1.

The number of radial nodes for $2s$, $3p$ and $3d$ orbitals, respectively are:

    (a) 2, 1, 0

    (b) 2, 1, 1

    (c) 1, 0, 0

    (d) 1, 1, 0

2.

What fraction of the total number of electrons is in the p-sublevels in Iron (Fe)?

    (a) 50%

    (b) 49%

    (c) 46.15%

    (d) 47.82%

3.

Which is the correct order of degree of hydration among the following ions?

    (a) $Be^{2+} > Mg^{2+} > Sr^{2+} > Ba^{2+}$

    (b) $Be^{2+} > Sr^{2+} > Mg^{2+} > Ba^{2+}$

    (c) $Ba^{2+} > Sr^{2+} > Mg^{2+} > Be^{2+}$

    (d) $Ba^{2+} > Mg^{2+} > Sr^{2+} > Be^{2+}$

4.

Consider the following statements regarding diagonal relationship of 'B' and 'Si':

    1. The electronegativity values of both the elements are almost same

    2. Both the elements have almost identical values of their ionic potential

Which of the statements given above is/are correct?

    (a) 1 and 2

    (b) 1 only

    (c) 2 only

    (d) Neither 1 nor 2

5.

Consider the following statements regarding Lanthanum:

    1. It is a f-block element

    2. It is an inner transition element

    3. It is a transition series element

    4. It is a rare earth metal

Which of the statements given above are correct?

    (a) 1, 2, 3 and 4

    (b) 2 and 4 only

    (c) 1, 2 and 4 only

    (d) 1 and 3 only

6.

Argon (Ar) is used in arc welding because of its:

    (a) High calorific value

    (b) Ability to lower the melting point of metal

    (c) Low reactivity

    (d) Flammability

7.

Which one of the following represents the correct order of ionic radii among K^+, S^{2-}, Cl^- and Ca^{2+}?

    (a) $Ca^{2+} > K^+ > Cl^- > S^{2-}$

    (b) $S^{2-} > Cl^- > K^+ > Ca^{2+}$

    (c) $Cl^- > S^{2-} > K^+ > Ca^{2+}$

    (d) $K^+ > Ca^{2+} > S^{2-} > Cl^-$

8.

The dipole moments of H─C≡C─Cl, CO and HCl are in the directions:

    (a) ←, ← and ← respectively

    (b) ←, ← and → respectively

    (c) →, → and → respectively

    (d) ←, → and ← respectively

9.

Consider the following pairs of species of oxygen and their magnetic behavior:

    1. O_2^-, O_2^{2-} → Both diamagnetic

    2. O_2^+, O_2^{2-} → Both paramagnetic

    3. O_2^+, O_2^- → Both paramagnetic

    4.   O, O_2^{2-} → Both paramagnetic

Which of the pair(s) of oxygen species given above represents the correct magnetic behavior?

    (a) 1 only

    (b) 1 and 2

    (c) 3

    (d) 2 and 4

10.

Consider the following statements regarding the properties of Nitric oxide (NO):

    1.   Nitric oxide gas is paramagnetic but liquid nitric oxide is diamagnetic

    2.   Nitric oxide gas is diamagnetic but liquid nitric oxide is paramagnetic

    3.   Nitric oxide is a neutral oxide and is not an acid anhydride

Which of the statement(s) given above is/are correct?

    (a) 1 and 3

    (b) 1 only

    (c) 2 and 3

    (d) 2 only

11.

Which one of the following substances has the greatest ionic character?

    (a) Cl_2O

    (b) NCl_3

    (c) $PbCl_2$

    (d) $BaCl_2$

12.

Consider the following statements regarding Madelung constant:

Statement-1: Madelung constant typically increases with coordination number

Statement-2: Large contribution towards Madelung constant comes from nearest neighbors, and such neighbors are more numerous when coordination number is large

Which one of the following is correct in respect of 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 but 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

13.

Which one of the following represents the correct order of melting point among $BeCl_2$, $MgCl_2$, $CaCl_2$ and $NaCl$?

    (a) $BeCl_2 < MgCl_2 < CaCl_2 < NaCl$

    (b) $MgCl_2 < BeCl_2 < CaCl_2 < NaCl$

    (c) $BeCl_2 < MgCl_2 < NaCl < CaCl_2$

    (d) $BeCl_2 < CaCl_2 < MgCl_2 < NaCl$

14.

What kind of defect(s) appear in AgBr crystal?

    (a) Schottky and Frenkel

    (b) Frenkel only

    (c) Schottky only

    (d) Metal excess defect

15.

Consider the following statements:

    1. N_2 molecule is paramagnetic

    2. O_2 molecule is diamagnetic

    3. CO^+ has more bond order than CO

    4. NO^+ has less bond order than NO

Which of the statement(s) given above is/are correct?

    (a) 1 and 4

    (b) 1 and 2

    (c) 3

    (d) 2 only

16.

The correct order of the bond angles among NH_3, NH_4^+ and NH_2^- is:

    (a) $NH_3 > NH_4^+ > NH_2^-$

    (b) $NH_4^+ > NH_3 > NH_2^-$

    (c) $NH_3 > NH_2^- > NH_4^+$

    (d) $NH_4^+ > NH_2^- > NH_3$

17.

Consider the following statements:

Statement-1: KO_2 is paramagnetic

Statement-2: The super oxide O_2^- is paramagnetic because it has one unpaired electron in π^* 2p molecular orbital

Which one of the following is correct in respect of 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 but 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

18.

Which one of the following is NOT a resonance structure of cyanate (OCN^-)?

(a)

(b)

(c)

(d)

19.

What are the spin only magnetic moments (in BM) for Ni (II) ion in a square planar and octahedral geometry, respectively?

(a) 0 (zero) and 2.83

(b) 2.83 and 0 (zero)

(c) 2.83 and 2.83

(d) 0 (zero) and 0 (zero)

20.

Which one of the following complexes is tetrahedral as well as diamagnetic?

(a) $[Ni(NH_3)_4]^{2+}$

(b) $[NiCl_4]^{2-}$

(c) $[Ni(CO)_4]$

(d) $[Ni(CN)_4]^{2-}$

21.

Which one of the following will NOT precipitate AgCl while reacting with excess of $AgNO_3$ solution at room temperature?

(The oxidation state of cobalt (Co) in all the complexes is +3)

(a) $CoCl_3.6NH_3$

(b) $CoCl_3.5NH_3$

(c) $CoCl_3.4NH_3$

(d) $CoCl_3.3NH_3$

22.

Which one of the following complexes CANNOT be ionized in solution?

    (a) $[Pt(NH_3)_6]Cl_4$

    (b) $K_2[PtF_6]$

    (c) $K_4[Fe(CN)_6]$

    (d) $[Co(NH_3)_3Cl_3]$

23.

The maximum denticity of the polydentate ligand tetraethylene pentamine is equal to:

    (a) 4

    (b) 2

    (c) 5

    (d) 3

24.

The correct IUPAC name of $K_2[Zn(OH)_4]$ is:

    (a) Dipotassium tetrahydroxo zinc (II)

    (b) Potassium tetrahydroxo zinc (II)

    (c) Potassium tetrahydroxido zincate (II)

    (d) Dipotassium tetrahydroxido zincate (II)

25.

Which one of the following octahedral complexes does NOT show geometrical isomerism?
('A' and 'B' are monodentate ligands)

    (a) $[MA_2B_4]$

    (b) $[MA_3B_3]$

    (c) $[MA_4B_2]$

    (d) $[MA_5B]$

26.

Which one of the following will NOT show optical isomerism?

    (a) $[Cr(C_2O_4)_3]^{3-}$

    (b) *Cis*-$[PtCl_2(en)_2]^{2+}$

    (c) $[Co(EDTA)]^-$

    (d) $[PtCl_2(NH_3)_2]$

27.

How many isomers are possible for $[Co(en)_2Cl_2]^+$ complex ion?

    (a) 1

    (b) 2

    (c) 3

    (d) 4

28.

Which one of the following equilibria will shift to the left in response to increase in pressure?

    (a) $N_2 + 3H_2 \leftrightarrows 2NH_3 + 22.2$ Kcal

    (b) $H_2 + I_2 + 12.4$ Kcal $\leftrightarrows 2HI$

    (c) $N_2 + O_2 \leftrightarrows 2NO - 43.2$ Kcal

    (d) $N_2O_4 + 14$ Kcal $\leftrightarrows 2NO_2$

29.

The correct order of the acidic strength of H_3PO_4, H_3PO_3 and H_3PO_2 is:

    (a) H_3PO_2 > H_3PO_3 > H_3PO_4

    (b) H_3PO_4 > H_3PO_3 > H_3PO_2

    (c) H_3PO_4 > H_3PO_2 > H_3PO_3

    (d) H_3PO_3 > H_3PO_4 > H_3PO_2

30.

Which one of the following substances has highest proton affinity?

    (a) H_2O

    (b) NH_3

    (c) H_2S

    (d) CH_3COOH

31.

An aqueous solution of HN_3 was diluted two times, three times, four times and five times using required amount of water. Considering 'α' to be the ionization constant and 'V' as the final volume of diluted solution, choose the correct answer from the following:

    (a) All the solutions will be acidic and the graph of α vs. V is non-linear

    (b) All the solutions will be basic and the graph of α vs. V is non-linear

    (c) All the solutions will be acidic and the graph of α vs. V is linear

    (d) All the solutions will be basic and the graph of α vs. V is linear

32.

Which one of the following represents the correct order of acidity of water and alcohols?

    (a) H_2O > RCH_2OH > R_2CHOH > R_3COH

    (b) RCH_2OH > R_2CHOH > R_3COH > H_2O

    (c) H_2O < RCH_2OH < R_2CHOH < R_3COH

    (d) RCH_2OH < R_2CHOH < R_3COH < H_2O

33.

A student calculated the pH of 10^{-7} M NaOH solution and 10^{-8} M HCl solution to be 7 and 8, respectively. To verify, the student performed experiment in laboratory using pH-meter. The instrument displays the pH of former and later solutions as 7.3 and 6.9, respectively. Choose the correct answer from the following:

    (a) The pH-meter is malfunctioned and the calculation results of the student are correct

    (b) The pH-meter is working properly and the calculation results of the student are incorrect

    (c) The pH-meter is malfunctioned and the calculation results of the student are wrong

    (d) The calculation results of the student are correct and the instrument is working properly only for acids

34.

Which one of the following has the pH value NOT equal to one?

    (a) 0.1 M HNO_3

    (b) 0.05 M H_2SO_4

    (c) 0.1 M CH_3COOH

    (d) 50 ml of 0.4 M HCl + 50 ml of 0.2 M NaOH

35.

What will be the pH of a buffer solution containing 0.20 mole of NH_4OH and 0.25 mole of NH_4Cl per litre?

(Dissociation constant of NH_4OH at room temperature is 1.81×10^{-5}, log1.81 = 0.2577 and log1.25 = 0.0969)

    (a) 9.161

    (b) 9.521

    (c) 8.161

    (d) 9.312

36.

The molarity of concentrated commercial HCl with 36 % (w/w) HCl and density 1.19 g/cm^3 is close to:

    (a) 11.7 M

    (b) 10.6 M

    (c) 11.2 M

    (d) 11.5 M

37.

Which one of the following primary standard is usually used to standardize KOH by titration?

    (a) Potassium acid phthalate

    (b) Sulphuric acid

    (c) Hydrochloric acid

    (d) Nitric acid

38.

While performing the titration between Mohr's salt solution and potassium dichromate solution using diphenylamine as indicator, a student forgot to add *o*-phosphoric acid. Choose the correct answer from the following:

    (a) The end point will be observed before the actual end point

    (b) The end point will be observed after the actual end point

    (c) The end point will never be observed

    (d) The end point will be observed at its actual end point as there was no need to add *o*-phosphoric acid

39.

Consider following statements in respect of titration between Ca^{2+} solution and EDTA solution using Eriochrome Black T as indicator (In):

    1. The end point will be red in color

    2. The end point will be blue in color

    3. The end point depends on pH of solution which is controlled by adding ammonia –ammonium citrate buffer

    4. The end point is observed since metal–In complex is more stable than metal–EDTA complex

Which of the statement(s) given above is/are correct?

    (a) 1, 3 and 4

    (b) 2, 3 and 4

    (c) 2 and 3 only

    (d) 2 only

40.

In acid base titration the color change of an indicator is expressed by:

$pH = pK'_{ln} + \log \frac{[In_B]}{[In_A]}$

(Where In_B = Indicator in the basic form, In_A = indicator in acid form)

The basic color of the indicator would be visible when:

   (a) $[In_B]/[In_A] > 10$
   (b) $[In_B]/[In_A] < 10$
   (c) $[In_A]/[In_B] > 10$
   (d) $[In_B] = [In_A]$

41.

Which one of the following comparisons of the average translational kinetic energy (K.E.) and the average molecular speeds of H_2 and N_2 gases at 300 K is correct?

	Average translational K.E.	Average molecular speed
(a)	$H_2 = N_2$	$H_2 = N_2$
(b)	$H_2 < N_2$	$H_2 > N_2$
(c)	$H_2 = N_2$	$H_2 < N_2$
(d)	$H_2 = N_2$	$H_2 > N_2$

42.

The expression of isothermal compressibility factor is:

(a) $K_T = \frac{1}{V}\left(\frac{\partial V}{\partial P}\right)_T$

(b) $K_T = -\frac{1}{V}\left(\frac{\partial V}{\partial P}\right)_T$

(c) $K_T = \frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_P$

(d) $K_T = -\frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_P$

43.

An equimolar mixture of H_2 and N_2 is allowed to effuse through a hole. What is the ratio of rate of diffusion of H_2 to that of N_2?

(M.W. of $H_2 = 2$ g mol^{-1} and M.W. of $N_2 = 28$ g mol^{-1})

   (a) 1 : 3.7
   (b) 3.7 : 1
   (c) 1 : 14
   (d) 14 : 1

44.

The temperature at which the average velocity of Nitrogen (N_2) is equal to that of Oxygen (O_2) at 320 K is:

(M.W. of $N_2 = 28$ g mol^{-1} and M.W. of $O_2 = 32$ g mol^{-1})

   (a) 365.68 K
   (b) 280 K
   (c) 225 K
   (d) 300 K

45.

Which one of the following relations for three types of velocities is true for oxygen gas at 300 K?
(where $\langle c^2 \rangle^{1/2}$ = root mean square velocity; $\langle c \rangle$ = average velocity; c_p = most probable velocity)

   (a) $\langle c^2 \rangle^{1/2} > c_p > \langle c \rangle$

   (b) $\langle c \rangle > c_p > \langle c^2 \rangle^{1/2}$

   (c) $\langle c^2 \rangle^{1/2} > \langle c \rangle > c_p$

   (d) $\langle c \rangle > \langle c^2 \rangle^{1/2} > c_p$

46.

Consider the following statements regarding the most probable speed of gas particles:

   1. The most probable speed increases with increasing temperature and with decreasing molar mass and simultaneously distribution becomes broader
   2. The most probable speed increases with increasing temperature and with increasing molar mass and distribution becomes sharp
   3. The most probable speed decreases with the decrease of temperature and with increasing molar mass and simultaneously distribution becomes sharp

Which of the statement(s) given above is/are correct?

   (a) 1 and 3

   (b) 2 and 3

   (c) 1 only

   (d) 2 only

47.

One hundred molecules of Oxygen (O_2) escape through a small hole on a container at a pressure of 1 torr and temperature of 300 K per second to vacuum. The number of hydrogen molecules that would escape per second through the same hole under the same conditions of temperature and pressure is:
(M.W. of O_2 = 32 g mol^{-1} and M.W. of H_2 = 2 g mol^{-1})

   (a) 1200

   (b) 800

   (c) 1600

   (d) 400

48.

The mean free path of a gas is:

   (a) Independent of temperature but dependent on pressure

   (b) Independent of pressure but dependent on temperature

   (c) Independent of both pressure and temperature

   (d) Dependent on both pressure and temperature

49.

Which one of the following is NOT a Maxwell thermodynamic relation?

   (a) $\left(\frac{\partial S}{\partial V} \right)_T = \left(\frac{\partial P}{\partial T} \right)_V$

   (b) $\left(\frac{\partial S}{\partial P} \right)_T = \left(\frac{\partial V}{\partial T} \right)_P$

   (c) $\left(\frac{\partial V}{\partial S} \right)_P = \left(\frac{\partial T}{\partial P} \right)_S$

   (d) $-\left(\frac{\partial P}{\partial S} \right)_V = \left(\frac{\partial T}{\partial V} \right)_S$

50.

Consider the following first order elementary reaction:

$$A_{(g)} \xrightleftharpoons[K_2]{K_1} B_{(g)}$$
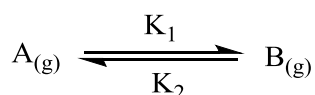
The half-life period of the forward reaction is 10 min. and that of the backward reaction is 1 min. What is the value of equilibrium constant for the above reaction?

    (a) 0.693

    (b) 0.0693

    (c) 0.10

    (d) 10.0

51.

Consider the following figure representing the increase in entropy of a substance from absolute zero to its gaseous state with temperature change:
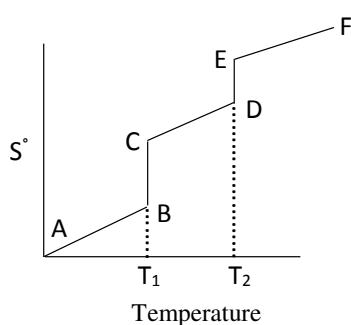
ΔS° (fusion) and ΔS° (vaporization) are respectively indicated by:

    (a) AB and BC

    (b) BC and CD

    (c) BC and DE

    (d) CD and DE

52.

Consider the following quantities:

    1. Concentration

    2. Volume

    3. Standard electrode potential

    4. Internal energy

Which of the following statements given below are correct?

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

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

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

    (d) 1, 2 and 4 are extensive quantities; 3 is intensive quantity

53.

Joule Thomson coefficient for a gas is given by:

(a) $\mu_{JT} = - C_P \left(\frac{\partial H}{\partial P}\right)_T$

(b) $\mu_{JT} = - \left(\frac{\partial H}{\partial P}\right)_T$

(c) $\mu_{JT} = - \frac{1}{C_P} \left(\frac{\partial H}{\partial P}\right)_T$

(d) $\mu_{JT} = \frac{1}{C_P} \left(\frac{\partial H}{\partial P}\right)_T$

54.

Consider the following statements regarding Joule Thomson effect:

1. Joule Thomson effect occurs at constant enthalpy
2. For perfect gas Joule Thomson coefficient is zero
3. Heating effect corresponds to positive value of Joule Thomson coefficient

Which of the statements given above is/are correct?

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

55.

For the reaction $H_2F_{2(g)} \rightarrow H_{2(g)} + F_{2(g)}$, ΔH is equal to:

(a) $\Delta E + 2RT$
(b) $\Delta E - 2RT$
(c) ΔE
(d) $\Delta E + RT$

56.

Which of the following thermodynamic relations are correct?

1. $\underset{T \to 0}{Lim}\ S = 0$

2. $S_T = \int_0^T \frac{C_P\ dT}{T}$

3. $-\Delta S = \left(\frac{\partial (\Delta G)}{\partial T}\right)_P$

Select the correct answer using the code given below:

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

57.

What is the sign of ΔG° and the value of K for an electrochemical cell for which $E^\circ_{cell} = 0.80V$?

(a) ΔG° is negative and K >1
(b) ΔG° is positive and K>1
(c) ΔG° is positive and K<1
(d) ΔG° is negative and K<1

58.

If $\Delta G = \Delta H - T\Delta S$ and $\Delta G = \Delta H + T \left(\frac{\delta(\Delta G)}{\delta T}\right)_P$ then the variation of emf of cell (E°) with temperature

T at constant pressure is given by:

(a) $\frac{\Delta H}{nF}$

(b) $\frac{\Delta G}{nF}$

(c) $\frac{\Delta S}{nF}$

(d) $-\frac{\Delta S}{nF}$

59.

Which of the following is correct about the sign of enthalpy and entropy changes of an evaporating liquid?

(a) ΔH is positive; ΔS is positive

(b) ΔH is negative; ΔS is negative

(c) ΔH is positive; ΔS is negative

(d) ΔH is negative; ΔS is positive

60.

Consider the following equilibrium process at 373K and 1 atm. pressure:

$$H_2O_{(l)} \rightleftharpoons H_2O_{(g)}$$
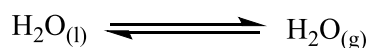
Which one of the following relations is true for the above process?

(a) $\Delta H = 0$

(b) $\Delta E = 0$

(c) $\Delta H = T\Delta S$

(d) $\Delta H = \Delta E$

61.

Which one of the following aqueous solutions has the lowest vapor pressure at room temperature?

(a) 0.1 molal hexaamminecobalt (III) chloride

(b) 0.1 molal barium chloride

(c) 0.1 molal glucose

(d) 0.1 molal Tris (ethylenediamine) copper (II) sulfate

62.

Compared to pure water, 1 M sugar-water solution will have a:

(a) Lower vapor pressure, lower boiling point and lower freezing point

(b) Lower vapor pressure, lower boiling point and higher freezing point

(c) Lower vapor pressure, higher boiling point and lower freezing point

(d) Higher vapor pressure, higher boiling point and higher freezing point

63.

The relation between osmotic pressure (Π) and lowering of vapor pressure in an infinitely dilute solution is:

(a) $\Pi = V^0 RT \ln \left(\frac{p}{p^0}\right)$

(b) $\Pi = \frac{RT}{V^0} \ln \left(\frac{p^0}{p}\right)$

(c) $\Pi = V^0 + RT \ln \left(\frac{p}{p^0}\right)$

(d) $\Pi = V^0 - RT \ln \left(\frac{p}{p^0}\right)$

64.

The vapor pressure of ethyl acetate at 293K is 72.8 torr. The vapor pressure of the solution obtained by dissolving 0.4 g of a non-volatile solute (molar mass = 60 gmol^{-1}) in 100 g of ethyl acetate at the same temperature is:

(a) 72.91 torr

(b) 72.37 torr

(c) 72.60 torr

(d) 72.00 torr

65.

People with high blood pressure are advised to have lower intake of salt in their food because:

1. Higher intake of salt causes higher osmotic pressure
2. It results in greater inflow of water in the cells and causes water retention in the tissue cells and intercellular spaces

Which of the statement(s) given above is/are correct?

(a) 1 only

(b) 2 only

(c) 1 and 2

(d) Neither 1 nor 2

66.

The equation $\Pi = c_2 RT$ is known as:

(where $c_2 = n_2/V$ is the molar concentration of the solute in the given solution and other symbols have their usual meanings)

(a) Van't Hoff equation

(b) Raoult's law equation

(c) Henry law equation

(d) Walden's rule

67.

The boiling point of Chloroform was raised by 0.325K when 5.141×10^{-4} kg of a non-volatile solute was dissolved in 35×10^{-3} kg of Chloroform. Calculate the molar mass of the solute?

(molal boiling point elevation constant for chloroform is 3.9 K kg mol^{-1})

(a) 0.215 kg mol^{-1}

(b) 0.176 kg mol^{-1}

(c) 0.195 kg mol^{-1}

(d) 0.151 kg mol^{-1}

68.

P is the total vapor pressure of an ideal binary liquid solution. If y_A and y_B are the amount fractions of the constituents in vapor phase, then which one of the following statements is correct?

(a) P varies linearly with y_A and y_B

(b) 1/P varies linearly with y_A and y_B

(c) P varies linearly with y_A and y_B and passes through origin

(d) 1/P varies linearly with y_A and y_B and passes through origin

69.

The Henry Law constant (K_i) for Hydrogen (H_2) in water at room temperature is 7.03×10^9 Pa. If the pressure of H_2 in equilibrium with water is 1.00×10^6 Pa at the same temperature, then the mole fraction of H_2 in the solution is:

(a) 0.00427

(b) 0.0427

(c) 0.000821

(d) 0.000142

70.

Specific conductance of a decimolar solution of KCl at 18°C is 1.12 Sm^{-1}. The resistance of a conductivity cell containing the solution at the same temperature was found to be 55 ohm. What is the cell constant?

(a) 0.616 cm^{-1}

(b) 0.716 cm^{-1}

(c) 0.516 cm^{-1}

(d) 0.699 cm^{-1}

71.

In acidic medium MnO_4^- converted to Mn^{2+}. The quantity of electricity in Faraday required to reduce 0.2 mole of MnO_4^- to Mn^{2+} would be:

(a) 0.2

(b) 0.4

(c) 1

(d) 2.5

72.

What will be the correct order of mobility of the following ions in aqueous solution at 298 K?

(a) $Cl^- > F^- > SO_4^{2-} > Br^-$

(b) $F^- > SO_4^{2-} > Br^- > Cl^-$

(c) $SO_4^{2-} > Br^- > Cl^- > F^-$

(d) $Br^- > SO_4^{2-} > Cl^- > F^-$

73.

At 291 K the ionic velocities of Ag^+ is 0.00057 cm/s and that of NO_3^- is 0.00063 cm/s. If the specific conductivity of 0.1N $AgNO_3$ solution is $0.00947 ohm^{-1}cm^{-1}$, then the degree of dissociation at this dilution is:

(a) 0.817

(b) 0.918

(c) 0.698

(d) 0.761

74.

Plots of equivalent conductance (Λ) *vs* square root of concentration ($\sqrt{C}$) of two electrolytes are given below, with Λ_0 being the equivalent conductance at infinite dilution:

(I)　　　　　　　　(II)
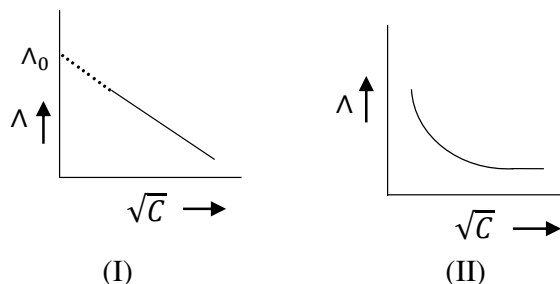
Which one of the following statements is correct?

(a) Plot I is for weak electrolyte and plot II is for strong electrolyte

(b) Extrapolation to Λ_0 as shown in plot I cannot be done

(c) Extrapolation to Λ_0 in plot II cannot be done to get the correct Λ_0

(d) Plots I and II are valid for any electrolyte for different range of concentrations

75.

Consider the following statements for an electrolyte solution which is diluted to approach infinite dilution:

　　　Statement-I:　Ion-ion interactions are reduced to effect the increase in conductance

　　　Statement-II:　The number of ions gets increased to effect increase in conductance

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

(a) Both the statements I and II are true for strong electrolytes

(b) Both the statements I and II are true for weak electrolytes

(c) Statement I is true for weak electrolytes and statement II is true for strong electrolytes

(d) Statement I is true for strong electrolytes and statement II is true for weak electrolytes

76.

The value of log $\gamma_\pm$ in the Debye-Huckel limiting law for a 0.01m KCl solution in water at 25 $^\circ$C is: (where $\gamma_\pm$ is the mean ionic activity coefficient)

(a) − 0.1018

(b) − 0.0509

(c) + 0.1018

(d) − 0.0254

77.

Consider the following plot:

Volume of base
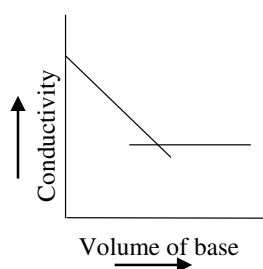
The above plot indicates the conductometric titration between:

    (a) Weak acid *vs* weak base

    (b) Strong acid *vs* weak base

    (c) Weak acid *vs* strong base

    (d) Strong acid *vs* strong base

78.

Consider the following plot for conductometric study of a reaction between KCl and $AgNO_3$ solutions:

Volume of $AgNO_3$ solution
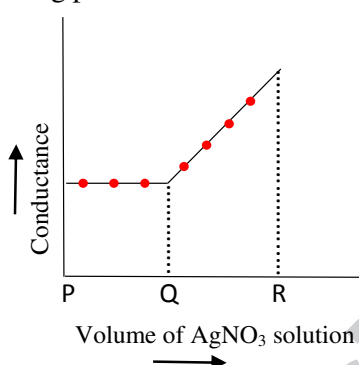
Cause/s behind the constancy of conductance in the region PQ is/are due to:

    (a) Precipitation of AgCl only

    (b) Replacement of Cl^- by NO_3^- with each species having equal conductance

    (c) Precipitation of AgCl and replacement of Cl^- by NO_3^-

    (d) Inert behavior of the instrument in this region

79.

Consider the following plot for the conductometric titration:
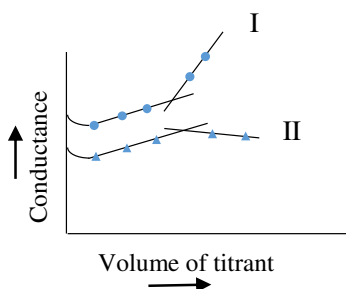
Which one of the following is correct in respect of above plot?

    (a) Plot I is for weak acid *vs* weak alkali; plot II is for weak acid *vs* strong alkali

    (b) Plot I is for strong acid *vs* strong alkali; plot II is for $AgNO_3$ solution *vs* NH_4Cl solution

    (c) Plot I is for $AgNO_3$ solution *vs* HCl; plot II is for $AgNO_3$ *vs* KCl

    (d) Plot I is for weak acid *vs* strong alkali; plot II is for weak acid *vs* weak alkali

80.

Two electrolytes AX and BX were chosen to determine transport number using moving boundary method. It is given that:

I: The cation B^+ moves slower than the cation A^+

II: The electrolyte BX is denser than AX

Which one of the following is correct?

    (a) The transport number of A^+ can be determined if AX is used as principal electrolyte and BX as indicator electrolyte

    (b) The transport number of B^+ can be determined if AX is used as indicator electrolyte and BX as principal electrolyte

    (c) The transport number of X^- can be determined if AX is used as indicator electrolyte and BX as principal electrolyte

    (d) The transport number of A^+, B^+ and X^- can be determined if AX is used as principal electrolyte and BX as indicator electrolyte

81.

The total number of delocalized pi-electrons in compounds I and II are:
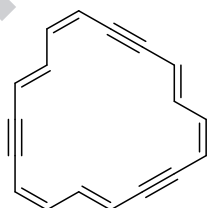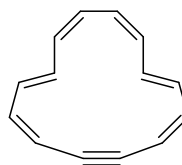
    (a) 18 and 14 respectively

    (b) 24 and 16 respectively

    (c) 16 and 12 respectively

    (d) 22 and 14 respectively

82.

Rank the following structures in order of increasing contribution to the resonance hybrid:
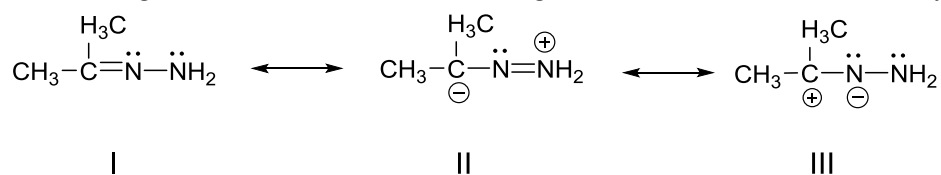
       I   II   III

    (a) II < I < III

    (b) III < II < I

    (c) III < I < II

    (d) I < II < III

83.

Which of the following indicated atoms in each species has sp^2-hybridization?
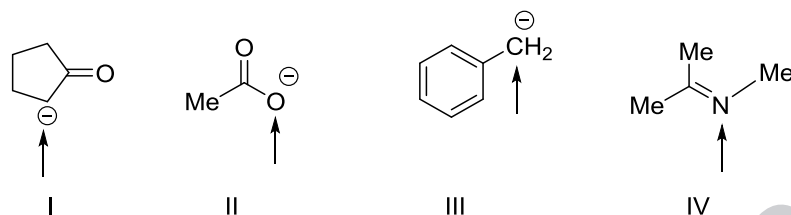
       I   II   III   IV

    (a) I and III only

    (b) I, III and IV only

    (c) II and IV only

    (d) I, II, III and IV

84.

The total number of hyperconjugative structures possible for the following carbocation is:
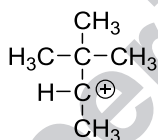
    (a) 3

    (b) 1

    (c) 4

    (d) 12

85.

Which one of the following statements regarding polarity of bonds is NOT true?

    (a) A compound with only one polar bond must be polar

    (b) A compound with two or more polar bonds will always be polar

    (c) A compound cannot be polar if it contains only nonpolar bonds

    (d) More electronegative atoms "pull" electron density towards them, making a dipole

86.

The correct order of the basicity of the following amines is:
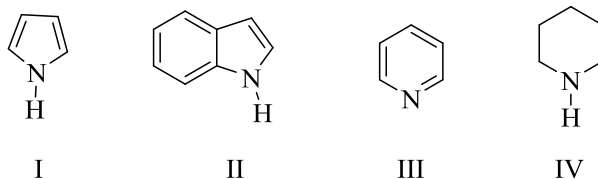
I   II   III   IV

(a) IV > III > II > I

(b) III > IV > I > II

(c) IV > III > I > II

(d) III > IV > II > I

87.

The correct order of stability of the following carbocations is:
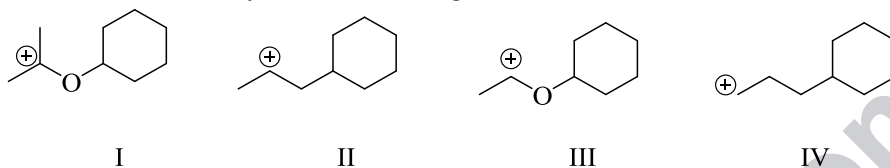
I   II   III   IV

(a) II > IV > I > III

(b) I > II > III > IV

(c) II > I > IV > III

(d) I > III > II > IV

88.

Rank the following compounds in order of their decreasing dipole moment:
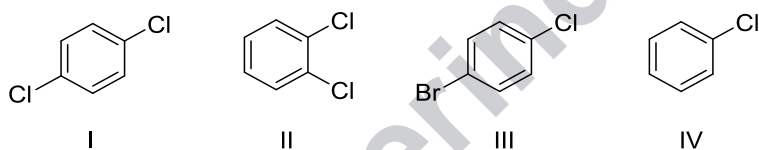
I   II   III   IV

(a) III > II > IV > I

(b) IV > III > I > II

(c) II > IV > III > I

(d) I > II > IV > III

89.

The relationship between the following pair of compounds is:
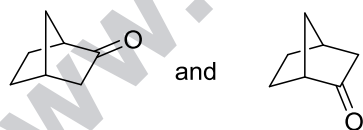
(a) Identical

(b) Enantiomers

(c) Diastereomers

(d) Constitutional isomers

90.

Consider the following set of compounds:

I   II   III   IV
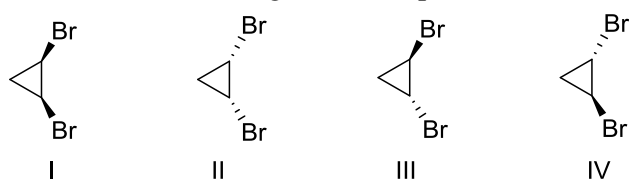
Which one of the following statements is NOT true about the above compounds (I–IV)?

    (a) I and II represent same structures and are *meso* compounds

    (b) [I and III] and [I and IV] are diastereomers

    (c) III and IV are enantiomers

    (d) III and IV are diastereomers

91.

The correct statement about the following molecule is:

COOH
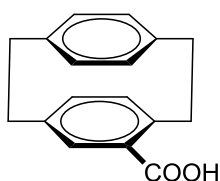
    (a) Molecule is chiral and possesses a chiral plane

    (b) Molecule is chiral and possesses a chiral axis

    (c) Molecule is achiral and possesses a plane of symmetry

    (d) Molecule is achiral and possesses a centre of symmetry

92.

A sample of lactic acid was found to have an enantiomeric excess (*ee*) of 14% with respect to R (+) isomer. What is the percentage of S (–) isomer in the sample?

    (a) 86

    (b) 57

    (c) 43

    (d) 72

93.

In 2-butanol observed angle of rotation is 1.03°, concentration of sample is 1M and length of sample tube is 10 cm. Specific angle of rotation will be:

    (a) 1.392°

    (b) 13.92°

    (c) 14.20°

    (d) 139.2°

94.

The absolute configuration of C2 and C3 in the following compound is:
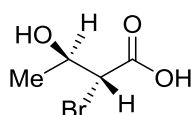
    (a) 2*R*, 3*S*

    (b) 2*S*, 3*R*

    (c) 2*S*, 3*S*

    (d) 2*R*, 3*R*

95.

The configuration of C1 and C2 carbons in the following molecule is:

C₆H₅
HO——1——H
Cl——2——H
CH₂CH₃
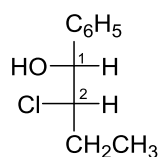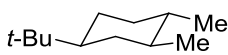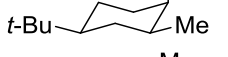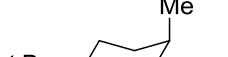
(a) 1*S*, 2*R*
(b) 1*R*, 2*R*
(c) 1*R*, 2*S*
(d) 1*S*, 2*S*

96.

The most stable conformation of the following compound is:

t-Bu ◄——————► Me
                 Me

(a) *t*-Bu ⟍⟍⟍⟍ Me
                  Me

(b) Me
     t-Bu ⟍⟍⟍⟍ Me

(c) Me
     t-Bu ⟍⟍⟍⟍
                  Me

(d) *t*-Bu ⟍⟍⟍⟍ Me
                  Me
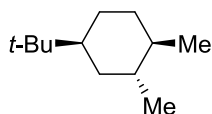
97.

The stereochemical notations for the following compound is:

OH   CH₃   Cl
            OH
         O
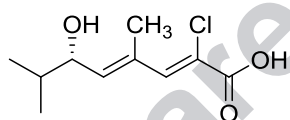
(a) 2*E*, 4*E*, 6*S*
(b) 2*Z*, 4*E*, 6*S*
(c) 2*Z*, 4*E*, 6*R*
(d) 2*Z*, 4*Z*, 6*R*

98.

The total number of geometrical isomers for the following compound is:

—CH=CH—CH=CH—CH=CH—
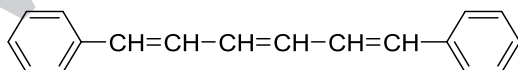
(a) 4
(b) 5
(c) 6
(d) 7

99.

The correct order of stability of Newman projections of 1, 2-dichloroethane is:

(a) anti > eclipsed > gauche

(b) gauche > eclipsed > anti

(c) gauche > anti > eclipsed

(d) anti > gauche > eclipsed

100.

Among the following, the Newman projections for *meso*-2,3-butanediol are:
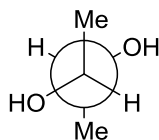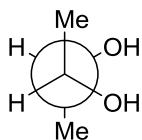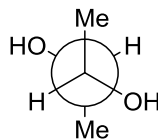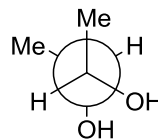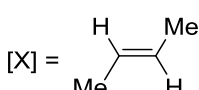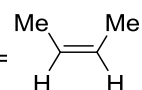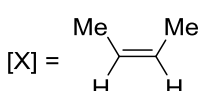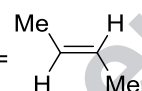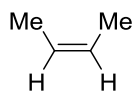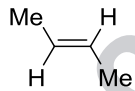
(a) I and II

(b) I and III

(c) III and IV

(d) II and IV

101.
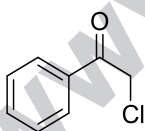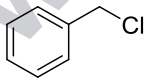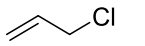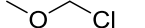
The major products [X] and [Y] formed in the following reactions are:

(a)

(b)

(c)

(d)
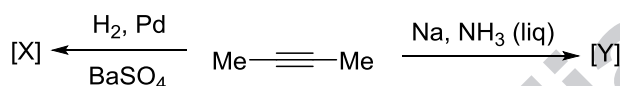
102.

Which one of the following chlorides undergoes a fastest S_N2 reaction with KI in acetone?

(a)

(b)

(c)

(d)

103.

Indicate the order of reactivity of HX in the following reaction:

ROH + HX $\longrightarrow$ RX + H$_2$O
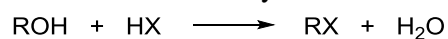
(a) HI > HBr > HCl

(b) HCl > HBr > HI

(c) HBr > HI > HCl

(d) HBr > HCl > HI

104.

Which isomer of 1,2,3,4,5,6-hexachlorocyclohexane shown below undergoes E2 elimination (dehydrohalogenation) most slowly?

(a)

(b)

(c)

(d)
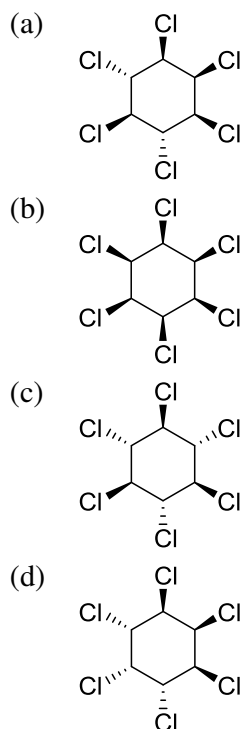
105.

The following reaction is an example of:

(a) E2 elimination

(b) E1 elimination

(c) E1cb elimination

(d) *Syn* elimination

106.
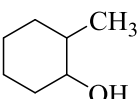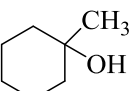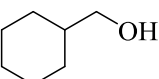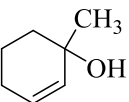
Which of the following statement is TRUE for the reaction mentioned below?

I   II
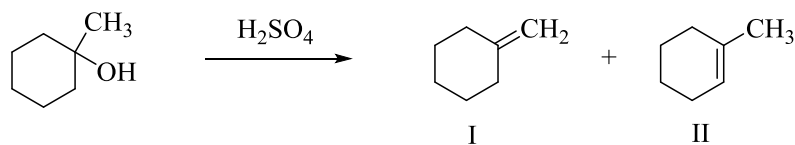
    (a) I is major and it is called Hoffmann product

    (b) I is minor and it is called Zaitsev product

    (c) II is major and it is called Zaitsev product

    (d) II is minor and it is called Hoffmann product

107.
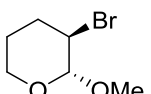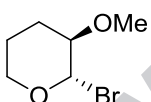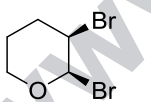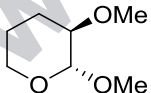
Which one of the following alcohols dehydrates the fastest when heated with acid?

(a)

(b)

(c)

(d)

108.

The major product formed in the following reaction is:
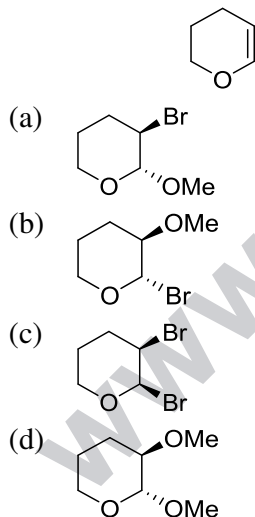
(a)

(b)

(c)

(d)

109.

Which one of the following alkenes will react most rapidly with concentrated sulphuric acid?

(a) $H_2C=CH_2$

(b) $(CH_3)_2C=CH_2$

(c) $Cl_2C=CCl_2$

(d) $F_3CCH=CHCH_3$
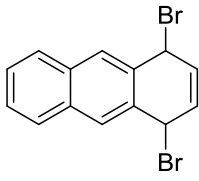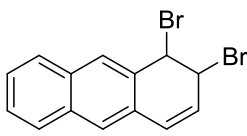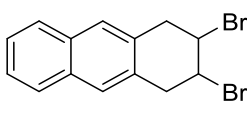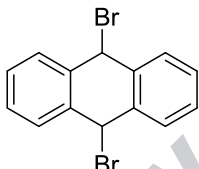
110.

The regioselective electrophilic addition of HOCl with propene proceeds through:

(a) $CH_3-\overset{\oplus}{C}H-CH_2Cl$

(b) $CH_3-\overset{\oplus}{C}H-CH_2OH$

(c)
$$CH_3-\underset{\underset{H}{|}}{\overset{\overset{OH}{|}}{C}}-\overset{\oplus}{C}H_2$$

(d)
$$CH_3-\underset{\underset{H}{|}}{\overset{\overset{Cl}{|}}{C}}-\overset{\oplus}{C}H_2$$

111.

Which one of the following products is formed when bromine adds to anthracene?

(a)

(b)

(c)

(d)

112.

The correct sequence of reactions to accomplish the following transformation is:
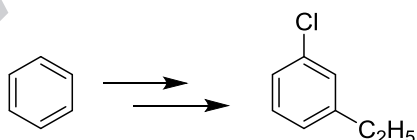
(a) (i) $CH_3CH_2Cl/AlCl_3$, (ii) $Cl_2/FeCl_3$

(b) (i) $Cl_2/FeCl_3$, (ii) $CH_3CH_2Cl/AlCl_3$

(c) (i) $CH_3COCl/AlCl_3$, (ii) $Cl_2/FeCl_3$, (iii) $Zn-Hg/HCl$

(d) (i) $CH_3COCl/AlCl_3$, (ii) $Zn-Hg/HCl$, (iii) $Cl_2/FeCl_3$

113.

The intermediate [X] and the major product [Y] formed in the following reaction are:
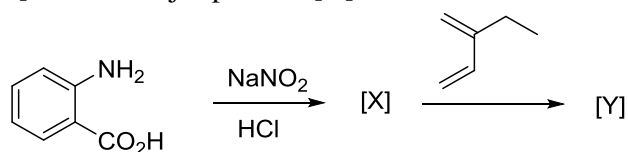
(a)

    [X] is carbocation and [Y] is
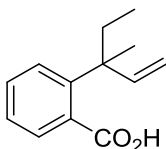
(b)

    [X] is carbanion and [Y] is
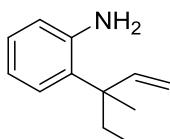
(c)

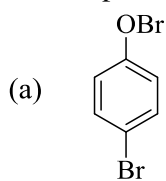   [X] is free radical and [Y] is
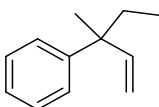
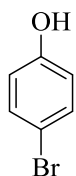(d)
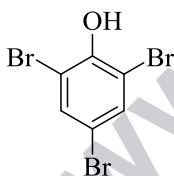
    [X] is benzyne and [Y] is
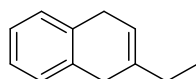
114.

Which is the major product formed in the reaction of phenol with bromine in carbon disulfide at 0–5°C temperature?
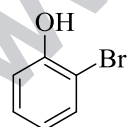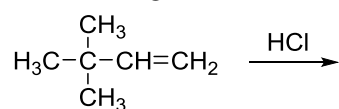
(a)

(b)

(c)

(d)

115.

Which is the major product formed in the reaction of *o*-chloroanisole with NaNH$_2$ in liquid ammonia at low temperature?

    (a) *o*-Anisidine

    (b) *m*-Anisidine

    (c) *p*-Anisidine

    (d) *o*-chloroaniline

116.

Predict the major product formed in the following reaction:
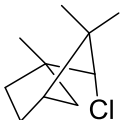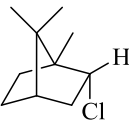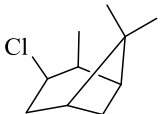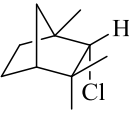
$$\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{H_3C-C-CH=CH_2}} \xrightarrow{\quad HCl \quad}$$

(a)
$$\underset{\underset{Cl}{|}}{\overset{\overset{CH_3}{|}}{H_3C-C-CH(CH_3)_2}}$$

(b)
$$\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{H_3C-C}}\underset{\underset{Cl}{|}}{\overset{\overset{H}{|}}{-C-CH_3}}$$

(c)
$$\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{H_3C-C}}\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{-C-CH_2Cl}}$$

(d)
$$\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{H_3C-C}}\underset{\underset{Cl}{|}}{\overset{\overset{H}{|}}{-C-CH_2Cl}}$$

117.

Consider the following reaction:

$$\xrightarrow{\text{HCl}} \text{'P'}$$
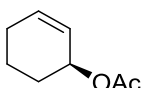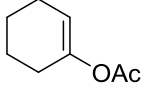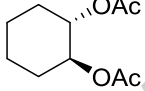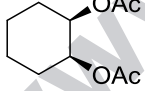
The major product 'P' of Wagner-Meerwein rearrangement is:

(a)

(b)

(c)

(d)

118.

The major product formed in the following reaction is:

$$\xrightarrow{\text{AcOH}}$$
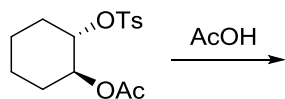
(a)

(b)

(c)

(d)

119.

Which one of the following is NOT a characteristic of neighboring group participation effect?

(a) An unusual stereochemical result

(b) An unexpectedly fast rate of reaction

(c) Formation of a rearranged product

(d) The extent of neighboring group participation increases with increasing the nucleophilicity of nucleophile in solvolysis reaction

120.

In which of the following solvents the neighboring group rate enhancement by phenyl group in the solvolysis of $PhCH_2CH_2OTs$ is maximum?

   (a) EtOH

   (b) HCOOH

   (c) CF_3COOH

   (d) CH_3COOH