CHM152 Quiz 3a 25 Pts Spring 2020 Name: Key

Show all work to receive credit.

1. (4 Pts)Given the following data for the reaction: A(g) + 2B(s) ⇋ AB_2(g)

Temperature (K)	K_c
300	1.2×10^{-2}
600	12
900	2.2×10^{5}

Is the reaction *endothermic* or *exothermic*?

Explain your reasoning.

Examine the two possibilities:
Endo: heat + A + B ⇌ AB_2 ← note adding heat gives more prod. and hence Larger K_c

Exo: A + B ⇌ AB_2 + heat

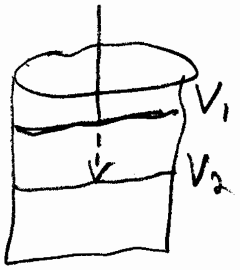
2. (2 Pts) Consider the following equilibrium,
$4NH_3(g) + 3O_2(g) \leftrightharpoons 2N_2(g) + 6H_2O(g) + 1531$ kJ
State whether the concentrations the reactants would *increase*, *decrease*, or *remain constant* after nitrogen gas was removed from the system.

decrease. Removing $N_2(g)$ would force more product to be formed.

3. (2 Pts) Consider the following equilibrium,
$4NH_3(g) + 3O_2(g) \leftrightharpoons 2N_2(g) + 6H_2O(g) + 1531$ kJ
State whether the concentrations of the products would *increase*, *decrease*, or *remain constant* when heat is added. Explain your reasoning.

The reaction is exothermic, Adding heat would drive the reaction to the left giving Less products and more reactants

4. (2 Pts) Consider the equilibrium equation C(s) + H_2O(g) ⇋ CO(g) + H_2(g), ΔH = 2296 J. Which way will the reaction shift if the volume of the container is decreased? Explain your reasoning.



1 mol gas ⇌ 2 moles gas

increasing pressure due to volume change will force reaction to Less moles of gas.

←

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Key

5. (5 Pts) At 700 K, the reaction $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ has the equilibrium constant $K_c = 4.3 \times 10^6$. A sampling during the course of the reaction showed the following concentrations to be present: $[SO_2] = 0.10$ M; $[SO_3] = 10.$ M; $[O_2] = 0.10$ M. Determine if the system is at equilibrium (Show calculations to support your answer). If it is not state which direction the reaction must proceed to achieve equilibrium and why.

$$Q_c = \frac{[SO_3]^2}{[SO_2]^2[O_2]} = \frac{[10]^2}{[0.10]^2[0.10]} = 1.0 \times 10^5$$

Since $Q_c < 4.3 \times 10^6$, the reaction is not @ equilibrium and will proceed from left to right (make more products).

$\longrightarrow$

6. (6 Pts) Two moles of PCl_5 are placed in a 5.0 L container. Dissociation takes place according to the equation $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$. At equilibrium, 0.40 mol of Cl_2 are present. Calculate the equilibrium constant (K_c) for this reaction under the conditions of this experiment.

	$PCl_5(g)$	$\rightleftharpoons$	$PCl_3(g)$	+	Cl_2
I	2 moles		0		0
C.	$-x$		$+x$		$+x$
E	$2-x$		x		$+x = 0.40$ moles

$x = 0.40$ moles

$2 - x = 1.6$ moles

$$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]}$$

$$K_c = \frac{\left[\frac{0.40}{5.0}\right]\left[\frac{0.40}{5.0}\right]}{\left[\frac{1.6}{5.0}\right]}$$

$K_c = 0.020$

7. (4 Pts) Equilibrium constants are known for the following reactions:

$S(s) + {}^3/_2O_2(g) \rightleftharpoons SO_3(g)$ $\quad K_c = 9.2 \times 10^{23}$

$SO_3(g) \rightleftharpoons SO_2(g) + {}^1/_2O_2(g)$ $\quad K_c = 4.8 \times 10^{-4}$

Calculate the equilibrium constant for the reaction below:

$S(s) + O_2(g) \rightleftharpoons SO_2(g)$

$$S(s) + \cancel{\tfrac{3}{2}}\,O_2(g) \rightleftharpoons \cancel{SO_3(g)}$$

$$\cancel{SO_3(g)} \rightleftharpoons SO_2(g) + \cancel{\tfrac{1}{2}O_2(g)}$$

Added: $S(s) + O_2(g) \rightleftharpoons SO_2$

So $K_c = (9.2 \times 10^{23})(4.8 \times 10^{-4})$

$K_c = 4.4 \times 10^{20}$