Unit 5.5: Gases & Gas Equilibrium

Name: _____ Pd____

CHAPTER 9 – 10 PRACTICE QUIZ

MULTIPLE CHOICE – NO CALCULATOR ALLOWED

←Linked at 7:26

9. Equal masses of Ne(*g*) and He(*g*) are placed in a sealed rigid container at 500 K. Which of the following statements is true about this system?

(A) The partial pressure of Ne(*g*) is less than the partial pressure of He(*g*).

(B) The partial pressure of Ne(*g*) is equal to the partial pressure of He(*g*).

(C) The average speed of Ne(*g*) particles is equal to the average speed of He(*g*) particles.

(D) The average speed of Ne(*g*) particles is greater than the average speed of He(*g*) particles.

10. Which of the following, upon reaction with excess hydrochloric acid, would produce the largest quantity of hydrogen gas?

(A) 1.0 mol Na

(B) 1.0 mol Mg

(C) 1.0 mol Al

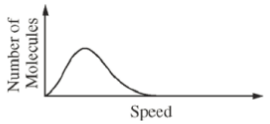
(D) 1.0 mol Ca

11. A gas mixture contains 14.0 g of carbon monoxide gas and 7.0 g of hydrogen gas. The total pressure of the gas mixture is 2.40 atm. What is the partial pressure of each gas in this mixture?

	Partial pressure of carbon monoxide gas	Partial pressure of hydrogen gas
(A)	0.15 atm	2.25 atm
(B)	0.30 atm	2.10 atm
(C)	0.60 atm	1.80 atm
(D)	1.60 atm	0.80 atm

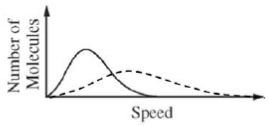
12. At which of the following temperatures and pressures would a real gas be most likely to deviate from ideal behavior?

	Temperature (K)	Pressure (atm)
(A)	100	0.01
(B)	100	50
(C)	1000	0.01
(D)	1000	50

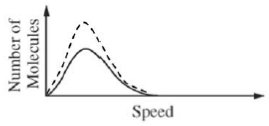


13. The graph above shows the speed distribution of molecules in a sample of oxygen gas at 25°C. Which of the following graphs is most likely to represent the speed distribution of the same number of molecules of hydrogen gas at 25°C (as a dashed curve)?

(A)



(C)



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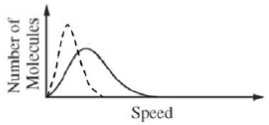
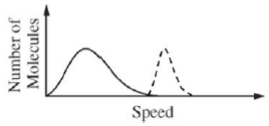
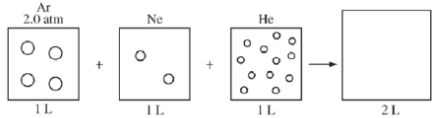


(D)





14. The figure above represents three sealed 1.0 L vessels, each containing a different inert gas at 298 K. The pressure of Ar in the first vessel is 2.0 atm. The ratio of the numbers of Ar, Ne, and He atoms in the vessels is 2:1:6, respectively. After all the gases are combined in a previously evacuated 2.0 L vessel, what is the total pressure of the gases at 298 K?

(A) 4.5 atm

(B) 6.0 atm

(C) 9.0 atm

(D) 18 atm

Container	A	B
Gas	Ar	He
Temperature	30°C	30°C
Pressure	2.0 atm	4.0 atm

15. The information in the table above refers to two different gases in identical rigid containers A and B. Which of the following statements is true?

(A) The average kinetic energy of the gas particles in Container B is greater than the average kinetic energy of the gas particles in Container A.

(B) The density of the gas in Container B is greater than the density of the gas in Container A.

(C) The number of gas particles in Container B is greater than the number of gas particles in Container A.

(D) The average speed of the gas particles in Container B is less than the average speed of the gas particles in Container A.

16. Samples of F_2 gas and Xe gas are mixed in a container of fixed volume. Initially, the partial pressure of the F_2 gas is 8.0 atm and the partial pressure of the Xe gas is 1.7 atm. When all of the Xe gas reacted, forming a solid compound, the pressure of the unreacted F_2 gas was 4.6 atm. The temperature remained constant. What is the formula of the solid compound?

(A) XeF

(B) XeF_2

(C) XeF_3

(D) XeF_4

CHAPTER 9 – 10 PRACTICE QUIZ

FREE RESPONSE – CALCULATOR IS ALLOWED

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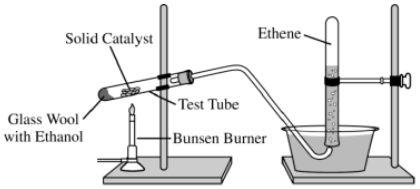


2. Ethene, $C_2H_4(g)$, may be prepared by the dehydration of ethanol, $C_2H_5OH(g)$, using a solid catalyst. A setup for the lab synthesis is shown in the diagram above. The equation for the dehydration reaction is given below.

$$C_2H_5OH(g) \xrightarrow{\text{catalyst}} C_2H_4(g) + H_2O(g)$$

A student added a 0.200 g sample of $C_2H_5OH(l)$ to a test tube using the setup shown above. The student heated the test tube gently with a Bunsen burner until all of the $C_2H_5OH(l)$ evaporated and gas generation stopped. When the reaction stopped, the volume of collected gas was 85.4 mL at 625.0 torr and 32.0°C. (The vapor pressure of water at 32.0°C is 35.7 torr.)

(a) Calculate the number of moles of $C_2H_4(g)$

(i) that are actually produced in the experiment and measured in the gas collection tube,

(ii) and that would be produced if the dehydration reaction went to completion.

(b) Calculate the percent yield of ethene in the experiment.

3. A sample of propane, $C_3H_8(g)$, is introduced into a previously evacuated rigid 5.00 L reaction vessel at 127°C. Then a sample of $O_2(g)$ is introduced into the same vessel at constant temperature. This mixture of $C_3H_8(g)$ and $O_2(g)$ is sparked so that a complete combustion reaction occurs, producing $CO_2(g)$ and $H_2O(g)$.

(a) Write a balanced chemical equation for the complete combustion of $C_3H_8(g)$.

(b) The table below represents the partial pressure of each substance, before and after the reaction occurs. Fill in the missing information in the table based on the stoichiometry of the reaction. Assume that temperature remains constant at 127°C.

Substance	$C_3H_8(g)$	$O_2(g)$	$CO_2(g)$	$H_2O(g)$
Partial pressure before the reaction at 127°C	0.200 atm	1.40 atm	0.00 atm	0.00 atm
Partial pressure after the reaction at 127°C	0.00 atm	0.400 atm		

(c) Calculate the mole fraction of $O_2(g)$ in the 5.00 L reaction vessel at 127°C

(i) before the reaction occurs,

(ii) and after the reaction occurs.

(d) Calculate the mass of $C_3H_8(g)$ that is consumed in the combustion reaction.

CHAPTER 15 PRACTICE QUIZ

MULTIPLE CHOICE – NO CALCULATOR ALLOWED

←Linked at 0:00

$$N_2O_5(g) \rightleftharpoons 2\,NO_2(g) + \tfrac{1}{2}\,O_2(g)$$

1. The equilibrium constant for the gas phase reaction above is 95 at 25°C. What is the value of the equilibrium constant for the following reaction at 25°C?

$$O_2(g) + 4\,NO_2(g) \rightleftharpoons 2\,N_2O_5(g)$$

(A) $(95)^2$

(B) $(95)^{\frac{1}{2}}$

(C) $\frac{1}{95}$

(D) $\frac{1}{95^2}$

Questions 2 – 5 refer to the following.

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

$PCl_5(g)$ decomposes into $PCl_3(g)$ and $Cl_2(g)$ according to the equation above. A pure sample of $PCl_5(g)$ is placed in a rigid, evacuated 1.00 L container. The initial pressure of the $PCl_5(g)$ is 1.00 atm. The temperature is held constant until the $PCl_5(g)$ reaches equilibrium with its decomposition products. The figures below show the initial and equilibrium conditions of the system.

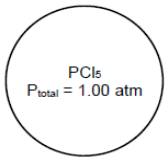


Figure 1: Initial

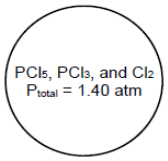


Figure 2: Equilibrium

2. As the reaction progresses toward equilibrium, the rate of the forward reaction

(A) increases until it becomes the same as the reverse reaction rate at equilibrium

(B) stays constant before and after equilibrium is reached

(C) decreases to become a constant nonzero rate at equilibrium

(D) decreases to become zero at equilibrium

3. Which of the following statements about K_p, the equilibrium constant for the reaction, is correct?

(A) $K_p > 1$

(B) $K_p < 1$

(C) $K_p = 1$

(D) It cannot be determined whether $K_p > 1$, $K_p < 1$, or $K_p = 1$ without additional information.

4. A mixture of $PCl_5(g)$, $PCl_3(g)$, and $Cl_2(g)$ is in a 1.00 L reaction vessel. The total pressure of the reaction system is 1.40 atm at equilibrium. Then the volume of the reaction vessel is reduced from 1.00 L to 0.50 L and equilibrium is re-established at constant temperature. What is the total pressure of the system at this point?

(A) Less than 1.40 atm

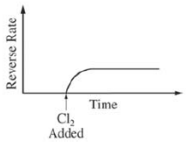
(B) Greater than 1.40 atm but less than 2.80 atm

(C) 2.80 atm

(D) Greater than 2.80 atm

5. Additional $Cl_2(g)$ is injected into the system at equilibrium. Which of the following graphs best shows the rate of the reverse reaction as a function of time? (Assume that the time for injection and mixing of the additional $Cl_2(g)$ is negligible.)

(A)



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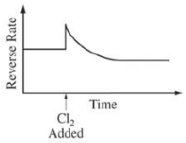

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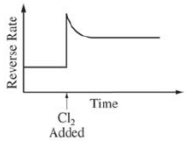

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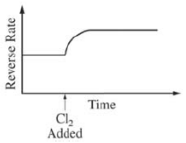


6.-10. skip, begin at 14:10

$$2\,XY(g) \rightleftharpoons X_2(g) + Y_2(g) \qquad K_p = 150 \text{ @ } 500\text{ K}$$

11. A certain gas, XY(g), decomposes as represented by the equation above. A sample of each of the three gases is put in a previously evacuated rigid container. The initial partial pressures of the gases are shown in the table below.

Gas	Initial Partial Pressure (atm)
XY	0.10
X_2	2.0
Y_2	2.0

The temperature of the reaction mixture is held constant at 500 K. In which direction, if any, will the reaction proceed?

(A) The reaction will form more products X_2 and Y_2.

(B) The reaction will form more reactant XY.

(C) The mixture is at equilibrium, so there will be no change in the partial pressure of any gas.

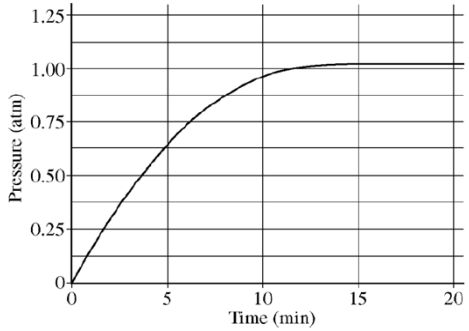
(D) The direction cannot be determined unless the volume of the container is known.

CHAPTER 15 PRACTICE QUIZ

FREE RESPONSE – CALCULATOR IS ALLOWED

←Linked at 16:13

1. In a study of the decomposition of calcium carbonate, a student added a 50.0 g sample of powdered calcium carbonate to a 1.00 L rigid container. The student sealed the container, pumped out all the gases, then heated the container in an oven at 1100 K. As the container was heated, the total pressure of the carbon dioxide gas in the container was measured over time. The data are plotted in the graph below.



(a) Write a balanced equation for the decomposition of calcium carbonate. The products are calcium oxide and carbon dioxide. Include symbols for phases of matter.

(b) The pressure in the container after 20 minutes of heating is equal to 1.04 atm. Calculate the number of moles of carbon dioxide gas present in the container at this point.

(c) The student repeated the experiment, but this time the student used a 100.0 g sample of powdered calcium carbonate. In this experiment, the final pressure in the container was 1.04 atm, which was the same final pressure as in the first experiment.

The student claimed that the final pressure in the container became constant during each experiment because all of the calcium carbonate had decomposed. Based on the data from these two experiments, do you agree with this claim? Explain.

(d) Write the expression for the equilibrium constant, K_p, for the decomposition of calcium carbonate at 1100 K.

(e) What is the value of K_p for this reaction at 1100 K? _____

(f) After 20 minutes, additional carbon dioxide gas was injected into the container, initially raising the pressure to 1.5 atm. After 20 additional minutes at 1100 K, the final pressure in the container was recorded. Would the final pressure inside the container be less than, greater than, or equal to 1.04 atm? Explain your reasoning.