A First Course on Kinetics and Reaction Engineering

Unit 4 Pre-Class Quiz

1. Match the quantities listed below to the corresponding equation

   a. Rate with respect to a species — i) $r_g = \frac{1}{V}\lim_{\Delta t \to 0}\frac{\Delta m_{cells}}{\Delta t} = \frac{1}{V}\frac{dm_{cells}}{dt}$

   b. Specific cell growth rate — ii) $r_{i,j} = \lim_{\Delta t \to 0}\frac{1}{V}\frac{\Delta n_{i,j}}{\Delta t} = \frac{1}{V}\frac{dn_{i,j}}{dt}$

   c. Generalized reaction rate — iii) $r_j = \frac{1}{V_{fluid}}\frac{d\xi_j}{dt}$

   d. Cell growth rate — iv) $\mu = \frac{r_g}{C_{cells}}$

   v) $r = f\left(T, P, \underline{x}\right)$

2. True or False? The rate expression for any reaction is the difference between two terms that depend upon the stoichiometry of the reaction as illustrated below for the reaction 2A ⇄ Y + Z.

$$r = k_{forward}C_A^2 - k_{reverse}C_Y C_Z$$

3. Which of the following is the Arrhenius expression?

   a. $K_j = \exp\left\{\frac{-\Delta G_j}{RT}\right\}$

   b. $k_j = \exp\left\{\frac{\Delta S_j}{R}\right\}\exp\left\{\frac{-\Delta H_j}{RT}\right\}$

   c. $K_j = K_{0,j}\exp\left\{\frac{-\Delta H_j}{RT}\right\}$

   d. $k_j = k_{0,j}\exp\left(\frac{-E_j}{RT}\right)$

   e. $k_j = k_{0,j}T^a\exp\left(\frac{-E_j}{RT}\right)$

4. True or False? The activation energy that appears in the Arrhenius expression can be positive or negative.
5. True of False? The temperature dependence of a rate coefficient is ALWAYS modeled using the Arrhenius expression.