

平成 27 年度 反応の化学b 学期末試験問題

以下の問に答えよ。数値は 3 桁まで求めよ。

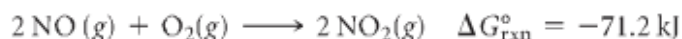
問 1. Partial Pressures and Mole Fractions

A 12.5-L scuba diving tank is filled with a heliox mixture containing 24.2 g of He and 4.32 g of O₂ at 298 K. Calculate the mole fraction and partial pressure of each component in the mixture and calculate the total pressure.

He の分子量 4.00, O₂ の分子量 32.00, 気体定数 $R = 0.0821 \text{ L atm mol}^{-1} \text{ K}^{-1}$.

問 2. Calculating ΔG_{rxn} under Nonstandard Conditions

Consider the following reaction at 298 K:



Compute ΔG_{rxn} under the following conditions:

$$P_{\text{NO}} = 0.100 \text{ atm}; P_{\text{O}_2} = 0.900 \text{ atm}; P_{\text{NO}_2} = 6.00 \text{ atm}$$

Is the reaction more or less spontaneous under these conditions than under standard conditions?

気体定数 $R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$.

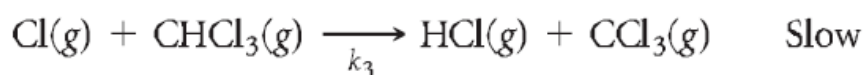
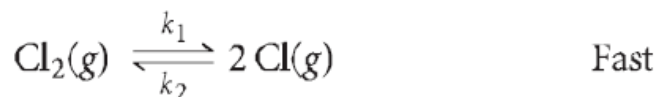
問 3.

Anthropologists can estimate the age of a bone or other organic matter by its carbon-14 content. The carbon-14 in a living organism is constant until the organism dies, after which carbon-14 decays with first-order kinetics and a half-life of 5730 years. Suppose a bone from an ancient human contains 3.84% of the C-14 found in living organisms. How old is the bone?

Anthropologist; 人類学者, carbon-14; 炭素の同位体 ¹⁴C.

問 4.

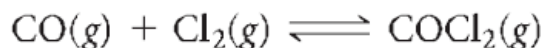
Consider the following three-step mechanism for a reaction:



- What is the overall reaction?
- Identify the intermediates in the mechanism.
- What is the predicted rate law?

問 5.

Consider the following reaction at equilibrium:



Predict whether the reaction will shift left, shift right, or remain unchanged upon each of the following disturbances:

- COCl_2 is added to the reaction mixture.
- Cl_2 is added to the reaction mixture.
- COCl_2 is removed from the reaction mixture.