• AP Chemistry 100

Name CALVIN
Period ___ Date ___/___/___

13 • Chemical Equilibria

QUIZ

1. Consider the equilibrium: $2\,SO_2(g) + O_2(g) \leftrightarrows 2\,SO_3(g)$ $K_c = 4.36\ \underline{M}^{-1}$
Calculate the value of "Q" for a situation in which the concentrations are $[SO_2] = 2.00\ \underline{M}$, $[O_2] = 1.50\ \underline{M}$, and $[SO_3] = 1.25\ \underline{M}$.

$$Q = \frac{[SO_3]^2}{[SO_2]^2[O_2]} = \frac{(1.25)^2}{(2.00)^2(1.50)} = \boxed{0.260\ M^{-1}}$$ 3pts

Does this mixture shift toward the reactants or products to reach equilibrium? toward products 1pt

$Q < K$

2. Study the discussion in your textbook about converting K_c and K_p. Write the K_p expression for the reaction in question 1 and calculate its value at 0°C. Remember, R = 0.0821 L·atm/mol·K.

$$K_p = K_c(RT)^{\Delta n} = (4.36)(0.0821 \times 273)^{-1} = \boxed{0.195}$$ 3pts

3. Consider the equilibrium $PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g)$.
How would the following changes affect the partial pressures of each gas at equilibrium?

	$PCl_3(g)$	$Cl_2(g)$	$PCl_5(g)$
a) addition of PCl_3	↑	↓ →	↑
b) removal of Cl_2	↑	↓ ←	↓
c) removal of PCl_5	↓	↓ →	↓
d) decrease in the volume of the container	↓	↓ →	↑
e) addition of He without change in volume	—	—	—

1pt each blank

4. How will each of the changes in question 3 affect the K_{eq}? (↑=increase; ↓=decrease; — = unchanged)

a — b — c — d — e —

5. Indicate how each of the following changes affects the amount of each gas in the system below, for which $\Delta H_{reaction} = +9.9$ kcal.

heat + $H_2(g) + CO_2(g) \rightleftharpoons H_2O(g) + CO(g)$

	$H_2(g)$	$CO_2(g)$	$H_2O(g)$	$CO(g)$
a) addition of CO_2	↓	↑ →	↑	↑
b) addition of H_2O	↑	↑ ←	↑	↓
c) addition of a catalyst	—	—	—	—
d) increase in temperature	↓	↓ →	↑	↑
e) decrease in the volume of the container	—	—	—	—

6. How will each of the changes in question 5 affect the equilibrium constant?

a — b — c — d ↑ e —

7. Consider the equilibrium: $2N_2O(g) + O_2(g) \rightleftharpoons 4NO(g)$
How will the amount of chemicals at equilibrium be affected by

	$2N_2O(g)$	$+ O_2(g)$	$\rightleftharpoons 4NO(g)$
a) adding N_2O	↑	↓ →	↑
b) removing O_2	↑	↓ ←	↓
c) increasing the volume of the container	↓	↓ →	↑
d) adding a catalyst	—	—	—

1 pt each blank

8. For the reaction, $4NH_3(g) + 3O_2(g) \rightleftharpoons 2N_2(g) + 6H_2O(l)$
How will the concentration of each chemical be affected by

	$4NH_3(g)$	$3O_2(g)$	$2N_2(g)$	$6H_2O(l)$
a) adding O_2 to the system	↓	↑ →	↑	—
b) adding N_2 to the system	↑	↑ ←	↑	—
c) removing H_2O from the system	—	—	—	—
d) decreasing the volume of the container	↓	↓ →	↑	—

9. Consider the equilibrium: $2N_2O(g) + O_2(g) \rightleftharpoons 4NO(g)$
3.00 moles of NO(g) are introduced into a 1.00-Liter evacuated flask. When the system comes to equilibrium, 1.00 mole of $N_2O(g)$ has formed. Determine the equilibrium concentrations of each substance. Calculate the K_c for the reaction based on these data.

	2 N_2O	O_2	4 NO
initial	0 M	0 M	3.00 M
change	+ 1.00 M	+0.50 M	−2.00 M
equilibrium	1.00 M	0.50 M	1.00 M

Remember: The "ice" box may be used with moles, molarity, or Liters (for gaseous equilibria)... never grams.

$$K_c = \frac{[NO]^4}{[N_2O]^2[O_2]} = \frac{(1.00)^4}{(1.00)^2(0.50)} = \boxed{2.0\ M}$$

3pts

Go VIKINGS!