Problem of the Day 18 CHEM 1252

1. Sulfur-38 is a radioactive isotope of that emits beta particles (high energy electrons). The emission is characterized by a **constant** half-life of 2.84 hours. This isotope can be incorporated into proteins to follow certain metabolic processes. A protein sample is prepared that is initially emitting 2004 beta particles per second.

(a) What is the overall order of the process described above?

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(b) What is tha value of the rate constant for this process (don't forget the units)

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(c) How long will it take for the beta particle emission to slow down to 501 counts per second?

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2. (a) The table to the right contains rate constant versus temperature data. Fill in the empty columns.

k (M^{-1} s^{-1})	ln k	T (°C)	T (K)	1/T (K^{-1})
6.74×10^{-5}		226.85		
2.80×10^{-5}		126.85		
1.16×10^{-5}		60.18		
4.84×10^{-6}		12.56		
2.01×10^{-6}		-23.15		
8.36×10^{-7}		-50.93		

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(b) Write down the Arrhenius equation such that these data can be plotted as a **straight** line (y = mx + b).

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(c) The slope and y-intercept from the equation above is m = -1755.7 K and b = - 6.0945. Calculate the activation energy and the frequency factor from this result.

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3. The decomposition reaction of $N_2O_{5(g)}$ is: $2\ N_2O_{5(g)} \longrightarrow 4\ NO_{2(g)} + O_{2(g)}$

(a) The rate of this reaction slows to 1/2 the initial rate when the concentration of $N_2O_5(g)$ decreases to half it initial concentration. What is the overall order of the reaction? You must justify your answer.

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(b) Write out the rate law for this reaction.

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(c) If the observed rate constant is $k = 3.21 \times 10^2\ s^{-1}$, calculate the initial rate of the reaction when the initial concentrations of $N_2O_{5(g)}$ are 1.0 M, 0.5 M, 0.25 M and 0.125 M.

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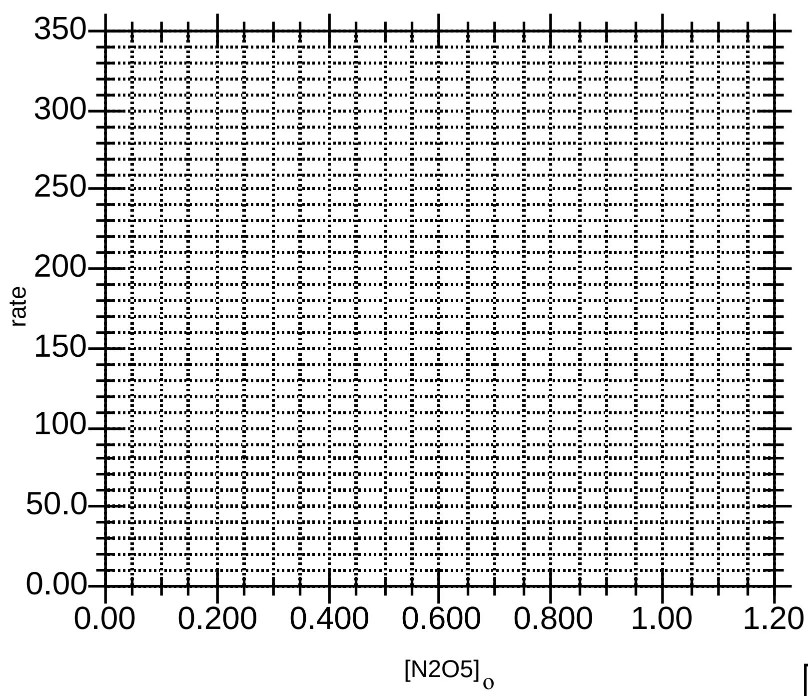
(d) On the graph at right, plot the data from part (c), and sketch a line through the data.

(e) On the graph from part (d), sketch what you think the rate versus $[N_2O_5]_o$ will look like for a zeroth order reaction.



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