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Class: 6B (24)

Objective:

To determine the activation energy of the reaction between bromate ion and bromate(V) ion in acid solution.

Discussion

1. $3\text{Br}_2(\text{aq}) + \text{C}_6\text{H}_5\text{OH}(\text{aq}) \rightarrow \text{C}_6\text{H}_5\text{Br}_3\text{OH}(\text{s}) + 3\text{H}^+(\text{aq}) + 3\text{Br}^-(\text{aq})$
2. Methyl red was used because the solutions are colourless, the end point cannot be determined. However, using methyl red as indicator to give some color to the solution, at the end point the solution was bleached from red to colorless.
3. No, as the rate of reaction increase directly proportional to the temperature, at the temperature=80°C, the rate is so fast that time interval cannot be measured.
4. It is because the time noted is the time when the solution has just been decolourised, therefore, how far the reaction has proceeded is not a factor.
5. From Arrhenius equation, we have $k = Ae^{-E_a/RT}$, where A is Arrhenius constant.

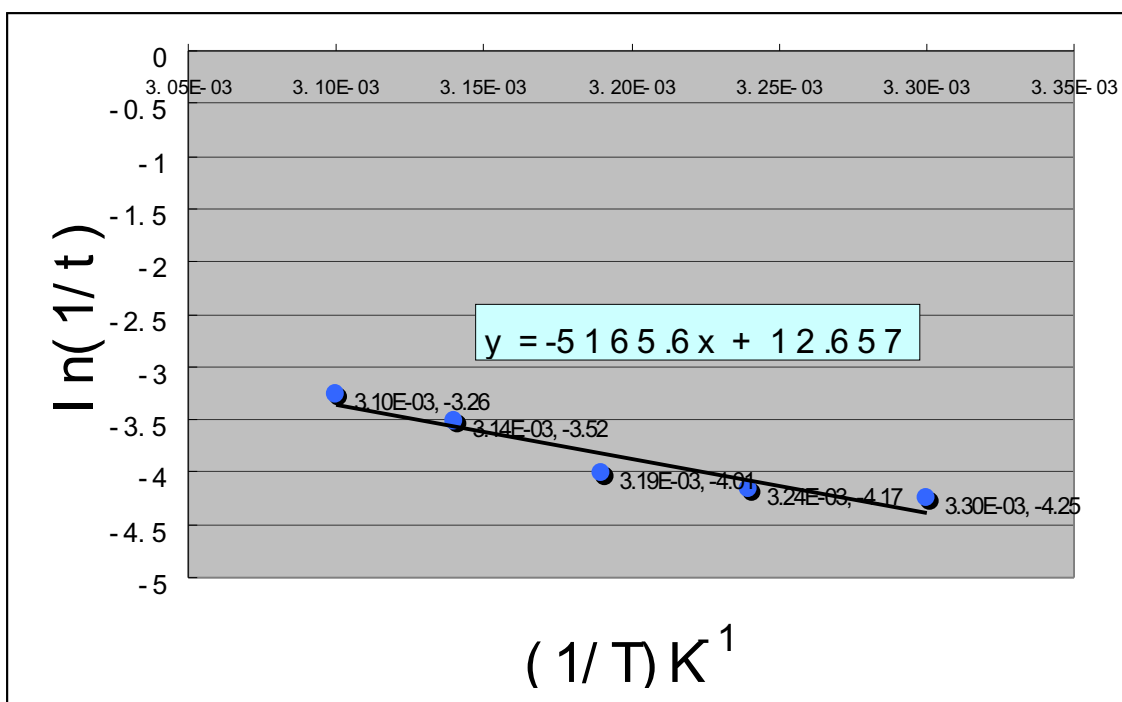
a) Yes, as all concentration terms have been kept constant. Therefore, the rate only varies as k, and the rate is directly proportional to 1/t & varies as k in the rate equation. We can substitute k by 1/t.

b) By taking natural logarithm of $k = Ae^{-E_a/RT}$, we have:
 $\ln k = (-E_a/RT) + \ln A$

C) Results:

Original Temperature(K)	Time(s)	$\ln(1/t)$	Final Temperature (K)	$(1/T) \times 10^{-3}$
303	70	-4.25	305	3.30
308	65	-4.17	310	3.24
313	55	-4.01	315	3.19
318	34	-3.52	319	3.14
323	26	-3.26	324	3.10

$\ln(1/t)$ VS against $1/T$



By the equation: $\ln(1/t) = (-E_a/R)(1/T) + \ln A$

□ slope of the graph = $-E_a/R$

$(-5165.6)(8.31) = -E_a$

$E_a = 42926 \text{ kJmol}^{-1}$

6. Temperature affects the rate of reaction as the kinetic energy of molecules increase when temperature increase, thus, increasing the collision frequency which affects the rate of reaction. The higher the energy, the higher chance to overcome the activation energy barrier.
7. Clock method means to follow a reaction by measuring the time taken to reach a predetermined stage.
In this task, we followed the reaction in different temperature and recorded different time taken. As rate of reaction inversely proportional to the time taken and reminded that the only factor affecting the reaction in this task is the rate.

In this experiment,



As the rate of reaction of phenol and bromide approaches zero in normal condition, sulphuric acid was added to provide an acidic medium to increase the rate of reaction.

The experiment is designed such that we can control the initial temperature of the reaction and record the different time taken.

Thus, we can follow the reaction.

8.

Conclusion

The activation energy of the reaction between bromate ion and bromate(V) ion in acid solution was determined. It is 42926kJmol^{-1} .