

Unit 10 Multiple Choice Practice

1. Which of the following has an average atomic or molecular speed closest to that of N_2 molecules at $0^\circ C$ and 1 atm?

a. Ne

b. Xe

c. O_2

(d.) $\overbrace{CO}^{28 \text{ g/mol}}$
 $\underline{28 \text{ g/mol}}$

2. A gas sample is confined in a rigid 5-L container. Which of the following will occur if the temperature of the container is increased?

I. The pressure of the gas will increase.

II. The density of the gas will increase.

III. The distance between the gas particles will increase.

(a.) I only

b. I and III only

b. III only

d. I, II, and III

3. At standard temperature and pressure, a 0.50 mol sample of H_2 gas and a separate 1.0 mol sample of O_2 gas have the same:

(a.) average molecular kinetic energy

c. effusion rate

b. average molecular speed

d. density

4. Equal numbers of moles of $He(g)$, $Ar(g)$, and $Ne(g)$ are placed in a glass vessel at room temperature. If the vessel has a pinhole-sized leak, which of the following will be true regarding the relative values of the partial pressures of the gases remaining in the vessel after some of the gas mixture has effused?

(a.) $P_{He} < P_{Ne} < P_{Ar}$ c. $P_{Ne} < P_{Ar} < P_{He}$ b. $P_{He} < P_{Ar} < P_{Ne}$ d. $P_{Ar} < P_{He} < P_{Ne}$

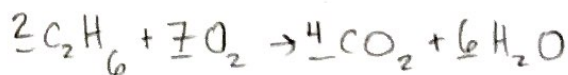
5. Consider the combustion of 6.0 g of ethane, C_2H_6 . What volume of carbon dioxide will be formed at STP?

a. 0.20 L

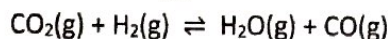
b. 2.2 L

(c.) 9.0 L

d. 22.4 L



$$\overset{1}{6.0 \text{ g } C_2H_6} \times \frac{1 \text{ mol } C_2H_6}{30 \text{ g } C_2H_6} \times \frac{4 \text{ mol } CO_2}{2 \text{ mol } C_2H_6} \times \frac{22.4 \text{ L}}{1 \text{ mol}} = \frac{45}{5} = 9$$



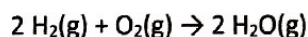
6. Which two stresses will each cause the equilibrium to shift to the left?
- a. increase $[\text{H}_2]$, increase $[\text{CO}]$ c. decrease $[\text{H}_2]$, increase $[\text{H}_2\text{O}]$
 b. increase $[\text{CO}_2]$, decrease $[\text{CO}]$ d. decrease $[\text{CO}_2]$, decrease $[\text{H}_2\text{O}]$
7. A mixture of helium and neon gases has a total pressure of 1.2 atm. If the mixture contains twice as many moles of helium as neon, what is the partial pressure due to neon?
- a. 0.2 atm b. 0.3 atm c. 0.4 atm d. 0.8 atm

$$\frac{1.2 \text{ atm}}{3} = 0.4$$

8. A 22.0 gram sample of an unknown gas occupies 11.2 L at STP. Which of the following could be the identity of the gas?
- a. CO_2 b. SO_3 c. O_2 d. He

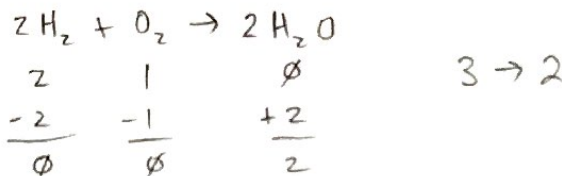
$$\frac{22 \text{ g}}{0.5 \text{ mol}} = 44 \text{ g/mol}$$

9. In an experiment, 2 moles of $\text{H}_2(\text{g})$ and 1 mole of $\text{O}_2(\text{g})$ were completely reacted according to the following equation in a sealed container of constant volume and temperature:



If the initial pressure in the container before the reaction is denoted as P_i , which of the following expressions gives the final pressure, assuming ideal gas behavior?

- a. P_i b. $2 P_i$ c. $(3/2) P_i$ d. $(2/3) P_i$



10. A gas sample with a mass of 10 grams occupies 5.0 liters and exerts a pressure of 2.0 atm at a temperature of 26°C . Which of the following expressions is equal to the molecular mass of the gas? The gas constant, R , is $0.08 \text{ (L atm)/(mol K)}$.

a. $\frac{(10.0)(0.08)(299)}{(2.0)(5.0)} \text{ g/mol}$

c. $\frac{(2.0)(5.0)}{(10.0)(0.08)(26)} \text{ g/mol}$

b. $\frac{(10.0)(0.08)(26)}{(2.0)(5.0)} \text{ g/mol}$

d. $\frac{(2.0)(5.0)}{(10.0)(0.08)(299)} \text{ g/mol}$

$$MM = \frac{dRT}{P} = \frac{mRT}{PV}$$

11. The following reaction is found at equilibrium: $\text{Ni}(s) + 4 \text{CO}(g) \rightleftharpoons \text{Ni}(\text{CO})_4(l)$ $\Delta H = -160.8 \text{ kJ/mol}$

Which of the following will cause this equilibrium to shift to the left?

- a. add some CO
 b. remove some $\text{Ni}(\text{CO})_4$
 c. decrease the volume
 d. increase the temperature

12. A gaseous mixture of oxygen and nitrogen is maintained at a constant temperature. Which of the following MUST be true regarding the two gases?

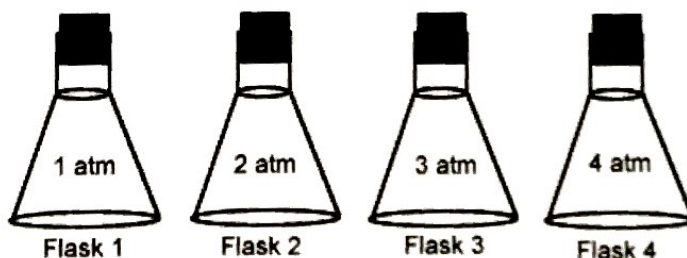
- a. Their average molecular speeds will be the same.
 b. Their average kinetic energies will be the same.
 c. Their partial pressures will be the same.
 d. Their densities will be the same.

13. Assume the amount of gas is constant. If the temperature increases and the pressure stays the same, then what will happen to the volume of a non-rigid container?

- a. stay the same
 b. increase
 c. decrease

14. How do gas particles respond to an increase in volume? *no right answer*

- a. increase in kinetic energy and decrease in temperature
 b. decrease in kinetic energy and decrease in pressure
 c. increase in temperature and increase in pressure
 d. decrease in kinetic energy and increase in temperature



15. Each of these flasks is the same size and at the same temperature. Which one contains the most molecules?

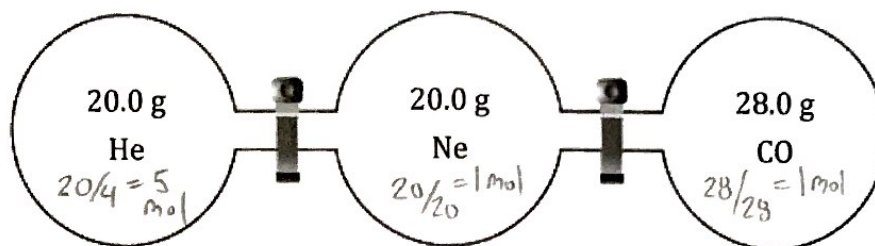
- a. Flask 1
 b. Flask 2
 c. Flask 3
 d. Flask 4

16. Because ideal gases have elastic collisions, when two gas particles collide:

- a. They bounce off each other with no loss in energy.
 b. They bounce off each other with a small loss in energy.
 c. They bounce off each other with a large loss in energy.
 d. They bounce off each other with a small increase in energy.

Use the following information to answer questions 17–21.

The diagram below shows three identical 1.0 L containers filled with the indicated amounts of gas. The stopcocks connecting the containers are originally closed and the gases are all at 25°C.



17. Which gas exerts the greatest pressure?

- a. He b. Ne c. CO d. All gases exert the same amount of pressure.

18. Which gas exerts the strongest IMFs?

- a. He b. Ne c. CO d. All gases have identical IMFs.

19. Which gas has the lowest density?

- a. He b. Ne c. CO d. All gases have the same density.

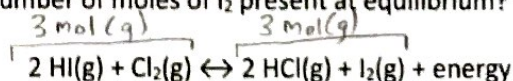
20. Which gas has the greatest average kinetic energy?

- a. He b. Ne c. CO d. All gases have identical average kinetic energy.

21. Which gas has the greatest average atomic or molecular velocity?

- a. He b. Ne c. CO d. All gases have the same average velocity.

22. A gaseous reaction occurs and comes to equilibrium, as shown below. Which of the following changes to the system will serve to increase the number of moles of I_2 present at equilibrium?



- a. Increasing the volume at constant temperature
 b. Decreasing the volume at constant temperature
 c. Increasing the temperature at constant volume
 d. Decreasing the temperature at constant volume

23. Which of the following has the most molecules?

- a. 1.00 L of CH_4 at 0°C and 1.00 atm
 b. 1.00 L of N_2 at 0°C and 1.00 atm
 c. 1.00 L of CO_2 at 20°C and 1.00 atm
 d. 1.00 L of CO at 0°C and 1.25 atm

24. A sealed container with 8.0 g of O_2 and 7.0 g of N_2 is kept at a constant temperature and pressure. Which of the following is true?

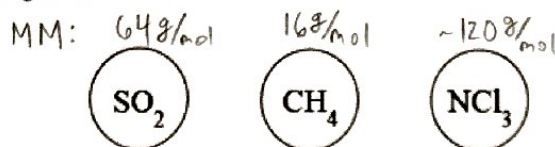
- a. The volume occupied by O_2 is greater than the volume occupied by N_2 .
 b. The volume occupied by O_2 is equal to the volume occupied by N_2 .
 c. The volume occupied by O_2 is less than the volume occupied by N_2 .
 d. The density of O_2 is less than the density of N_2 .

25. In an ideal gas, the Kelvin temperature:

- a. fluctuates widely when the gas is in a sealed container.
 b. is inversely proportional to the kinetic energy of the gas
 c. is directly proportional to the kinetic energy of the gas
 d. is a measure of the potential energy of the gas

Use the following information to answer questions 26–28.

10.0 g each of three different gases are present in three glass containers of identical volume, as shown below. The temperature of all three gases is held constant at 298 K.



26. The container with which gas would have the greatest pressure?

- a. SO_2 b. CH_4 c. NCl_3 d. All three containers would have the same pressure.

27. Which of the gases would have the greatest density?

- a. SO_2 b. CH_4 c. NCl_3 d. All three gases would have the same density.

28. If a small, pinhole-sized leak were to be drilled into each container, the container with which gas would experience the fastest pressure decrease?

- a. SO_2 b. CH_4 c. NCl_3 d. All gases would decrease pressure at the same rate.

29. Which of the following assumption(s) is (are) valid based on kinetic molecular theory?

- ✓ I. Gas molecules have negligible volume.
- ✓ II. Gas molecules exert no attractive forces on each other
- ✓ III. The temperature of a gas is directly proportional to its kinetic energy.

- a. I only b. II and III only
 b. III only **d. I, II, and III**

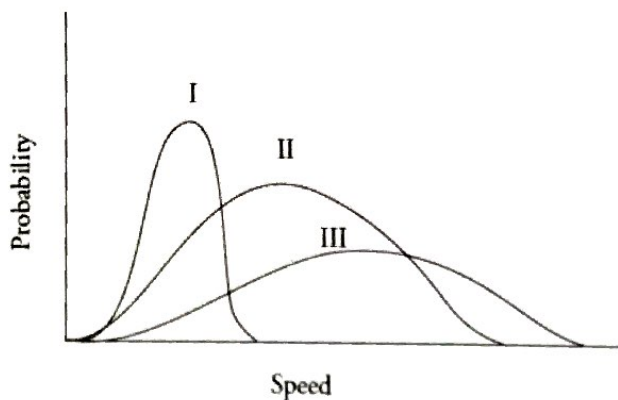
30. A 0.33 mole sample of $\text{CaCO}_3(\text{s})$ is placed in a 1 L evacuated flask, which is then sealed and heated. The $\text{CaCO}_3(\text{s})$ decomposes completely according to the balanced equation below. The total pressure in the flask, measured at 300 K, is closest to which of the following?



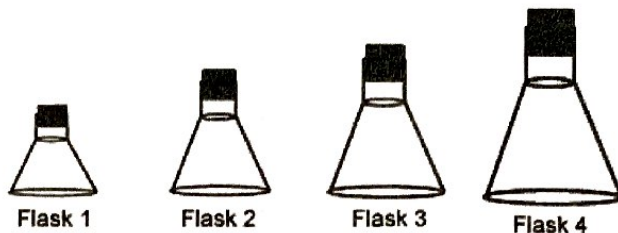
- a. 2.0 atm b. 4.1 atm **c. 8.1 atm** d. 16 atm

$$0.33 \text{ mol CaCO}_3 \times \frac{1 \text{ mol CO}_2}{1 \text{ mol CaCO}_3} = 0.33 \text{ mol CO}_2 \quad \left. \vphantom{0.33 \text{ mol CaCO}_3} \right\} P = \frac{nRT}{V} = \frac{(0.33)(8/100)(300 \text{ K})}{1} = \left(\frac{1}{3}\right)(8)(3)$$

31. Identify the three gases represented on the Maxwell-Boltzmann diagram below. Assume all gases are at the same temperature.



- | | I | II | III |
|-----------|--------------|--------------|--------------|
| a. | H_2 | N_2 | F_2 |
| b. | H_2 | F_2 | N_2 |
| c. | F_2 | N_2 | H_2 |
| d. | N_2 | F_2 | H_2 |



32. Each of the flasks above contains the same number of molecules. In which container is the pressure the lowest?

- a. Flask 1 b. Flask 2 c. Flask 3 d. Flask 4

33. A sample of 0.010 mole of nitrogen dioxide gas is confined at 127°C and 2.5 atm. What would be the pressure of this sample at 27°C and the same volume?

- a. 0.033 atm b. 0.33 atm c. 1.25 atm d. 1.88 atm

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} \Rightarrow \frac{2.5 \text{ atm}}{400 \text{ K}} = \frac{P_2}{300 \text{ K}} \Rightarrow P_2 = \frac{(300)(2.5)}{400 \text{ K}} = \frac{3}{4} \times \frac{5}{2} = \frac{15}{8} \approx 2$$

34. Nitrogen gas was collected over water at 25°C. If the vapor pressure of water at 25°C is 23 mmHg, and the total pressure in the container is measured at 781 mmHg, what is the partial pressure of the nitrogen gas?

- a. 23 mmHg b. 46 mmHg c. 551 mmHg d. 758 mmHg

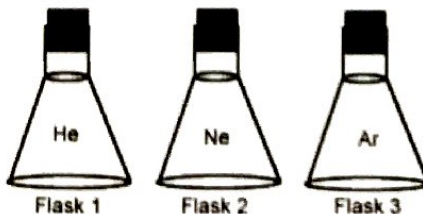
$$\begin{array}{r} 781 \\ - 23 \\ \hline 758 \end{array}$$

35. A mixture of gases contains 1.5 moles of oxygen, 3.0 moles of nitrogen, and 0.5 mole of water vapor. If the total pressure is 700 mmHg, what is the partial pressure of the nitrogen gas?

- a. 210 mmHg b. 280 mmHg c. 350 mmHg d. 420 mmHg

$$X_{N_2} = \frac{3 \text{ mol } N_2}{5 \text{ mol total}}$$

$$P_{N_2} = \left(\frac{3}{5}\right)(700) \approx 420$$



36. If all of these flask are the same size, at the same temperature, and contain the same number of molecules, in which flask will the pressure be the highest?

- a. Flask 1 b. Flask 2 c. Flask 3 d. All have the same pressure.