

## Equilibrium Review

Topics we have covered:

Defining Equilibrium

Writing equilibrium law

Equilibrium constant (calculating, what it means, and what it tells you)

Calculating concentration and  $K_c$  at equilibrium

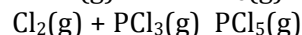
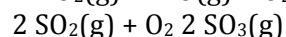
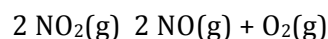
Using ICE tables to calculate concentrations and  $K_c$

LeChatelier's Principle

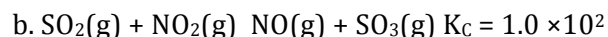
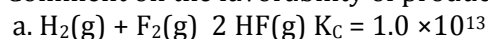
Real life examples of LeChatelier's (Chicken shells)

Interpreting Graphs

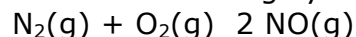
1. Write the equilibrium law ( $K_c$ ) for each of the following reactions:



2. Comment on the favorability of product formation in each of the reactions.

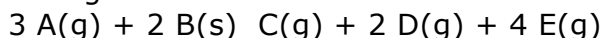


3. At a high temperature the following system reaches equilibrium.



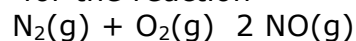
An analysis of the equilibrium mixture in a 4.0 L flask gives the following results: nitrogen 2.0 moles; oxygen 2.0 moles; nitrogen monoxide 0.080 moles. Calculate the  $K_c$  for the reaction. (1.5 marks)

4. For the following reaction



A 1.00 L container initially holds 5.0 moles of A, 5.0 moles of B and 1.0 mole each of C, D and E. When the reaction is allowed to proceed, there are 2.5 mol of D at equilibrium. What is the value of  $K_c$ ? (2.5 marks)

5. If  $K = 1.00 \times 10^{-4}$  for the reaction



Find the equilibrium concentration of NO if the initial  $[\text{N}_2]$  and  $[\text{O}_2]$  is 1.00 mol/L. (3 marks)

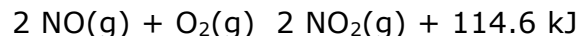
6. For the reaction



Predict the effect on the position of the equilibrium that results from

- a) increasing the total pressure by decreasing volume.
- b) injecting more  $\text{Cl}_2$  gas without changing the volume
- c) increasing the temperature.
- d) increasing the volume of the container.
- e) adding a catalyst.

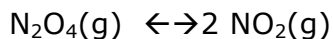
7. In the equilibrium reaction



What will be the change in the equilibrium  $[\text{NO}_2]$  under each of the following conditions?

a)  $\text{O}_2$  is added. b)  $\text{NO}$  is removed. c) energy is added.

8. For the following reaction  $\Delta H = +58.9 \text{ kJ}$



how will the equilibrium  $[\text{NO}_2]$  be affected by the following?

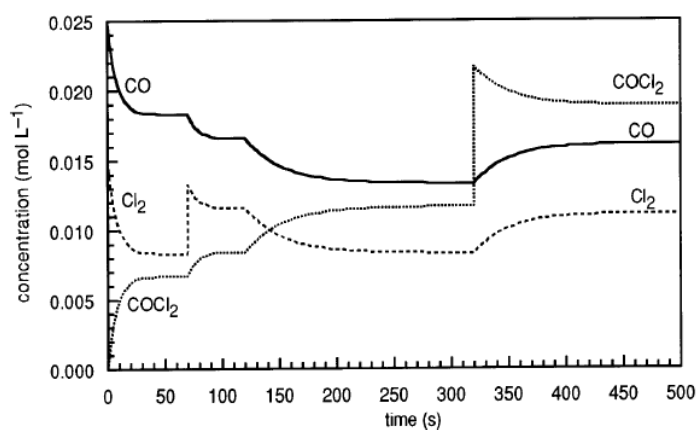
a) an increase in pressure. b) an increase in temperature. c) the addition of a catalyst.

9. Suggest four ways to increase the concentration of  $\text{SO}_3$  in the following equilibrium reaction.

Explain why the concentration increases.



10.



a. Write a balanced equation to represent the reaction studied.

b. How much time was required for the system to reach initial equilibrium? What about after the addition of  $\text{COCl}_2$ ?

c. Calculate an approximate value for the equilibrium constant  $K$ , using the concentrations at time  $t = 60 \text{ s}$ .

d. Explain the changes 70 s after the initiation of the reaction.