MHT CET 2023 Question Paper Shift 1

Question 1. How many of the total triangles will be equilateral triangles if any 3 vertices of a regular hexagon are joined randomly?

Answer. 1/10

Question 2. Why is the Hinsberg reagent used?

Answer. To distinguish primary, secondary, and tertiary amines
Solution. The Hinsberg reagent, also known as the Hinsberg test or Hinsberg's reagent, is used in organic chemistry as a means to distinguish primary, secondary, and tertiary amines. It is named after the German chemist Arthur Hinsberg, who developed this test.

The Hinsberg reagent consists of a mixture of benzenesulfonyl chloride ($C_6H_5SO_2Cl$) and sodium hydroxide (NaOH). When the Hinsberg reagent is added to a sample containing an amine compound, it reacts differently depending on the type of amine present.

Primary amines react with the Hinsberg reagent to form sulfonamide salts, which are soluble in aqueous solutions. This reaction involves the replacement of the hydrogen atom attached to the nitrogen atom in the primary amine with the benzenesulfonyl group ($C_6H_5SO_2$-), resulting in the formation of an easily soluble sulfonamide salt.

Secondary amines also react with the Hinsberg reagent but form insoluble sulfonamide precipitates. This occurs because the benzenesulfonyl group replaces only one of the hydrogen atoms attached to the nitrogen atom, leaving the other hydrogen atom intact. The resulting sulfonamide compound is less soluble and forms a precipitate.

Tertiary amines do not react with the Hinsberg reagent under normal conditions. This is because they lack a hydrogen atom attached to the nitrogen atom that can be replaced by the benzenesulfonyl group.

By observing the solubility or formation of precipitates when the Hinsberg reagent is added to a sample, chemists can deduce the type of amine present in the compound being tested. This test is particularly useful in organic chemistry for the identification and classification of amines.

Question 3. How to (or which reaction is used to) prepare carboxylic acid?

Answer. Alcohol oxidation or Aldehyde oxidation.
Solution. Carboxylic acids can be prepared through various methods, but one common and widely used reaction is the oxidation of primary alcohols or aldehydes. This reaction is known as the alcohol oxidation or aldehyde oxidation.

1. Oxidation of Primary Alcohols: Primary alcohols ($R\text{-}CH_2OH$) can be oxidized to carboxylic acids (R-COOH) using an oxidizing agent such as potassium permanganate ($KMnO_4$), chromium trioxide (CrO_3), or Jones reagent (chromic acid in sulfuric acid).
   The general reaction equation is as follows: $R\text{-}CH_2OH + [O] \rightarrow R\text{-}COOH + H_2O$
   For example, the oxidation of ethanol (CH_3CH_2OH) using potassium permanganate results in the formation of acetic acid (CH_3COOH):
   $CH_3CH_2OH + [O] \rightarrow CH_3COOH + H_2O$
2. Oxidation of Aldehydes: Aldehydes (R-CHO) can also be oxidized to carboxylic acids (R-COOH) using similar oxidizing agents. The reaction is similar to alcohol oxidation but starts from an aldehyde rather than an alcohol.
   The general reaction equation is as follows: $R\text{-}CHO + [O] \rightarrow R\text{-}COOH$
   For example, the oxidation of formaldehyde (HCHO) using silver

oxide (Ag_2O) or Tollen's reagent (ammoniacal silver nitrate) leads to the formation of formic acid (HCOOH):
HCHO + [O] → HCOOH

It's important to note that there are other methods to prepare carboxylic acids, such as hydrolysis of nitriles, oxidation of alkylbenzenes, decarboxylation of carboxylic acid derivatives, and more. The choice of method depends on the starting materials and specific requirements of the synthesis.

Question 4. What remains constant in an adiabatic process?

Answer. Entropy
Solution. In an adiabatic process, the term "adiabatic" refers to the absence of heat exchange between the system and its surroundings. In such a process, heat is neither added to nor removed from the system. Consequently, the quantity that remains constant in an adiabatic process is the entropy.

The entropy (S) of a system is a measure of its disorder or the distribution of energy within the system. In an adiabatic process, where no heat is exchanged with the surroundings, the entropy of the system remains constant.

Additionally, for an ideal gas undergoing an adiabatic process, two other quantities remain constant: the product of pressure (P) and volume (V) raised to the power of the ratio of specific heat capacities (γ), and the product of temperature (T) and volume raised to the power of γ. These relationships can be expressed as:

P^γ * V^γ = constant T *

V^(γ-1) = constant

Here, γ represents the ratio of specific heat capacities (Cp/Cv) for the gas.

So, in summary, in an adiabatic process, the entropy (S), the product of pressure and volume raised to the power of γ (P^γ * V^γ), and the product of temperature and volume raised to the power of γ (T * V^(γ-1)) all remain constant.

Question 5. If $(x + iy)^{1/3} = a + ib$, then find x/a + y/b.

Question 6. Find the area bounded by the region $y = x^2$ and y = |x|.

Question 7. ∫ [(ex (x + 1)) / ($\cos^2(xe^{-x})$] dx = ?If y(x) = $2^x + 2^y = 2$ then find the domain of x.

Question 8. If a = i + j and b = 2i - k, then find the point of the intersection of the lines r x a = b x a and r x b = a x b.

Question 9. f(y) = [(1 - $\sin^{-1}x$)/(1 + $\sin^{-1}x$)] then find f'(y) = x = 0 and y=1

Question 10. If y = $\log_{\sin x}\tan x$ then find dy/dx at x = π/4.

Question 11. In a log of 20 baskets, there are 6 defective baskets. If two baskets are drawn at random without replacement, what is the probability that it will be a defective basket?

Question 12. Find the number of common tangents for two given circles.

Question 13. $\sec^2(\tan^{-1}2)$ + cosec2($\cot^{-1}3$)=?

Question 14. ∫ log cot(cotx) dx/sin2x = ?

Question 15. Find the solution of differential equation dy/dx = $(1+y^2)(1+x^2)$.

Question 16. Find the vector equation of line 2x + 4 = 3y + 1 = 6z - 3.

Question 17. Arrange the compounds in the increasing order of their ionic strength.

Question 18. Identify the structure of gamahexene.

Question 19. Find L_0/L_1 for an open organ pipe.

Question 20. Find the change in pressure if the volume is reduced by 32%. Assume □ = 5/3