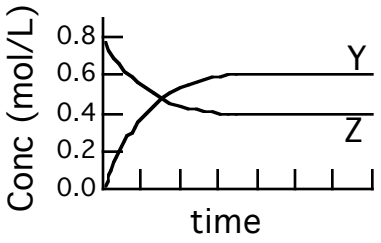
EXAM TWO CHM 203 (DR. MATTSON) 11 FEBRUARY 2004	Quiz: _____ / 50 A ≥ 46.5; B+ ≥ 43.5; B ≥ 41.0; C+ ≥ 37.5; C ≥ 34.00; D ≥ 30.00	Name:

Instructions: Show all work whenever a calculation is required! You will receive credit for how you worked each problem as well as for the correct answer. This exam is worth 50 points. BOX YOUR ANSWERS!

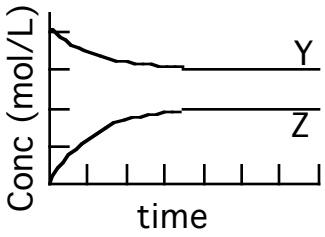
1. (9 pts) Answer the following True/False questions based on information can you tell about the equilibrium at 300 K between Y and Z from the graph below.



T F (a) The stoichiometry is 2 Z $\rightleftharpoons$ Y.

Explain if FALSE

T F (b) The reaction of Y to form Z at 300 K would look like:



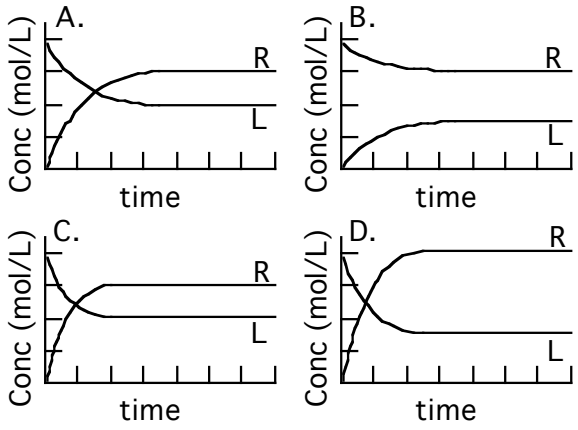
Explain if FALSE

T F (c) The equilibrium constant will increase with an increase in pressure.

Explain if FALSE

2. (4 pts) Again referring to the graph shown in Question 1, determine the value of the equilibrium constant.

3. (3 pts) Which pair of figures shows the role of adding a catalyst to the reaction mixture? (Circle two: Figure A, B, C, D)



Explain

4. (4 pts) Suppose 1.00 mol of hydrogen iodide is placed in an empty 10.0 L container. Calculate the concentration of HI and H_2 at equilibrium.

$$2\ HI(g) \rightleftharpoons H_2(g) + I_2(g)$$

$$K_c^{400\ K} = 0.0204$$

5. (4 pts) Suppose that $[N_2O_4(g)] = 0.35$ M and $[NO_2(g)] = 0.28$ M at some point in time. Is the system at equilibrium? If not, which direction (RIGHT or LEFT) must is shift in order to establish equilibrium?

$$N_2O_4(g) \rightleftharpoons 2\ NO_2(g) \quad K_c^{363\ K} = 0.27$$

6. Consider the equilibrium:

$$4\ CO(g) + 2\ NO_2(g) \rightleftharpoons 4\ CO_2(g) + N_2(g)$$

$$K_c\ ^{300\ K} = 212;\ \Delta H = -1198\ kJ$$

(a) (4 pts) Calculate K_p at 300 K.

(b) (5 pts) Predict which of the following changes will increase the equilibrium concentration of $NO_2(g)$. (More than one possible answer.)

a. increase the temperature

b. decrease the container volume

c. remove $CO_2(g)$ from the equilibrium mixture

d. add more $N_2(g)$ to the equilibrium mixture

e. add a catalyst

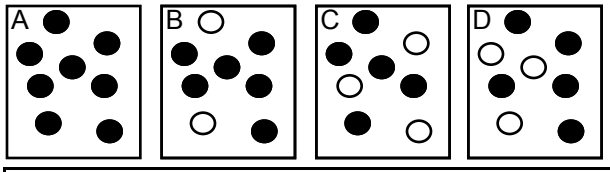
(c) (4 pts) Determine K_c and ΔH for the following equilibrium:

$$4\ CO_2(g) + N_2(g) \rightleftharpoons 4\ CO(g) + 2\ NO_2(g)$$

7. (3 pts) The equilibrium between A(g), represented by ●, and B(g), represented by ○, is:

$$A(g) \rightleftharpoons B(g)$$

The following reaction sequence represents the concentrations: A = 10 s; B = 20 s; C = 30 s and D = 40 s. Does the reaction come to equilibrium within the 40 s depicted? Explain.



8. (4 pts) Consider the Haber reaction

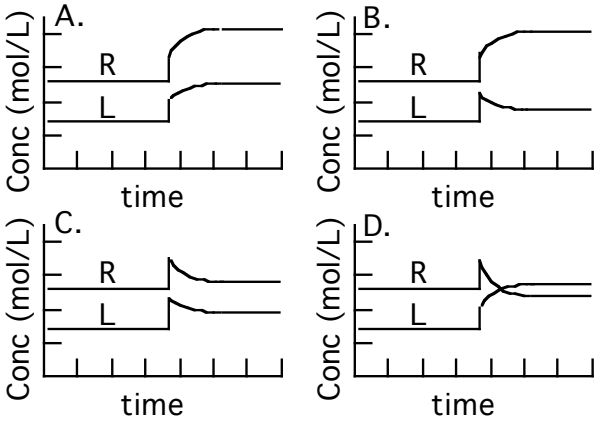
$$N_2(g) + 3\ H_2(g) \rightleftharpoons 2\ NH_3(g)$$

Suppose that 0.40 mol N_2 and 1.0 mol H_2, were placed in a 1.0-L container. At equilibrium, $[NH_3]$ = 0.22 M. Determine K_c.

9. (3 pts) Consider the following equilibrium:

$$L(g) \rightleftharpoons 2\ R(g)$$

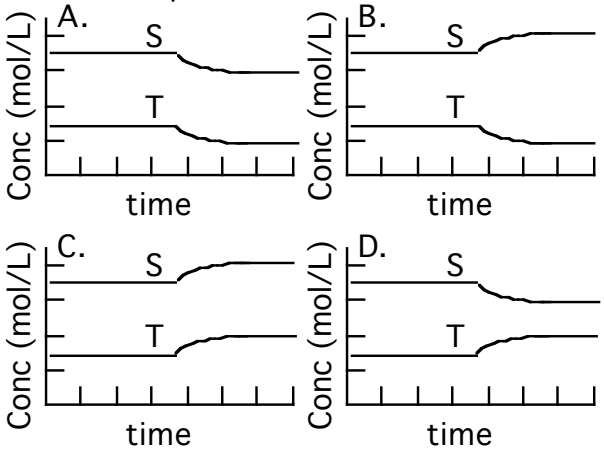
Which of the following graphs could represent how the concentrations of L and R would compensate if the volume of the container were suddenly decreased? Circle: A B C D



10. (3 pts) Consider the following equilibrium:

$$S(g) \rightleftharpoons T(g) \quad \Delta H = +45\ kJ$$

What if the temperature of the reaction mixture were increased? Which of the following graphs could represent how the concentrations of S and T would compensate.. Circle: A B C D



Answers: (tentative)

1. (a) False, 2 Z → 3Y; (b) false, although the equilibrium concentrations seem to give the correct Kc value, the changes in concentration don't agree with the reaction stoichiometry; (c) False, only temperature changes the equilibrium constant. However, an increase in overall pressure (= decrease in volume) drives the reaction left to re-establish equilibrium
2. $K_c = [Y]^3/[Z]^2 = 1.35$
3. A and C
4. [HI] = 0.0778 mol/L; $[H_2]$ = 0.0111 mol/L
5. No, shift right
6. (a) 8.61; (b) A and D; (c) $K_c = 4.72 \times 10^{-3}$, ΔH = +1198 kJ
7. yes, both "C" and "D" depict three B molecules and 5 "A" molecules, therefore the sequence has established equilibrium
8. $K_c = 0.555$
9. D
10. D