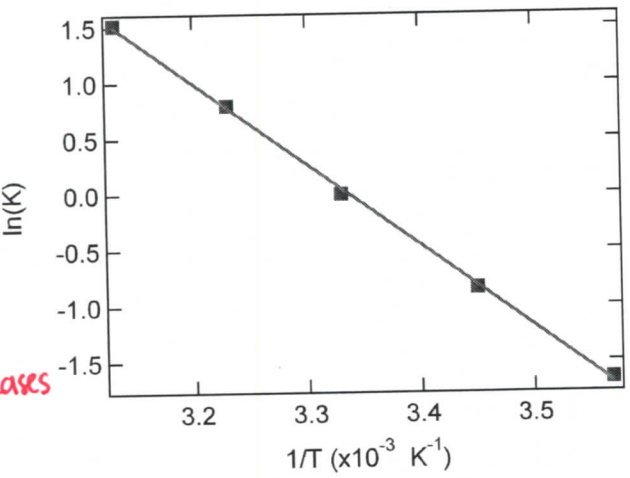
ChBE 3130A Lively Quiz 10 **Date:**_____

Name: Solutions

Problem 1: The reaction constants vs. temperature relationship for two different reactions are shown in the plots below. Label which reaction is exothermic and which reaction is endothermic.

Endothermic

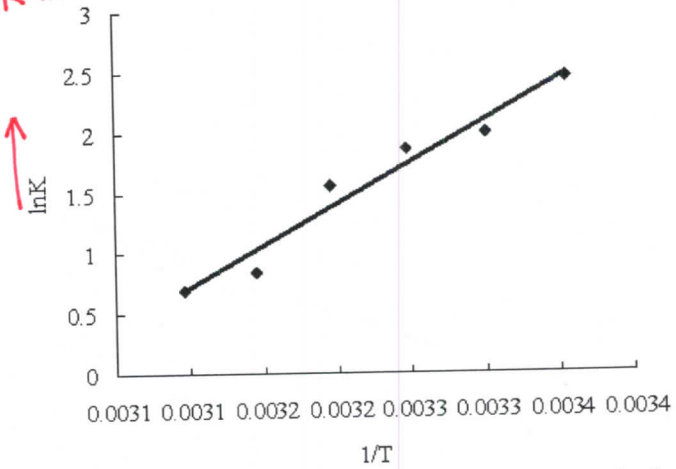


K decreases

$\frac{1}{T}$ increases → T decreases

K increases

Exothermic



$\frac{1}{T}$ increases ⇒ T decreases

Problem 2: Consider the following gas phase reaction: $NO + (1/2)O_2 \rightarrow NO_2$.

(a) What is the total stoichiometric number for this reaction? $-1/2$

(b) What will happen to the reaction coordinate if pressure is increased at constant temperature? increase

Problem 3: Utilizing the reaction thermodynamic data below, calculate the equilibrium constant at 300K[1] for A+2B→2C

$\Delta H^o_{f,A} = 50$ kJ/mol

$\Delta H^o_{f,B} = 40\ kJ/mol$

$\Delta H^o_{f,C} = 60\ kJ/mol$

$\Delta H^\circ = \sum \nu_i \Delta H^\circ_{f,i} = 2(60) - 2(40) - 50 = -10$ KJ/mol

$\Delta S^\circ = \sum \nu_i \Delta S^\circ_{f,i} = 2(0.6) - 2(0.4) - 0.5 = -0.1$ KJ/mol

$\Delta S^o_{f,A} = 0.5\ kJ/(mol \cdot K)$

$\Delta S^o_{f,B} = 0.4\ kJ/(mol \cdot K)$

$\Delta S^o_{f,C} = 0.6\ kJ/(mol \cdot K)$

$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ = (-10) - (300K)(-0.1) = 20\ \frac{KJ}{mol}$

$K = exp\left(\frac{-\Delta G^o_{rxn}}{RT}\right)$

$K = \exp\left[-\frac{\Delta G^\circ}{RT}\right] = \exp\left[\frac{(-20\,000\ J/mol)}{(8.314\ \frac{J}{mol.K})(300K)}\right] = 3.293 \times 10^{-4}$

[1] Note that the standard "bubble" refers to a temperature of 300K for this problem