

Name: _____

Period: _____

Seat#: _____

Directions: Any worksheet that is labeled with an * means it is suggested extra practice. We do not always have time to assign every possible worksheet that would be good practice for you to do. You can do this worksheet when you have extra time, when you finish something early, or to help you study for a quiz or a test. If and when you choose to do this Extra Practice worksheet, please do the work on binder paper. If we end up with extra class time then portions of this may turn into required work. If that happens you will be told which problems are turned into required. Remember there is tons of other extra practice on the class website...and the entire internet! See me if you need help finding practice on a topic you are struggling with.

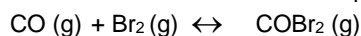
- 1) What is Dynamic Equilibrium Video – Fuse School
https://www.youtube.com/watch?v=wID_ImYQAgQ
- 2) Le Chatelier's Principle Video Part 1 – Fuse School
<https://www.youtube.com/watch?v=7zuUV455zFs>
- 3) Le Chatelier's Principle Video Part 2 – Fuse School
<https://www.youtube.com/watch?v=XhQ02egUs5Y>
- 4) Reversible reactions – Bozeman Science
<https://www.youtube.com/watch?v=b6WmwVNDf4>
- 5) Equilibrium video – Bozeman Science
<https://www.youtube.com/watch?v=cHAjhM3y3ds>
- 6) Le Chatelier's Principle – Bozeman Science
https://www.youtube.com/watch?v=PciV_Wuh9V8
- 7) Equilibrium Calculations – Crash Course
<https://www.youtube.com/watch?v=DP-vWN1yXrY>
- 8) Equilibrium Constant – Bozeman Science
<https://www.youtube.com/watch?v=xfGIEXWDRZE&t=0s&list=PLIIVwaZQkS2op2kDuFifhStNsS49LaxkZ&index=66>
- 9) Reaction Quotient – Bozeman Science
<https://www.youtube.com/watch?v=60Sylqei2DY&list=PLIIVwaZQkS2op2kDuFifhStNsS49LaxkZ&index=64&t=0s>
- 10) Equilibrium Disturbances – Bozeman Science
<https://www.youtube.com/watch?v=dd5p0VZ-MZg&t=0s&list=PLIIVwaZQkS2op2kDuFifhStNsS49LaxkZ&index=68>
- 11) Calculating K, the Equilibrium Constant – The Organic Chemistry Tutor
<https://www.youtube.com/watch?v=aJ0KNQ5-Kal>
- 12) Calculating K, the Equilibrium Constant – Bozeman Science
<https://www.youtube.com/watch?v=xfGIEXWDRZE>
- 13) ICE Table Calculations - C. Sorensen-Unruh
https://www.youtube.com/watch?v=tT-2xk9ZG_A
- 14) ICE Table Calculations – chemisNATE
<https://www.youtube.com/watch?v=WgB2kKWtGnKA>
- 15) 5% Rule <https://www.youtube.com/watch?v=y6nSdGA11zc>
- 16) $__ \text{NH}_3(g) + __ \text{O}_2(g) \leftrightarrow __ \text{NO}(g) + __ \text{H}_2\text{O}(g) + \text{energy}$
Determine the direction of shift resulting from each applied stress. Explain your reasoning:
 - a. addition of NO (g)
 - b. removal of O₂ (g)
 - c. increase the pressure by decreasing the volume
 - d. decreasing the temperature
 - e. adding a catalyst
- 17) Write equilibrium expressions for the following:
 - a. $2\text{NO}_2(g) \leftrightarrow \text{N}_2\text{O}_4(g)$
 - b. $\text{N}_2(g) + 3\text{H}_2(g) \leftrightarrow 2\text{NH}_3(g)$
 - c. $2\text{SO}_2(g) + \text{O}_2(g) \leftrightarrow 2\text{SO}_3(g)$
- 18) Write the K_{sp} expression for the following reactions:
 - a. AlPO_4
 - b. AgCN
 - c. $\text{Zn}_3(\text{AsO}_4)_2$
- 19) State the effect of an increase in temperature:
 - a. $2\text{SO}_2 + \text{O}_2 \leftrightarrow 2\text{SO}_3 + \text{Heat}$
 - b. $\text{Heat} + \text{PCl}_5 \leftrightarrow \text{PCl}_3 + \text{Cl}_2$
 - c. $\text{Heat} + \text{N}_2 + \text{O}_2 \leftrightarrow 2\text{NO}$
 - d. $\text{CO} + \text{H}_2\text{O} \leftrightarrow \text{CO}_2 + \text{H}_2 + \text{Heat}$
 - e. $\text{N}_2 + 3\text{H}_2 \leftrightarrow 2\text{NH}_3 + \text{Heat}$
- 20) State the effect of an increase of pressure:
 - a. $2\text{NO}(g) + \text{O}_2(g) \leftrightarrow 2\text{NO}_2(g) + \text{Heat}$
 - b. $\text{CaCO}_3(s) \leftrightarrow \text{CaO}(s) + \text{CO}_2(g)$
 - c. $\text{H}_2(g) + \text{I}_2(g) \leftrightarrow 2\text{HI}(g)$
 - d. $\text{C}_2\text{H}_4(g) + \text{H}_2(g) \leftrightarrow \text{C}_2\text{H}_6(g)$
 - e. $\text{N}_2(g) + 3\text{H}_2(g) \leftrightarrow 2\text{NH}_3(g)$
- 21) State the effect on the following equilibria if the stated stress is applied to the equilibrium indicated:
 - a. (add O₂) $2\text{CO}(g) + \text{O}_2(g) \leftrightarrow 2\text{CO}_2(g) + \text{Heat}$
 - b. (remove I₂) $2\text{HI}(g) + \text{O}_2(g) \leftrightarrow 2\text{H}_2\text{O}(l) + \text{I}_2(s)$
 - c. (add CO) $\text{H}_2\text{O}(l) + \text{CO}(g) \leftrightarrow \text{H}_2(g) + \text{CO}_2(g)$
 - d. (decrease pressure) $\text{CO}(g) + 2\text{H}_2(g) \leftrightarrow \text{CH}_3\text{OH}$
 - e. (remove HCl) $\text{H}_2(g) + \text{Cl}_2(g) \leftrightarrow 2\text{HCl}(g)$
- 22) What is the effect on the [concentration] of chlorine if we---
 - a. (Add PCl₅) $\text{PCl}_5(g) \leftrightarrow \text{PCl}_3(g) + \text{Cl}_2(g)$
 - b. (Add CO) $\text{CO}(g) + \text{Cl}_2(g) \leftrightarrow \text{COCl}_2(s)$
 - c. (Decr. pressure) $\text{H}_2(g) + \text{Cl}_2(g) \leftrightarrow 2\text{HCl}(g)$
 - d. (Incr. pressure) $2\text{HI}(g) + \text{Cl}_2(g) \leftrightarrow 2\text{HCl}(g) + \text{I}_2(s)$
 - e. (Cool) $4\text{HCl}(aq) + \text{O}_2(g) \leftrightarrow 2\text{Cl}_2(g) + 2\text{H}_2\text{O}(l) + \text{heat}$

Dougherty Valley HS Chemistry Equilibrium – Extra Practice

- 23) For the system, if we start with 0.100 mol/L of CO₂ and H₂, what are the concentrations of the reactants and products at equilibrium given that K_{eq} = 0.64 at 900K?



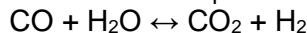
- 24) COBr₂ can be formed by reacting CO with Br₂. A mixture of 0.400 mol CO, 0.300 mol Br₂, and 0.0200 mol COBr₂ is sealed in a 5.00L flask. Calculate equilibrium concentrations for all gases K_{eq} = 0.680.



- 25) 2NH₃(g) ↔ N₂(g) + 3H₂(g) At 500 K, the following concentrations were measured: [N₂] = 3.0 × 10⁻² M, [H₂] = 3.7 × 10⁻² M, [NH₃] = 1.6 × 10⁻² M. What is K_c?

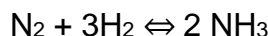
- 26) At 1000 K, the equilibrium partial pressures for the reaction below are: CH₄ = 0.20 atm, H₂S = 0.25 atm, CS₂ = 0.52 atm, and H₂ = 0.10 atm. What is K_p?

- 27) A mixture of 1.0 mole carbon dioxide and 1.0 mole carbon monoxide are contained in a 1 liter vessel. Later 2.0 moles of water vapor is then introduced into the vessel. The following reversible reaction takes place



This reaction has an equilibrium constant of 0.64. How many moles of the different molecules will be present after equilibrium is obtained?

- 28) 3.00 moles of N₂ gas and 1.00 mole of H₂ gas are combined in a 1 L reaction vessel. At equilibrium 0.663 moles of H₂ remain. What are the resulting concentrations?

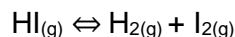


- 29) Phosphorus pentachloride decomposes into Phosphorous tri chloride and Chlorine gas. 0.500 moles of pure Phosphorus pentachloride is placed in a 2.00 L bottle. What are the resulting concentrations?



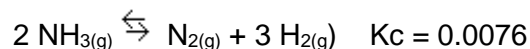
$$K_c = 0.0211$$

- 30) Consider the reaction for the decomposition of hydrogen iodine gas at 448C. The initial concentration of HI was 1.00 mol/L. Once an equilibrium was established, the concentration of HI was measured to be 0.078 mol/L. Calculate the equilibrium constant.

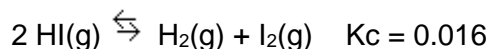


- 31) Nitrogen dioxide can break down into nitrogen monoxide and oxygen gas. The equilibrium constant for this reaction is K = 0.40. If the equilibrium concentration of NO₂ gas is 0.2M and the equilibrium concentration of NO gas is 1M, what is the equilibrium concentration of the oxygen gas?

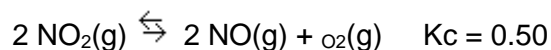
- 32) A mixture consisting initially of 3.00 moles NH₃, 2.00 moles of N₂, and 5.00 moles of H₂, in a 5.00 L container was heated to 900 K, and allowed to reach equilibrium. Determine the equilibrium concentration for each species present in the equilibrium mixture.



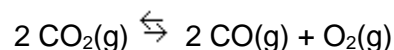
- 33) 4.00 moles of HI are placed in an evacuated 5.00 L flask and then heated to 800 K. The system is allowed to reach equilibrium. What will be the equilibrium concentration of each species?



- 34) 0.600 moles of NO and 0.750 moles of O₂ are placed in an empty 2.00 L flask. The system is allowed to establish equilibrium. What will be the equilibrium concentration of each species in the flask?



- 35) The concentrations of an equilibrium mixture of O₂, CO, and CO₂ were 0.18 M, 0.35 M, and 0.029 M respectively. Enough CO was added to the flask containing the equilibrium mixture to momentarily raise its concentration to 0.60 M. What will be the concentration of each species in the flask once equilibrium has been re-established after the additional carbon monoxide was added?



- 36) Which of the following is a true statement about the role of catalysts in a reaction?

- Catalysts more effectively lowers the activation energy in the forward direction.
- Catalysts generally react with one or more reactants to form intermediates that subsequently give the final reaction product..
- If a catalyst affects the equilibrium of the reaction, it must be consumed as the reaction proceeds.
- Catalysts can may increase the reaction rate or selectivity or enable the reaction at a lower temperature.