

FINAL JEE-MAIN EXAMINATION – JANUARY, 2023

(Held On Tuesday 31ST January, 2023)

TIME : 3 : 00 PM to 6 : 00 PM

CHEMISTRY

SECTION-A

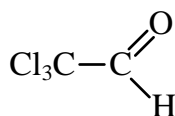
31. In the following halogenated organic compounds the one with maximum number of chlorine atoms in its structure is :

- (1) Chloral (2) Gammaxene
(3) Chloropicrin (4) Freon -12

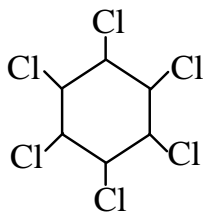
Official Ans. by NTA (2)

Allen Ans. (2)

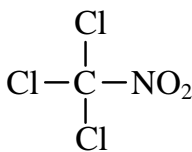
Sol. (1) Chloral



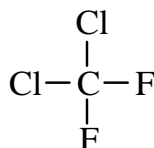
(2) Gammaxene



(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)

Allen Ans. (1)

Sol.

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

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

TEST PAPER WITH SOLUTION

- (A) Chloroxylonol (B) Bithional
(C) Veronal (D) Prontosil
(E) Terpeneol

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)

Allen Ans. (1)

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

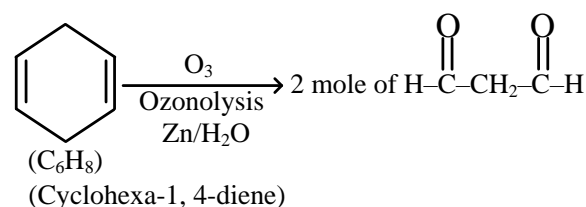
34. A hydrocarbon 'X' with formula C_6H_8 uses two moles of H_2 on catalytic hydrogenation of its one mole. On ozonolysis, 'X' yields two moles of methane dicarbaldehyde. The hydrocarbon 'X' is :

- (1) hexa-1, 3, 5-triene
(2) 1-methylcyclopenta-1, 4-diene
(3) cyclohexa-1, 3-diene
(4) cyclohexa-1, 4-diene

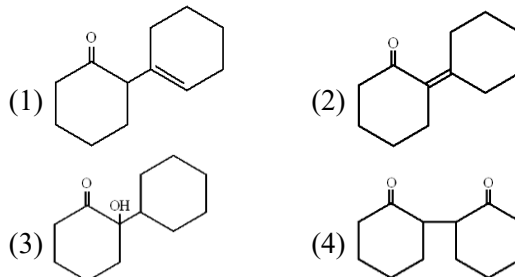
Official Ans. by NTA (4)

Allen Ans. (4)

Sol.



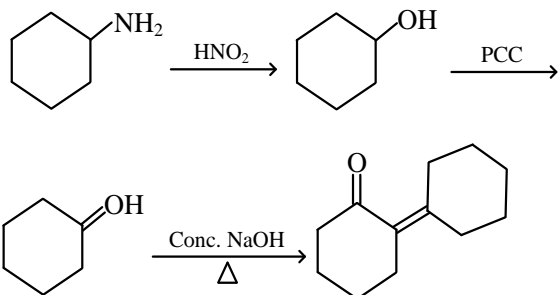
35. Cyclohexylamine when treated with nitrous acid yields (P). On treating (P) with PCC results in (Q). When (Q) is heated with dil. NaOH we get (R) The final product (R) is :



Official Ans. by NTA (2)

Allen 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 :

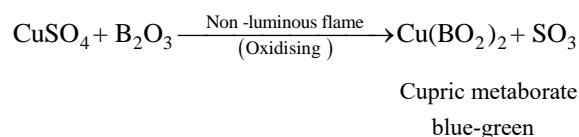
- (1) Both **Statement I** and **Statement II** are true
- (2) **Statement I** is true but **Statement II** is false
- (3) Both **Statement I** and **Statement II** are false
- (4) **Statement I** is false but **Statement II** is true

Official Ans. by NTA (3)

Allen Ans. (3)

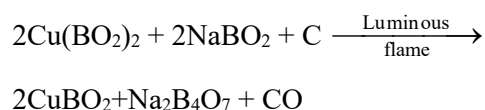
Sol. (Borax Bead Test)

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.

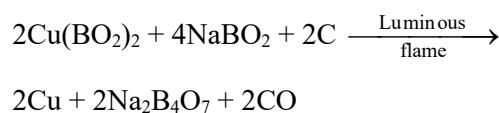


Two reactions may take place in reducing flame (Luminous flame)

(i) The blue-green $\text{Cu(BO}_2)_2$ is reduced to colourless cuprous metaborate as :



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



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)

Allen Ans. (4)

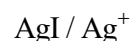
Sol. (A) $\Delta T_b \propto i \times c$

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

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

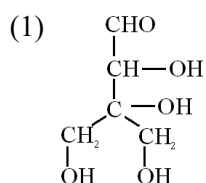
$$(D) M = \frac{30 \times 10 \times 1.26}{98} \approx 4.09 \text{ M}$$

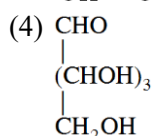
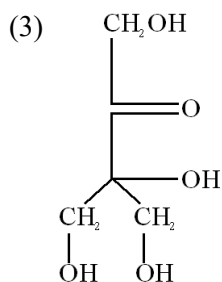
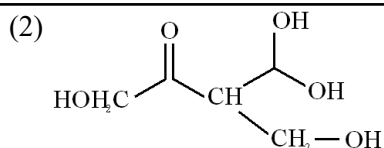
(E) When KI solutions is added to AgNO_3 solution, positively charged solution results due to adsorption of Ag^+ ions from dispersion medium



Positively charged

38. Compound A, $\text{C}_5\text{H}_{10}\text{O}_5$, given a tetraacetate with Ac_2O and oxidation of A with $\text{Br}_2 - \text{H}_2\text{O}$ gives an acid, $\text{C}_5\text{H}_{10}\text{O}_6$. Reduction of A with HI gives isopentane. The possible structure of A is :





Official Ans. by NTA (1)

Allen Ans. (1)

Sol. (i) Formation of tetraacetate with Ac_2O means compound A has four $-\text{OH}$ 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)

Allen 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) $\text{BBr}_3 > \text{BI}_3 > \text{BCl}_3 > \text{BF}_3$

(2) $\text{BCl}_3 > \text{BF}_3 > \text{BBr}_3 > \text{BI}_3$

(3) $\text{BF}_3 > \text{BCl}_3 > \text{BBr}_3 > \text{BI}_3$

(4) $\text{BI}_3 > \text{BBr}_3 > \text{BCl}_3 > \text{BF}_3$

Official Ans. by NTA (4)

Allen Ans. (4)

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

$\text{BF}_3 > \text{BCl}_3 > \text{BBr}_3 > \text{BI}_3$ (extent of back bonding)
 $(2p-2p) \quad (2p-3p) \quad (2p-4p) \quad (2p-5p)$

$\text{BF}_3 < \text{BCl}_3 < \text{BBr}_3 < \text{BI}_3$ (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)	$\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \xrightarrow{\text{Fe(s)}} 2\text{NH}_3(\text{g})$	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)

Allen 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)

Allen Ans. (1)

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)

Allen 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)

Allen 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 ?

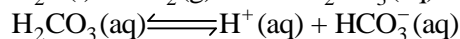
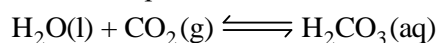
- (1) $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3$
(2) $4\text{NO}_2 + \text{O}_2 + 2\text{H}_2\text{O} \rightarrow 4\text{HNO}_3$
(3) $2\text{SO}_2 + \text{O}_2 + 2\text{H}_2\text{O} \rightarrow 2\text{H}_2\text{SO}_4$
(4) $\text{N}_2\text{O}_5 + \text{H}_2\text{O} \rightarrow 2\text{HNO}_3$

Official Ans. by NTA (1)

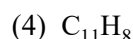
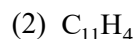
Allen Ans. (1)

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.



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 ?



Official Ans. by NTA (1)

Allen Ans. (1)

Sol. $\text{C}_x\text{H}_y + \left(x + \frac{y}{4}\right)\text{O}_2 \rightarrow x\text{CO}_2 + \frac{y}{2}\text{H}_2\text{O}$

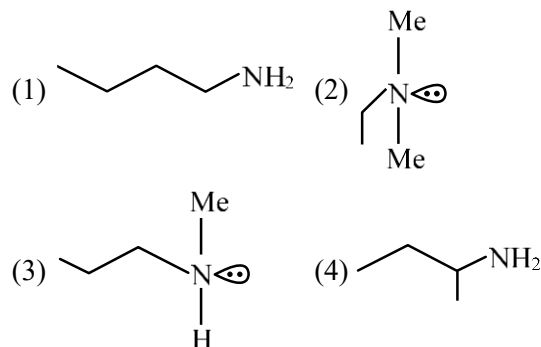
$$\frac{y}{2} = 4 \therefore y = 8$$

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

$$\therefore x = 9$$

\therefore Hydrocarbon will be $= \text{C}_9\text{H}_8$

47. An organic compound $[\text{A}](\text{C}_4\text{H}_{11}\text{N})$, shows optical activity and gives N_2 gas on treatment with HNO_2 . The compound $[\text{A}]$ reacts with PhSO_2Cl producing a compound which is soluble in KOH . The structure of A is:



Official Ans. by NTA (4)

Allen Ans. (4)

Sol. $\text{C}_4\text{H}_{11}\text{N}$ 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)

Allen 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)

Allen Ans. (1)

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

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

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

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

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

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

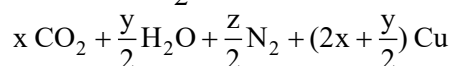
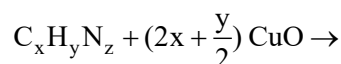
(3) Pd (4) Copper oxide

Official Ans. by NTA (2)

Allen 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 .



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 $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ is -96.0 kJ/mol , this complex will absorb maximum at wavelength ____ nm. (nearest integer)

Assume Planck's constant (h) = $6.4 \times 10^{-34} \text{ Js}$ Speed

of light (c) = $3.0 \times 10^8 \text{ m/s}$ and Avogadro's constant

(N_A) = $6 \times 10^{23} / \text{mol}$.

Official Ans. by NTA (480)

Allen Ans. (480)

Sol. $(\text{Ti}^{+3}(\text{H}_2\text{O})_6)^{3+}$

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

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

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

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

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

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

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

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

$$= 480 \text{ nm}$$

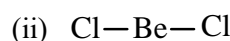
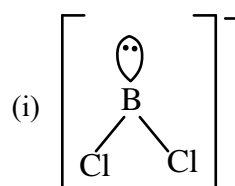
52. Amongst the following, the number of species having the linear shape is ____.

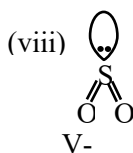
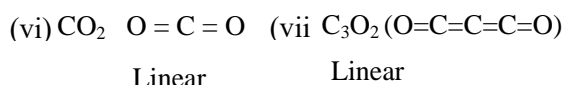
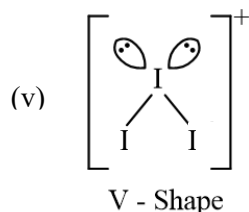
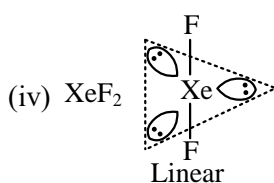
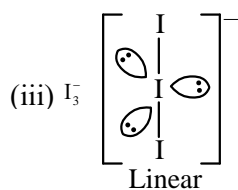
$\text{XeF}_2, \text{I}_3^+, \text{C}_3\text{O}_2, \text{I}_3^-, \text{CO}_2, \text{SO}_2, \text{BeCl}$ and BCl_2^\ominus

Official Ans. by NTA (5)

Allen Ans. (5)

Sol.





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

Official Ans. by NTA (25)

Allen Ans. (25)

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

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

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

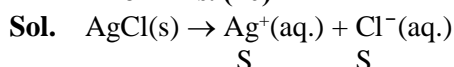
Ans. $25 \times 10^4 \Omega^{-1} \text{cm}^2 \text{mol}^{-1}$

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

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

Official Ans. by NTA (10)

Allen Ans. (10)



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

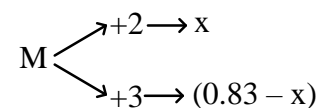
$$-\log K_{sp} = 10$$

55. A sample of a metal oxide has formula $\text{M}_{0.83}\text{O}_{1.00}$. The metal M can exist in two oxidation states +2 and +3. In the sample of $\text{M}_{0.83}\text{O}_{1.00}$, the percentage of metal ions existing in +2 oxidation state is _____ % (nearest integer)

Official Ans. by NTA (59)

Allen Ans. (59)

Sol.

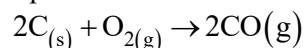


$$2x + 3(0.83 - x) = 2$$

$$x = 0.49$$

$$\% \text{M}^{2+} = \frac{0.49}{0.83} \times 100 = 59\%$$

56. Assume carbon burns according to following equation :

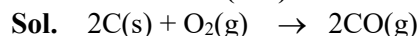


When 12 g carbon is burnt in 48 g of oxygen, the volume of carbon monoxide produced is _____ $\times 10^{-1} \text{L}$ at STP [nearest integer]

[Given : Assume CO as ideal gas, Mass of C is 12g mol^{-1} , Mass of O is 16g mol^{-1} and molar volume of an ideal gas at STP is 22.7L mol^{-1}]

Official Ans. by NTA (227)

Allen Ans. (227)



1mol 1.5 mol

Limiting reagent is carbon. One mole carbon produces one mole CO. Hence, volume at STP is $227 \times 10^{-1} \text{litre}$

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

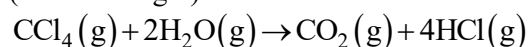
Official Ans. by NTA (2)

Allen Ans. (2)

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

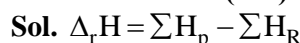
58. Enthalpies of formation of $\text{CCl}_4(\text{g})$, $\text{H}_2\text{O}(\text{g})$, $\text{CO}_2(\text{g})$ and

$\text{HCl}(\text{g})$ are -105 , -242 , -394 and -92kJ mol^{-1} respectively. The magnitude of enthalpy of the reaction given below is _____ kJ mol^{-1} (nearest integer)



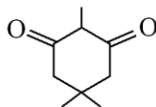
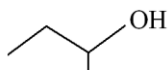
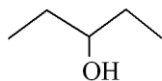
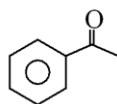
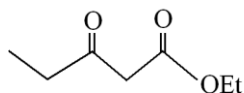
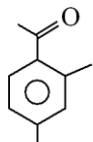
Official Ans. by NTA (173)

Allen Ans. (173)



$$= (-394 + 4 \times -92) - (-105 + (2 \times -242)) = -173 \text{kJ/mol}$$

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

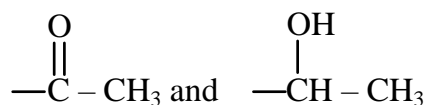


Official Ans. by NTA (3)

Allen 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 _____ $\times 10^{-2} \text{ min}$. (Nearest integer)

(Given : $\ln 10 = 2.303$

$\log 2 = 0.3010$)

Official Ans. by NTA (17)

Allen Ans. (17)

Sol.

$$\begin{aligned} C &= \frac{C_0}{2^n} = \frac{C_0}{32} \\ n &= 5 \\ t &= 5t_{1/2} \\ &= \frac{5 \times 0.693}{20} = \frac{0.693}{4} \\ &= 0.17325 \text{ min} = 17.325 \times 10^{-2} \text{ min.} \end{aligned}$$