Physical Chemistry

1. ***(20%)*** Please describe the following terms:
   (1) physical adsorption and chemisorption
   (2) Langmuir adsorption isotherm
   (3) Boltzmann distribution law
   (4) van der Waals forces

2. ***(20%)*** For a second-order reaction A + B $\longrightarrow$ products with rate = k [A][B] and initial concentrations $[A]_0 = [B]_0 = a$, calculate the rate coefficient if half of the reactants were reacted in 9 seconds.

3. ***(20%)*** An enzymatic reaction is represented as

$$E + S \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} ES; \quad ES \xrightarrow{k_2} P + E$$

   The concentration of enzyme-substrate complex [ES] is assumed to maintain at a constant value throughout the reaction.
   Please derive an equation to express the reaction rate.

4. ***(20%)*** (1) State the Arrhenius law.
   (2) A second-order reaction in solution has a rate constant (k) of 5.7×10^{-5} $dm^3\ mol^{-1}\ s^{-1}$ at 40°C. Calculate the activation energy (E) and the preexponential factor (A), assuming the Arrhenius law to apply. (R is the gas constant, equal to 8.314 $J\ K^{-1}\ mol^{-1}$)

5. ***(20%)*** Please make a statement to describe what is (a) DNA, (b) DNA chip.