

Chemistry 2710 Spring 2001 Assignment 1

Solutions

1. (a) $2x - 2x^{-3} = 2\left(x - \frac{1}{x^3}\right)$

(b) $-ke^{-kt}$

2. (a)

$$\begin{aligned}\int_{a_0}^{a(t)} \frac{dx}{x^n} &= \int_{a_0}^{a(t)} x^{-n} dx \\ &= \frac{1}{1-n} x^{1-n} \Big|_{a_0}^{a(t)} \\ &= \frac{1}{1-n} \left(a(t)^{1-n} - a_0^{1-n} \right)\end{aligned}$$

(b)

$$\begin{aligned}\int_3^{15} \frac{dx}{x} &= \ln x \Big|_3^{15} \\ &= \ln 15 - \ln 3 = \ln(15/3) = \ln 5\end{aligned}$$

3. (a) We first convert both masses to numbers:

$$n_{S_8} = \frac{32.0 \text{ g}}{256.48 \text{ g/mol}} = 0.125 \text{ mol}$$

$$n_{Cl_2} = \frac{71.0 \text{ g}}{70.906 \text{ g/mol}} = 1.00 \text{ mol}$$

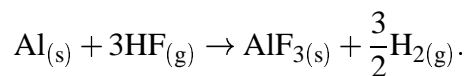
To completely react 0.125 mol of S_8 , we would need $4(0.125 \text{ mol}) = 0.500 \text{ mol}$ of chlorine. The chlorine is therefore in excess. The number of moles of product formed is therefore $4(0.125 \text{ mol}) = 0.500 \text{ mol}$. The mass of disulfur dichloride is therefore

$$m_{S_2Cl_2} = (0.500 \text{ mol})(135.03 \text{ g/mol}) = 67.5 \text{ g}.$$

(b)

$$V = \frac{nRT}{P} = \frac{(1.00 \text{ mol})(8.314510 \text{ JK}^{-1} \text{ mol}^{-1})(323.15 \text{ K})}{90 \times 10^3 \text{ Pa}} = 0.030 \text{ m}^3.$$

4. We must start with a balanced reaction:



$$\begin{aligned}\Delta \bar{H}^\circ &= \Delta \bar{H}_{f(\text{AlF}_3)}^\circ + \frac{3}{2}\Delta \bar{H}_{f(\text{H}_2)}^\circ - \left(\Delta \bar{H}_{f(\text{Al})}^\circ + 3\Delta \bar{H}_{f(\text{HF})}^\circ \right) \\ &= -1510.4 - 3(-273.30) \text{ kJ/mol} = -690.5 \text{ kJ/mol}.\end{aligned}$$

$$\begin{aligned}\Delta \bar{S}^\circ &= \bar{S}_{(\text{AlF}_3)}^\circ + \frac{3}{2}\bar{S}_{(\text{H}_2)}^\circ - \left(\bar{S}_{(\text{Al})}^\circ + 3\bar{S}_{(\text{HF})}^\circ \right) \\ &= 66.5 + \frac{3}{2}(130.680) - [28.30 + 3(173.779)] \text{ JK}^{-1} \text{ mol}^{-1} \\ &= -287.117 \text{ JK}^{-1} \text{ mol}^{-1}.\end{aligned}$$

5. The slope is 2.39 and the y intercept is 1.23. In other words, the line of best fit is $y = 2.39x + 1.23$.