Name: _____

CHM 112 Exam 1 Spring

Short Answer

1. For a first-order reaction that has a rate constant of $6.9 \times 10^{-4}\ s^{-1}$;

   a) if the initial concentration of the only reactant is 0.25 M, what is the concentration after 8.4 min?
   b) How long will it take for the concentration to decrease to 0.15 M?
   c) How long will it take for the reaction to be 60% complete?

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2. The rate constants for a reaction were determined at two temperatures. At 100.0 K the rate constant is $2.0 \times 10^{3}\ s^{-1}$, and at 500.0 K the rate constant is $4.07 \times 10^{7}\ s^{-1}$. Calculate the activation energy for the reaction.

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3. The reaction between carbon monoxide and nitrogen dioxide has the experimentally determined rate law; rate = $k[NO_2]^2$

$$CO + NO_2 \rightarrow CO_2 + NO$$

The following mechanisms have been proposed;

mechanism 1: $CO + NO_2 \rightarrow CO_2 + NO$

mechanism 2: $NO_2 + NO_2 \rightarrow NO_3 + NO$ slow
$NO_3 + CO \rightarrow NO_2 + CO_2$ fast

mechanism 3: $NO_2 \rightarrow NO + O$ slow
$CO + O \rightarrow CO_2$ fast

Which mechanism is most likely. Briefly explain your choice for each possibility

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4. In a reversible reaction, the energy of activation for the forward reaction is 118 kJ/mol, and the energy of activation for the reverse direction is 217 kJ/mol. Sketch a reaction coordinate diagram. Label completely. What is the enthalpy, H for the reaction?

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5. In a kinetic study of the reactiom;

$2\ NO(g) + H_2(g) \quad N_2O(g) + H_2O(g)$

the data for the initial rates;

Initial concentrations (M)		Rate (M/s)
[NO]	[H_2]	
6.4×10^{-3}	2.2×10^{-3}	2.6×10^{-5}
12.8×10^{-3}	2.2×10^{-3}	1.0×10^{-4}
6.4×10^{-3}	4.4×10^{-3}	5.1×10^{-5}

Obtain the rate law
What is the value of the rate constant?

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6. The rate constant for a second-order reaction is 1.15/M at 25 degrees C. How long (seconds) will it take for the concentration of the single reactant to decrease from 0.55 M to 0.45 M?

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7. Consider this equilibrium;
   $C(s) + H_2O(g) = CO(g) + H_2(g)$

   Which direction will this reaction go if;
   a) CO is added to the reaction mixture
   b) H_2O is condensed and removed from the reaction mixture
   c) C is added to the reaction mixture

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