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 normal rain water is slightly acidic and its pH value is 5.6 because of which one of the following?

(1) $4NO_2 + O_2 + 2H_2O \rightarrow 4HNO_3$

(2) $CO_2 + H_2O \rightarrow H_2CO_3$

(3) $N_2O_5 + H_2O \rightarrow 2HNO_3$

(4) $2SO_2 + O_2 + 2H_2O \rightarrow 2H_2SO_4$

Answer (2)

Sol. Normally rain water has a pH of 5.6 due to presence of H^+ ions formed by the reaction of rain water with carbon dioxide present in the atmosphere.

$$H_2O(l) + CO_2(g) \rightleftharpoons H_2CO_3(g)$$

Hence correct answer is (2)

32. Given below are two statements:

Statement I : Upon heating a borax bead dipped in cupric sulphate in a luminous flame, the colour of the bead becomes green.

Statement II: The green colour observed is due to the formation of copper(I) metaborate.

In the light of the above statements, choose the **most appropriate** answer from the options given below.

(1) **Statement I** is false but **Statement II** is true

(2) **Statement I** is true but **Statement II** is false

(3) Both **Statement I** and **Statement II** are false

(4) Both **Statement I** and **Statement II** are true

Answer (3)

Sol. Both statements are incorrect.

33. Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A): The first ionization enthalpy of 3d series elements is more than that of group 2 metals.

Reason (R): In 3d series of elements successive filling of d-orbitals takes place.

In the light of the above statements, choose the **correct** answer from the options given below.

(1) **(A)** is true but **(R)** is false

(2) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**

(3) **(A)** is false but **(R)** is true

(4) Both **(A)** and **(R)** are true but **(R)** is **not** the correct explanation of **(A)**

Answer (2)

Sol. The first ionization energy of 3d series elements is more than that of group 2 metals because in 3d series of elements successive filling of d-orbitals takes place.

34. The element playing significant role in neuromuscular function and interneuronal transmission is

(1) Li (2) Mg

(3) Ca (4) Be

Answer (3)

Sol. Ca plays significant role in muscular function and interneuronal transmission.

35. Arrange the following orbitals in decreasing order of energy.

A. n = 3, l = 0, m = 0

B. n = 4, l = 0, m = 0

C. n = 3, l = 1, m = 0

D. n = 3, l = 2, m = 1

The correct option for the order is

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

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

Answer (4)

Sol. (A) n = 3, l = 0, m = 0 ; 3s

(B) n = 4, l = 0, m = 0 ; 4s

(C) n = 3, l = 1, m = 1; 3p

(D) n = 3, l = 2, m = 1 ; 3d

Correct order of energy will be (D) > (B) > (C) > (A)

36. Evaluate the following statements for their correctness.

A. The elevation in boiling point temperature of water will be same for 0.1 M NaCl and 0.1 M urea.

B. Azeotropic mixture boil without change in their composition.

C. Osmosis always takes place from hypertonic to hypotonic solution.

D. The density of 32% H_2SO_4 solution having molarity 4.09 M is approximately 1.26 g mL^{-1}.

E. A negatively charged sol is obtained when KI solution is added to silver nitrate solution.

Choose the correct answer from the options given below.

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

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

Answer (4)

Sol. Elevation in boiling point temperature of water will be higher for 0.1 M NaCl as compared to 0.1 M urea.

Azeotropic mixtures boil without change in their composition

Osmosis always takes place from hypotonic (low concentration of solute) solution to hypertonic (high concentration of solute) solution.

A negative charged sol is obtained when KI solution is added to silver nitrate solution whereas positive charged sol is obtained when $AgNO_3$ solution is added to KI solution.

Let the mass of H_2SO_4 (32%) is 100.

$\therefore$ wt of H_2SO_4 = 32

Moles of H_2SO_4 = $\frac{32}{98}$

Now, $4.09 = \frac{32}{98 \times V} \Rightarrow V = 79$ ml

Density = $\frac{100}{79} = 1.265$

Hence, correct answer is (4) B and D only

37. When a hydrocarbon A undergoes complete combustion it require 11 equivalents of oxygen and produces 4 equivalents of water. What is the molecular formula of A?

(1) $C_{11}H_8$ (2) C_9H_8

(3) $C_{11}H_4$ (4) C_5H_8

Answer (2)

Sol. $C_xH_y + \left(x + \frac{y}{4}\right)O_2 \longrightarrow xCO_2 + \frac{y}{2}H_2O$

$x + \frac{y}{4} = 11$

$\frac{y}{2} = 4$

$\therefore$ y = 8

x = 9

$\therefore$ C_9H_8 will be the formula of hydrocarbon A.

38. The Lewis acid character of boron tri halides follows the order

(1) $BBr_3 > BI_3 > BCl_3 > BF_3$

(2) $BCl_3 > BF_3 > BBr_3 > BI_3$

(3) $BI_3 > BBr_3 > BCl_3 > BF_3$

(4) $BF_3 > BCl_3 > BBr_3 > BI_3$

Answer (3)

Sol. Correct order of Lewis acidity is

$BI_3 > BBr_3 > BCl_3 > BF_3$

39. A hydrocarbon 'X' with formula C_6H_8 uses two moles H_2 on catalytic hydrogenation of its one mole. On ozonolysis, 'X' yields two moles of methane dicarbaldehyde. The hydrocarbon 'X' is

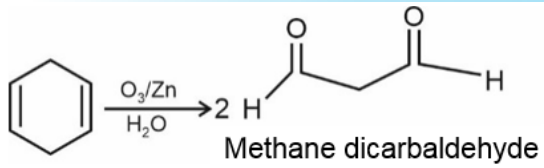
(1) hexa –1, 3, 5–triene

(2) cyclohexa – 1, 3 – diene

(3) cyclohexa – 1, 4 – diene

(4) 1 – methylcyclopenta – 1, 4 – diene

Answer (3)

Sol. 

Methane dicarbaldehyde

Hence, correct answer is (3)

40. In the following halogenated organic compounds the one with maximum number of chlorine atoms in its structure is

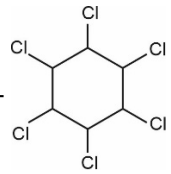
(1) Chloropicrin (2) Freon – 12

(3) Gammaxene (4) Chloral

Answer (3)

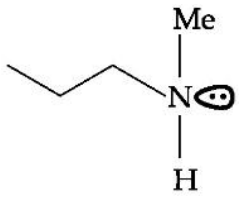
Sol. Chloropicrin — $Cl_3C - NO_2$

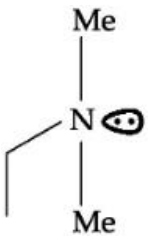
Freon-12 — CF_2Cl_2

Gammaxene — 

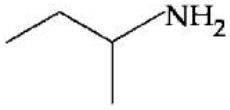
Chloral — $Cl_3C–CHO$

41. An organic compound [A] ($C_4H_{11}N$), shows optical activity and gives N_2 gas on treatment with HNO_2. The compound [A] reacts with $PhSO_2Cl$ producing a compound which is soluble in KOH. The structure of A is :

(1) 

(2) 

(3) 

(4) 

Answer (4)

Sol. Only primary amines react with $PhSO_2Cl$ to produce a compounds which are soluble in KOH. Option (3) and (4) are primary amines but the given compound is also optically active.

Hence the correct answer is (4).

42. Which of the following elements have half-filled f-orbitals in their ground state?

(Given : atomic number Sm = 62; Eu = 63; Tb = 65; Gd = 64, Pm = 61)

(A) Sm (B) Eu

(C) Tb (D) Gd

(E) Pm

Choose the **correct** answer from the options given below:

(1) A and E only (2) B and D only

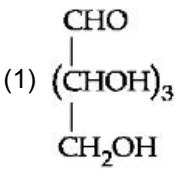
(3) C and D only (4) A and B only

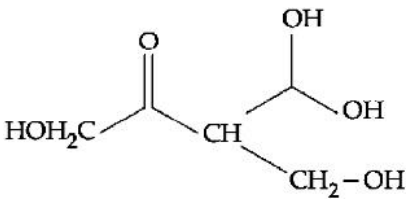
Answer (2)

Sol.

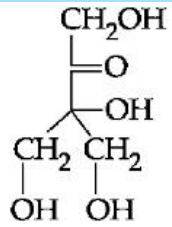
Element	Electronic configuration
(A) Sm	$[Xe]4f^6 6s^2$
(B) Eu	$[Xe]4f^7 6s^2$
(C) Tb	$[Xe]4f^9 6s^2$
(D) Gd	$[Xe]4f^7 5d^1 6s^2$
(E) Pm	$[Xe]4f^5 6s^2$

43. Compound A, $C_5H_{10}O_5$, given a tetraacetate with AC_2O and oxidation of A with $Br_2 – H_2O$ gives an acid, $C_5H_{10}O_6$. Reduction of A with HI gives isopentane. The possible structure of A is :

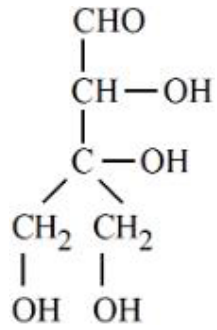
(1) 

(2) 

(3)

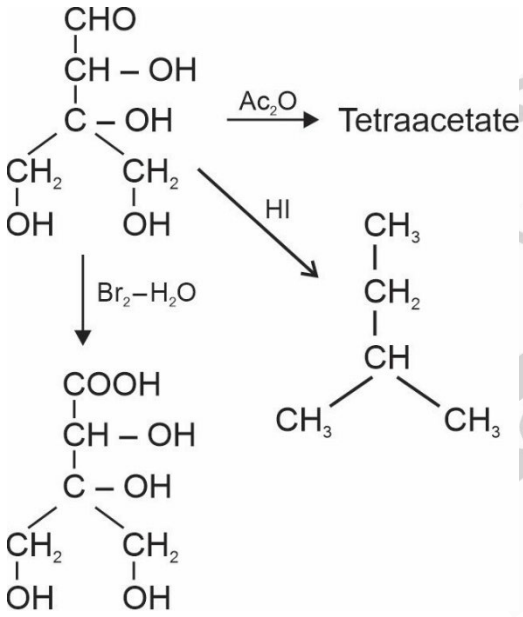


(4)



Answer (4)

Sol.



Correct answer is (4)

44. Which of the following compounds are not used as disinfectants?

(A) Chloroxylenol (B) Bithional

(C) Veronal (D) Prontosil

(E) Terpineol

Choose the **correct** answer from the options given below:

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

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

Answer (2)

Sol. (A) Chloroxylenol

(B) Bithional

(E) Terpineol

are used as disinfectants.

45. Incorrect statement for the use of indicators in acid-base titration is :

(1) Phenolphthalein may be used for a strong acid vs strong base titration.

(2) Phenolphthalein is a suitable indicator for a weak acid vs strong base titration.

(3) Methyl orange may be used for a weak acid vs weak base titration.

(4) Methyl orange is a suitable indicator for a strong acid vs weak base titration.

Answer (3)

Sol. There is no suitable indicator that can be used in the titration of weak acid and weak base.

Hence correct answer (3).

46. Given below are two statements

Statement I: H_2O_2 is used in the synthesis of Cephalosporin

Statement II: H_2O_2 is used for the restoration of aerobic conditions to sewage wastes.

In the light of the above statements, choose the **most appropriate** answer from the options given below

(1) **Statement I** is incorrect but **Statement II** is correct

(2) Both **Statement I** and **Statement II** are incorrect

(3) **Statement I** is correct but **Statement II** is incorrect

(4) Both **Statement I** and **Statement II** are correct

Answer (4)

Sol. H_2O_2 is used in the synthesis of hydroquinone, tartaric acid and certain food products and pharmaceuticals (cephalosporin).

Nowadays it is also used in environmental (green) chemistry for example in pollution control treatment of domestic and industrial effluents, oxidation of cyanides restoration of aerobic condition to sewage waste.

Hence both statements are correct.

47. Which one of the following statements is incorrect?

(1) Boron and Indium can be purified by zone refining method

(2) van Arkel method is used to purify tungsten

(3) The malleable iron is prepared from cast iron by oxidising impurities in a reverberatory furnace

(4) Cast iron is obtained by melting pig iron with scrap iron and coke using hot air blast

Answer (2)

Sol. Van Arkel method is used to purify Zirconium or Titanium. Rest all statements are correct.

Hence correct answer is option (2).

48. In Dumas method for the estimation of N_2, the sample is heated with copper oxide and the gas evolved is passed over

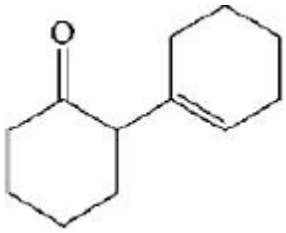
(1) Pd (2) Copper gauze

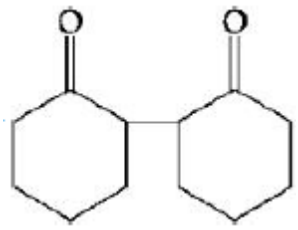
(3) Ni (4) Copper oxide

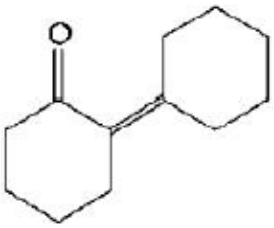
Answer (2)

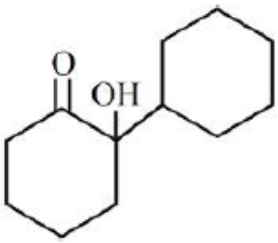
Sol. In dumas method for the estimation of N_2, the sample is heated with copper oxide and the gas evolved is passed over copper gauze.

49. Cyclohexylamine when treated with nitrous acid yields (P). On treating (P) with PCC results in (Q). When (Q) is heated with dil. NaOH we get (R). The final product (R) is

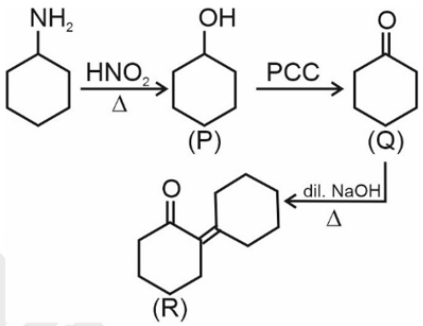
(1) 

(2) 

(3) 

(4) 

Answer (3)

Sol. 

50. Match **List I** with **List II**

	LIST-I		**LIST-II**
A.	Physisorption	I.	Single Layer Adsorption
B.	Chemisorption	II.	20 – 40 kJ mol^{-1}
C.	$N_2(g) + 3H_2(g) \xrightarrow{Fe(s)} 2NH_3(g)$	III.	Chromatography
D.	Analytical Application or Adsorption	IV.	Heterogeneous catalysis

Choose the **correct** answer from the options given below

(1) A – II, B – I, C – IV, D – III

(2) A – IV, B – II, C – III, D – I

(3) A – II, B – III, C – I, D – IV

(4) A – III, B – IV, C – I, D – II

Answer (1)

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

	List I		List II
A.	Physisorption	(II)	20 – 40 kJ mol^{-1}
B.	Chemisorption	(I)	Single Layer Adsorptions
C.	$N_2(g) + 3H_2(g) \xrightarrow{Fe(s)} 2NH_3(g)$	(IV)	Heterogeneous catalysis
D.	Analytical Application or Adsorption	(III)	Chromatography

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 andw the on-screen virtual numeric keypad in the place designated to enter the answer.

51. The rate constant for a first order reaction is 20 min^{-1}. The time required for the initial concentration of the reactant to reduce to its $\frac{1}{32}$ level is _____ × 10^{-2} min. (Nearest integer)
(Given: ln 10 = 2.303
log 2 = 0.3010)

Answer (17)

Sol. K = 20 min^{-1}

$$t_{1/2} = \frac{0.6932}{20} = \frac{\ln 2}{20}$$

Required time = $n \times t_{1/2}$

n will be 5

Required time = $\frac{5 \times 0.6932}{20}$

= 0.173 min

= 17.3 × 10^{-2} min

52. The resistivity of a 0.8 M solution of an electrolyte is 5 × 10^{-3} Ω cm. Its molar conductivity is _____ × 10^4 Ω^{-1} cm^2 mol^{-1}. (Nearest integer)

Answer (25)

Sol. Molar conductivity = $\frac{k \times 1000}{C}$

$$= \frac{\frac{1}{5 \times 10^{-3}} \times 1000}{0.8}$$

$$= \frac{10^6}{4} = 0.25 \times 10^6$$

= 25 × 10^4 $\Omega^{-1}cm^2mol^{-1}$

53. If the CFSE of $[Ti(H_2O)_6]^{3+}$ is –96.0 kJ/mol, this complex will absorb maximum at wavelength _____ nm. (Nearest integer)
Assume Planck's constant (h) = 6.4 × 10^{-34} Js, Speed of light (c) = 3.0 × 10^8 m/s and Avogadro's Constant (N_A) = 6 × 10^{23}/mol.

Answer (480)

Sol. $[Ti(H_2O)_6]^{3+}$, CFSE $= -0.4\Delta_0$

= –96.0 kJ mol^{-1}

$$\therefore \Delta_0 = \frac{-96.0}{-0.4}$$

$$\therefore \Delta_0 = 240 \text{ kJ mol}^{-1}$$

$$\lambda = \frac{64 \times 10^{-34} \times 3 \times 10^8 \times 6 \times 10^{23}}{240 \times 10^3}$$

$$= \frac{6.4 \times 3}{240} \times 10^{-29} \times 6 \times 10^{23}$$

$$= 480 \times 10^{-9} \text{m}$$

= 480 nm

54. Assume carbon burns according to following equation:

$$2C_{(s)} + O_{2(g)} \rightarrow 2CO(g)$$

When 12 g carbon is burnt in 48 g of oxygen, the volume of carbon monoxide produced is _____ × 10^{-1} L at STP [nearest integer]
[Given : Assume CO as ideal gas, Mass of C is 12 g mol^{-1}, Mass of O is 16 g mol^{-1} and molar volume of an ideal gas at STP is 22.7 L mol^{-1})

Answer (227)

$2C(s) + O_2(g) \longrightarrow 2CO(g)$

Sol. $\frac{12}{12} = 1\,\text{mole}$ $\qquad$ $1\,\text{mol}$

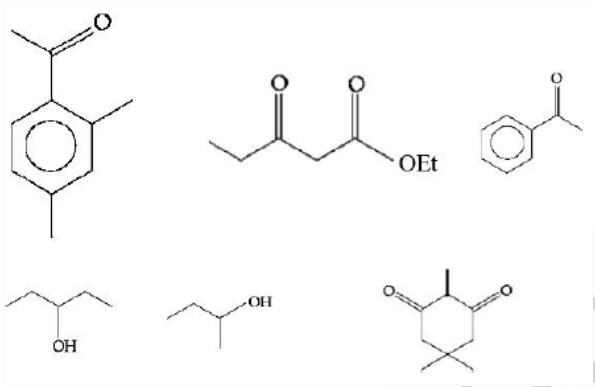
Given that molar volume at STP is 22.7 L

Hence 22.7 L of CO(g) will be formed

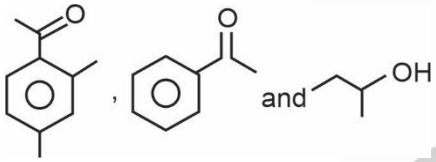
Required volume will be $22.7 \times 10 \times 10^{-1}$

$= 227 \times 10^{-1}$L

55. The number of molecules which gives haloform test among the following molecules is _____.



Answer (03)

Sol. 

will give positive haloform test

56. The number of alkali metal(s), from Li, K, Cs, Rb having ionization enthalpy greater than 400 kJ mol^{-1} and forming stable superoxide is _____.

Answer (02)

Sol.

Ionization enthalpy / $kJmol^{-1}$	Li	K	Rb	Cs
	520	419	403	376

Li does not form superoxide.

Hence the correct answer is 02.

57. A sample of a metal oxide has formula $M_{0.83}O_{1.00}$. The metal M can exist in two oxidation states +2 and +3. In the sample of $M_{0.83}O_{1.00}$, the percentage of metal ions existing in +2 oxidation state is _____ %. (Nearest integer).

Answer (59)

Sol. $\%M^{3+} = \frac{0.34}{0.83} \times 100 = 40.96 \approx 41\%$

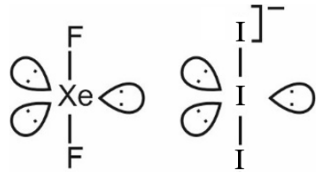
$\%\ M^{2+} = 100 - 41 = 59\%$

Hence correct answer is 59

58. Amongst the following, the number of species having the linear shape is _____.

XeF_2, I_3^+, C_3O_2, I_3^-, CO_2, SO_2, $BeCl_2$ and $BCl_2^{\ominus}$

Answer (05) I



$O{=}C{=}C{=}C{=}O$, $O{=}C{=}O$, $Cl{-}Be{-}Cl$

59. Enthalpies of formation of $CCl_4(g)$, $H_2O(g)$, $CO_2(g)$ and HCl(g) are –105, –242, –349 and –92 kJ mol^{-1} respectively. The magnitude of enthalpy of the reaction given below is _____ kJ mol^{-1}. (Nearest integer)

$CCl_4(g) + 2H_2O(g) \rightarrow CO_2(g) + 4HCl(g)$

Answer (173)

Sol. $CCl_4(g) + 2H_2O(g) \rightarrow CO_2(g) + 4HCl(g)$

Enthalpy of above reaction

$= \Delta H_f(CO_2(g)) + 4\Delta H_f(HCl(g)) - \Delta H_f(CCl_4) - 2\Delta H_f(H_2O)$

$= -394 - 4 \times 92 + 105 + 2 \times 242$

$= -394 - 368 + 105 + 484$

$= -173$ kJ mol^{-1}

Hence the magnitude of this will be 173 kJ mol^{-1}.

60. At 298 K, the solubility of silver chloride in water is 1.434×10^{-3} g L^{-1}. The value of $-\log K_{sp}$ for silver chloride is _____.

(Given mass of Ag is 107.9 g mol^{-1} and mass of Cl is 35.5 g mol^{-1})

Answer (10)

Sol. $AgCl \rightleftharpoons Ag^+ + Cl^-$

$K_{sp} = (Ag^+)(Cl^-) = S \times S = S^2$

$S = \sqrt{K_{sp}}$

$S = \frac{1.434 \times 10^{-3}}{143.4} = 10^{-5}$

$K_{sp} = S^2 = 10^{-10}$

$\Rightarrow -\log(K_{sp}) = -\log(10^{-10}) = 10$