

平成 25 年度 反応の化学b 期末試験問題

関数電卓のみ、持込可。下記の問に答えなさい。

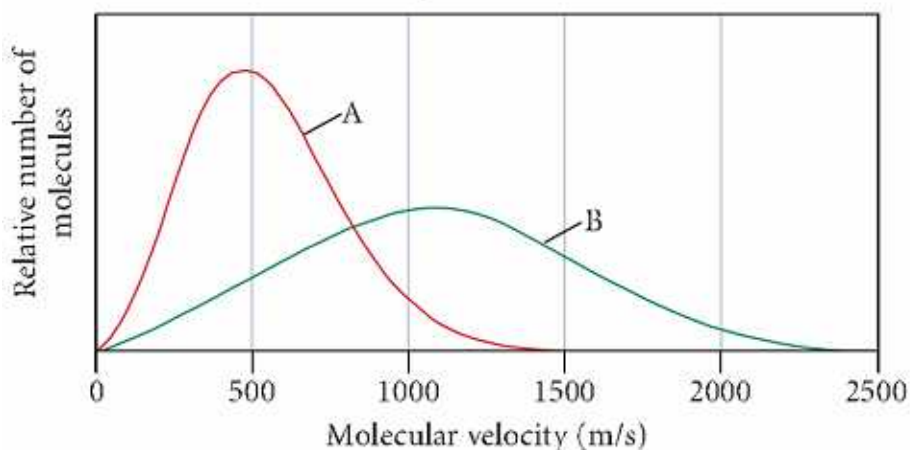
問 1. Root Mean Square Velocity

Calculate the root mean square velocity of oxygen molecules at 25 °C.

酸素分子 1mol の質量 32.00 g. 気体定数 $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$. $T = 273 \text{ K}$.

問 2.

The following graph shows the distribution of molecular velocities for two different molecules (A and B) at the same temperature. Which molecule has the higher molar mass? Which molecule would have the higher rate of effusion?



問 3. $\Delta H_{\text{rxn}}^{\circ}$ and Standard Enthalpies of Formation

Use the standard enthalpies of formation to determine $\Delta H_{\text{rxn}}^{\circ}$ for the following reaction:



ただし、反応物および生成物の ΔH_f° は以下の表に与えられる。

Reactant or product	ΔH_f° (kJ/mol, from Appendix IIB)
$\text{NH}_3(\text{g})$	-45.9
$\text{O}_2(\text{g})$	0.0
$\text{NO}(\text{g})$	+91.3
$\text{H}_2\text{O}(\text{g})$	-241.8

問 4. Reaction Mechanisms

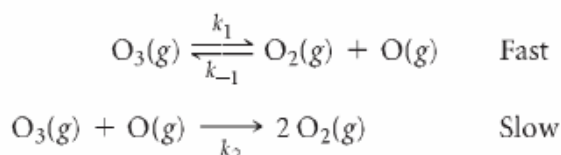
Ozone naturally decomposes to oxygen by the following reaction:



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

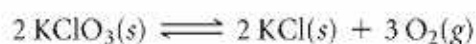
$$\text{Rate} = k[\text{O}_3]^2[\text{O}_2]^{-1}$$

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



問 5. Effect of a Volume Change on Equilibrium

Consider the following reaction at chemical equilibrium:



What is the effect of decreasing the volume of the reaction mixture? Increasing the volume of the reaction mixture? Adding an inert gas at constant volume?

問 6.

Consider the following reaction:

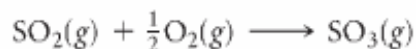


Each of the following entries in the table below represents equilibrium partial pressures of A and B under different initial conditions. What are the values of a and b in the reaction?

P_A (atm)	P_B (atm)
4.0	2.0
2.0	1.4
1.0	1.0
0.50	0.71
0.25	0.50

問 7. Calculating the Standard Change in Free Energy for a Reaction using $\Delta G_{\text{rxn}}^{\circ} = \Delta H_{\text{rxn}}^{\circ} - T\Delta S_{\text{rxn}}^{\circ}$

One of the possible initial steps in the formation of acid rain is the oxidation of the pollutant SO_2 to SO_3 by the following reaction:



Calculate $\Delta G_{\text{rxn}}^{\circ}$ at 25 °C and determine whether the reaction is spontaneous.

ただし、反応物および生成物の ΔH , ΔS は以下の表に与えられる。

Reactant or product	ΔH_f° (kJ/mol)	S° (in J/mol·K)
$\text{SO}_2(\text{g})$	-296.8	248.2
$\text{O}_2(\text{g})$	0	205.2
$\text{SO}_3(\text{g})$	-395.7	256.8

問 8.

When 1 mol of a gas burns at constant pressure, it produces 2418 J of heat and does 5 kJ of work. Identify ΔE , ΔH , q , and w for the process.