Combined Geo-Scientist (P) Examination, 2024

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T.B.C. : SBVP–B–CHE **Test Booklet Series**

Serial No. 1006713

TEST BOOKLET

A

Paper—II

(CHEMISTRY)

Time Allowed : Two Hours **Maximum Marks : 300**

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1. Which among the following principal quantum numbers has/have five degenerate *d*-orbitals?
   (a) 2
   (b) 3 only
   (c) 4 only
   (d) Both 3 and 4

2. Which one of the following statements related to radial distribution plots for hydrogen atom is ***not*** correct?
   (a) Most probable radius varies as $3s > 3p > 3d$.
   (b) Most probable radius varies as $1s < 2s < 3s$.
   (c) Most probable radius varies as $2p < 3p$.
   (d) Most probable radius varies as $3s < 3p < 3d$.

3. Which one of the following sets of quantum numbers represents the highest energy state?

	n	l	m_l	m_s
(a)	4	0	0	$+\frac{1}{2}$
(b)	3	0	0	$-\frac{1}{2}$
(c)	3	1	1	$+\frac{1}{2}$
(d)	3	2	1	$-\frac{1}{2}$

4. Which one of the following groups of elements contains true metals only?
   (a) Carbon, boron, silicon
   (b) Magnesium, aluminium, selenium
   (c) Boron, carbon, nitrogen
   (d) Sodium, thallium, bismuth

5. The electronic configuration of an element *A* is $[Xe]4f^1 5d^1 6s^2$ and that of an element *B* is $[Xe]4f^3 6s^2$. The elements *A* and *B* are
   (a) transition element and lanthanide, respectively
   (b) lanthanide and actinide, respectively
   (c) transition element and actinide, respectively
   (d) both lanthanides

6. The physical and chemical properties of elements are periodic functions of their
   (a) atomic weight
   (b) atomic size
   (c) atomic number
   (d) atomic shape

7. Which one of the following represents the correct order of ionic radii among Y^{3+}, La^{3+}, Eu^{3+} and Lu^{3+}?
   (a) $Y^{3+} < La^{3+} < Eu^{3+} < Lu^{3+}$
   (b) $Lu^{3+} < Eu^{3+} < La^{3+} < Y^{3+}$
   (c) $Eu^{3+} < La^{3+} < Lu^{3+} < Y^{3+}$
   (d) $Lu^{3+} < Y^{3+} < Eu^{3+} < La^{3+}$

8. Using Slater's rule, the effective nuclear charge experienced by 3*d*-electron in titanium (atomic number 22) is
   (a) 22·0 (b) 7·53
   (c) 5·14 (d) 3·65

9. Atomic size of nitrogen is less than carbon atom, yet carbon shows maximum catenation property while nitrogen does not. The reason for this is
   (a) lone pair-lone pair repulsions in N—N single bond make the bond weaker to allow catenation
   (b) catenation is not dependent on atomic size
   (c) carbon has poor multiple bonds formation ability
   (d) nitrogen exists as an inert gas and therefore does not react

10. Consider the following statements :

1. Sulfur has a higher ionization energy than phosphorus.
2. Sulfur has a lower ionization energy than phosphorus.
3. Sulfur has a lower electron affinity than chlorine.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) 1 and 3
(d) 2 and 3

11. Which one of the following represents the correct order of bond angle among H_2O, H_2Te, H_2Se and H_2S?

(a) $H_2O > H_2S > H_2Se > H_2Te$
(b) $H_2S > H_2Se > H_2O > H_2Te$
(c) $H_2O > H_2Se > H_2S > H_2Te$
(d) $H_2Te > H_2O > H_2S > H_2Se$

12. Consider the following statements :

1. On moving from left to right in the periodic table, the metallic character of elements decreases.
2. On moving from left to right in the periodic table, the oxides of elements become less basic.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

13. Carbon is able to show allotropic forms due to

(a) its smaller size
(b) its higher electronegativity
(c) its higher ionization enthalpy and unavailability of *d*-orbitals
(d) catenation and $p\pi$—$p\pi$ bond formation

14. A neutral atom of an element has two *K*, eight *L* and five *M* electrons. What will be the total number of *p*-electrons in the element?

(a) 9
(b) 8
(c) 7
(d) 6

15. Consider the following statements :

Statement–1 :

An aqueous solution of NaH_2PO_4 is acidic and that of Na_2HPO_4 is basic in nature.

Statement–2 :

An equimolar mixture of NaH_2PO_4 and Na_2HPO_4 acts as a buffer.

Which one of the following is correct with respect to the above statements?

(a) Both Statement–1 and Statement–2 are true and Statement–1 is not the correct explanation of Statement–2
(b) Both Statement–1 and Statement–2 are true and Statement–1 is the correct explanation of Statement–2
(c) Statement–1 is true but Statement–2 is false
(d) Statement–1 is false but Statement–2 is true

16. In SO_3, one *p*-orbital and two *d*-orbitals are used in S=O π-bond formation. However, all S=O bond lengths are identical. This is due to

(a) involvement of equivalent hybrid orbitals in π-bonding

(b) considerable polarity in bonds

(c) delocalization of π-bonds in the molecule

(d) ionic covalent resonance in the molecule

17. Consider the following statements regarding NF_3 :

1. NF_3 has bond angle value much lower than tetrahedral bond angle.
2. NF_3 is a good Lewis base.

Which of the statements given above is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

18. Which one of the following reactions is ***not*** possible between diborane and ammonia?

(a) $B_2H_6 + \underset{\text{(Excess)}}{NH_3} \xrightarrow[\text{Low } T]{} B_2H_6 \cdot 2NH_3$

(b) $B_2H_6 + \underset{\text{(Excess)}}{NH_3} \xrightarrow[\text{High } T]{} (BN)_x$

(c) $B_2H_6 + 2NH_3 \xrightarrow[\text{Aqueous medium}]{\text{RT}} B_4H_{10} + N_2 + 4H_2$

(d) $B_2H_6 + 2NH_3 \xrightarrow[\text{High } T]{} B_3N_3H_6$

19. For ZnS, a radius ratio ($r_{Zn^{2+}}/r_{S^{2-}}$) of 0·52 suggests a coordination number, of 6 for both cation and anion. However, in reality, ZnS adopts a coordination number of 4 : 4. This is because

(a) ZnS is a true covalent compound

(b) ZnS is an ionic compound with considerable covalency

(c) Zn^{2+} is too small to occupy octahedral holes

(d) S^{2-} ions are too large to provide higher coordination number to Zn^{2+}

20. Theoretically calculated lattice energy (using Born-Landé equation) of hypothetical molecule $NaCl_2$ is –2180 kJ/mol while that of NaCl is –755 kJ/mol. (Both the molecules are assumed to be formed from elements in their standard states.) Yet NaCl is a stable molecule while $NaCl_2$ does not exist. The reason for this is

(a) dissociation energy of Cl_2 molecule is too high

(b) second ionization energy of Na metal is too high

(c) electron affinity of Cl atom is too low

(d) Born-Landé equation cannot predict the correct lattice energy of these molecules

21. The solubility of an ionic compound in a solvent depends on

(a) lattice enthalpy only

(b) solvation enthalpy only

(c) lattice enthalpy and solvation enthalpy both

(d) ionization enthalpy of metal

22. Consider the following statements regarding Frenkel defect in solids :

Statement–1 :

Compounds having Frenkel defects have some covalent character.

Statement–2 :

Compounds having Frenkel defects have small positive ions and large negative ions, where small positive ions are highly polarizing and large negative ions are readily polarized.

Which one of the following is correct with respect to the above statements?

(a) Both Statement–1 and Statement–2 are true and Statement–2 is the correct explanation of Statement–1

(b) Both Statement–1 and Statement–2 are true and Statement–2 is not the correct explanation of Statement–1

(c) Statement–1 is true but Statement–2 is false

(d) Statement–1 is false but Statement–2 is true

23. Two types of F atoms in $(CH_3)PF_4$ are indistinguishable while in $(CH_3)_2PF_3$, equatorially placed F atom is distinguishable from apical F atom with the help of ^{19}F NMR spectroscopy. The reason for the same is

(a) $(CH_3)PF_4$ has a square pyramidal geometry while $(CH_3)_2PF_3$ has a trigonal bipyramidal geometry

(b) $(CH_3)PF_4$ has all equivalent hybrid orbitals but $(CH_3)_2PF_3$ has non-equivalent hybrid orbitals

(c) inductive effect of methyl groups is higher in $(CH_3)_2PF_3$ than in $(CH_3)PF_4$

(d) two methyl groups pose higher rigidity in the molecule to allow pseudorotation in $(CH_3)_2PF_3$

24. The bond angle in H_2O molecule is 104·5°. The *p*-character in non-bonding set of orbitals will be [where $\cos(104{\cdot}5°) = -0{\cdot}25$]

(a) 20%

(b) 70%

(c) 75%

(d) 80%

25. The wave function

$$\Psi = \Psi_{cov} + \lambda\Psi_{H^+H^-} + \lambda\Psi_{H^-H^+}$$

expresses the phenomenon of

(a) vibration

(b) resonance

(c) conjugation

(d) orbital

26. Werner confirmed the presence of primary and secondary valencies in the coordination compounds $CoCl_3 \cdot 6NH_3$, $CoCl_3 \cdot 5NH_3$ and $CoCl_3 \cdot 4NH_3$ by

(a) treating cold aqueous solutions of cobalt complexes with excess of silver nitrate solution

(b) treating cold aqueous solutions of cobalt complexes with excess of barium nitrate solution

(c) treating cold aqueous solutions of cobalt complexes with excess of barium chloride solution

(d) treating cold aqueous solutions of cobalt complexes with excess of sodium nitrate solution

27. Which one among the following chelate rings will be more stable?

(a) Four-membered chelate ring

(b) Five-membered chelate ring

(c) Six-membered chelate ring

(d) Seven-membered chelate ring

28. Which one of the following is the correct IUPAC name of $Li[AlH_4]$?

(a) Lithium aluminium hydride

(b) Lithium aluminium tetrahydride

(c) Lithium tetrahydridoaluminate(III)

(d) Lithium tetrahydroaluminate(III)

29. Consider the following reaction :

$$[Co(NH_3)_4Cl_2]^+ + Cl^- \rightarrow [Co(NH_3)_3Cl_3] + NH_3$$

How many isomers of the product complex are possible for the above reaction?

(a) 1

(b) 2

(c) 3

(d) 5

30. The effective atomic number of $K_4[Fe(CN)_6]$ complex is

(a) 34

(b) 35

(c) 36

(d) 38

31. The formula for the coordination compound amminediaquachlorido-platinum(IV) tetrachloridoplatinate(II) is

(a) $[PtCl(NH_3)(H_2O)_2][PtCl_4]$

(b) $[PtCl(NH_3)(H_2O)_2]_2[PtCl_4]_3$

(c) $[PtCl(NH_3)(H_2O)_2]_3[PtCl_4]_2$

(d) $[PtCl(NH_3)(H_2O)_2]_2[PtCl_4]$

32. How many millilitres of 0·25 *M* solution of H_2SO_4 will react with 10 mL of 0·25 *M* solution of NaOH?

(a) 1 mL

(b) 2·5 mL

(c) 5 mL

(d) 10 mL

33. Which one of the following represents the correct order of acidity among CO_2, SO_2 and SO_3?

(a) $SO_3 > SO_2 > CO_2$

(b) $SO_2 > SO_3 > CO_2$

(c) $SO_2 > CO_2 > SO_3$

(d) $CO_2 > SO_2 > SO_3$

34. Which of the following statements regarding Ostwald's dilution law is/are ***not*** correct? (Where α = degree of dissociation, k = equilibrium constant for dissociation, c = concentration of solution)

1. Activity coefficients are taken as unity.
2. Ostwald's law is valid for strong electrolytes.
3. One may conclude $\alpha = \sqrt{\frac{k}{c}}$.

Select the correct answer using the code given below.

(a) 1 only

(b) 2 only

(c) 1 and 3

(d) 2 and 3

35. Which one of the following statements is correct?

(a) Water is strong electrolyte.

(b) The value of ionic product of water varies with temperature.

(c) The concentrations of H^+ and OH^- in 10^{-5} *M* HCl solution are same.

(d) The ionization constant and ionic product of water are same.

36. The pH of a buffer solution containing 6·0 mL of CH_3COOH (0·2 M) and 4·0 mL of CH_3COONa (0·2 M) solutions will be approximately [where $pK_a(CH_3COOH) = 4{\cdot}76$; $\log 2 = 0{\cdot}30$, $\log 3 = 0{\cdot}48$]

(a) 6·0

(b) 5·13

(c) 4·58

(d) 2·46

37. Which one of the following does ***not*** represent a correct expression for hydrolysis constant for the equilibrium reaction $A^- + H_2O \rightleftharpoons OH^- + HA$?

(a) $K_h = [OH^-][HA]/[A^-]$

(b) $pK_h = pK_w - pK_a$

(c) $K_h = K_w / K_a$

(d) $K_h = [OH^-][HA]$

38. Which one among the following compounds does ***not*** form primary standard solution?

(a) Na_2CO_3

(b) NaOH

(c) ZnO

(d) Potassium hydrogen phthalate

39. While performing the titration of $KMnO_4$ with clear Mohr's salt solution, a student obtained brown precipitate in the conical flask instead of a colourless solution, much before the end point was reached. What could be the possible source of error?

(a) Reaction mixture was not heated to 60 °C

(b) Fe^{2+} in the Mohr's salt solution hydrolyzed to precipitate brown hydroxide

(c) Reaction medium was not made acidic

(d) Too large quantity of $KMnO_4$ had been added to the Mohr's salt solution

40. In which one of the following titrations are metal-ion indicators used?

(a) Acid-base titration

(b) Precipitation titration

(c) Complexometric titration

(d) Redox titration

41. The total kinetic energy of 2 moles of an ideal gas at 300 K is approximately (where $R = 8{\cdot}3\ JK^{-1}\ mol^{-1}$)

(a) $1{\cdot}25 \times 10^{-20}$ J

(b) $6{\cdot}3 \times 10^{-21}$ J

(c) $7{\cdot}5 \times 10^{3}$ J

(d) $1{\cdot}9 \times 10^{3}$ J

42. The root mean square velocity of one mole of a monatomic gas having molar mass M is u_{rms}. The relation between u_{rms} and the average kinetic energy E of the gas is

(a) $u_{rms} = \sqrt{\frac{E}{3M}}$

(b) $u_{rms} = \sqrt{\frac{2E}{M}}$

(c) $u_{rms} = \sqrt{\frac{E}{2M}}$

(d) $u_{rms} = \sqrt{\frac{3E}{2M}}$

43. Consider the following statements regarding kinetic energy of a gas :

Statement–1 :

At 25 °C, the average kinetic energy of hydrogen gas molecules is the same as that of helium gas atoms.

Statement–2 :

The kinetic energy of a gas depends on the temperature and does not depend on the nature of the gas.

Which one of the following is correct with respect to the above statements?

(a) Both Statement–1 and Statement–2 are true and Statement–2 is the correct explanation of Statement–1

(b) Both Statement–1 and Statement–2 are true and Statement–2 is not the correct explanation of Statement–1

(c) Statement–1 is true but Statement–2 is false

(d) Statement–1 is false but Statement–2 is true

44. Consider the following van der Waals' constant values of two gases X and Y :

Gas	$\frac{a}{\text{kPa dm}^6\ \text{mol}^{-2}}$	$\frac{b}{\text{dm}^3\ \text{mol}^{-1}}$
X	657	0·04
Y	363	0·11

Which one of the following is correct with respect to the van der Waals' constant values of X and Y in the table given above?

(a) X is more easily liquefied than Y

(b) Y is more easily liquefied than X

(c) Ease of liquefaction does not depend upon the van der Waals' constant a

(d) Ease of liquefaction does not depend upon the van der Waals' constant b

45. Consider the following statements regarding speed distribution of molecules :

1. The total area under the plots of $\left(\frac{1}{N}\right)\left(\frac{dN_u}{du}\right)$ versus u is a measure of the total number of molecules in the collection.
2. The curve at any temperature is parabolic near the origin.
3. The majority of molecules have speeds which cluster around the average value $\bar{u}$ in the distribution curve.

Which of the statements given above is/are correct?

(a) 1 and 2

(b) 1 and 3

(c) 2 and 3

(d) 3 only

46. At constant volume, the mean free path of a gas is

(a) directly proportional to temperature only

(b) inversely proportional to pressure

(c) directly proportional to both temperature and pressure

(d) independent of temperature and pressure

47. Hydrogen molecule (H_2) with molar mass 2 g mol^{-1} effuses through a small hole at a temperature of 300 K and pressure of 5 torr. Under the same conditions, methane (CH_4) with molar mass 16 g mol^{-1} is also allowed to effuse. The ratio of the rate of effusion of hydrogen (r_{H_2}) and methane (r_{CH_4}) is

(a) 2·828 : 1

(b) 1 : 2·828

(c) 1 : 8

(d) 8 : 1

48. The work involved in a reversible adiabatic expansion of an ideal gas from p_i and V_i to p_f and V_f is given by

1. $w = \dfrac{p_f V_f - p_i V_i}{\gamma - 1}$

2. $w = -nC_{v,m}T_i\left[1-\left(\dfrac{p_f}{p_i}\right)^{\frac{R}{C_{p,m}}}\right]$

3. $w = \dfrac{p_f V_f - p_i V_i}{1-\gamma}$

4. $w = nC_{p,m}T_i\left[1-\left(\dfrac{p_f}{p_i}\right)^{\frac{R}{C_{p,m}}}\right]$

Select the correct answer using the code given below.

(a) 1 and 2 only

(b) 1, 2 and 3 only

(c) 3 and 4 only

(d) 1, 2, 3 and 4

49. Consider the following variables :

1. Dielectric constant
2. Surface tension
3. Energy
4. Enthalpy

Which one of the following regarding classification of variables is correct?

(a) 1 and 3 are intensive variables; 2 and 4 are extensive variables

(b) 1 and 2 are intensive variables; 3 and 4 are extensive variables

(c) 1 and 4 are intensive variables; 2 and 3 are extensive variables

(d) 2 and 3 are intensive variables; 1 and 4 are extensive variables

50. Consider the following statements regarding compressibility factor (Z) :

Statement–1 :

If a system at state A is converted to state B by two methods (reversible compression and irreversible compression), then the change in internal energy of the system is the same in both the processes.

Statement–2 :

Change in internal energy is a state function.

Which one of the following is correct with respect to the above statements?

(a) Both Statement–1 and Statement–2 are true and Statement–2 is the correct explanation of Statement–1

(b) Both Statement–1 and Statement–2 are true and Statement–2 is not the correct explanation of Statement–1

(c) Statement–1 is true but Statement–2 is false

(d) Statement–1 is false but Statement–2 is true

51. A 0·04 mole sample of a monatomic gas at 1·00 atm pressure and 298 K expands isothermally and reversibly from an initial volume of 1·0 L to 10·0 L. It is then heated to 500 K, followed by isothermal compression to 1·00 L and finally cooled to 25 °C. The ΔU for the overall process is

(a) 228 J *(b)* –228 J

(c) zero *(d)* 456 J

52. Consider the following statements :

Statement–1 :

The temperature of a perfect gas is unchanged by Joule-Thomson expansion.

Statement–2 :

For a perfect gas, Joule-Thomson coefficient (μ) is zero.

Which one of the following is correct with respect to the above statements?

(a) Both Statement–1 and Statement–2 are true and Statement–2 is the correct explanation of Statement–1

(b) Both Statement–1 and Statement–2 are true and Statement–2 is not the correct explanation of Statement–1

(c) Statement–1 is true but Statement–2 is false

(d) Statement–1 is false but Statement–2 is true

53. In a free expansion process

(a) the work done is zero and the heat transfer is zero

(b) the work done is zero but the heat flows into the system

(c) work is done by the system but the heat transfer is zero

(d) work is done on the system and the heat flows out of the system

54. Consider the following hypothetical reactions :

$X(g) + Y(g) \rightarrow XY(g)$; $\Delta H_1 = a$ kJ mol^{-1}

$X(g) + Z(g) \rightarrow XZ(g)$; $\Delta H_2 = b$ kJ mol^{-1}

ΔH for the reaction

$$Y(g) + XZ(g) \rightarrow XY(g) + Z(g)$$

will be

(a) $(a+b)$ kJ mol^{-1}

(b) a kJ mol^{-1}

(c) b kJ mol^{-1}

(d) $(a-b)$ kJ mol^{-1}

55. The maximum efficiency of an engine operating between 127 °C and 27 °C is

(a) 78·7% (b) 25%

(c) 21·25% (d) 75%

56. Consider the following reaction :

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$$

The values of ΔH and ΔG are –290 kJ and –230 kJ, respectively, at 300 K. What will be the value of ΔG at 320 K, assuming that there is no variation of ΔH and ΔS with temperature?

(a) 0·2 kJ

(b) –532 kJ

(c) –226 kJ

(d) –49 kJ

57. Consider the following statements regarding change of enthalpy (ΔH) and change of entropy (ΔS) for a chemical reaction at any temperature T:

1. If ΔH is negative and ΔS is positive, the reaction will be spontaneous at all temperatures.
2. If ΔH is positive and ΔS is negative, the reaction will be spontaneous at low temperatures.
3. When both ΔH and ΔS are positive, the reaction will proceed spontaneously at high temperatures.

Which of the statements given above is/are correct?

(a) 1 and 2

(b) 1 and 3

(c) 2 and 3

(d) 2 only

58. Consider the following reactions :

1. $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$; $\Delta_r H = -285{\cdot}8 \text{ kJ mol}^{-1}$
2. $\frac{1}{2}N_2(g) + O_2(g) \rightarrow NO_2(g)$; $\Delta_r H = +33{\cdot}2 \text{ kJ mol}^{-1}$

Which one of the following is correct with respect to the above reactions?

(a) Reaction 1 is endothermic and non-spontaneous at all temperatures

(b) Reaction 2 is exothermic and spontaneous at all temperatures

(c) Reaction 2 is endothermic and non-spontaneous at all temperatures

(d) Reaction 1 is exothermic and spontaneous at all temperatures

59. The experimental results of colligative properties of solutions are often found to differ from the calculated values due to

1. association of the concerned solute
2. dissociation of the concerned solute
3. the solutions being often non-ideal

Select the correct answer using the code given below.

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

60. The vapour pressure of pure water decreases from 24 torr to 23 torr on adding x amount of a solute (molar mass 480 g mol^{-1}) in 150 g of water. The value of x is

(a) 114 g (b) 128 g

(c) 167 g (d) 1124 g

61. Consider a solution of 50 g of an enzyme dissolved in water to give 2 dm^3 of solution at 27 °C. The osmotic pressure of the given solution is (where molar mass of enzyme = 90000 g mol^{-1} and $R = 0{\cdot}083\ dm^3\ bar\ K^{-1}\ mol^{-1}$)

(a) 0·49 kPa

(b) 0·69 kPa

(c) 0·89 kPa

(d) 1·09 kPa

62. Consider the following values of normal boiling point and molal boiling point elevation constant for some solvents :

Solvent	*Normal boiling point* (K)	*Molal boiling point elevation constant* $\left(\frac{K_b}{K\ kg\ mol^{-1}}\right)$
Water	373·15	0·52
Ethanol	351·5	1·20

Which one of the following solutions would result in the greatest boiling point elevation?

(a) 0·05 *M* lithium chloride in water

(b) 0·05 *M* lithium chloride in ethanol

(c) 0·05 *M* magnesium chloride in water

(d) 0·05 *M* magnesium chloride in ethanol

63. When a non-volatile solute is dissolved in a volatile solvent, the depression in the freezing point is

(a) inversely proportional to the molality of the solution

(b) directly proportional to the molality of the solution

(c) independent of the amount of solute present in the solution

(d) directly proportional to the mole fraction of the solvent present

64. Consider the following statements regarding Henry's law :

1. The Henry's law constant depends on the nature of the gas.
2. CO_2 is more soluble than O_2.
3. The Henry's law constant does not depend on the nature of the solvent.
4. The Henry's law constant depends on the temperature.

(The Henry's law constant values of CO_2 and O_2 in water at 298 K are $3{\cdot}01 \times 10^3$ kPa kg mol^{-1} and $7{\cdot}92 \times 10^4$ kPa kg mol^{-1}, respectively)

Which of the statements given above are correct?

(a) 1 and 2 only

(b) 1, 2 and 3

(c) 1, 2 and 4

(d) 3 and 4

65. The value of the Henry's law constant of O_2 in water at 298 K is $8{\cdot}0 \times 10^4$ kPa kg mol^{-1}. When its partial pressure is 20 kPa, the molar concentration of O_2 in water at 25 °C is

(a) 25 mmol dm^{-3}

(b) 0·25 mmol dm^{-3}

(c) $0{\cdot}4 \times 10^{-3}$ kg mol^{-1}

(d) 4×10^{-3} mol kg^{-1}

66. A conductivity cell was calibrated using 0·1 *M* KCl solution and the measured resistance was 100 Ω. The resistance of the same cell when filled with 0·02 *M* KCl solution is 500 Ω. The molar conductivity of 0·02 *M* KCl solution will be (the conductivity of 0·1 *M* KCl solution is 1·3 S m^{-1})

(a) 13·0 S cm^2 mol^{-1}

(b) $130{\cdot}0 \times 10^{-4}$ S cm^2 mol^{-1}

(c) 130·0 S cm^2 mol^{-1}

(d) 260·0 S cm^2 mol^{-1}

67. The molar conductivities at infinite dilution Λ_m^∞ for HNO_3, CH_3COOH and $NaNO_3$ are 421·2 S cm^2 mol^{-1}, 391·0 S cm^2 mol^{-1} and 121·5 S cm^2 mol^{-1}, respectively. The Λ_m^∞ for CH_3COONa will be

(a) 51·5 S cm^2 mol^{-1}

(b) 91·3 S cm^2 mol^{-1}

(c) 151·5 S cm^2 mol^{-1}

(d) 201·0 S cm^2 mol^{-1}

68. The correct order of molar conductance at infinite dilution of LiCl, NaCl and KCl is

(a) LiCl > NaCl > KCl

(b) KCl > NaCl > LiCl

(c) NaCl > KCl > LiCl

(d) KCl > LiCl > NaCl

69. Consider the following statements regarding ionic molar conductivities :

Statement–1 :

With increasing dilution, the conductivity keeps on increasing.

Statement–2 :

With increasing dilution, the degree of ionization of weak electrolytes increases, and the mobility of ions also increases.

Which one of the following is correct with respect to the above statements?

(a) Both Statement–1 and Statement–2 are true and Statement–2 is the correct explanation of Statement–1

(b) Both Statement–1 and Statement–2 are true and Statement–2 is not the correct explanation of Statement–1

(c) Statement–1 is true but Statement–2 is false

(d) Statement–1 is false but Statement–2 is true

70. Consider the following statements regarding ionic molar conductivities :

Statement–1 :

The Walden's rule holds good for tetramethylammonium ion and picrate ion.

Statement–2 :

The effective radii of tetramethyl-ammonium ion and picrate ion in the solvent are larger and very different from the crystallographic radii of the ions.

Which one of the following is correct with respect to the above statements?

(a) Both Statement–1 and Statement–2 are true and Statement–2 is the correct explanation of Statement–1

(b) Both Statement–1 and Statement–2 are true and Statement–2 is not the correct explanation of Statement–1

(c) Statement–1 is true but Statement–2 is false

(d) Statement–1 is false but Statement–2 is true

71. Consider the following statements regarding movement of ions :

1. Ionic mobility is inversely proportional to the potential gradient.
2. Ionic mobility is directly proportional to the ionic speed.
3. Transport number of the ions is inversely proportional to the ionic speed.
4. Sum of the transport numbers of ions in a solution is equal to one.

Which of the statements given above are correct?

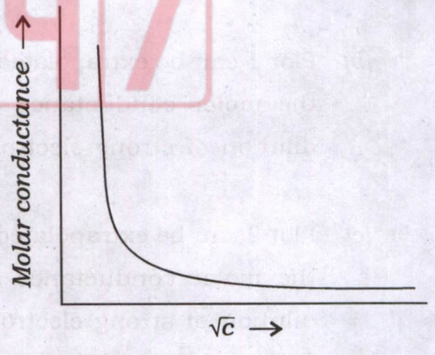
(a) 1 and 2 only

(b) 1, 2 and 3

(c) 3 and 4

(d) 1, 2 and 4

72. The following graph shows the variation of molar conductance with the concentration of a/an



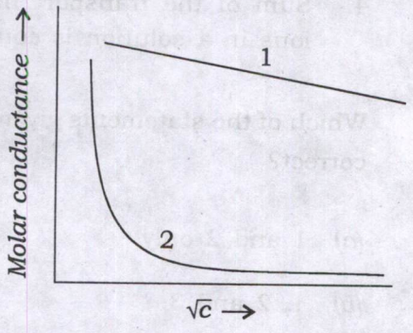
(a) strong acid

(b) weak acid

(c) buffer

(d) ethanol

73. Consider the following graph showing the variation of molar conductance with concentration :



Which one of the following statements is correct with respect to the above graph?

(a) Plot 1 can be extrapolated to obtain the molar conductance at infinite dilution of weak electrolytes.

(b) Plot 1 can be extrapolated to obtain the molar conductance at infinite dilution of strong electrolytes.

(c) Plot 2 can be extrapolated to obtain the molar conductance at infinite dilution of strong electrolytes.

(d) Both plots 1 and 2 can be extrapolated to obtain the molar conductance at infinite dilution of strong and weak electrolytes, respectively.

74. The term $A\sqrt{c}$ in the Onsager equation $\Lambda = \Lambda^{\infty} - (A + B\Lambda^{\infty})\sqrt{c}$ represents the

(a) decrease in molar conductivity due to the electrophoretic effect

(b) decrease in molar conductivity due to the asymmetry effect

(c) increase in molar conductivity due to the electrophoretic effect

(d) increase in molar conductivity due to the asymmetry effect

75. The conductivity of 0·001 *M* dichloroacetic acid solution is $3{\cdot}88 \times 10^{-5}$ S cm^{-1}. The molar conductivities at infinite dilution for HCl, NaCl and $CHCl_2COONa$ (sodium dichloroacetate) are 426 S cm^2 mol^{-1}, 126 S cm^2 mol^{-1} and 88 S cm^2 mol^{-1}, respectively. The degree of dissociation and dissociation constant of dichloroacetic acid will be respectively

(a) 0·2 and $1{\cdot}1 \times 10^{-6}$

(b) 0·1 and $1{\cdot}1 \times 10^{-6}$

(c) 0·2 and $1{\cdot}1 \times 10^{-4}$

(d) 0·1 and $1{\cdot}1 \times 10^{-5}$

76. The conductivity and molar conductance of CaF_2 at 18 °C are 4×10^{-5} S cm^{-1} and 200 S cm^2 mol^{-1}, respectively. The K_{sp} for CaF_2 will be

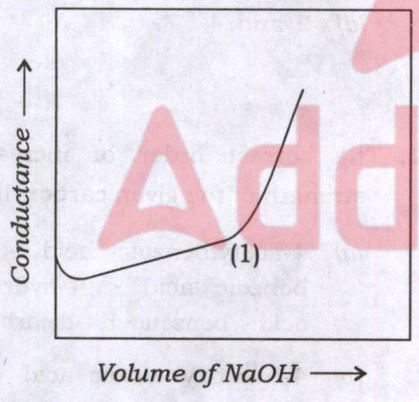
(a) $4{\cdot}0 \times 10^{-8}$

(b) $3{\cdot}2 \times 10^{-11}$

(c) $8{\cdot}0 \times 10^{-12}$

(d) $2{\cdot}0 \times 10^{-12}$

77. In the given plot of conductometric titration of CH_3COOH vs. NaOH, the area around point (1) is curved due to



(a) neutralization of weak acid with weak base

(b) hydrolysis of the salt CH_3COONa

(c) suppression of dissociation of CH_3COOH

(d) poor conductance of CH_3COOH

78. Consider the following table showing the apparent transport numbers of Cd^{2+} ion in CdI_2 solutions of different molalities :

m/mol kg^{-1}	t_+
0·05	0·40
0·1	0·36
1·0	0·30
2·5	0·10
4·0	–0·06
5·0	–0·12
8·0	–0·40
10·0	–0·60

Which one of the following interpretations is correct with respect to the table given above?

(a) In dilute solutions, Cd^{2+} ion migrates towards the anode and I^- migrates towards the cathode and vice versa in concentrated solutions.

(b) In dilute solutions, Cd^{2+} ion migrates towards the cathode and I^- migrates towards the anode and vice versa in concentrated solutions.

(c) In dilute solutions, Cd^{2+} ion migrates towards the cathode and I^- migrates towards the anode and in concentrated solutions, Cd^{2+} ion migrates towards the cathode and CdI_4^{2-} migrates towards the anode.

(d) In dilute solutions, Cd^{2+} ion migrates towards the anode and I^- migrates towards the cathode and in concentrated solutions, Cd^{2+} ion migrates towards the anode and CdI_4^{2-} migrates towards the cathode.

79. The transport number of ions in a 1·0 *M* solution of $AgNO_3$ was determined using a 0·3 *M* solution of $Cd(NO_3)_2$ in the moving boundary method. When a current of 15 mA was passed for 30 min, the boundary swept through a volume of 0·1 cm^3. The transport number of Ag^+ is (Faraday's constant = 96500 C mol^{-1})

(a) 0·36

(b) 0·64

(c) 0·71

(d) 0·83

80. Which of the following electrolytes should be given to a chemist to be used as an indicator electrolyte in the determination of the transport number of Ag^+ in $AgNO_3$ solution using the moving boundary method?

(a) $Cd(NO_3)_2$

(b) $LiNO_3$ only

(c) $CdCl_2$ only

(d) Both $LiNO_3$ and $CdCl_2$

81. Consider the following statements regarding structures of naphthalene and biphenylene :

1. The C1-C2 bond order is more than C2-C3 bond in naphthalene.
2. The C2-C3 bond order is more than C1-C2 bond in naphthalene.
3. The C1-C2 bond order is more than C2-C3 bond in biphenylene.
4. The C2-C3 bond order is more than C1-C2 bond in biphenylene.

Which of the statements given above are correct?

(a) 1 and 3

(b) 1 and 4

(c) 2 and 3

(d) 2 and 4

82. The correct order of increasing acid strength of the given carboxylic acids is

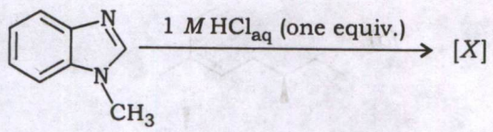
(a) 4-acetylbenzoic acid < 4-cyano-benzoic acid < 4-hydroxybenzoic acid < benzene-1,4-dicarboxylic acid

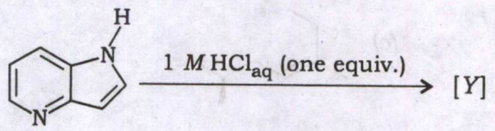
(b) 4-hydroxybenzoic acid < 4-acetyl-benzoic acid < 4-cyanobenzoic acid < benzene-1,4-dicarboxylic acid

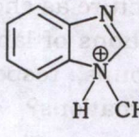
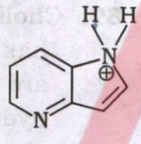
(c) 4-hydroxybenzoic acid < benzene-1,4-dicarboxylic acid < 4-acetyl-benzoic acid < 4-cyanobenzoic acid

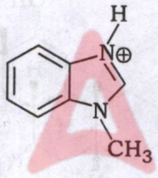
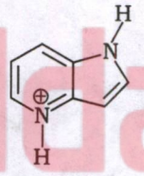
(d) 4-cyanobenzoic acid < 4-acetyl-benzoic acid < benzene-1,4-dicarboxylic acid < 4-hydroxy-benzoic acid

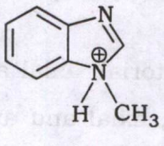
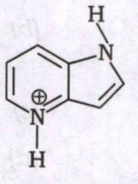
83. The major products [*X*] and [*Y*] formed in the following reactions are

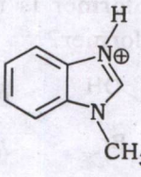
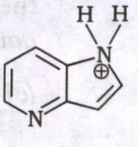




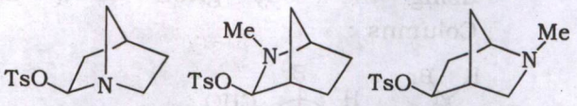
(a) [*X*] =  [*Y*] = 

(b) [*X*] =  [*Y*] = 

(c) [*X*] =  [*Y*] = 

(d) [*X*] =  [*Y*] = 

84. The correct decreasing order of reactivity towards ionization under acidic conditions of the following compounds is



I *II* *III*

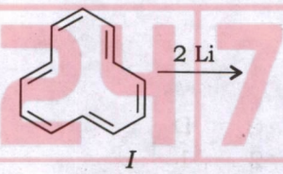
(a) *I* > *III* > *II*

(b) *I* > *II* > *III*

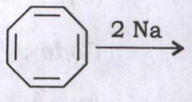
(c) *III* > *II* > *I*

(d) *II* > *III* > *I*

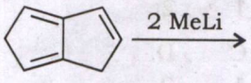
85. The products of which of the following reactions are aromatic in nature?



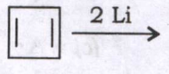
I



II



III



IV

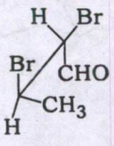
(a) *I*, *II* and *IV* only

(b) *II* and *III* only

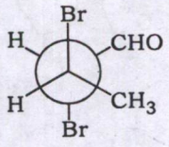
(c) *III* and *IV* only

(d) *I*, *II*, *III* and *IV*

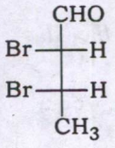
86. Match the pair of compounds from Column–I with their stereochemical relationship with each other from Column–II and select the correct answer using the code given below the Columns :



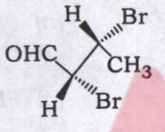
M



N



O



P

Column–I	*Column–II*
(A) *M* and *N*	1. Identical
(B) *M* and *O*	2. Diastereomers
(C) *M* and *P*	3. Enantiomers
(D) *N* and *P*	

Code :

(a)	A	B	C	D
	2	3	2	1
(b)	A	B	C	D
	3	3	1	2
(c)	A	B	C	D
	1	3	1	2
(d)	A	B	C	D
	3	1	2	1

87. Which one of the following has an achiral stereoisomer?

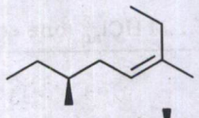
(a) 2,3-Dibromo-2,3-dimethylbutane

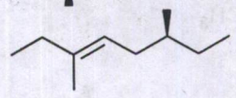
(b) 2-Bromo-4-methylpentan-3-ol

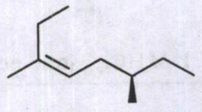
(c) 2,3-Dibromopentane

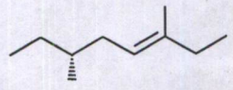
(d) 1,2-Dibromocyclobutane

88. The structure which is consistent with (*R*, *Z*)-3,6-dimethyloct-3-ene as its IUPAC name is

(a) 

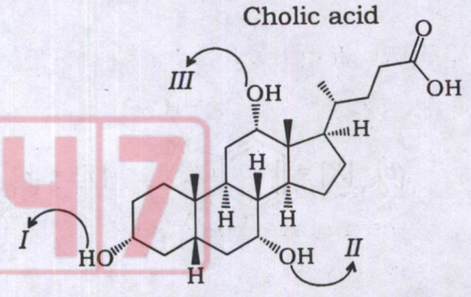
(b) 

(c) 

(d) 

89. Cholic acid, a major constituent of bile, has the structure as shown below. What are the positions of labeled *I*, *II* and *III* hydroxyl groups, respectively, in their chair conformations?

Cholic acid



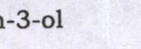
(a) Equatorial, equatorial and axial

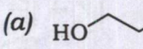
(b) Equatorial, equatorial and equatorial

(c) Equatorial, axial and axial

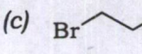
(d) Axial, axial and axial

90. In which one of the following compounds, the *anti*-conformer is more stable than *gauche* conformer?

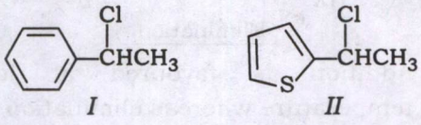
(a) 

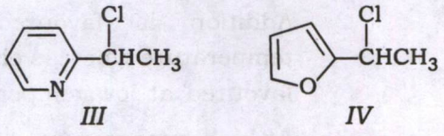
(b) 

(c)

(d) 

91. The increasing order of S_N1 solvolysis reactivity in ethanol of the following substrates is





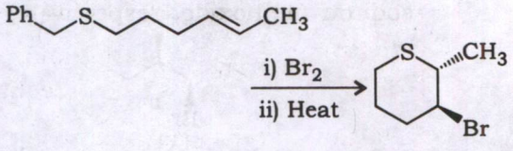
(a) *I* < *II* < *IV* < *III*

(b) *III* < *I* < *IV* < *II*

(c) *III* < *I* < *II* < *IV*

(d) *II* < *III* < *IV* < *I*

92. The number of S_N2 processes involved in the mechanism of the following reaction is



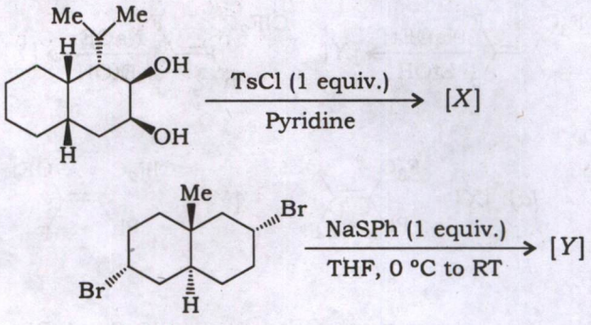
(a) two

(b) three

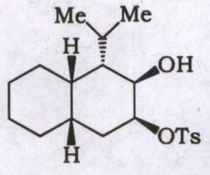
(c) four

(d) five

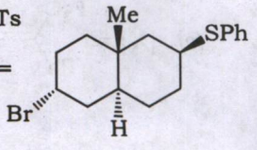
93. The major products [*X*] and [*Y*] formed in the following reactions are



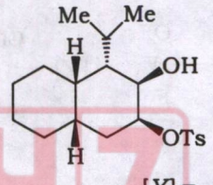
(a) [*X*] =



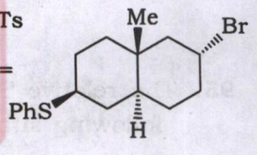
[*Y*] =



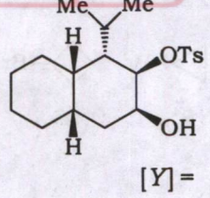
(b) [*X*] =



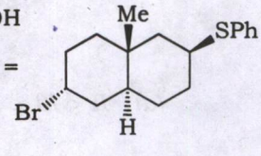
[*Y*] =



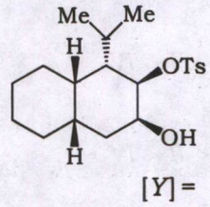
(c) [*X*] =



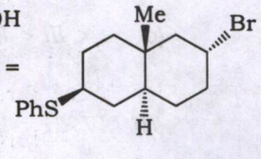
[*Y*] =



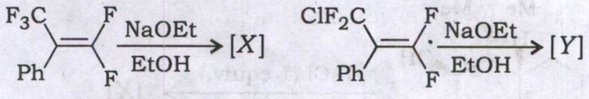
(d) [*X*] =

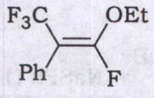
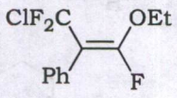


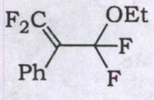
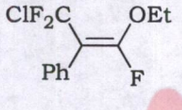
[*Y*] =

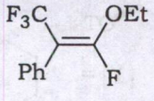
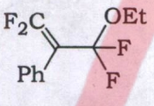


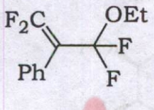
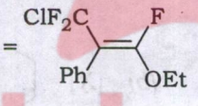
94. The major products [*X*] and [*Y*] formed in the following reactions are



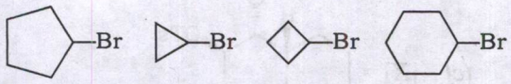
(a) [*X*] =  [*Y*] = 

(b) [*X*] =  [*Y*] = 

(c) [*X*] =  [*Y*] = 

(d) [*X*] =  [*Y*] = 

95. The relative S_N2 reactivity order of the following substrates is



I *II* *III* *IV*

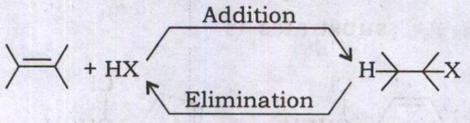
(a) *II* < *III* < *IV* < *I*

(b) *II* < *III* < *I* < *IV*

(c) *I* < *III* < *II* < *IV*

(d) *IV* < *I* < *III* < *II*

96. Which of the following statements are correct about the following reactions?

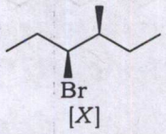


1. Addition is favoured at low temperature whereas elimination is favoured at high temperature.
2. Addition is favoured at high temperature whereas elimination is favoured at low temperature.
3. At high temperature, ΔG is positive for addition reaction whereas ΔG is negative for elimination reaction.
4. At high temperature, ΔG is negative for addition reaction whereas ΔG is positive for elimination reaction.

Select the correct answer using the code given below.

(a) 1 and 3
(b) 1 and 4
(c) 2 and 3
(d) 2 and 4

97. The major products formed in *E*2 and S_N2 reactions of the substrate [*X*] with sodium methoxide, respectively, are



[*X*]

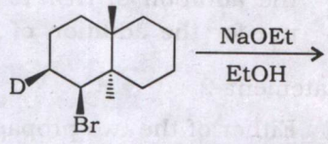
(a) (*Z*)-3-methylhex-3-ene and (3*R*,4*R*)-3-methoxy-4-methylhexane

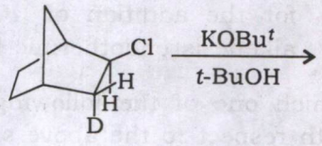
(b) (*Z*)-3-methylhex-3-ene and (3*R*,4*S*)-3-methoxy-4-methylhexane

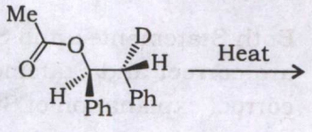
(c) (*E*)-3-methylhex-3-ene and (3*R*,4*S*)-3-methoxy-4-methylhexane

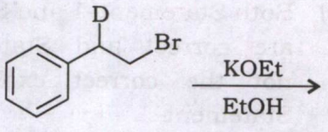
(d) (*E*)-3-methylhex-3-ene and (3*R*,4*R*)-3-methoxy-4-methylhexane

98. In which one of the following elimination reactions, deuterium is ***not*** retained in the alkene formed as the major product?

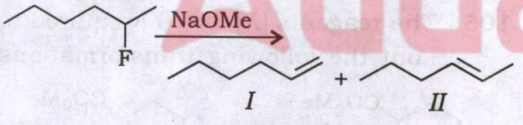
(a) 

(b) 

(c) 

(d) 

99. Which one of the following statements is correct regarding the given reaction?



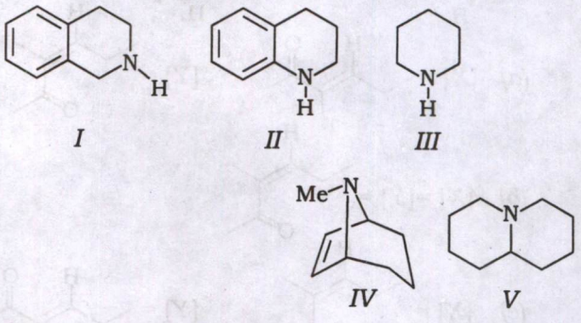
(a) The major product formed is *I* and is called Zaitsev product.

(b) The major product formed is *I* and is called Hofmann product.

(c) The major product formed is *II* and is called Zaitsev product.

(d) The major product formed is *II* and is called Hofmann product.

100. Which of the following substrates do ***not*** form trimethylamine as one of the products in its Hofmann exhaustive methylation method?



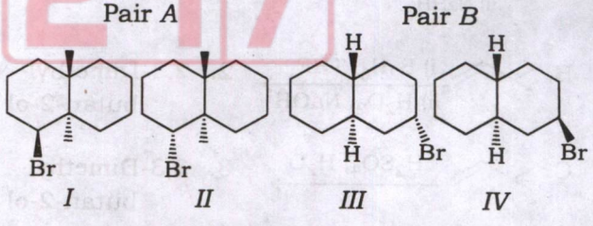
(a) *I*, *II* and *III*

(b) *I* and *II* only

(c) *III*, *IV* and *V*

(d) *IV* and *V* only

101. Which of the compounds in Pair *A* and Pair *B* are more reactive towards elimination reaction using NaOEt/EtOH?



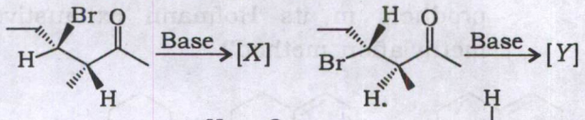
(a) Pair *A* : *I* is more reactive than *II*
Pair *B* : *III* is more reactive than *IV*

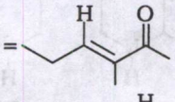
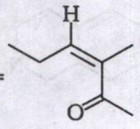
(b) Pair *A* : *I* is more reactive than *II*
Pair *B* : *IV* is more reactive than *III*

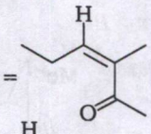
(c) Pair *A* : *II* is more reactive than *I*
Pair *B* : *III* is more reactive than *IV*

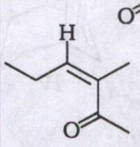
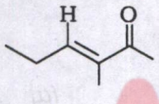
(d) Pair *A* : *II* is more reactive than *I*
Pair *B* : *IV* is more reactive than *III*

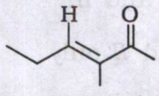
102. The major products [*X*] and [*Y*] formed in the following reactions are



(a) [*X*] =  [*Y*] = 

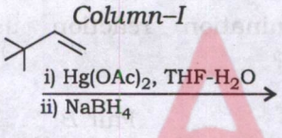
(b) [*X*] = [*Y*] = 

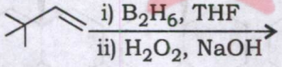
(c) [*X*] =  [*Y*] = 

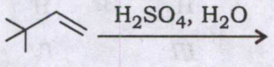
(d) [*X*] = [*Y*] = 

103. Match the reactions from Column–I with the major products formed from Column–II and select the correct answer using the code given below the Columns :

Column–I

A. 

B. 

C. 

Column–II

1. 3,3-Dimethyl-butan-1-ol
2. 2,3-Dimethyl-butan-2-ol
3. 3,3-Dimethyl-butan-2-ol
4. 2,3-Dimethyl-butan-1-ol

Code :

(a)	A	B	C
	2	4	1
(b)	A	B	C
	4	3	2
(c)	A	B	C
	3	1	2
(d)	A	B	C
	3	4	1

104. Consider the following statements :

Statement–1 :

The peroxide effect is observed for the addition of HBr to alkene but not for the addition of HCl or HI.

Statement–2 :

Either of the two propagation steps for the addition of HCl or HI to alkene is endothermic in nature.

Which one of the following is correct with respect to the above statements?

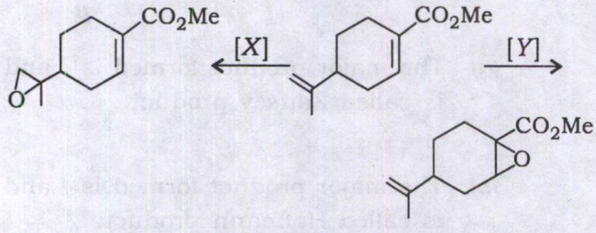
(a) Both Statement–1 and Statement–2 are correct and Statement–2 is the correct explanation of Statement–1

(b) Both Statement–1 and Statement–2 are correct and Statement–2 is not the correct explanation of Statement–1

(c) Statement–1 is correct but Statement–2 is incorrect

(d) Statement–1 is incorrect but Statement–2 is correct

105. The reagents [*X*] and [*Y*] required to carry out the following transformations are



(a) [*X*] = *m*-CPBA and [*Y*] = CH_3CO_3H

(b) [*X*] = CH_3CO_3H and [*Y*] = *m*-CPBA

(c) [*X*] = H_2O_2 /NaOH and [*Y*] = CH_3CO_3H

(d) [*X*] = CH_3CO_3H and [*Y*] = H_2O_2 /NaOH

106. Which one of the following statements is ***not*** correct regarding the following reaction?

Dibenzalacetone + 1 mol Diethylmalonate $\xrightarrow{NaOEt}$ Monocyclic product

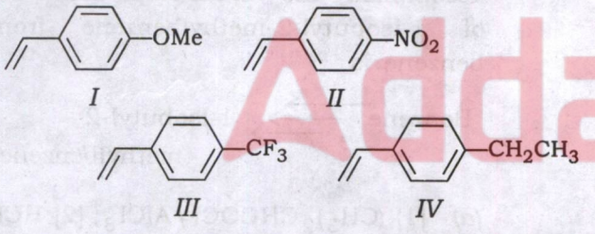
(a) The product is formed by two successive Michael additions.

(b) The product is formed by Michael addition followed by intra-aldol condensation.

(c) Monocyclic product does not give the test of unsaturation with bromine.

(d) The double bond equivalence of monocyclic product is twelve.

107. Classify the following substituted styrenes with respect to their preferred mode of addition polymerization and select the correct answer accordingly :



I *II* *III* *IV*

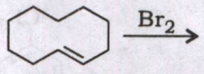
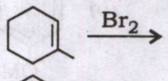
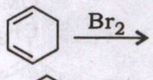
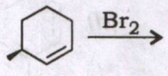
(a) *I* and *IV* undergo anionic polymerization while *II* and *III* undergo cationic polymerization

(b) *III* and *IV* undergo cationic polymerization while *I* and *II* undergo anionic polymerization

(c) *I*, *III* and *IV* undergo cationic polymerization while *II* undergoes anionic polymerization

(d) *I* and *IV* undergo cationic polymerization while *II* and *III* undergo anionic polymerization

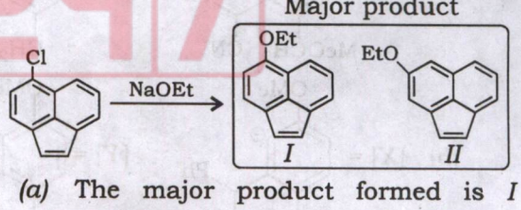
108. Match the reactions from Column–I with the stereochemical outcome of the products described in Column–II and select the correct answer using the code given below the Columns :

Column–I	*Column–II*
A. 	1. Formation of diastereomers
B. 	2. Formation of racemic mixture
C. 	3. Formation of *meso*-isomer
D. 	4. Formation of constitutional isomers

Code :

(a)	A	B	C	D
	2	1	4	3
(b)	A	B	C	D
	2	4	1	3
(c)	A	B	C	D
	3	2	4	1
(d)	A	B	C	D
	4	2	1	2

109. Which one of the following statements is correct for the indicated reaction?



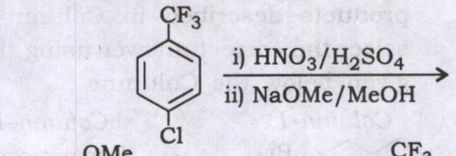
(a) The major product formed is *I* and the reaction proceeds through addition-elimination pathway.

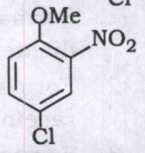
(b) The major product formed is *II* and the reaction proceeds through addition-elimination pathway.

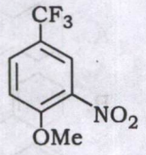
(c) The major product formed is *I* and the reaction proceeds through elimination-addition pathway.

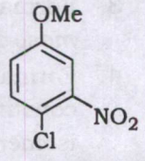
(d) The major product formed is *II* and the reaction proceeds through elimination-addition pathway.

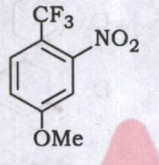
110. The major product formed in the following reaction is



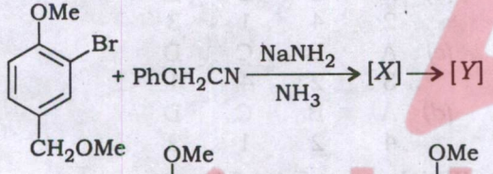
(a) 

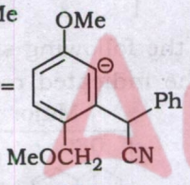
(b) 

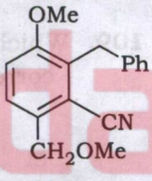
(c) 

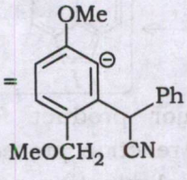
(d) 

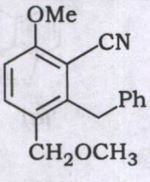
111. The intermediate [*X*] and the major product [*Y*] formed in the following reaction are

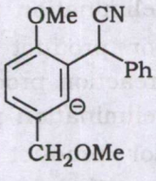


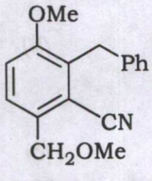
(a) [*X*] = 

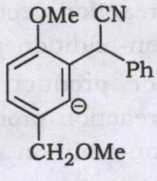
[*Y*] = 

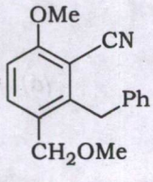
(b) [*X*] = 

[*Y*] = 

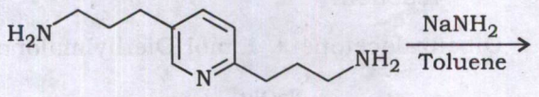
(c) [*X*] = 

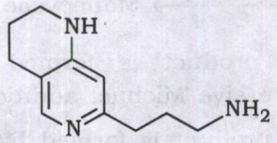
[*Y*] = 

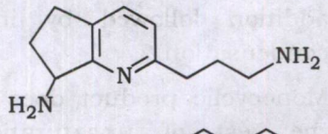
(d) [*X*] = 

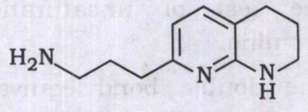
[*Y*] = 

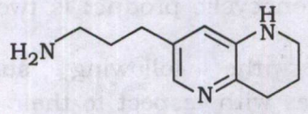
112. The major product formed in the following reaction is



(a) 

(b) 

(c) 

(d) 

113. The correct sequence of reactions to accomplish the multi-step synthesis of 1-isobutyl-2-methylbenzene from benzene is

Benzene ⟹ 1-Isobutyl-2-methylbenzene

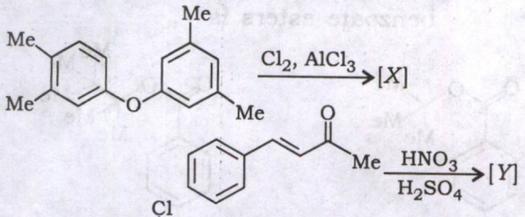
(a) [1] $(CH_3)_2CHCOCl / AlCl_3$; [2] HCl, Zn(Hg)/heat; [3] dilute H_2SO_4; [4] CH_3Cl, $AlCl_3$; [5] fuming H_2SO_4

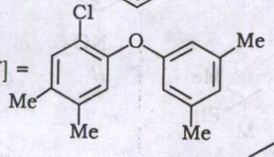
(b) [1] CH_3Cl, $AlCl_3$; [2] dilute H_2SO_4; [3] $(CH_3)_2CHCOCl / AlCl_3$; [4] HCl, Zn(Hg)/heat; [5] fuming H_2SO_4

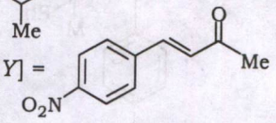
(c) [1] $(CH_3)_2CHCl / AlCl_3$; [2] fuming H_2SO_4; [3] CH_3Cl, $AlCl_3$; [4] dilute H_2SO_4

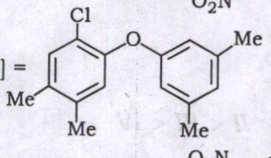
(d) [1] $(CH_3)_2CHCOCl / AlCl_3$; [2] HCl, Zn(Hg)/heat; [3] fuming H_2SO_4; [4] CH_3Cl, $AlCl_3$; [5] dilute H_2SO_4

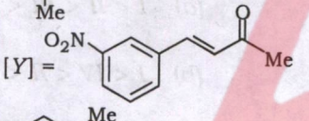
114. The major products [*X*] and [*Y*] formed in the following reactions are

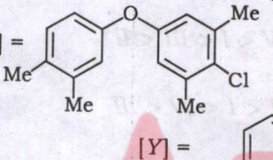


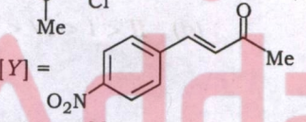
(a) [*X*] = 

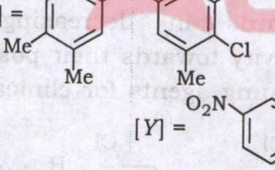
[*Y*] = 

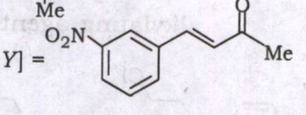
(b) [*X*] = 

[*Y*] = 

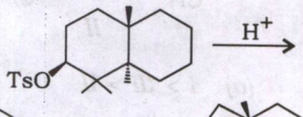
(c) [*X*] = 

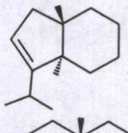
[*Y*] = 

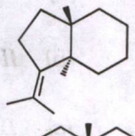
(d) [*X*] = 

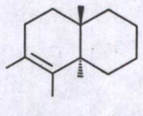
[*Y*] = 

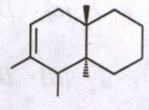
115. The major product formed in the following reaction is



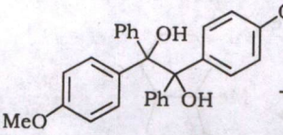
(a) 

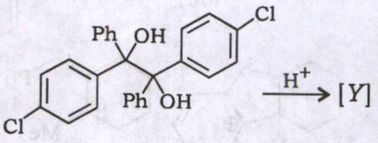
(b) 

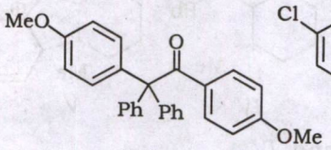
(c) 

(d) 

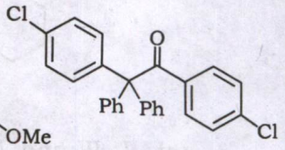
116. The major products [*X*] and [*Y*] formed in the following reactions are



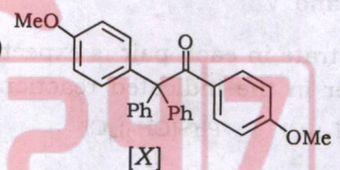


(a) 

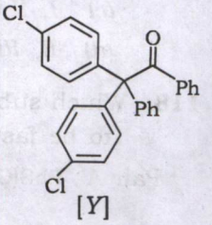
[*X*]



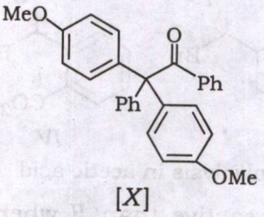
[*Y*]

(b) 

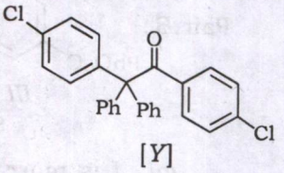
[*X*]



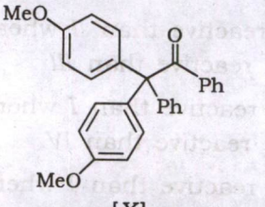
[*Y*]

(c) 

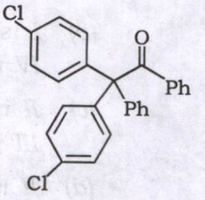
[*X*]



[*Y*]

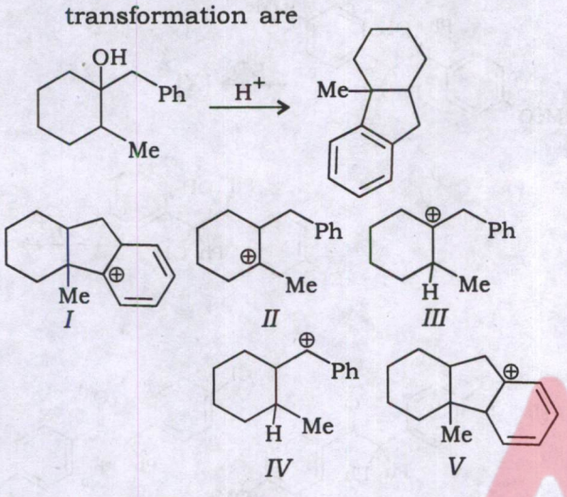
(d) 

[*X*]



[*Y*]

117. The reasonable carbocation intermediates which are likely to form in the reaction mechanism of the following transformation are



(a) *I*, *III* and *IV*

(b) *III*, *IV* and *V*

(c) *I*, *II* and *IV*

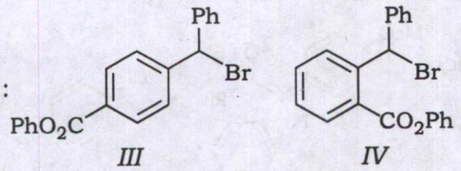
(d) *II*, *III* and *V*

118. Which substrate in each pair is expected to be faster in the indicated reaction?

Pair *A* : $PhS(CH_2)_3Cl$ (*I*) $PhS(CH_2)_4Cl$ (*II*)

Solvolysis in methanol

Pair *B* :



Solvolysis in acetic acid

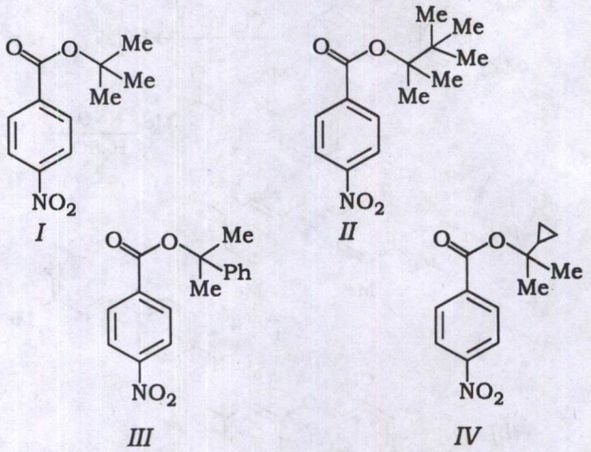
(a) *I* is more reactive than *II* whereas *III* is more reactive than *IV*

(b) *I* is more reactive than *II* whereas *IV* is more reactive than *III*

(c) *II* is more reactive than *I* whereas *III* is more reactive than *IV*

(d) *II* is more reactive than *I* whereas *IV* is more reactive than *III*

119. The relative rate of solvolysis in aqueous acetone of the following tertiary *p*-nitrobenzoate esters is



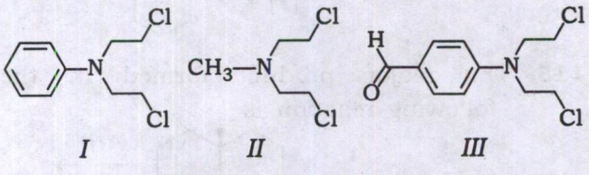
(a) *I* < *II* < *III* < *IV*

(b) *I* < *IV* < *II* < *III*

(c) *IV* < *I* < *III* < *II*

(d) *II* < *I* < *IV* < *III*

120. Arrange the following three nitrogen mustards in decreasing order of reactivity towards their possible use as alkylating agents for clinical purpose :



(a) *I* > *III* > *II*

(b) *II* > *I* > *III*

(c) *III* > *I* > *II*

(d) *II* > *III* > *I*

SPACE FOR ROUGH WORK

SPACE FOR ROUGH WORK

SPACE FOR ROUGH WORK

SPACE FOR ROUGH WORK

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