cr}(\text{CN})_6]^{3-}$
37. Which one of the following is expected to exhibit a Jahn-Teller distortion?
 (A) $[\text{Mn}(\text{OH}_2)_6]^{3+}$
 (B) $[\text{Mn}(\text{CN})_6]^{3-}$ ①
 (C) $[\text{Fe}(\text{CN})_6]^{2-}$
 (D) $[\text{Cr}(\text{OH}_2)_6]^{3+}$
38. The Y^{3+} ion is:
 (A) hard, and favours ligands with N- and/or O-donor atoms
 (B) hard, and favours ligands with S- and/or P-donor atoms
 (C) soft, and favours ligands with S- and/or P-donor atoms
 (D) soft, and favours ligands with N- and/or O-donor atoms ①
39. The reactions of $[\text{PtCl}_4]^{2-}$ with NH_3 (reaction I) and of $[\text{PtCl}_4]^{2-}$ with $[\text{NO}_2]^-$ followed by NH_3 (reaction II) are ways of preparing:
 (A) I: $\text{trans-}[\text{PtCl}_2(\text{NH}_3)_2]$; II: $\text{trans-}[\text{PtCl}_2(\text{NH}_3)(\text{NO}_2)]^-$ ①
 (B) I: $\text{cis-}[\text{PtCl}_2(\text{NH}_3)_2]$; II: $\text{trans-}[\text{PtCl}_2(\text{NH}_3)(\text{NO}_2)]^-$
 (C) I: $\text{cis-}[\text{PtCl}_2(\text{NH}_3)_2]$; II: $\text{cis-}[\text{PtCl}_2(\text{NH}_3)(\text{NO}_2)]^-$
 (D) I: $\text{trans-}[\text{PtCl}_2(\text{NH}_3)_2]$; II: $\text{cis-}[\text{PtCl}_2(\text{NH}_3)(\text{NO}_2)]^-$
40. The ground state term symbol for Eu^{3+} is:
 (A) ${}^7\text{F}^0$
 (B) ${}^7\text{F}^6$ ①
 (C) ${}^3\text{F}^0$
 (D) ${}^3\text{F}^6$
41. Lanthanoid hydrides of formula LnH_2 :
 (A) contain the lanthanoid metal in oxidation state +2
 (B) are electrically conducting materials
 (C) possess 3-dimensional covalent structures
 (D) are mixed valence Ln(I)/Ln(III) compounds ②
42. Which of the following series contains only paramagnetic metal ions?
 (A) $\text{La}^{3+}, \text{Ce}^{3+}, \text{Sm}^{3+}$ ①
 (B) $\text{Sm}^{3+}, \text{Ho}^{3+}, \text{Lu}^{3+}$
 (C) $\text{Ce}^{3+}, \text{Eu}^{3+}, \text{Yb}^{3+}$
 (D) $\text{La}^{3+}, \text{Gd}^{3+}, \text{Eu}^{3+}$

43. Within the HSAB principle, a hard acid: (A) has a low charge density (B) shows a preference for soft bases (C) is not very polarizable (D) shows a preference for donor atoms of low electronegativity
44. For the substitution of one H_2O ligand in $[\text{Al}(\text{OH}_2)_6]^{3+}$ by F^- , $\log K_1 = 6.10$ at 298 K. The value of ΔG_0 for this process is: (A) $-34.8 \text{ kJ mol}^{-1}$ (B) $-15.1 \text{ kJ mol}^{-1}$ (C) $+34.8 \text{ kJ mol}^{-1}$ (D) $+15.1 \text{ kJ mol}^{-1}$
45. Which of the following equilibria has the largest value of binding constant (K)? (Hb = haemoglobin) (A) $\text{Hb} + \text{O}_2 = \text{Hb}(\text{O}_2)$ (B) $\text{Hb}(\text{O}_2) + \text{O}_2 = \text{Hb}(\text{O}_2)_2$ (C) $\text{Hb}(\text{O}_2)_2 + \text{O}_2 = \text{Hb}(\text{O}_2)_3$ (D) $\text{Hb}(\text{O}_2)_3 + \text{O}_2 = \text{Hb}(\text{O}_2)_4$
46. Which of the following is tri-functional Siloxane? (A) Dimethyl silicon chloride (B) Trimethyl silicon chloride (C) Tetramethyl silicon chloride (D) Monomethyl silicon chloride
47. Which of the following statements about fluorosulfonic acid, HSO_3F , is incorrect? (A) HSO_3F has a high dielectric constant (B) A mixture of HSO_3F and SbF_5 behaves as a superacid (C) HSO_3F is less viscous than H_2SO_4 (D) HSO_3F cannot be handled in glass apparatus
48. $[\text{Cr}(\text{CN})_6]^{3-}$ is expected to be: (A) paramagnetic with $\mu_{\text{eff}} \approx 3.87 \mu\text{B}$ (B) diamagnetic (C) paramagnetic with $\mu_{\text{eff}} < 3.87 \mu\text{B}$ (D) paramagnetic with $\mu_{\text{eff}} > 3.87 \mu\text{B}$
49. Which of the protein activates Ca^{2+} pump? (A) Troponin C (B) Calmodulin (C) Actin (D) Tropomyosin
50. For high spin and low spin d^6 octahedral complex ML_6 , the generally observed spin allowed transitions are (A) two and one (B) zero and one (C) one and two (D) two and two

$$m = 9 \quad 2\alpha$$

$$i = 1 - \alpha + \frac{\alpha}{n} \quad \therefore 1 - \alpha = \frac{1}{2}$$

$$1 - \alpha = \frac{1}{2} \quad \therefore \alpha = \frac{1}{2}$$

51. Acetic acid in benzene solution forms dimer due to intermolecular H-bonding. For this case Van't Hoff factor is:
 (A) $i = 1$
 (B) $i > 1$
 (C) $i < 1$
 (D) inclusive

52. 90% of a first-order reaction completes in 90 minutes. 50% of the reaction will be over in approximately:
 (A) 50 minutes
 (B) 54 minutes
 (C) 27 minutes
 (D) 62 minutes

$$90 = \frac{0.434}{K} \log \frac{1}{1-0.9}$$

$$K = \frac{0.434}{90} \log \frac{1}{0.1}$$

$$K = \frac{0.434}{90} \times 1$$

$$K = \frac{0.434}{90}$$

53. Time for completion of 75% of a reaction is thrice the time for completion of 50% of the same reaction. Hence, the order of the reaction is:
 (A) 0
 (B) 1
 (C) 2
 (D) 3

$$t_{75} = 3 t_{50}$$

$$\frac{0.693}{K} = 3 \times \frac{0.693}{K}$$

$$1 = 3$$

54. A cell reaction is spontaneous if:
 (A) $E_{\text{cell}} > 0$
 (B) $\Delta G < 0$
 (C) $K > 1$
 (D) all of these

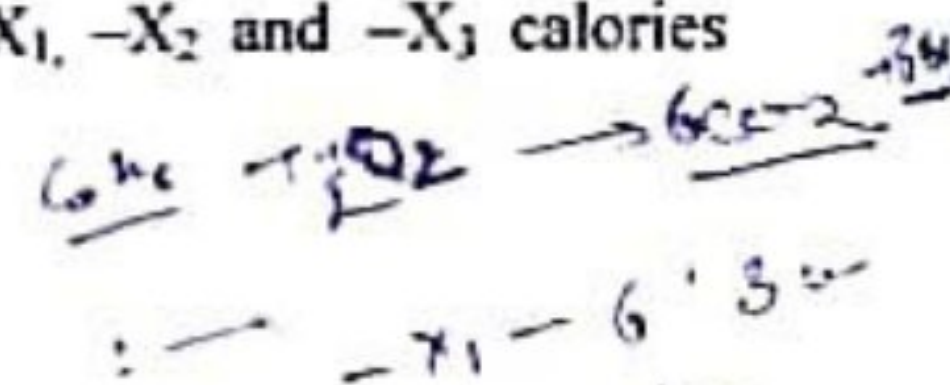
$$\Delta G < 0$$

$$K > 1$$

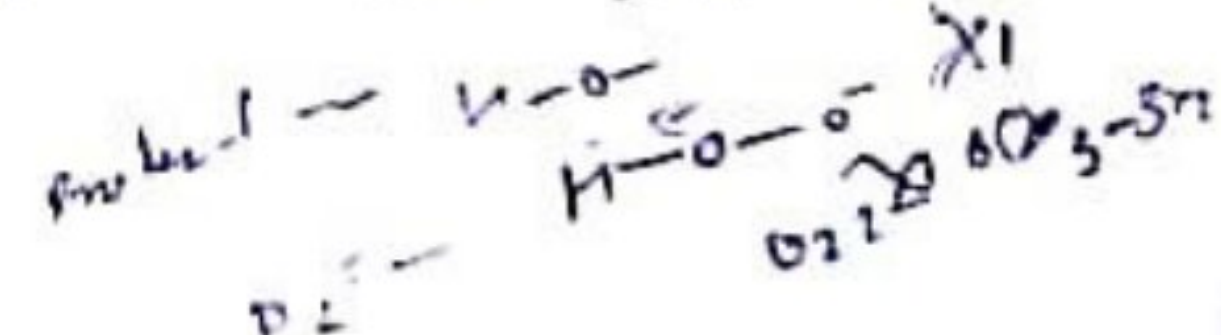
55. Under which of the following conditions, H_2 has the highest entropy per mole?
 (A) H_2 at 25 °C at 1 atm
 (B) H_2 at STP
 (C) H_2 at 100 K at 1 atm
 (D) H_2 at 0 K at 1 atm

$$S \propto \ln T$$

56. If the heat of formation of $C_6H_6(l)$, $H_2O(l)$ and $CO_2(g)$ are $-X_1$, $-X_2$ and $-X_3$ calories respectively, then heat of combustion of $C_6H_6(l)$ is.
 (A) $X_1 - X_2 - X_3$
 (B) $X_1 - 6X_2 - 3X_3$
 (C) $X_1 + X_2 + X_3$
 (D) $X_1 - 3X_2 - 6X_3$



57. Conjugate base of HO_2^- is:
 (A) O_2^- (superoxide ion)
 (B) H_2O_2
 (C) O_2^{2-} (peroxide ion)
 (D) O_2^+



58. 'x' moles of lead acetate and 0.1 mole of acetic acid were taken in 1 litre solution to make a solution of pH = 5.04. The value of 'x' will be..... if pK_a of CH_3COOH is 4.74:
 (A) 0.2 mole
 (B) 0.05 mole
 (C) 0.1 mole
 (D) 0.02 mole

$$pH = pK_a + \log \frac{[A^-]}{[HA]}$$

$$5.04 = 4.74 + \log \frac{x}{0.1}$$

$$0.3 = \log \frac{x}{0.1}$$

$$\frac{x}{0.1} = 10^{0.3}$$

$$x = 0.1 \times 10^{0.3}$$

$$x = 0.1 \times 2$$

$$x = 0.2$$

59. A solution containing 1 mole per litre each of $Cu(NO_3)_2$, $AgNO_3$, $Hg(NO_3)_2$ and $Mg(NO_3)_2$ is being electrolyzed by using inert electrodes. The values of the standard oxidation potentials in volts are $Ag/Ag^+ = -0.8$; $Hg/Hg^{2+} = -0.79$; $Cu/Cu^{2+} = -0.34$; $Mg/Mg^{2+} = 2.37$. The order in which metals will be formed at the cathode will be:
 (A) Ag, Cu, Hg, Mg
 (B) Ag, Hg, Cu, Mg
 (C) Ag, Hg, Cu
 (D) Cu, Hg, Ag

$$E^\circ_{Ag/Ag^+} = -0.8$$

$$E^\circ_{Hg/Hg^{2+}} = -0.79$$

$$E^\circ_{Cu/Cu^{2+}} = -0.34$$

$$E^\circ_{Mg/Mg^{2+}} = 2.37$$

60. E°_{red} (standard reduction electrode potentials) of different half-cells are given:

$$E^{\circ}_{Cu^{2+}/Cu} = 0.34 \text{ V}; E^{\circ}_{Zn^{2+}/Zn} = -0.76 \text{ V}$$

$$E^{\circ}_{Ag^{+}/Ag} = 0.80 \text{ V}; E^{\circ}_{Mg^{2+}/Mg} = -2.37 \text{ V}$$

In which cell is ΔG° is most negative?

- (A) $Zn | Zn^{2+} (1M) || Mg^{2+} (1M) | Mg$
 (B) $Zn | Zn^{2+} (1M) || Ag^{+} (1M) | Ag$
 (C) $Cu | Cu^{2+} (1M) || Ag^{+} (1M) | Ag$
 (D) $Ag | Ag^{+} (1M) || Mg^{2+} (1M) | Mg$

61. A catalyst accelerates the rate of reaction by:

- (A) decreasing energy of activation
 (B) increasing Arrhenius constant
 (C) increasing both energy of activation and Arrhenius constant
 (D) decreasing both energy of activation and Arrhenius constant

62. Which of the following can act as a protective colloid?

- (A) silica gel
 (B) gelatin
 (C) oil-in-water emulsion
 (D) all of these

63. The class of voids that can exist in any close-packed structures are:

- (A) trigonal, tetrahedral
 (B) trigonal, octahedral
 (C) tetrahedral, octahedral
 (D) only octahedral

64. An electron trapped in an anion vacancy within the crystal is called:

- (A) n-type conductor
 (B) p-type conductor
 (C) insulator
 (D) F-centre

65. The ratio between the root mean square speeds of H_2 at 50 K and O_2 at 800 K, is:

- (A) $\frac{1}{4}$
 (B) 1
 (C) 2
 (D) 4

66. The r.m.s. velocity of hydrogen is $\sqrt{7}$ times the r.m.s. velocity of nitrogen. If T is the temperature of the gas then.

- (A) $T(H_2) = T(N_2)$
 (B) $T(H_2) > T(N_2)$
 (C) $T(H_2) < T(N_2)$
 (D) $T(H_2) = \sqrt{7} T(N_2)$

67. Which of the following is a natural fibre?

- (A) Starch
 (B) Rubber
 (C) Cellulose
 (D) Optical resolution

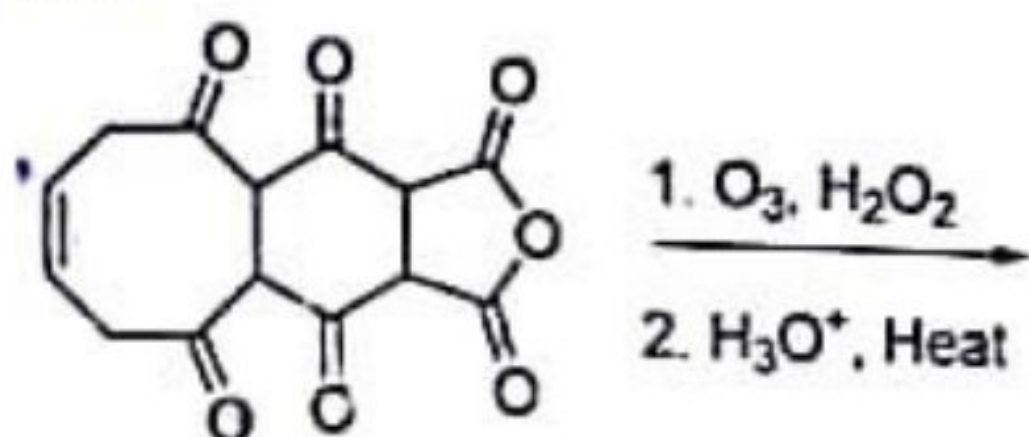
68. The reason for normalizing a wavefunction ψ is:

- (A) to guarantee that ψ is square-integrable.
 (B) to make $\psi^* \psi$ equal to the probability distribution function for the particle.
 (C) to make ψ an eigenfunction for the Hamiltonian operator.
 (D) to make ψ satisfy the boundary conditions for the problem.

69. Which of the following is not a condensation polymer?

- (A) Glyptal
 (B) Nylon-66
 (C) Dacron
 (D) PTFE

70. Total number of carbonyl groups present in the final product of the following reaction sequence are:



(A) 6

(B) 8

(C) 2

(D) 4

71. Which of the following will give aldol?

(A) Formaldehyde

(C) Crotonaldehyde

(B) Pivaldehyde

(D) Benzaldehyde

72. The IUPAC name of $\text{C}_6\text{H}_5\text{COCl}$ is:

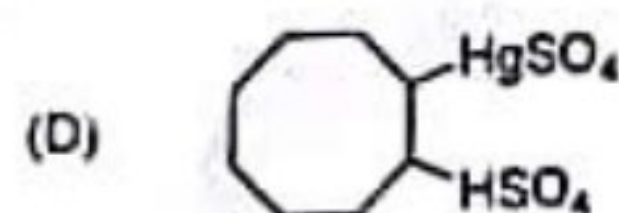
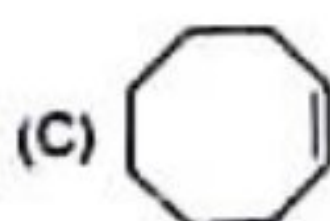
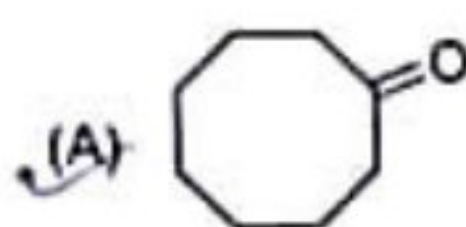
(A) Benzoyl chloride

(C) Benzene chloro ketone

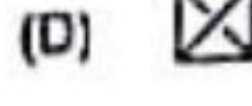
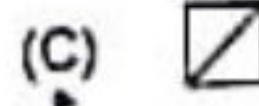
(B) Benzene carbonyl chloride

(D) Chloro phenyl ketone

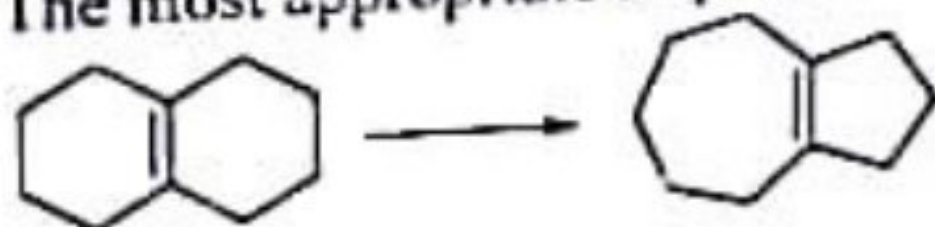
73. The reaction of cyclooctyne with HgSO_4 in presence of aq. H_2SO_4 gives:



74. When 1-Bromo-3-chlorocyclobutane is treated with two equivalents of Na, in the presence of ether, it will produce.



75. The most appropriate sequence of reactions for carrying out the following conversion



- (A) (i) Peracid; (ii) H^+ ; (iii) $\text{Zn} / \text{dil. HCl}$
(B) (i) Alkaline KMnO_4 ; (ii) H^+ ; (iii) $\text{Zn} / \text{dil. HCl}$
(C) (i) Alkaline KMnO_4 ; (ii) NaIO_4 ; (iii) $\text{N}_2\text{H}_4 / \text{KOH}$
(D) (i) $\text{O}_3 / \text{Me}_2\text{S}$; (ii) NaOEt ; (iii) $\text{N}_2\text{H}_4 / \text{KOH}$

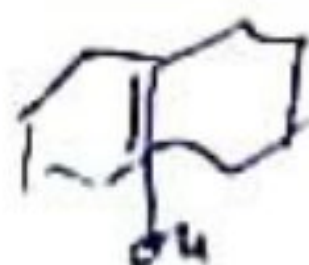
76. Which of the following is an example of basic dye?

(A) Alizarine

(B) Indigo

(C) Malachite

(D) Orange-I

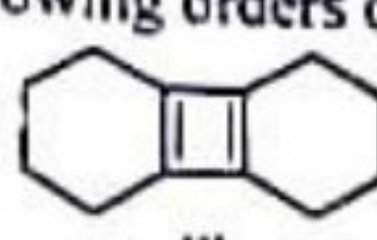
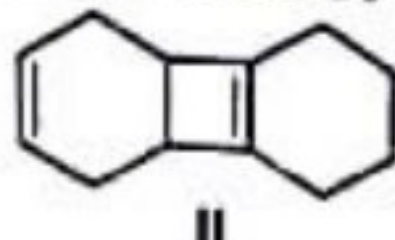
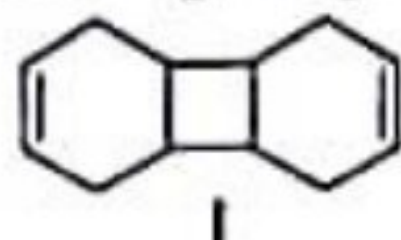


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77. The pH of the solution containing following zwitterion $\text{H}_3\text{N}^+\text{CH}(\text{R})\text{COO}^-$ species is:
- (A) 7 (B) 9 (C) 4 (D) 0

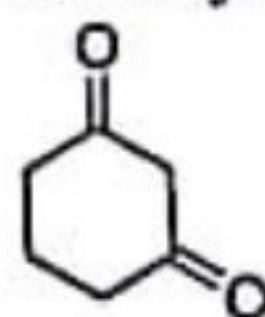
78. One letter code for 'Lysine' amino acid is:
- (A) L (B) K (C) R (D) Y

79. Among the given dienes, which of the following orders of stability is correct?



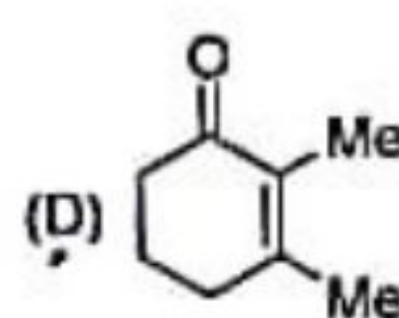
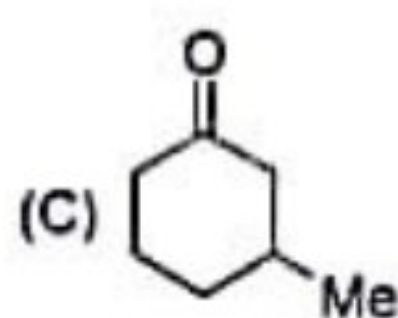
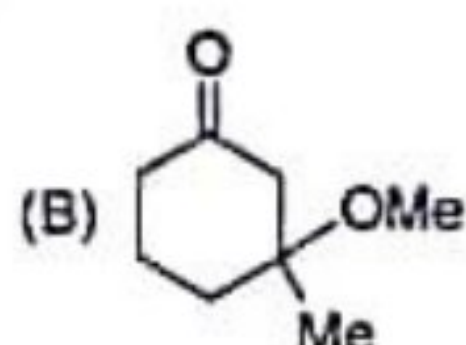
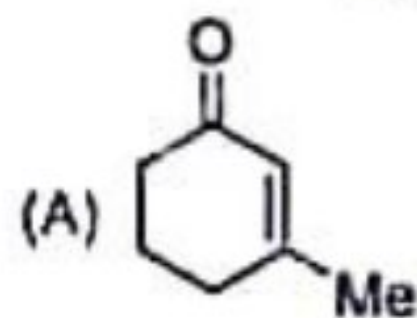
- (A) I > II > III (B) II > I > III (C) III > I > II (D) II > III > I

80. The major product 'A' formed in the following reaction sequence is:



1. CH_2N_2 , Et_2O
2. MeMgCl , Et_2O
3. H_3O^+

A



81. During the addition polymerisation, the reaction proceeds via:
- (A) Step-growth process (B) Free-radical chain reaction
(C) Cascade process (D) Addition reaction

82. In DNA the percentage of guanine is 23, what will be the percentage of thymine?
- (A) 27 (B) 23 (C) 46 (D) 77

83. For the following reaction sequence what will be the overall percentage of D?
- $\text{A} \xrightarrow{90\%} \text{B} \xrightarrow{50\%} \text{C} \xrightarrow{90\%} \text{D}$
- (A) 90% (B) 59.5% (C) 40.5% (D) 50%

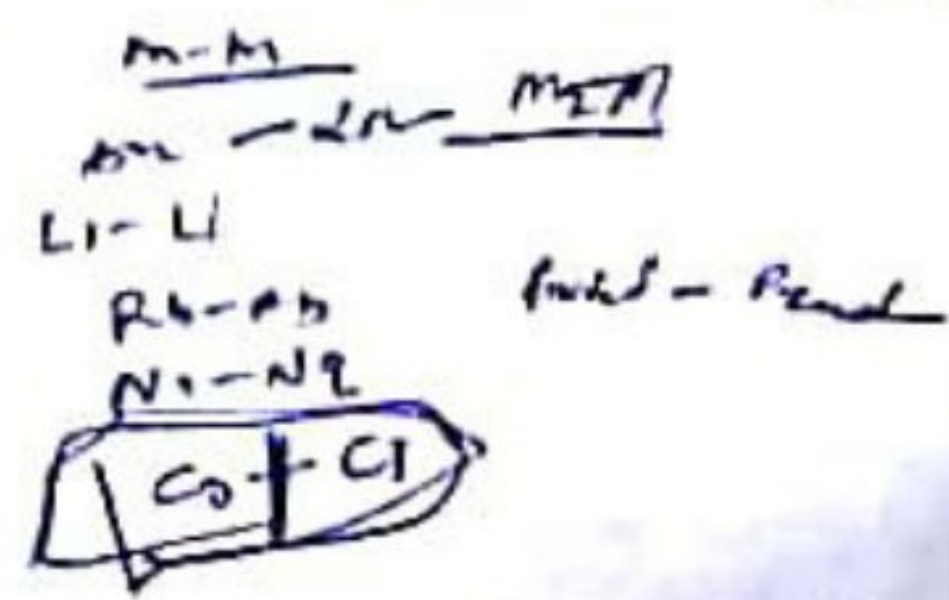
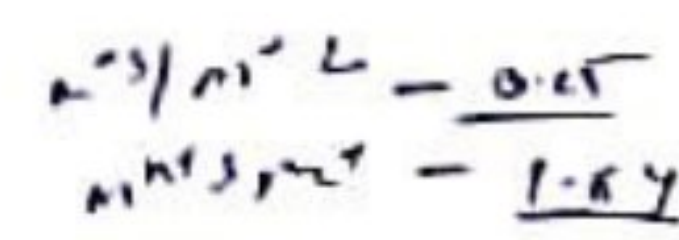
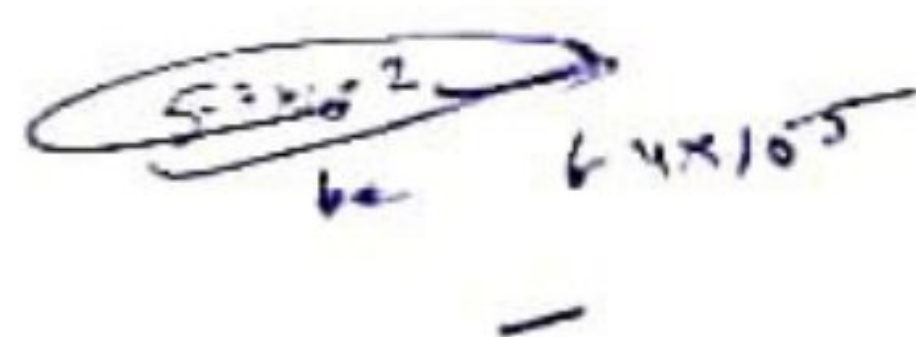
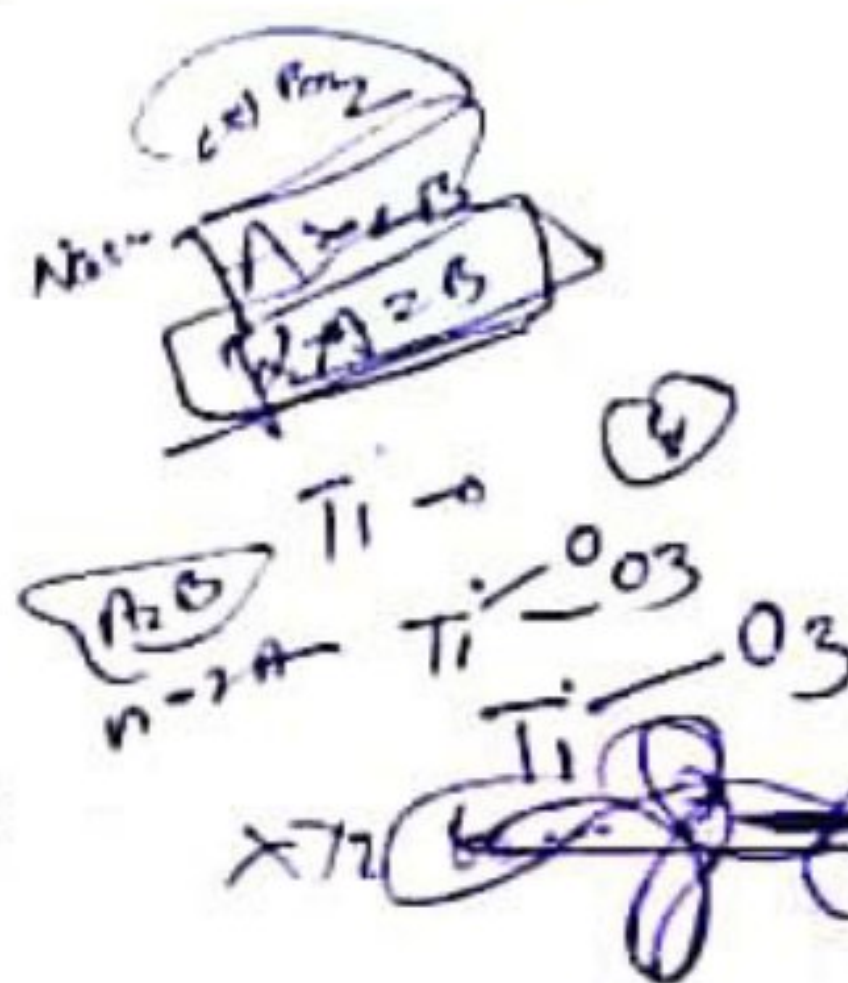
84. Which of the following atomic orbitals can overlap with an atomic orbital of the same type on an adjacent atom (both atoms lie on the x axis) to give a π bond?
- (A) $2p_x$ (B) $3d_{xy}$
(C) $2s$ (D) $3p_x$

85. In the emission spectrum of hydrogen, which series of emission lines falls in the visible region?
- (A) Lyman (B) Paschen
(C) Balmer (D) Pfund

86. For which of the following elements, is the process of attaching the first electron the most exothermic?
- (A) O (B) H
(C) I (D) Na

87. In an MO diagram for the formation of H_2O in which the z axis bisects the H-O-H angle:
- (A) the O $2p_z$ atomic orbital interacts with an in-phase combination of H 1s atomic orbitals
 - (B) the O $2p_z$ atomic orbital interacts with an out-of-phase combination of H 1s atomic orbitals
 - (C) the O $2p_z$ atomic orbital is non-bonding
 - (D) the O 2s atomic orbital is non-bonding
88. An X_2 molecule lies so that the X nuclei are on the z axis. The bonding MO formed by the overlap of two $2p_x$ orbitals contains:
- (A) no nodal planes
 - (B) one nodal plane
 - (C) a nodal plane between the nuclei
 - (D) two nodal planes
89. Which of the following statements is true about an XY_2 lattice?
- (A) The coordination number of X_2^{n+} is twice that of Y^{n-}
 - (B) The coordination number of X_2^{n+} is half that of Y^{n-}
 - (C) The unit cell contains twice as many X_2^{n+} ions as Y^{n-}
 - (D) The coordination environments of X_2^{n+} and Y^{n-} are the same
90. The coordination numbers of Ti(IV) and O^{2-} in rutile are, respectively:
- (A) 6 and 3
 - (B) 3 and 6
 - (C) 2 and 4
 - (D) 4 and 2
91. Which of the following statements is incorrect about oxalic acid ($\text{H}_2\text{C}_2\text{O}_4$) for which $K_{a(1)} = 5.9 \times 10^{-2} \text{ M}$ and $K_{a(2)} = 6.4 \times 10^{-5} \text{ M}$?
- (A) The observation that $K_{a(1)} > K_{a(2)}$ is general for dibasic acids
 - (B) Both $\text{H}_2\text{C}_2\text{O}_4$ and its conjugate base behave as weak acids
 - (C) $\text{p}K_{a(1)} > \text{p}K_{a(2)}$
 - (D) Oxalic acid forms salts including $\text{Na}_2\text{C}_2\text{O}_4$, MgC_2O_4 and KHC_2O_4
92. In neutral aqueous solution, E° for the $\text{Mn}^{3+}/\text{Mn}^{2+}$ couple is +1.54 V. At pH 14, E° for the $\text{Mn}(\text{OH})_3/\text{Mn}(\text{OH})_2$ couple is +0.15 V. Which of the following statements is incorrect?
- (A) At pH 14, Mn(II) and Mn(III) both precipitate from aqueous solution as hydroxides
 - (B) Mn(III) is less stable with respect to reduction to Mn(II) at pH 14 than at pH 7
 - (C) The $\text{Mn}(\text{OH})_3/\text{Mn}(\text{OH})_2$ couple refers to an equilibrium involving Mn(III) and Mn(II)
 - (D) At pH 7, $\text{Mn}^{3+}(\text{aq})$ is a relatively strong oxidizing agent
93. The enthalpy change for the dissociation: $\text{M}_2(\text{g}) \rightarrow 2\text{M}(\text{g})$ is:
- (A) more positive for Li_2 than for K_2
 - (B) more positive for Rb_2 than for K_2
 - (C) more positive for Na_2 than for Li_2
 - (D) more positive for Cs_2 than for K_2
94. BeF_2 dissolves in water to give $[\text{Be}(\text{OH}_2)_n]^{2+}$ where:
- (A) $n = 2$
 - (B) $n = 3$
 - (C) $n = 4$
 - (D) $n = 6$

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95. In which reaction does the cluster core undergo a significant change in shape?
- (A) $B_{10}H_{14} + C_2H_2 \rightarrow 1,2-C_2B_{10}H_{12} + 2H_2$
- (B) $Cs_2[B_6H_6] + HCl \rightarrow Cs[B_6H_7] + CsCl$
- (C) $B_5H_9 + KH \rightarrow K[B_5H_8] + H_2$
- (D) $B_4H_{10} + CO \rightarrow 1-B_4H_8(CO) + H_2$

96. Which of the following statements is incorrect?
- (A) GeO_2 dissolves in basic aqueous solution to give $[Ge(OH)_6]^{2-}$
- (B) A C_{60} molecule has I_h symmetry
- (C) $Pb(NO_3)_2$ and PbO_2 are both water soluble
- (D) ^{119}Sn is an NMR active nucleus

97. Which reaction is unlikely to work?
- (A) $AsF_3 + SbF_5 \rightarrow [AsF_2]^+ + [SbF_6]^-$
- (B) $AlCl_3 + SbCl_5 \rightarrow [SbCl_4]^+ + [AlCl_4]^-$
- (C) $SbCl_5 + 5HF \rightarrow SbF_5 + 5HCl$
- (D) $2SbCl_3 + Cl_2 + 4CsCl \rightarrow 4Cs^+ + [SbCl_6]^- + [SbCl_6]^{2-}$

98. The following data are for solutions at pH 0:
- $[S_2O_8]^{2-} + 2e^- \rightleftharpoons 2[SO_4]^{2-} \quad ; E^\circ = +2.01 \text{ V}$
- $[Cr_2O_7]^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O \quad ; E^\circ = +1.33 \text{ V}$
- $[MnO_4]^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O \quad ; E^\circ = +1.51 \text{ V}$

From the data, you can deduce that, at pH 0:

- (A) $[S_2O_8]^{2-}$ will oxidize Cr^{3+}
- (B) $[S_2O_8]^{2-}$ will reduce $[MnO_4]^-$
- (C) $[SO_4]^{2-}$ will be oxidized by $[Cr_2O_7]^{2-}$
- (D) $[S_2O_8]^{2-}$ will reduce $[Cr_2O_7]^{2-}$

99. Which of the following correctly describes the trends in values of Pauling electronegativities (χ_P) and ionic radii (r_{ion})?
- (A) $\chi_P: F < Cl < Br < I$; $r_{ion}: F < Cl < Br < I$
- (B) $\chi_P: F > Cl > Br > I$; $r_{ion}: F < Cl < Br < I$
- (C) $\chi_P: F < Cl < Br < I$; $r_{ion}: F > Cl > Br > I$
- (D) $\chi_P: F > Cl > Br > I$; $r_{ion}: F > Cl > Br > I$

100. Which statement about $FXeOSO_2F$ is incorrect?
- (A) The environment about the Xe centre is linear
- (B) The oxidation state of Xe is +2
- (C) $FXeOSO_2F$ is an ionic salt
- (D) $FXeOSO_2F$ can be prepared by treating XeF_2 with fluorosulfonic acid

