Name:

Kinetics Quiz

(22 points)

MY HOBBY: EXTRAPOLATING

Image from: http://xkcd.com/605/
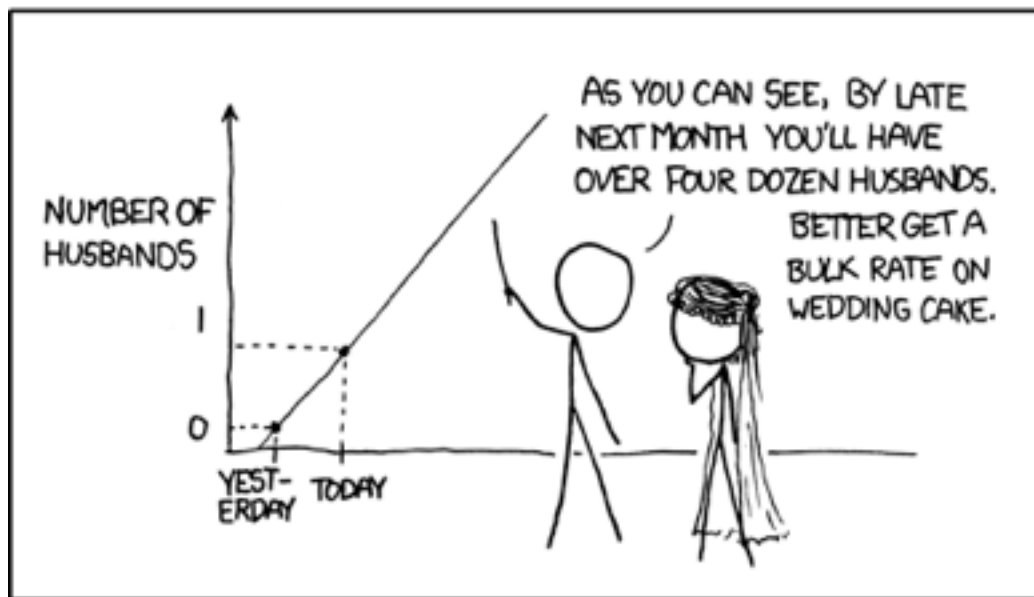
$$k = Ae^{-\frac{E_a}{RT}}$$

$$\ln k = -\frac{E_a}{RT} + \ln A$$

$$\ln \frac{k_2}{k_1} = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

R = 8.314 J/mol•K

Part 1, Multiple choice: circle the letter of the ONE best answer (1 each)

1. Which of the following statements is TRUE?
    A) Rate constants are independent of temperature.
    B) A catalyst raises the activation energy of a reaction.
    C) Increasing the concentration of a reactant always increases the rate of the reaction.
    D) None of the above are true.

2. What are the units of k for this rate law?

$$rate = k[Cl_2][NO]^2$$

A) $dm^3\ mol^{-1}s^{-2}$

B) $dm^6\ mol^{-2}s^{-1}$

C) $dm^9\ mol^{-3}s^{-1}$

D) $dm^6\ mol^{-2}s$

3. Which of the following statements is TRUE?

A) An increase in temperature leads to an increase in rate primarily because it leads to more frequent collisions.

B) An increase in temperature leads to an increase in rate primarily because it lowers the activation energy of a reaction.

C) An increase in temperature leads to an increase in rate primarily because it increases the energy of the reactant particles.

D) None of the above are true.

4. For a reaction that follows the general rate law, Rate = $k[A][B]^2$, what will happen to the rate of reaction if the concentration of B is increased by a factor of 5? The rate will

A) decrease by a factor of 1/5.

B) increase by a factor of 10.

C) increase by a factor of 5.

D) increase by a factor of 25.

Free Response

5. Explain by reference to the Maxwell-Boltzmann distribution why the rate of a reaction increases when a catalyst is introduced. (3)

6. For the following reaction:

$$2A_{(g)} + B_{(g)} \rightarrow C_{(g)} + D_{(g)}$$
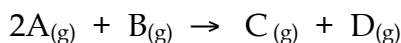
the initial rate (of disappearance of B) was measured at 25°C as a function of the initial concentrations of A & B The following results were found.
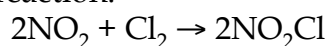
[A], mol dm^{-3}	[B] mol dm^{-3}	Initial rate, mol dm^{-3} s^{-1}
0.030	0.0055	8.55 × 10^{-3}
0.060	0.0055	3.42 × 10^{-2}
0.030	0.0110	3.42 × 10^{-2}

a) Deduce the rate law for this process. (4)

b) Calculate the rate constant, k and give its units. (2)

c) What is the rate of the reaction when [A] = 0.10 mol dm^{-3} and [B] = 0.020 mol dm^{-3}? (2)

7. Consider this gas phase reaction:

$$2NO_2 + Cl_2 \rightarrow 2NO_2Cl$$

The rate equation for this reaction is Rate = $k[NO_2][Cl_2]$

a) Explain, by reference to this reaction, why the rate equation cannot be derived from the stoichiometric equation (2)

b) Suggest a two-step mechanism for this reaction. (3)

c) If the total volume of the reaction container were decreased by half at constant temperature, state and explain the effect on the rate of the reaction. (2)