## CHEMISTRY
Category -1 (Q. 41 to 70)
(Carry 1 mark each. Only one option is correct. Negative mark: -¼)

41. Equal volume of two solutions A and B of a strong acid having pH = 6·0 and pH = 4·0 respectively are mixed together to form a new solution. The pH of the new solution will be in the range

(A) between 5 and 6   (B) between 6 and 7

(C) between 4 and 5 ✓   (D) between 3 and 4

42. P and Q combines to form two compounds PQ_2 and PQ_3. If 1 g PQ_2 is dissolved in 51 g benzene the depression of freezing point becomes 0·8°C. On the other hand if 1 g PQ_3 is dissolved in 51 g of benzene, the depression of freezing point becomes 0·625°C. The atomic mass of P and Q are (K_f of benzene = 5·1 K kg mol^{-1})

(A) 35, 55   (B) 45, 45

(C) 55, 45   (D) 55, 35 ✓

43. Identify the major product (G) in the following reaction
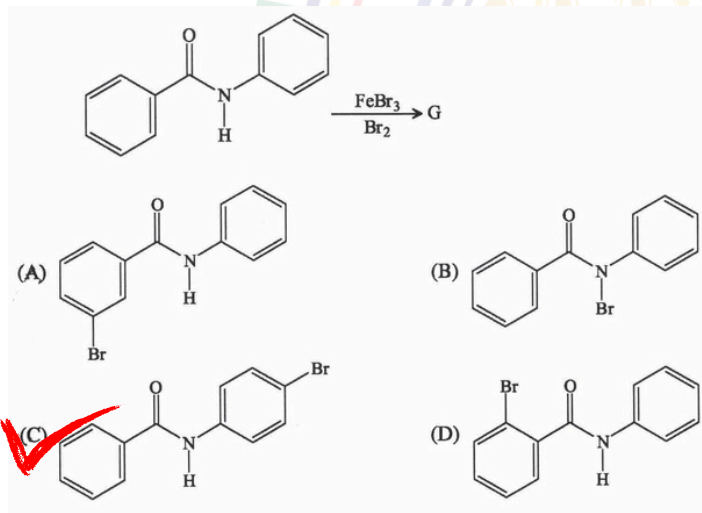
44. The number of terminal and bridging hydrogens in B_2H_6 are respectively

(A) 4 and (এবং) 2 ✓   (B) 2 and (এবং) 4

(C) 2 and (এবং) 2   (D) 4 and (এবং) 4

45. If three elements A, B, C crystalise in a cubic solid lattice with B atoms at the cubic centres, C atoms at the centre of edges and A atoms at the corners, then formula of the compound is

(A) AB_3C (B) A_3BC

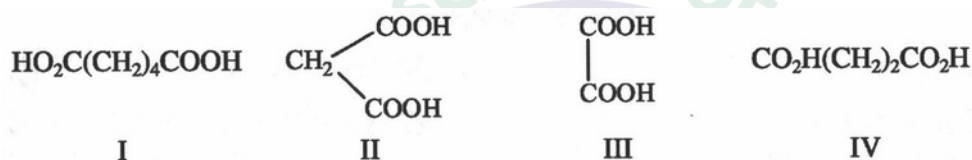(C) ABC_3 ✓   (D) ABC

46. An LPG (Liquified Petroleum Gas) cylinder weighs 15·0 kg when empty. When full, it weighs 30·0 kg and shows a pressure of 3·0 atm. In the course of usage at 27 °C, the mass of the full cylinder is reduced to 24·2 kg. The volume of the used gas in cubic metre at the normal usage condition (1 atm and 27 °C) is (assume LPG to be normal butane and it behaves ideally)

(A) 24·6 m³

(B) 246 m³

(C) 0·246 m³

(D) 2·46 m³ ✓

47. The molar conductances of $Ba(OH)_2$, $BaCl_2$ and NH_4Cl at infinite dilution are 523·28, 280·0 and 129·8 S cm² mol⁻¹ respectively. The molar conductance of NH_4OH at infinite dilution will be

(A) 125·72 S cm² mol⁻¹

(B) 251·44 S cm² mol⁻¹ ✓

(C) 502·88 S cm² mol⁻¹

(D) 754·32 S cm² mol⁻¹

48. Arrange the following compounds in order of their increasing acid strength

$HO_2C(CH_2)_4COOH$ $CH_2 \begin{smallmatrix} COOH \\ \\ COOH \end{smallmatrix}$ $\begin{smallmatrix} COOH \\ | \\ COOH \end{smallmatrix}$ $CO_2H(CH_2)_2CO_2H$

I   II   III   IV

(A) I < II < III < IV

(B) IV < III < II < I

(C) I < IV < II < III ✓

(D) II < I < III < IV

49. Adiabatic free expansion of ideal gas must be

(A) Isobaric

(B) Isochoric

(C) Isothermal ✓

(D) Isoentropic

50. Which of the following hydrogen bonds is likely to be the weakest?

(A) C – H··· O ✓

(B) N – H··· O

(C) O – H··· O

(D) O – H··· F

51. Which of the following compounds is most reactive in S_N1 reaction?

(A) [structure with Br]

(B) [structure with Br] ✓

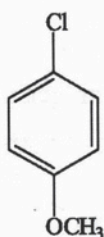(C) [structure with H, Br]

(D) [structure with Br]

52. Which one among the following compounds will most readily be dehydrated under acidic condition?

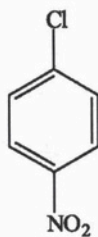(A)

(B)

(C)

(D)
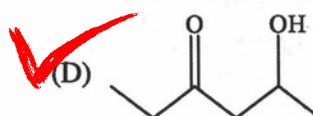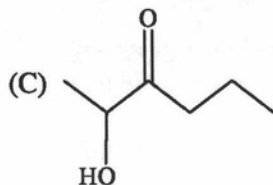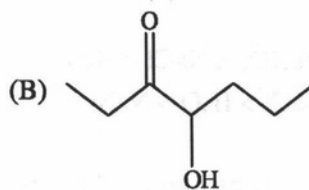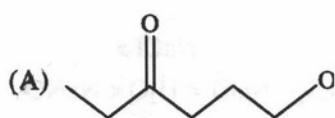
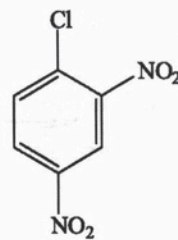53. Increasing order of the nucleophilic substitution of following compounds is
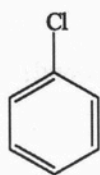
I   II   III   IV

(A) I<III<II<IV   (B) II<I<III<IV

(C) II<III<I<IV   (D) IV<III<II<I

What is the four-electron reduced form of O_2?

(A) Superoxide   (B) Peroxide

54. (C) Oxide   (D) Ozone

55. The common stable oxidation states of Eu and Gd are respectively

(A) + 3 and (এবং) + 3   (B) + 3 and (এবং) + 2

(C) + 2 and (এবং) + 3   (D) + 2 and (এবং) + 2

56. Increasing order of solubility of AgCl in (i) H_2O, (ii) 1M NaCl (aq.), (iii) 1M $CaCl_2$ (aq.) and (iv) 1M $NaNO_3$ (aq.) solution
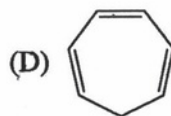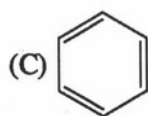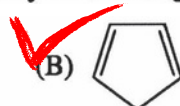
(A) $CaCl_2$ < $NaNO_3$ < NaCl < H_2O (B) $CaCl_2$ > H_2O > NaCl > $NaNO_3$

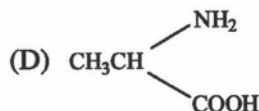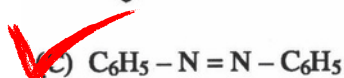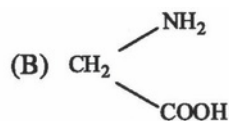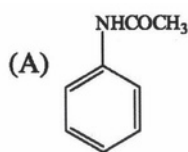(C) $CaCl_2$ > NaCl > H_2O > $NaNO_3$ (D) $CaCl_2$ < NaCl < H_2O < $NaNO_3$

57. Which of the following hydrocarbons reacts easily with MeMgBr to give methane?
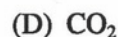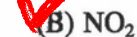
(A)

(B)

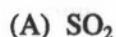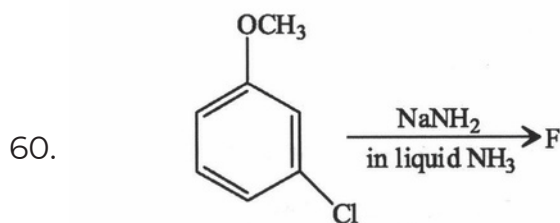(C)

(D)

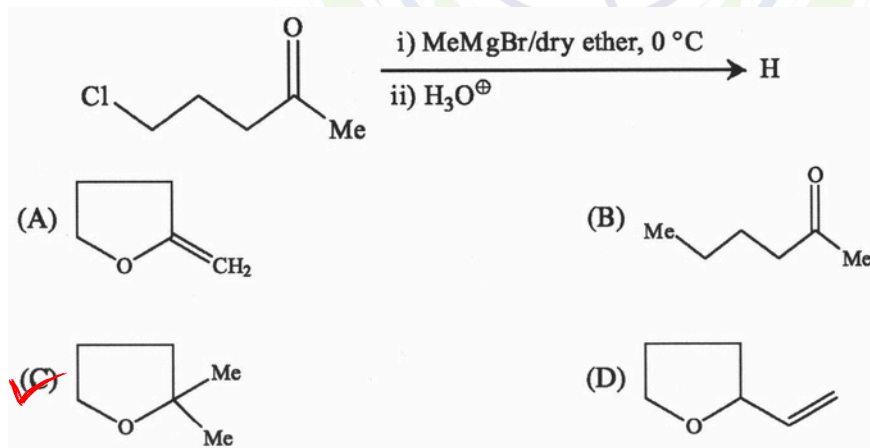**58.** Kjeldahl's method cannot be used for the estimation of nitrogen in which compound?

(A) NHCOCH$_3$ attached to benzene ring

(B) CH_2 with NH_2 and $COOH$ groups

(C) $C_6H_5 - N = N - C_6H_5$

(D) CH_3CH with NH_2 and $COOH$ groups

59. Which of the following oxides is paramagnetic?

(A) SO_2

(B) NO_2

(C) SiO_2

(D) CO_2

60. The major product (F) in the following reaction is

3-chloroanisole $\xrightarrow[\text{in liquid NH}_3]{\text{NaNH}_2}$ F

(A) o-Anisidine

(B) m-Anisidine

(C) p-Anisidine

(D) p-Chloro aniline

61. In the following reaction, the major product (H) is

Cl-substituted ketone $\xrightarrow[\text{ii) H}_3O^{\oplus}]{\text{i) MeMgBr/dry ether, 0 °C}}$ H

(A) tetrahydrofuran with $=CH_2$

(B) Me chain with ketone O and Me

(C) tetrahydrofuran with Me, Me substituents

(D) tetrahydrofuran with vinyl group

62. The number of lone pair of electrons and the hybridization of Xenon (Xe) in $XeOF_2$ are

(A) 1, sp^3

(B) 1, dsp^2

(C) 3, dsp^3

(D) 2, sp^3d
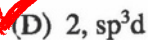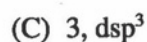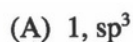
63. The coagulating power of electrolytes having ions Na^+, Al^{3+} and Ba^{2+} for As_2S_3 sol increases in the order

(A) $Al^{3+} < Ba^{2+} < Na^+$ (B) $Na^+ < Ba^{2+} < Al^{3+}$

(C) $Ba^{2+} < Na^+ < Al^{3+}$ (D) $Al^{3+} < Na^+ < Ba^{2+}$

64. An optically active alkene having molecular formula C_8H_{16} gives acetone as one of the products on ozonolysis. The structure of the alkene is

65. How many electrons are needed to reduce N_2 to NH_3?
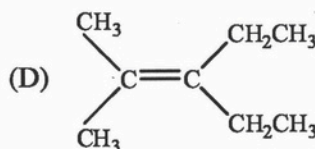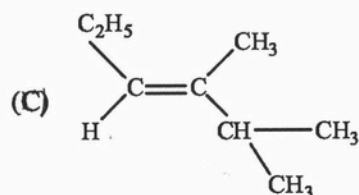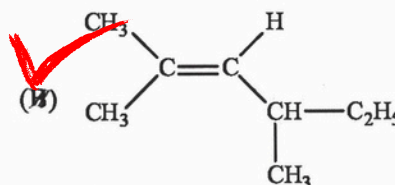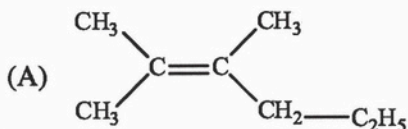
(A) 3   (B) 4

(C) 5   (D) 6

66. For a chemical reaction, half-life period ($t_{\frac{1}{2}}$) is 10 minutes. How much reactant will be left after 20 minutes if one starts with 100 moles of reactant and the order of the reaction be (i) zero, (ii) one and (iii) two?

(A) 0, 25, 33·33   (B) 25, 0, 33·33

(C) 33·33, 25, 0   (D) 25, 33·33, 0

67. $_5B^{10} + {_2He^4} \rightarrow X + {_0n^1}$

(A) $_7N^{14}$ (B) $_7N^{13}$

(C) $_6C^{12}$ (D) $_7N^{12}$
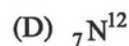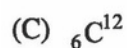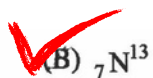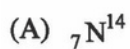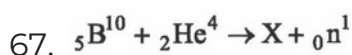
68. How many oxygen atoms are present in 0·36 g of a drop of water at STP?

(A) $6·023 \times 10^{22}$ (B) $1·205 \times 10^{22}$

(C) $6·023 \times 10^{23}$ (D) $1·205 \times 10^{23}$

69. The bond order of HeH^+ is

(A) 1   (B) 2

(C) 3   (D) 4

70. $360\ cm^3$ of a hydrocarbon diffuses in 30 minutes, while under the same conditions $360\ cm^3$ of SO_2 gas diffuses in one hour. The molecular formula of the hydrocarbon is

(A) CH_4 (B) C_2H_6

(C) C_2H_4 (D) C_2H_2

Category -2 (Q. 71 to 75)
(Carry 2 marks each. Only one option is correct. Negative mark: -½)

71. As per the following equation, $0.217\ g$ of HgO (molecular mass $= 217\ g\ mol^{-1}$) reacts with excess iodide. On titration of the resulting solution, how many mL of $0.01\ M\ HCl$ is required to reach the equivalence point?

$$HgO + 4I^- + H_2O \longrightarrow HgI_4^{2-} + 2OH^-$$

(A) 50 mL   (B) 200 mL

(C) 10 mL   (D) 5 mL

72. Consider the following gas phase dissociation, $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ with equilibrium constant K_P at a particular temperature and at pressure P. The degree of dissociation (α) for $PCl_5(g)$ is
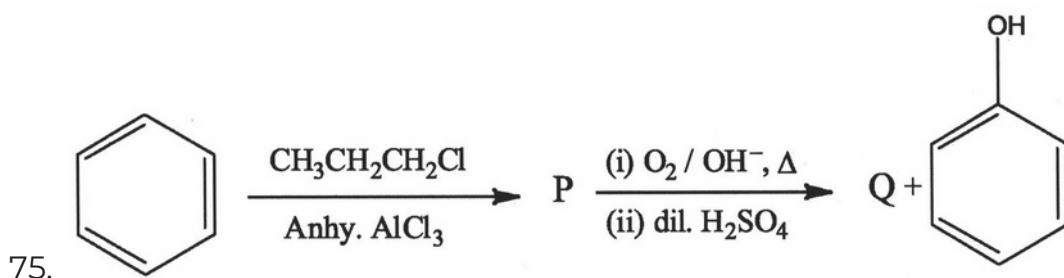
$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

(A) $\alpha = \left(\dfrac{K_P}{K_P + P}\right)^{1/3}$ (B) $\alpha = \left(\dfrac{K_P}{K_P + P}\right)$

(C) $\alpha = \left(\dfrac{K_P}{K_P + P}\right)^{1/2}$ (D) $\alpha = \left(\dfrac{K_P}{K_P + P}\right)^{2}$

73. An egg takes 4.0 minutes to boil at sea level where the boiling point of water is $T_1\ K$, where as it takes 8.0 minutes to boil on a mountain top where the boiling point of water is $T_2\ K$. The activation energy for the reaction that takes place during the boiling of egg is

(A) $0.693\dfrac{T_1 - T_2}{T_1 T_2}$ (B) $0.693\dfrac{T_2 - T_1}{T_1 T_2}$

(C) $0.693R\dfrac{T_1 T_2}{T_2 - T_1}$ (D) $0.693R\dfrac{T_1 T_2}{T_1 - T_2}$

74. Compound given below will produce effervescence when mixed with aqueous sodium bicarbonate solution

(A) [structure: toluene with NO$_2$ at meta position, CH$_3$]

(B) CH_3COCH_3

(C) [structure: naphthalen-2-ol with OH]

✓ (D) [structure: 2,4,6-trinitrophenol, OH with O$_2$N, NO$_2$, NO$_2$ substituents]

75.

[reaction scheme: benzene ring $\xrightarrow[\text{Anhy. AlCl}_3]{CH_3CH_2CH_2Cl}$ P $\xrightarrow[\text{(ii) dil. H}_2SO_4]{\text{(i) O}_2/\text{OH}^-, \Delta}$ Q + phenol (OH on benzene ring)]
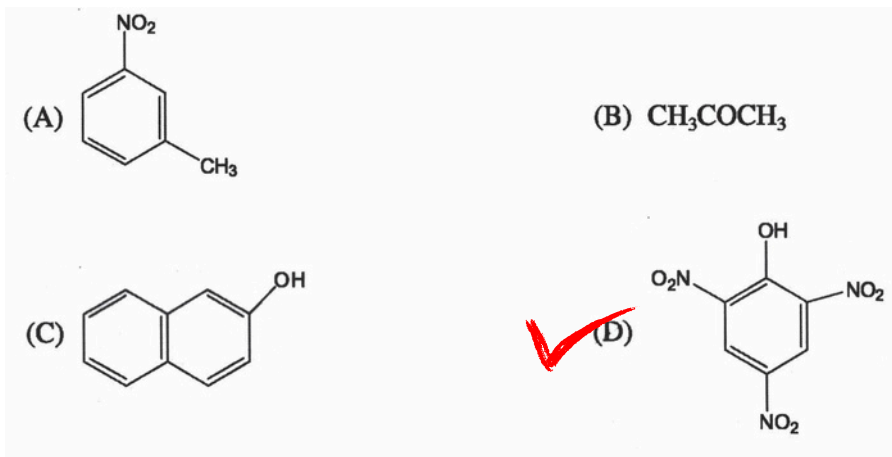
The major product 'P' and 'Q' in the above reactions are

(A) [benzene with CH$_2$CH$_2$CH$_3$] and (এবং) CH_3CH_2CHO

(B) [benzene with CH$_2$CH$_2$CH$_3$] and (এবং) [acetone: CH$_3$–C(=O)–CH$_3$]

✓ (C) [benzene with isopropyl group] and (এবং) [(CH$_3$)$_2$C=O]

(D) [benzene with isopropyl group] and (এবং) CH_3CH_2CHO
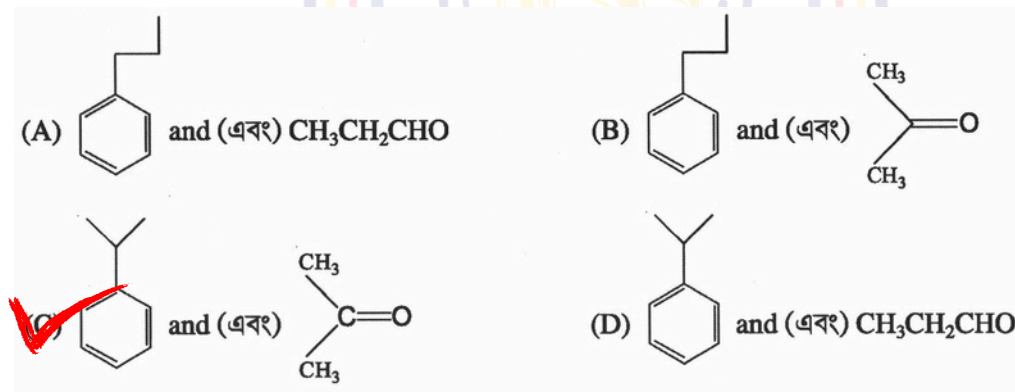
Category -3 (Q. 76 to 80)
(Carry 2 marks each. One or more options are correct. No negative marks)

76. Which pair of ions among the following can be separated by precipitation method?
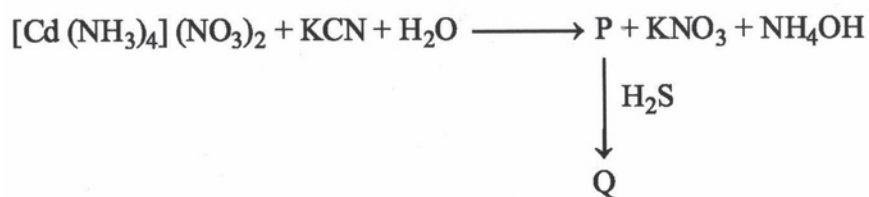
(A) Eu (II) and (এবং) Dy (III)

(B) Gd (III) and (এবং) Dy (III)
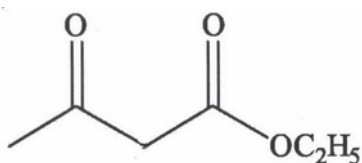
✓ (C) Eu (II) and (এবং) Yb (II)

(D) Eu (II) and (এবং) Gd (II)

77. Identify 'P' and 'Q' in the following reaction

$$[Cd(NH_3)_4](NO_3)_2 + KCN + H_2O \longrightarrow P + KNO_3 + NH_4OH$$

$$\downarrow H_2S$$

$$Q$$

(A) $P = K_2 [Cd (CN)_4]$, $Q = CdS$

(B) $P = CdS$, $Q = K_2 [Cd (CN)_4]$

(C) $P = Cd (NO_3)_2$, $Q = CdSO_4$

(D) $P = [Cd (OH_2)_4](NO_3)_2$, $Q = [Cd (NO_3)_4] (NO_3)_2$

78. Which of the following statement(s) is/are correct about the given compound?

(A) It exhibits tautomerism.

(B) It does not react with metallic sodium.

(C) It gives reddish-violet coloration with $FeCl_3$ solution.

(D) It gives precipitate with 2,4-dinitrophenyl hydrazine solution.

79. X is an extensive property and x is an intensive property of a thermodynamic system. Which of the following statement(s) is (are) correct?

(A) xX is extensive.

(B) $\dfrac{x}{X}$ is intensive.

(C) $\dfrac{X}{x}$ is extensive.

(D) $\dfrac{dX}{dx}$ is intensive.

80. The compound(s) showing optical activity is/are