

the formation of urea ($\text{NH}_4\text{NOCNH}_4$) from the Ammonium isocyanate ($\text{CH}_4\text{N}_2\text{O}$) have been prepared ($\text{NH}_4\text{CNO} \longrightarrow \text{NH}_2\text{CONH}_2$).

at the beginning 22.9 g from Ammonium isocyanate has been solved in water so 1.00 L (LITER) from the Solution prepared.

1) order of reaction?

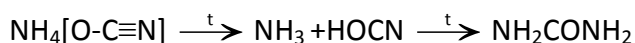
2) rate constant (K)?

3) the mass of Ammonium isocyanate that has been remained after 300 minutes?

T/min 0 20 50 65 150

m(urea) 0 7 12.1 13.8 17.7

Solution:



1. The reaction is second order, $v = kC_{\text{NH}_3}C_{\text{HOCN}}$.
2. For a second order reaction when $C_{\text{NH}_3} = C_{\text{HOCN}}$ rate constant calculated for the formula:

$k = \frac{x}{c_0 \cdot t(c_0 - x)}$, where c_0 – concentration of ammonium isocyanate, M; x – concentration of urea, M. Because, $M(\text{NH}_4[\text{O}-\text{C}\equiv\text{N}]) = M(\text{NH}_2\text{CONH}_2)$ we will use masses of these compounds.

$$k_1 = \frac{7}{22.9 \cdot 20 \cdot (22.9 - 7)} = 9.61 \cdot 10^{-4} \text{ l/mol}\cdot\text{min}$$

$$k_2 = \frac{12.1}{22.9 \cdot 50 \cdot (22.9 - 12.1)} = 9.78 \cdot 10^{-4} \text{ l/mol}\cdot\text{min}$$

$$k_3 = \frac{13.8}{22.9 \cdot 65 \cdot (22.9 - 13.8)} = 1.01 \cdot 10^{-3} \text{ l/mol}\cdot\text{min}$$

$$k_4 = \frac{17.7}{22.9 \cdot 150 \cdot (22.9 - 17.7)} = 9.911 \cdot 10^{-4} \text{ l/mol}\cdot\text{min}$$

So, during the reaction all constants are value equal, with corrected for experimental date.

3. The mass of Ammonium isocyanate that has been remained after 300 minutes calculated for the formula:

$$m = \frac{m_0}{1 + km_0 t} = \frac{22.9}{1 + 9.8 \cdot 10^{-4} \cdot 22.9 \cdot 300} = 3.40 \text{ g}$$

Answer:

1. The reaction is second order.

2. $k=9.8 \cdot 10^{-4} \text{ l/mol} \cdot \text{min}$.

3. $m(\text{NH}_4[\text{O}-\text{C}\equiv\text{N}]) = 3.40 \text{ g}$.

The rate constant is constant within experimental error inevitable, there-
Consequently, this reaction is the reaction of the first order.