平成 24 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.　　　　　Calculating Density

A man receives a platinum ring from his fiancée. Before the wedding, he notices that the ring feels a little light for its size and decides to measure its density. He places the ring on a balance and finds that it has a mass of 3.15 grams. He then finds that the ring displaces 0.233 cm^3 of water. Is the ring made of platinum?

物体の体積を量る時は水に沈めて、溢れた水の体積を求める。

すなわち、指輪の体積は 0.233 cm^3 である。

また、白金の密度は 21.4 g/cm^3　である。

注）　density ; 密度, fiancée ; フィアンセ ♥, platinum ; 白金, balance ; 天秤

問 2.　　　　　Gases in Chemical Reactions

Methanol (CH_3OH) can be synthesized by the following reaction:

$$CO(g) + 2H_2(g) \longrightarrow CH_3OH(g)$$
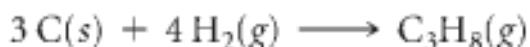
What volume (in liters) of hydrogen gas, measured at a temperature of 355 K and a pressure of 738 mmHg, is required to synthesize 35.7 g of methanol?

760 mmHg = 1 atm, molar mass CH_3OH = 32.04 g/mol, 気体定数 $R = 0.082$ L atm mol^{-1} K^{-1}.
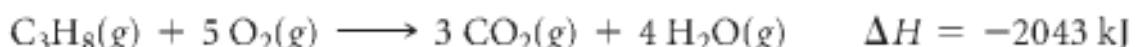
注）　synthesize ; 合成する

問 3.　　　　　Hess's Law

Find ΔH_{rxn} for the following reaction:

$$3C(s) + 4H_2(g) \longrightarrow C_3H_8(g)$$

Use the following reactions with known ΔH's:

$$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(g) \qquad \Delta H = -2043 \text{ kJ}$$
$$C(s) + O_2(g) \longrightarrow CO_2(g) \qquad \Delta H = -393.5 \text{ kJ}$$
$$2H_2(g) + O_2(g) \longrightarrow 2H_2O(g) \qquad \Delta H = -483.6 \text{ kJ}$$

ΔH_{rxn} ; enthalpy of reaction, or heat of reaction (反応熱).

問 4. Using the Two-Point Form of the Arrhenius Equation

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

$$NO_2(g) + CO(g) \longrightarrow NO(g) + CO_2(g)$$

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

アレニウス式は $k = A\exp(-\dfrac{E_a}{RT})$ ，あるいは $\ln k = -\dfrac{E_a}{RT} + \ln A$ である。
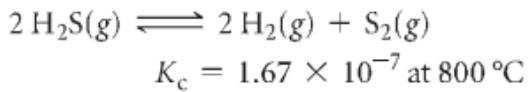
ヒント；まず、(T_1, k_1) (T_2, k_2) において $\ln\dfrac{k_2}{k_1} = \dfrac{E_a}{R}(\dfrac{1}{T_1} - \dfrac{1}{T_2})$ を示しなさい。

気体定数 $R = 8.31$ J K^{-1} mol^{-1}

問 5. Finding Equilibrium Concentrations from Initial Concentrations in Cases with a Small Equilibrium Constant

Consider the following reaction for the decomposition of hydrogen disulfide:

$$2\,H_2S(g) \rightleftharpoons 2\,H_2(g) + S_2(g)$$
$$K_c = 1.67 \times 10^{-7} \text{ at } 800\,°C$$

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。

	[H_2S]	[H_2]	[S_2]
Initial	0.0250	0.00	0.00
Change			
Equil			