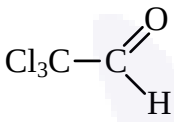
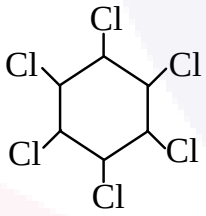
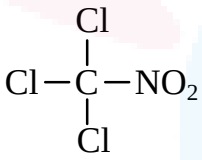
FINAL JEE–MAIN EXAMINATION – JANUARY, 2023
Held On Tuesday 31th January, 2023
TIME : 03:00 PM to 06:00 PM

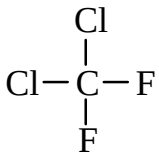
SECTION-A

31. In the following halogenated organic compounds the one with maximum number of chlorine atoms in its structure is :
(1) Chloral (2) Gammaxene
(3) Chloropicrin (4)Freon -12
Official Ans. by NTA (2)
Ans. (2)

Sol. (1) Chloral 

(2) Gammaxene 

(3) Chloropicrin 

(4) Freon - 12 

32. Incorrect statement for the use of indicators in acid-base titration is :
(1) Methyl orange may be used for a weak acid vs weak base titration.
(2) Methyl orange is a suitable indicator for a strong acid vs weak base titration
(3) Phenolphthalein is a suitable indicator for a weak acid vs strong base titration
(4) Phenolphthalein may be used for a strong acid vs strong base titration.
Official Ans. by NTA (1)
Ans. (1)

Sol.

Indicator	pH range
Methyl orange	3.2 – 4.5
Phenolpthalein	8.3 – 10.5

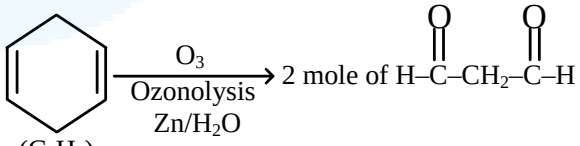
Methyl orange may be used for a strong acid vs strong base and strong acid vs weak base titration.
Phenolpthalein may be used for a strong acid vs strong base and weak acid vs strong base titration.

33. 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, E (2) A, B
(3) B, D, E (4) C, D
Official Ans. by NTA (4)
Ans. (1)

Sol. Veronal is neurological medicine, Prontosil is antibiotic, rest all are disinfectants.

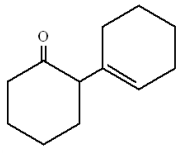
34. A hydrocarbon 'X' with formula C_6H_8 uses two moles of H_2 on catalytic hydrogenation of its one mole. On ozonolysis, 'X' yields two moles of methane dicarbaldehyde. The hydrocarbon 'X' is :
(1) hexa-1, 3, 5-triene
(2) 1-methylcyclopenta-1, 4-diene
(3) cyclohexa-1, 3-diene
(4) cyclohexa-1, 4-diene
Official Ans. by NTA (4)
Ans. (4)

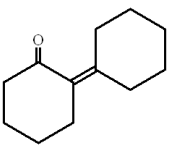
Sol.

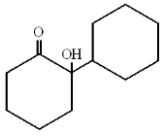


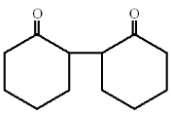
(C_6H_8)
(Cyclohexa-1, 4-diene)

35. 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) 

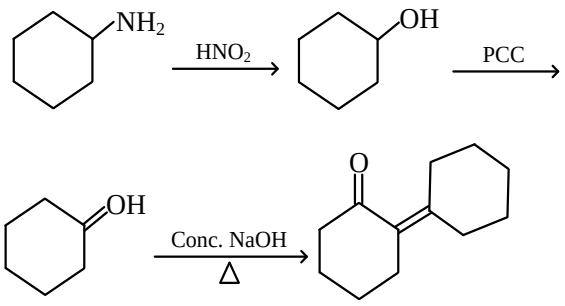
(2) 

(3) 

(4) 

Official Ans. by NTA (2)
Ans. (2)

Sol.



36. 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) Both **Statement I** and **Statement II** are true

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

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

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

Official Ans. by NTA (3)

Ans. (3)

Sol. (Borax Bead Test)

On treatment with metal salt, boric anhydride forms metaborate of the metal which gives different colours in oxidising and reducing flame. For example, in the case of copper sulphate, following reactions occur.

$$CuSO_4 + B_2O_3 \xrightarrow[(\text{Oxidising})]{\text{Non-luminous flame}} \underset{\substack{\text{Cupric metaborate}\\ \text{blue-green}}}{Cu(BO_2)_2} + SO_3$$

Two reactions may take place in reducing flame (Luminous flame)

(i) The blue-green $Cu(BO_2)_2$ is reduced to colourless cuprous metaborate as :

$$2Cu(BO_2)_2 + 2NaBO_2 + C \xrightarrow[\text{flame}]{\text{Luminous}} 2CuBO_2 + Na_2B_4O_7 + CO$$

(ii) Cupric metaborate may be reduced to metallic copper and bead appears red opaque.

$$2Cu(BO_2)_2 + 4NaBO_2 + 2C \xrightarrow[\text{flame}]{\text{Luminous}} 2Cu + 2Na_2B_4O_7 + 2CO$$

37. 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 mixtures 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) B, D, and E only (2) A, B, and D only

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

Official Ans. by NTA (4)

Ans. (4)

Sol. **(A)** $\Delta T_b \propto i \times c$

(B) Azeotropic mixtures have same composition in both liquid and vapour phase.

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

(D) $M = \dfrac{30 \times 10 \times 1.26}{98} \approx 4.09\,M$

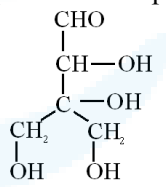
(E) When KI solutions is added to $AgNO_3$ solution, positively charged solution results due to adsorption of Ag^+ ions from dispersion medium

$$AgI / Ag^+$$

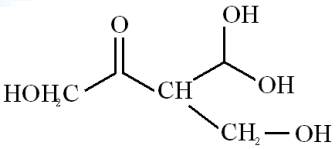
Positively charged

38. 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 :

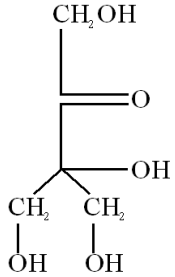
(1)



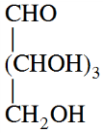
(2)



(3)



(4)



Official Ans. by NTA (1)

Ans. (1)

Sol. **(i)** Formation of tetraacetete with Ac_2O means compound A has four –OH linkage.
Reduction of A with HI gives Isopentane i.e. molecule contains five carbon atom.

39. 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) B > D > C > A
(2) D > B > C > A
(3) A > C > B > D
(4) D > B > A > C
Official Ans. by NTA (2)
Ans. (2)

Sol. (A) n = 3; l = 0; m = 0 ; 3s orbital
(B) n = 4; l = 0; m = 0 ; 4s orbital
(C) n = 3; l = 1; m = 0 ; 3p orbital
(D) n = 3; l = 2; m = 0 ; 3d orbital
As per Hund's rule energy is given by (n+*l*) value. If value of (n+*l*) remains same then energy is given by n only.

40. 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) $BF_3 > BCl_3 > BBr_3 > BI_3$
(4) $BI_3 > BBr_3 > BCl_3 > BF_3$
Official Ans. by NTA (4)
Ans. (4)

Sol. Extent of back bonding, reduces down the group leading to more Lewis acidic strength

$$\underset{(2p-2p)}{BF_3} > \underset{(2p-3p)}{BCl_3} > \underset{(2p-4p)}{BBr_3} > \underset{(2p-5p)}{BI_3}\ (\text{extent of back bonding})$$

$$BF_3 < BCl_3 < BBr_3 < BI_3\ (\text{lewis acidic nature})$$

41. 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 – III, C – I, D – IV
(2) A – III, B – IV, C – I, D - II
(3) A – IV, B – II, C – III, D - I
(4) A – II, B – I, C – IV, D – III
Official Ans. by NTA (4)
Ans. (4)

Sol. (A) Physisorption = 20 – 40 kJ/mol and Chemisorption = 80 – 240 kJ/mol
(B) Physisorption is multi-layered and chemisorption is unimolecular layered.
(C) In heterogeneous catalysis, medium and catalyst are in different phases.
(D) Chromatography uses adsorption to purify/separate mixtures.

42. 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) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**
(2) Both **(A)** and **(R)** are true but **(R)** is **not** the correct explanation of (A)
(3) **(A)** is false but **(R)** is true
(4) **(A)** is true but **(R)** is false
Official Ans. by NTA (1)
Ans. (3)

Sol. From Sc to Mn ionization energy is less than that of Mg.
For 3d series :

	Sc	Ti	V	Cr	Mn
IE (KJ/mol)	631	656	650	653	717
	Fe	Co	Ni	Cu	Zn
IE (KJ/mol)	762	758	736	745	906

For 2nd Group

	Be	Mg	Ca	Sr	Ba	Ra
IE (KJ/mol)	631	656	650	653	717	762

43. The element playing significant role in neuromuscular function and interneuronal transmission is :
(1) Be (2) Ca (3) Li (4) Mg
Official Ans. by NTA (2)
Ans. (2)

Sol. Calcium plays important role in neuromuscular function, interneuronal transmission, cell membrane etc.

44. 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) Both **Statement I** and **Statement II** are correct

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

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

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

Official Ans. by NTA (1)

Ans. (1)

Sol. It is used in the synthesis of hydroquinone, tartaric acid and certain food products and pharmaceuticals (cephalosporin) etc. Restoration of aerobic conditions to sewage wastes etc.

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

(1) $CO_2 + H_2O \rightarrow H_2CO_3$

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

(3) $2SO_2 + O_2 + 2H_2O \rightarrow 2H_2SO_4$

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

Official Ans. by NTA (1)

Ans. (1)

Sol. We are aware that normally rain water has a pH of 5.6 due to the presence of H^+ ions formed by the reactions of rain water with carbon dioxide present in the atmosphere.

$$H_2O(l) + CO_2(g) \rightleftharpoons H_2CO_3(aq)$$
$$H_2CO_3(aq) \rightleftharpoons H^+(aq) + HCO_3^-(aq)$$

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

(1) C_9H_8

(2) $C_{11}H_4$

(3) C_5H_8

(4) $C_{11}H_8$

Official Ans. by NTA (1)

Ans. (1)

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

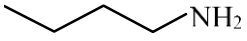
$\frac{y}{2} = 4 \ \therefore \ y = 8$

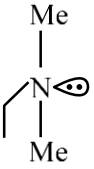
$x + \frac{8}{4} = 11$

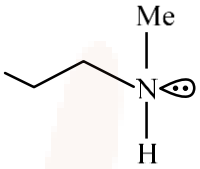
$\therefore \ x = 9$

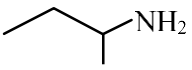
$\therefore$ Hydrocarbon will be $= C_9H_8$

47. 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) 

Official Ans. by NTA (4)

Ans. (4)

Sol. $C_4H_{11}N$ releases N_2 with HNO_2 i.e. it is primary amine.

After reacting with Hinsberg reagent it forms a compound which is soluble in KOH,

Hence, the amine is primary.

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

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

Official Ans. by NTA (2)

Ans. (2)

Sol. Van – Arkel process is used for purification of Ti, Zr, Hf and B.

49. 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) B and D only (2) A and E only

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

Official Ans. by NTA (1)

Ans. (1)

Sol. 1. $_{62}Sm : 4f^6 6s^2$

2. $_{64}Gd : 4f^7 5d^1 6s^2$

3. $_{63}Eu : 4f^7 6s^2$

4. $_{65}Tb : 4f^9 6s^2$

5. $_{61}Pm : 4f^5 6s^2$

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

(1) Ni (2) Copper gauze

(3) Pd (4) Copper oxide

Official Ans. by NTA (2)

Ans. (2)

Sol. Duma's method.

The nitrogen containing organic compound, when heated with CuO in a atmosphere of CO_2, yields free N_2 in addition to CO_2 and H_2O.

$$C_xH_yN_z + (2x + \frac{y}{2})\,CuO \rightarrow x\,CO_2 + \frac{y}{2}H_2O + \frac{z}{2}N_2 + (2x + \frac{y}{2})\,Cu$$

Traces of nitrogen oxides formed, if any, are reduced to nitrogen by passing the gaseous mixture over heated copper gauze.

SECTION-B

51. If the CFSE of $\left[Ti(H_2O)_6\right]^{3+}$ is -96.0 kJ / mol, this complex will absorb maximum at wavelength ___ nm. (nearest integer)

Assume Planck's constant $(h) = 6.4 \times 10^{-34}$ Js Speed of light $(c) = 3.0 \times 10^8$ m / s and Avogadro's constant $(N_A) = 6 \times 10^{23}$ / mol .

Official Ans. by NTA (480)

Ans. (480)

Sol. $\left(Ti^{+3}(H_2O)_6\right)^{3+}$

$Ti^{+3} : 3d^1$

C.F.S.E. $= -0.4 \times \Delta_0$

$$= -\frac{96 \times 10^3}{N_0} J$$

$$\Delta_0 = \frac{96 \times 10^3}{0.4 \times 6 \times 10^{23}}$$

$$\Rightarrow \frac{hc}{\lambda} = \frac{96 \times 10^3}{0.4 \times 6 \times 10^{23}}$$

$$\lambda = \frac{0.4 \times 6 \times 10^{23} \times 6.4 \times 10^{-34} \times 3 \times 10^8}{96 \times 10^3}$$

$= 0.48 \times 10^{-6}$m

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

$= 480$ nm

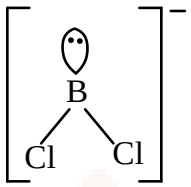
52. Amongst the following, the number of species having the linear shape is _____.

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

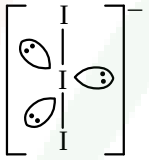
Official Ans. by NTA (5)

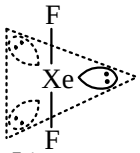
Ans. (5)

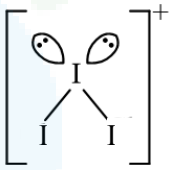
Sol.

(i)  BCl_2^-

(ii) Cl—Be—Cl BeCl$_2$

(iii) I_3^-  Linear

(iv) XeF_2  Linear

(v)  I_3^+

V - Shape

(vi) CO_2 O = C = O Linear

(vii C_3O_2 (O=C=C=C=O) Linear

(viii)  SO_2

V-Shape

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

Official Ans. by NTA (25)

Ans. (25)

Sol. $\Lambda_m = \frac{\kappa \times 1000}{M}$

$$\Lambda_m = \frac{1}{\rho} \times \frac{1000}{M}$$

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

Ans. $25 \times 10^4\ \Omega^{-1}\ cm^{-2}\ mol^{-1}$

54. 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})
Official Ans. by NTA (10)
Ans. (10)

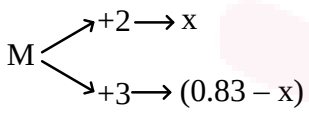
Sol. $AgCl(s) \rightarrow Ag^{+}(aq.) + Cl^{-}(aq.)$
S S

$$K_{sp}=S^2=\left(\frac{1.43}{143.4}\times10^{-3}\right)^2=10^{-10}$$

$-\log K_{sp}=10$

55. 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)
Official Ans. by NTA (59)
Ans. (59)

Sol.



$2x+3(0.83-x)=2$
$x=0.49$

$$\%\,M^{2+}=\frac{0.49}{0.83}\times100$$
$=59\%$

56. 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 _____ $\times10^{-1}$ 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}]
Official Ans. by NTA (227)
Ans. (227)

Sol. $2C(s) + O_2(g) \rightarrow 2CO(g)$
1mol 1.5 mol
Limiting reagent is carbon. One mole carbon produces one mole CO. Hence, volume at STP is 227×10^{-1} litre

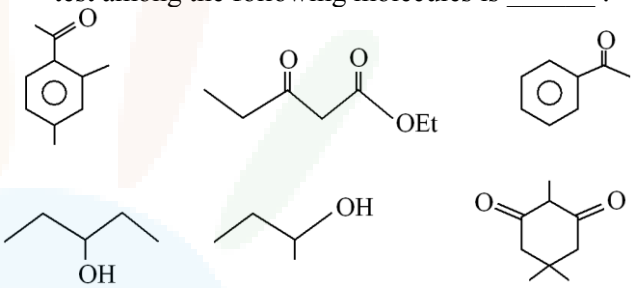
57. The number of alkali metal(s), from Li, K, Cs, Rb having ionization enthalpy greater than 400 kJ mol^{-1} and forming stable super oxide is _____.
Official Ans. by NTA (2)
Ans. (2)

Sol. K, Rb and Cs form stable super oxides but Cs has ionisation enthalpy less than 400 kJ.

58. Enthalpies of formation of $CCl_4(g), H_2O(g), CO_2(g)$ and $HCl(g)$ are −105, −242, −394 and −92 kJ mol^{-1} respectively. The magnitude of enthalpy of the reaction given below is _____ kJ mol^{-1} (nearest integer)
$CCl_4(g)+2H_2O(g)\rightarrow CO_2(g)+4HCl(g)$
Official Ans. by NTA (173)
Ans. (173)

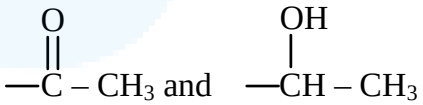
Sol. $\Delta_r H=\sum H_p-\sum H_R$
$=(-394+4\times-92)-(-105+(2\times-242))$
$=-173$ kJ/mol

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



Official Ans. by NTA (3)
Ans. (3)

Sol.
Molecules having



gives positive haloform test.

60. 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 _____ $\times10^{-2}$ min. (Nearest integer)
(Given : $\ln 10=2.303$
$\log 2=0.3010$)
Official Ans. by NTA (17)
Ans. (17)

Sol.

$$C=\frac{C_o}{2^n}=\frac{C_o}{32}$$
$n=5$
$t=5t_{1/2}$
$$=\frac{5\times0.693}{20}=\frac{0.693}{4}$$
$= 0.17325$ min $= 17.325\times10^{-2}$ min.