CHEMISTRY

SECTION – A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer :

31. The correct order of hydration enthalpies is

(A) K^+ (B) Rb^{+p}

(C) Mg^{2+} (D) Cs^+

(E) Ca^{2+}

Choose the correct answer from the options given below:

(1) E > C > A > B > D (2) C > E > A > D > B

(3) C > A > E > B > D (4) C > E > A > B > D

Answer (4)

Sol. Hydration enthalpy $\propto$ charge density

$\therefore$ The correct order of charge density is

$Mg^{2+} > Ca^{2+} > K^+ > Rb^+ > Cs^+$

$\therefore$ The order of hydration enthalpy

C > E > A > B > D

32. Number of cyclic tripeptides formed with 2 amino acids A and B is:

(1) 3 (2) 2

(3) 4 (4) 5

Answer (2)

Sol. The cyclic tripeptides possible with amino acids A and B will be

AAB, BBA

There are only two possibilities.

33. Which of the given compounds can enhance the efficiency of hydrogen storage tank?

(1) Li/P_4

(2) $NaNi_5$

(3) SiH_4

(4) Di-isobutylaluminium hydride

Answer (2)

Sol. Tanks of metal alloy like $NaNi_5$, $Ti\text{-}TiH_2$, $Mg\text{-}MgH_2$ are used for the storage of dihydrogen.

34. Match List I with List II.

List I	List II
Antimicrobials	Names
(A) Narrow spectrum antibiotic	(I) Furacin
(B) Antiseptic	(II) Sulphur dioxide
(C) Disinfectants	(III) Penicillin G
(D) Broad spectrum antibiotic	(IV) Chloramphenicol

Choose the correct answer from the options given below:

(1) (A)-II, (B)-I, (C)-IV, (D)-III

(2) (A)-III, (B)-I, (C)-II, (D)-IV

(3) (A)-III, (B)-I, (C)-IV, (D)-II

(4) (A)-I, (B)-II, (C)-IV, (D)-III

Answer (2)

Sol. Narrow spectrum antibiotic $\rightarrow$ Penicillin G

Antiseptic $\rightarrow$ Furacin

Disinfectants $\rightarrow$ Sulphur dioxide

Broad spectrum antibiotic $\rightarrow$ chloramphenicol

$\therefore$ Correct matching is:

A $\rightarrow$ III, B $\rightarrow$ I, C $\rightarrow$ II, D $\rightarrow$ IV

35. During the borax bead test with $CuSO_4$, a blue green colour of the bead was observed in oxidising flame due to the formation of

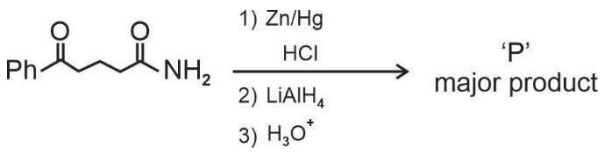
(1) CuO (2) $Cu(BO_2)_2$

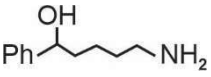
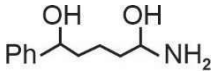
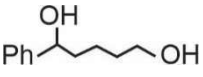
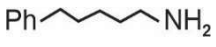
(3) Cu_3B_2 (4) Cu

Answer (2)

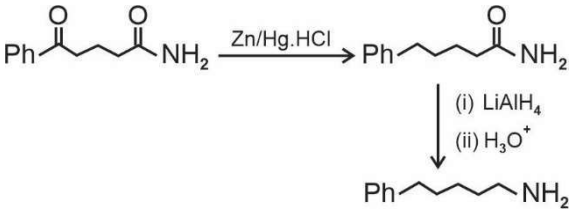
Sol. When borax is heated in a Bunsen burner flame with CuO on loop of platinum wire, a blue coloured $Cu(BO_2)_2$ bead is formed

36. The major product 'P' for the following sequence of reactions is :



(1) 
(2) 
(3) 
(4) 

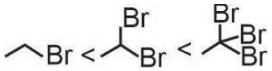
Answer (4)

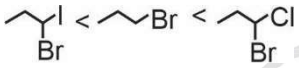
Sol. 

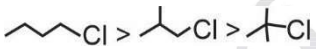
37. Identify the correct order for the given property for following compounds.

(A) Boiling Point : 

(B) Density : 

(C) Boiling Point : 

(D) Density : 

(E) Boiling Point : 

Choose the correct answer from the option given below :

(1) (A), (C) and (E) only (2) (A), (B) and (E) only

(3) (A), (C) and (D) only (4) (B), (C) and (D) only

Answer (1)

Sol. → As mass of the compound increases then their boiling point will also increase. Therefore 'A', 'C' are correct.

→ As branching of the compound increases then boiling point decreases. Therefore 'E' is correct.

Density of Et-Cl → 0.89 g/ml

Et -Br → 1.47 g/ml

Et -I → 1.94 g/ml

∴ Option 'B' is incorrect

* No option contains correct option

A, C and E are correct

38. "A" obtained by Ostwald's method involving air oxidation of NH_3, upon further air oxidation produces "B". "B" on hydration forms an oxoacid of Nitrogen along with evolution of "A". The oxoacid also produces "A" and gives positive brown ring test.

Identify A and B, respectively.

(1) NO, NO_2 (2) N_2O_3, NO_2

(3) NO_2, N_2O_4 (4) NO_2, N_2O_5

Answer (1)

Sol. Ostwald's process is :

$$4NH_3 + 5O_2 \longrightarrow \underset{(A)}{4NO} + 6H_2O$$

$$\underset{(A)}{2NO} + O_2 \longrightarrow \underset{(B)}{2NO_2}$$

$$4NO_2 + 2H_2O + O_2 \longrightarrow 4HNO_3$$

∴ A and B are NO and NO_2 respectively

39. The standard electrode potential (M^{3+}/M^{2+}) for V, Cr, Mn & Co are –0.26 V, –0.41 V, +1.57 V and +1.97 V, respectively. The metal ions which can liberate H_2 from a dilute acid are

(1) V^{2+} and Cr^{2+}

(2) V^{2+} and Mn^{2+}

(3) Cr^{2+} and Co^{2+}

(4) Mn^{2+} and Co^{2+}

Answer (1)

Sol. E° of H^+/H_2 is zero

∴ The metals having less reduction potential can produce H_2 gas with dilute acid.

∴ V and Cr metal can produce H_2 gas

40. Match List I with List II

List I	List II
Reaction	Reagents
(A) Hoffmann Degradation	(I) Conc.KOH, Δ
(B) Clemenson reduction	(II) $CHCl_3$, $NaOH/H_3O^{\oplus}$
(C) Cannizaro reaction	(III) Br_2, NaOH
(D) Reimer-Tiemann Reaction	(IV) Zn-Hg/HCl

Choose the correct answer from the option given below :

(1) (A)-III, (B) -IV, (C) – II, (D)-I

(2) (A)-III, (B) -IV, (C) –I, (D)-II

(3) (A)-II, (B) -IV, (C) –I, (D)-III

(4) (A)-II, (B) -I, (C) – III, (D)-IV

Answer (2)

Sol.

	Reaction		Reagents
(A)	Hoffmann degradation	$\longrightarrow$	Br_2, NaOH
(B)	Clemenson reduction	$\longrightarrow$	Zn-Hg/HCl
(C)	Cannizaro-reaction	$\longrightarrow$	Conc. KOH, Δ
(D)	Reimer-Tiemann reaction	$\longrightarrow$	$CHCl_3$, $NaOH/H_3O^+$

$\therefore$ Correct match is :

(A)-III, (B) -IV, (C) -I, (D)-II

41. The magnetic behavior of Li_2O, Na_2O_2 and KO_2, respectively, are

(1) Paramagnetic, paramagnetic and diamagnetic

(2) Diamagnetic, diamagnetic and paramagnetic

(3) Paramagnetic, diamagnetic and paramagnetic

(4) Diamagnetic, paramagnetic and diamagnetic

Answer (2)

Sol. $Li_2O \rightarrow$ diamagnetic

$Na_2O_2 \rightarrow$ diamagnetic

$KO_2 \rightarrow$ paramagnetic (as O_2^- is para magnetic)

42. The bond dissociation energy is highest for

(1) Cl_2 (2) I_2

(3) F_2 (4) Br_2

Answer (1)

Sol. Bond dissociation energy of Cl_2 is highest among the halogen.

43. The shortest wavelength of hydrogen atom in Lyman series is λ. The longest wavelength in Balmer series of He^+ is

(1) $\frac{5}{9\lambda}$ (2) $\frac{5\lambda}{9}$

(3) $\frac{36\lambda}{5}$ (4) $\frac{9\lambda}{5}$

Answer (4)

Sol. $\frac{hc}{\lambda} = 13.6$ (i)

For longest wavelength in Balmer series transition will be $3 \rightarrow 2$

$$\therefore \Delta E = 13.6 \times 2^2 \times \left(\frac{1}{4} - \frac{1}{9}\right)$$

$$= 13.6 \times 4 \times \frac{5}{4 \times 9}$$

$$\frac{hc}{\lambda^1} = 13.6 \times \frac{5}{9}$$

$$\therefore \lambda^1 = \frac{9}{5}\lambda$$

44. The reaction representing the Mond process for metal refining is _____.

(1) $Zr + 2I_2 \xrightarrow{\Delta} ZrI_4$

(2) $Ni + 4CO \xrightarrow{\Delta} Ni(CO)_4$

(3) $ZnO + C \xrightarrow{\Delta} Zn + CO$

(4) $2K[Au(CN)_2] + Zn \xrightarrow{\Delta} K_2[Zn(CN)_4] + 2Au$

Answer (2)

Sol. Mond process is need for the purification of Ni metal

$$\therefore \underset{\text{(impure)}}{Ni} + 4CO \xrightarrow{330-350\ k} Ni(CO)_4$$

$$Ni(CO)_4 \xrightarrow{450-470\ k} \underset{\text{(pure)}}{Ni} + 4CO$$

45. Chiral complex from the following is

Here en = ethylene diamine

(1) trans – $[Co(NH_3)_4Cl_2]^+$

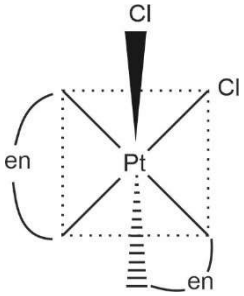
(2) cis – $[PtCl_2(en)_2]^{2+}$

(3) cis – $[PtCl_2(NH_3)_2]$

(4) trans – $[PtCl_2(en)_2]^{2+}$

Answer (2)

Sol. Cis – $[Pt\ Cl_2(en)_2]^{2+}$



has no any element of symmetry so it is optically active.

46. Compound that will give positive Lassaigne's test for both nitrogen and halogen is

(1) $CH_3NH_2 \cdot HCl$ (2) $NH_2OH \cdot HCl$

(3) NH_4Cl (4) $N_2H_4 \cdot HCl$

Answer (1)

Sol. $CH_3NH_2 \cdot HCl$ will give positive Lassaigne's test for both nitrogen and halogen.

47. Which of the following salt solutions would coagulate the colloid solution formed when $FeCl_3$ is added to NaOH solution, at the fastest rate?

(1) 10 mL of 0.1 mol dm^{-3} $Ca_3(PO_4)_2$

(2) 10 mL of 0.2 mol dm^{-3} $AlCl_3$

(3) 10 mL of 0.1 mol dm^{-3} Na_2SO_4

(4) 10 mL of 0.15 mol dm^{-3} $CaCl_2$

Answer (2)

Sol. In the coagulation of a negative sol, the flocculating power is in the order.

$\therefore$ $Al^{3+} > Ba^{2+} > Na^+$ and $FeCl_3$ with NaOH forms a negative sol.

$\therefore$ $AlCl_3$ coagulate it most.

48. The increasing order of pK_a for the following phenols is

(A) 2,4-Dinitrophenol

(B) 4-Nitrophenol

(C) 2,4,5-Trimethylphenol

(D) Phenol

(E) 3-Chlorophenol

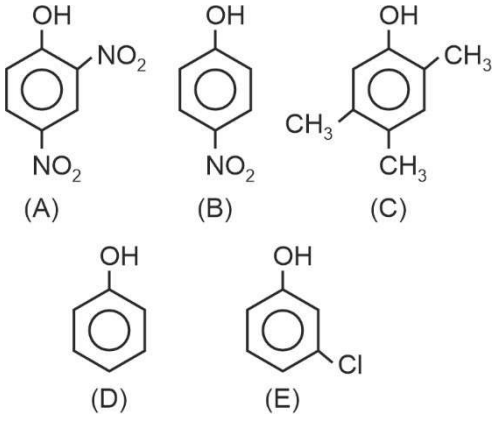
Choose the correct answer from the option given below :

(1) (C), (E), (D), (B), (A) (2) (C), (D), (E), (B), (A)

(3) (A), (E), (B), (D), (C) (4) (A), (B), (E), (D), (C)

Answer (4)

Sol.



Their acidic order is A > B > E > D > C.

$\therefore$ Their pK_a value is A < B < E < D < C.

49. Correct statement about smog is

(1) NO_2 is present in classical smog

(2) Classical smog also has high concentration of oxidizing agents

(3) Photochemical smog has high concentration of oxidizing agents

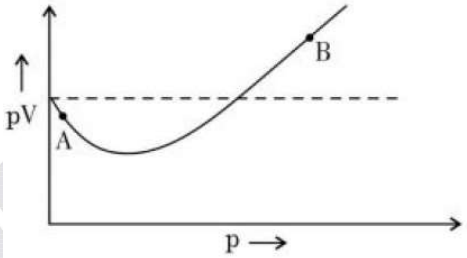
(4) Both NO_2 and SO_2 are present in classical smog

Answer (3)

Sol.

- Classical smog occurs in cool humid climate.
  It is a mixture of smoke, fog and sulphur dioxide.
  Chemically, it is a reducing mixture and so it is also called as reducing smog.
- Photochemical smog has high concentration of oxidising agents.

50. For 1 mol of gas, the plot of pV vs. p is shown below. p is the pressure and V is the volume of the gas.



What is the value of compressibility factor at point A?

(1) $1-\frac{a}{RTV}$ (2) $1+\frac{b}{V}$

(3) $1-\frac{b}{V}$ (4) $1+\frac{a}{RTV}$

Answer (1)

Sol. At point 'A', 'a' is considerable and 'b' is negligible.

$\therefore$ $\left(p+\frac{a}{V^2}\right)V = RT$

$pV+\frac{a}{V} = RT$

$Z = 1-\frac{a}{VRT}$

SECTION - B

Numerical Value Type Questions: This section contains 10 questions. In Section B, attempt any five questions out of 10. The answer to each question is a **NUMERICAL VALUE.** For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the second decimal place; e.g. 06.25, 07.00, –00.33, –00.30, 30.27, –27.30) using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.

51. Millimoles of calcium hydroxide required to produce 100 mL of the aqueous solution of pH 12 is $x \times 10^{-1}$. The value of x is _____ (Nearest integer).

Answer (05.00)

Sol. pH = 12

$\therefore$ $[OH^-] = 10^{-2}$

$$\frac{\text{milli mole of } Ca(OH)_2 \times 2}{100} = 10^{-2}$$

$\therefore$ milli moles of $Ca(OH)_2$ required = 5×10^{-1}

52. Solid Lead nitrate is dissolved in 1 litre of water. The solution was found to boil at 100.15°C. When 0.2 mol of NaCl is added to the resulting solution, it was observed that the solution froze at –0.8°C. The solubility product of $PbCl_2$ formed is _____ $\times 10^{-6}$ at 298 K. (Nearest integer)

Given : $K_b = 0.5$ K kg mol^{-1} and $K_f = 1.8$ K kg mol^{-1}. Assume molality to be equal to molarity in all cases.

Answer (13.00)

Sol. $0.15 = 3 \times 0.5 \times M$

$M_{Pb(NO_3)_2} = 0.1$ molar

$$Pb(NO_3)_2 + 2NaCl \longrightarrow PbCl_2 + 2NaNO_3$$

$\Delta T_f = iK_f \cdot m$

$0.8 = (0.4 + 3s)\,1.8$

$s = 0.0148$

$\therefore$ solubility product $= 4s^3$

$= 4 \times (0.0148)^3$

$\approx 13 \times 10^{-6}$

53. Water decomposes at 2300 K

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

The percent of water decomposing at 2300 K and 1 bar is _____ (Nearest integer).

Equilibrium constant for the reaction is 2×10^{-3} at 2300 K.

Answer (02)

Sol. $$H_2O \longrightarrow H_2 + \frac{1}{2}O_2$$

$$K_p = \frac{P_T^{\frac{3}{2}}\left(1+\frac{\alpha}{2}\right)\alpha^{\frac{3}{2}}}{2^{\frac{1}{2}}P_T\left(1+\frac{\alpha}{2}\right)^{\frac{3}{2}}(1-\alpha)}$$

$$2\times10^{-3} = \frac{\alpha^{\frac{3}{2}}}{2^{\frac{1}{2}}} \text{ [as } \alpha << 1 \text{ and let } P_T = 1]$$

$$\alpha^{\frac{3}{2}} = 2^{\frac{3}{2}} \times 10^{-3}$$

$$\approx 2 \times 10^{-2}$$

$\therefore$ % of water decomposition = 2%

54. The number of molecules or ions from the following, which do not have odd number of electrons are _____.

(A) NO_2 (B) ICl_4^-

(C) BrF_3 (D) ClO_2

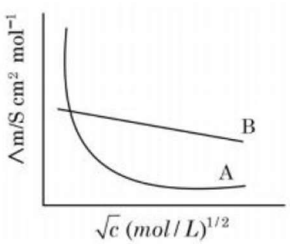
(E) NO_2^+ (F) NO

Answer (03.00)

Sol. The odd electronic species are :

NO_2, ClO_2, NO

55. Following figure shows dependence of molar conductance of two electrolytes on concentration. Λ_m° is the limiting molar conductivity.



The number of **incorrect** statement(s) from the following is _____

(A) Λ_m° for electrolyte A is obtained by extrapolation.

(B) For electrolyte B, Λ_m vs $\sqrt{c}$ graph is a straight line with intercept equal to Λ_m°

(C) At infinite dilution, the value of degree of dissociation approaches zero for electrolyte B.

(D) Λ_m° for any electrolyte A or B can be calculated using λ° for individual ions.

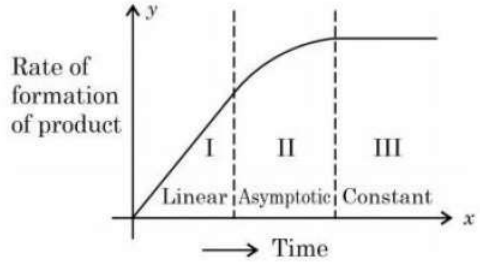
Answer (02.00)

Sol. (A) Λ_m° for 'A' cannot be obtained by extra polation.

(C) At infinite dilution, value of degree of dissociation approaches one.

$\therefore$ A and C are incorrect

56. For certain chemical reaction $X \rightarrow Y$, the rate of formation of product is plotted against the time as shown in the figure. The number of **correct** statement/s from the following is_____



(A) Over all order of this reaction is one

(B) Order of this reaction can't be determined

(C) In region I and III, the reaction is of first and zero order respectively

(D) In region-II, the reaction is of first order

(E) In region-II, the order of reaction is in the range of 0.1 to 0.9.

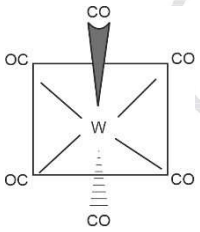
Answer (02.00)

Sol. Ether the order w.r.t. reaction is negative in region I and II or the order of the reaction depends only on the concentration of product. So by that reasoning if order of the reaction depends only on the concentration of product then statement C and E are correct.

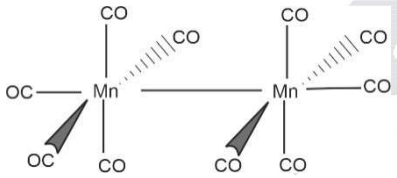
57. The sum of bridging carbonyls in $W(CO)_6$ and $Mn_2(CO)_{10}$ is_____.

Answer (00.00)

Sol. $W(CO)_6$

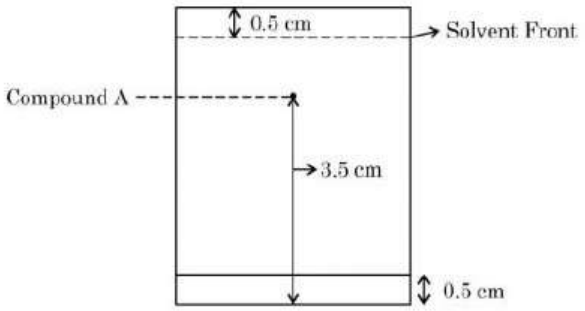


$Mn_2(CO)_{10}$



therefor there are no any bridging carbonyl are present.

58. Following chromatogram was developed by adsorption of compound 'A' on a 6 cm TLC glass plate. Retardation factor of the compound 'A' is_____ × 10^{-1}.



Answer (06.00)

Sol. Retardation factor = $\frac{3}{5} = 0.6 = 6 \times 10^{-1}$

59. Consider the following reaction approaching equilibrium at 27°C and 1 atm pressure

$$A + B \underset{k_r=10^2}{\overset{k_f=10^3}{\rightleftharpoons}} C + D$$

The standard Gibb's energy change ($\Delta_rG°$) at 27°C is (–)_____ kJ mol^{-1}

(Nearest integer).

(Given : R = 8.3 J K^{-1} mol^{-1} and ln 10 = 2.3)

Answer (06.00)

Sol. $\Delta G = -RT\ln(k_{eq})$

$$k_{(eq)} = \frac{k_f}{k_r} = 10$$

$\Delta G = -8.3 \times 300 \times \ln(10)$

$= -8.3 \times 300 \times 2.3$

$= -5.727$ kJ/mol

≈ -6 kJ / mol

60. 17 mg of a hydrocarbon (M.F. $C_{10}H_{16}$) takes up 8.40 mL of the H_2 gas measured at 0°C and 760 mm of Hg. Ozonolysis of the same hydrocarbon yields

$$CH_3-\underset{\underset{O}{\|}}{C}-CH_3, \quad H-\underset{\underset{O}{\|}}{C}-H,$$

$$H-\underset{\underset{O}{\|}}{C}-CH_2-CH_2-\underset{\underset{O}{\|}}{C}-\underset{\underset{O}{\|}}{C}-H$$

The number of double bond/s present in the hydrocarbon is_____

Answer (03.00)

Sol. $C_{10}H_{16} + H_2 \longrightarrow$

$\frac{17\times10^{-3}}{136}$ $\quad$ $\frac{1\times8.4\times10^{-3}}{0.082\times273}$

0.125 milli moles $\quad$ 0.375 milli moles

0.125 milli moles of $C_{10}H_{16}$ required 0.375 milli moles of H_2 therefore there are total 3 π-bonds.

$\therefore$ DOU will also be equal to 3