Name _____ AP Chemistry

HW 12_1: Due 2/28/20 Complete both free response questions. One or both will be graded. Show all work. Box and clearly label all final answers

1. In an experiment, all the air in a rigid 2.0 L flask is pumped out. Then some liquid ethanol is injected into the sealed flask, which is held at 35°C. The amount of liquid ethanol initially decreases, but after five minutes the amount of liquid ethanol in the flask remains constant. Ethanol has a boiling point of 78.5°C and an equilibrium vapor pressure of 100 torr at 35°C.

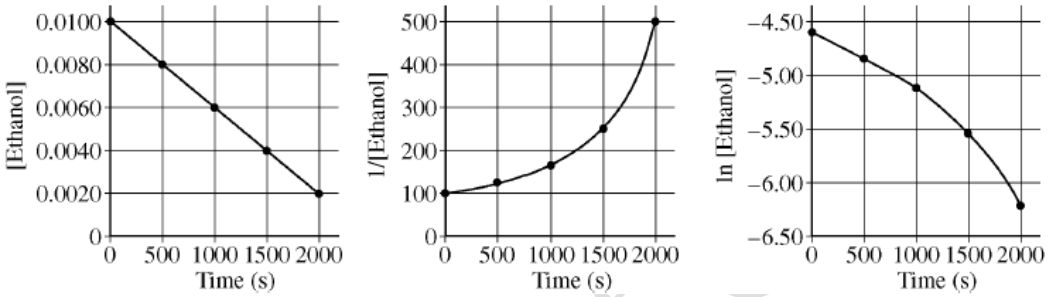
(a) When the amount of liquid ethanol in the flask is constant, is the pressure in the flask greater than, less than, or equal to 100 torr? Justify your answer.

(b) The flask is then heated to 45°C, and the pressure in the flask increases. In terms of kinetic molecular theory, provide TWO reasons that the pressure in the flask is greater at 45°C than at 35°C.

In a second experiment, which is performed at a much higher temperature, a sample of ethanol gas and a copper catalyst are placed in a rigid, empty 1.0 L flask. The temperature of the flask is held constant, and the initial concentration of the ethanol gas is 0.0100 *M*. The ethanol begins to decompose according to the chemical reaction represented below.

$$CH_3CH_2OH(g) \rightarrow CH_3CHO(g) + H_2(g)$$

The concentration of ethanol gas over time is used to create the three graphs below.



(c) Given that the reaction order is zero, one, or two, use the information in the graphs to respond to the following.

(i) Determine the order of the reaction with respect to ethanol. Justify your answer.

(ii) Write the rate law for the reaction.

(iii) Determine the rate constant for the reaction, including units.

(d) The pressure in the flask at the beginning of the experiment is 0.40 atm. If the ethanol completely decomposes, what is the final pressure in the flask?

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2. $A(aq) + 2\,B(aq) \rightarrow 3\,C(aq) + D(aq)$

For the reaction above, carried out in solution at 30 °C, the following kinetic data were obtained:

Experiment	Initial concentration of Reactants mole liter^{-1} A_o	B_o	Initial Rate of Reaction mole liter^{-1} hour^{-1}
1	0.12	0.18	3.46×10^{-2}
2	0.060	0.12	1.15×10^{-2}
3	0.030	0.090	4.32×10^{-3}
4	0.24	0.090	3.46×10^{-2}

(a) What is the order of the reaction with respect to A?
(b) What is the order of the reaction with respect to B?
(c) Write the rate-law expression for this reaction.
(d) Calculate the value of the specific rate constant k at 30°C and specify its units.
(e) Assume that the reaction goes to completion. Under the conditions specified for experiment 2, what would be the final molar concentration of C?

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