

平成 26 年度 反応の化学b 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. Using the Two-Point Form of the Arrhenius Equation

The reaction between nitrogen dioxide and carbon monoxide is given by the following equation:



The rate constant at 701 K was measured as $2.57 \text{ M}^{-1} \cdot \text{s}^{-1}$ and that at 895 K was measured as $567 \text{ M}^{-1} \cdot \text{s}^{-1}$. Find the activation energy for the reaction in kJ/mol.

アレニウス式は $k = A \exp\left(-\frac{E_a}{RT}\right)$, あるいは $\ln k = -\frac{E_a}{RT} + \ln A$ である。

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

問 2. Reaction Mechanisms

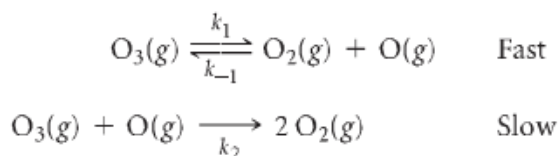
Ozone naturally decomposes to oxygen by the following reaction:



The experimentally observed rate law for this reaction is as follows:

$$\text{Rate} = k[\text{O}_3]^2[\text{O}_2]^{-1}$$

Show that the following proposed mechanism is consistent with the experimentally observed rate law.



ヒント; まず、以下のことが成り立っていることを示す。

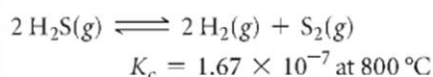
Rate (forward) = rate (backward)

$$k_1[\text{O}_3] = k_{-1}[\text{O}_2][\text{O}]$$

$$[\text{O}] = \frac{k_1[\text{O}_3]}{k_{-1}[\text{O}_2]}$$

問 3. Finding
Equilibrium Concentrations in
Cases with a Small
Equilibrium Constant

Consider the following reaction for the decomposition of hydrogen disulfide:



A 0.500-L reaction vessel initially contains 0.0125 mol of H_2S at 800°C . Find the equilibrium concentrations of H_2 and S_2 .

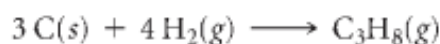
注) decomposition ; 分解, sulfide ; 硫化物, vessel 容器

ヒント; まず、下の表を完成しなさい。

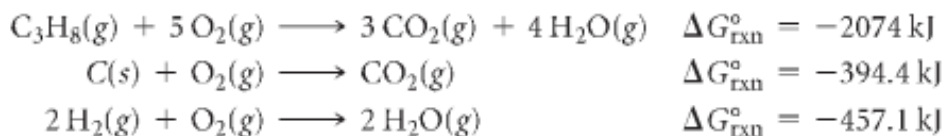
	$[\text{H}_2\text{S}]$	$[\text{H}_2]$	$[\text{S}_2]$
Initial	0.0250	0.00	0.00
Change			
Equil			

問 4. Determining $\Delta G_{\text{rxn}}^\circ$ for a Stepwise Reaction

Find $\Delta G_{\text{rxn}}^\circ$ for the following reaction:

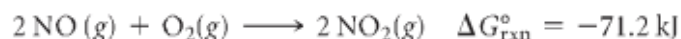


Use the following reactions with known ΔG° s:



問 5. Calculating ΔG_{rxn} under Nonstandard Conditions

Consider the following reaction at 298 K:



Compute ΔG_{rxn} under the following conditions:

$$P_{\text{NO}} = 0.100 \text{ atm}; P_{\text{O}_2} = 0.100 \text{ atm}; P_{\text{NO}_2} = 2.00 \text{ atm}$$

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

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

ヒント: 下式を用いる。

$$\Delta G_{\text{rxn}} = \Delta G_{\text{rxn}}^\circ + RT \ln Q$$