Chapter 15 Worksheet 4

Name: | UGA ID:

Instructions:

- Please enter your first and last name as it appears on the eLC roster (do not use a nickname).
- Your UGA myID is a combination of letters and numbers (example: mine is sre13137). **Do not use your 81x number.**
- If you do not have a printer, type your answers in the then upload the worksheet template to Gradescope by Monday, October 19 at 11:59 pm. Write your work on separate sheets of paper, convert to a PDF and upload to eLC.
- If you have a printer download the worksheet, convert it to a PDF and upload to Gradescope by Monday, October 19 at 11:59 pm. You do not need to upload anything to eLC.

1. Consider this system at equilibrium.

$$2\ NO_{(g)} + Cl_{2(g)} \leftrightharpoons 2\ NOCl_{(g)}$$

If the volume of the container is suddenly doubled at constant temperature, when the system returns to equilibrium

[ ]

A. The number of moles of NOCl will have increased.

B. The value of the equilibrium constant will have increased.

C. The number of moles of Cl_2 will have increased.

D. The number of moles of NO will have decreased.

2. Increasing the temperature of an exothermic reaction:

[ ]

A. Decreases K.

B. Increases K.

C. Has no effect on K. K is a constant.

3. If the temperature of a reaction is increased,

[ ]

A. rate constants always increase and equilibrium constants always decrease.

B. rate constants always increase and equilibrium constants always increase.

C. rate constants always decrease and equilibrium constants always decrease.

D. rate constants always decrease and equilibrium constants always increase.

E. rate constants always decrease and equilibrium constants either increase or decrease.

F. rate constants always increase and equilibrium constants either increase or decrease.

4. Indicate which of these statements about catalysts are true.

1) In an equilibrium process, a catalyst increases the rate of the forward reaction, but leaves the rate of the reverse reaction unchanged.

2) A catalyst is not consumed in the course of a reaction.

3) A catalyst must be carefully chosen to shift the equilibrium toward products.

[ ]

A. Only statement 1 is true.

B. Only statement 2 is true.

C. Only statement 3 is true.

D. 1 and 2 are true.

E. 2 and 3 are true.

F. 1 and 3 are true.

G. All of the statements are true.

H. None of the statements are true.

5. Consider a mixture of A, B, C, and D in which the reaction is at equilibrium.

$$A + B \leftrightharpoons C + D$$

A. Adding some extra C will initially

[ ]

A. Increase the forward rate

B. Increase the backward rate

C. Decrease the forward rate

D. Decrease the backward rate

B. The amount of D will

[ ]

A. increase

B. Decrease

C. Remain the same

C. The amount of A and B will

[ ]

A. Increase

B. Decrease

C. Remain the same

6. Given the reaction

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

$$\Delta H = -222.6\ kJ/mol\text{-}rxn \qquad K_c = 0.16 \text{ at } 450\ °C$$

A. What happens when more nitrogen gas is introduced to a system already at equilibrium? The temperature and volume are constant.

[ ]

A. Reactants are consumed and Products are produced to reach a new equilibrium condition.

B. Products are consumed and Reactants are produced to reach a new equilibrium condition.

C. Nothing changes.

B. What happens when more ammonia gas is introduced to a system already at equilibrium? The temperature and volume are constant

[ ]

A. Reactants are consumed and Products are produced to reach a new equilibrium condition.

B. Products are consumed and Reactants are produced to reach a new equilibrium condition.

C. Nothing changes.

C. What happens when the temperature is decreased for a system already at equilibrium?

[ ]

A. Reactants are consumed and Products are produced to reach a new equilibrium condition.

B. Products are consumed and Reactants are produced to reach a new equilibrium condition.

C. Nothing changes.

D. What happens when the volume is increased for a system already at equilibrium?

[ ]

A. Reactants are consumed and Products are produced to reach a new equilibrium condition.

B. Products are consumed and Reactants are produced to reach a new equilibrium condition.

C. Nothing changes.

7. For a specific reaction, which of the following statements can be made about K, the equilibrium constant?

[ ]

A. It always remains the same at different reaction conditions.

B. It increases if the concentration of one of the products is increased.

C. It changes with changes in the temperature.

D. It increases if the concentration of one of the reactants is increased.

E. It may be changed by the addition of a catalyst.

8. Consider the equilibrium system represented by the equation:

$$2\ H_2O_{(g)} \leftrightharpoons\ 2\ H_{2(g)} + O_{2(g)}$$

Given that the forward reaction is endothermic, which of these changes will decrease the equilibrium concentration of water?

A. Adding more oxygen

B. Adding a solid phase catalyst

C. Decreasing the volume of the container.

D. Increasing the temperature at constant pressure.

E. Adding helium gas.

F.

9. If $\Delta G° < 0$, a compound is _____ relative to its elements.

A. Stable

B. Unstable

10. What is K_p for the reaction,

$$3\ NO(g) \rightleftharpoons N_2O(g) + NO_2(g)$$

ΔH^o=-155.5 kJ/mol ΔS^o=-171.5 J/mol K ΔG^o=-104.4 kJ/mol

11. At equilibrium, a 2.00 L flask contains 0.1816 moles of dinitrogen tetroxide and 0.04558 moles of nitrogen dioxide at 298 K.

$$N_2O_4(g) \rightleftharpoons 2\ NO_2(g)$$

Use K_p to determine the standard Gibbs free energy (in kJ/mol) for the system?

12. When $\Delta G = 0$,

A. The equilibrium constant is 1.

B. The system has reached equilibrium.

C. The reaction will be too slow to observe.

D. All of the above are correct.

E. A and B above are both correct.

13. $\Delta G° = -RT \ln K$

K is large if $\Delta G°$ is…

A. negative and small

B. negative and large

C. positive and small

D. positive and large

14. At 25 °C, $\Delta G° = -198$ kJ for the reaction, $NO(g) + O_3(g) \rightleftharpoons NO_2(g) + O_2(g)$. Calculate ΔG under the following conditions:

Species	Partial pressure, atm
NO	$+1.0 \times 10^{-6}$
O_3	1.0×10^{-7}
NO_2	3.0×10^{-6}
O_2	0.20

15. If Q decreases by a factor of 2, and Q is less than K, then ΔG is

A. also reduced by half.

B. a negative value.

C. a positive value.

D. zero.