Unit 14 – AP Review **Name _____**

2022 FRQ #5 **Period _____**

5. The following equation represents the decomposition of N_2O_5, for which the rate law is rate = $k[N_2O_5]$.

$$2\ N_2O_{5(g)} \rightarrow 4\ NO_{(g)} + O_{2(g)}$$

A sample of pure $N_2O_{5(g)}$ is placed in an evacuated container and allowed to decompose at a constant temperature of 300 K. The concentration of $N_2O_{5(g)}$ in the container is measured over a period o time and the measurements are recorded in the following table.

Time (hr)	$[N_2O_5]\,(M)$
0	0.160
1.67	0.0800
3.33	0.0400
5.00	0.0200

a) Determine the value of the rate constant, *k*, for the reaction. Include units in your answer.

b) The following mechanism is proposed for the decomposition of $N_2O_{5(g)}$.

Step 1: $N_2O_{5(g)} \rightarrow NO_{2(g)} = NO_{3(g)}$

Step 2: $NO_{2(g)} + NO_{3(g)} \rightarrow NO_{2(g)} + NO_{(g)} + O_{2(g)}$

Step 3: $N_2O_{5(g)} + NO_{(g)} \rightarrow 3\ NO_{2(g)}$

Identify which step is the proposed mechanism (1, 2, or 3) is the rate-determining step. Justify your answer in terms of the rate law given.

$2\ N_2O_{5(g)} \rightarrow 4\ NO_{2(g)} + O_{2(g)}$ rate = $k[N_2O_5]$.

c) If this experiment was repeated at the same temperature but with twice the initial concentration of N_2O_5, would the value of *k* increase, decrease, or remain the same? Explain your reasoning.