# HW03 - Non-Ideal Gases

This is a preview of the published version of the quiz

Started: Sep 14 at 3pm

## Quiz Instructions

### Homework 03 - Non-Ideal Gases

**Question 1** 2 pts

Two gases are contained in gas bulbs connected by a valve. Gas A is present in a 1 liter bulb at a pressure of 818 torr. Gas B exerts a pressure of 328 torr in a 1 liter bulb. The valve is opened and the two gases come to equilibrium. What is the partial pressure of gas A expressed after equilibrium?

- 1640 torr
- 656 torr
- 409 torr
- 164 torr

**Question 2** 2 pts

A mixture of oxygen and helium is 92.3% by mass oxygen. It is collected at atmospheric pressure (745 torr). What is the partial pressure oxygen in this mixture? Hint: partial pressures are calculated from the total pressure via MOLE FRACTIONS.

- 412 torr
- 688 torr
- 447 torr

- 333 torr

## Question 3

2 pts

If the average speed of a water molecule at 25°C is 640 m/s, what is the average speed at 100°C?

- 320 m/s
- 1280 m/s
- 716 m/s
- 572 m/s

## Question 4

2 pts

Air bags in automobiles contain crystals of sodium azide ($NaN_3$) which, during a collision, decompose rapidly to give nitrogen gas and sodium metal. (Potassium nitrate and silicon dioxide are added to remove the sodium metal by converting it into a harmless material.) The nitrogen gas liberated behaves as an ideal gas and any solid produced has a negligible volume (its volume can be ignored). Calculate the mass of sodium azide required to generate enough nitrogen gas to fill a 57.0 L air bag at 1.04 atm and 16°C.

- 108 g
- 2.50 g
- 163 g
- 1960 g

## Question 5

1 pts

What is the root mean square speed of the nitrogen gas molecules generated in question 4?

- 507 m/s
- 16.0 m/s
- 1.59 m/s
- 50.4 m/s

## Question 6

1 pts

Which of the following statements about Kinetic-Molecular Theory of gases is FALSE?

- The distance between molecules is much larger than the diameter of each molecule.
- The average kinetic energy of gas molecules in a sample of gas is independent of temperature.
- Collisions between molecules are elastic.
- Gases consist of molecules in continuous random motion.

## Question 7

1 pts

A plot of the Maxwell distribution of speeds for the same sample of gas at different temperatures shows that...

- at high temperatures, most molecules have speeds close to their average speed.
- as the temperature increases, a high proportion of molecules have very slow speeds.
- at low temperatures, most molecules have speeds close to their average speed.
- as the temperature decreases, a high proportion of molecules have very high speeds.

as the temperature decreases, the distribution of speeds widens.

## Question 8

1 pts

Consider the gases $H_2$, Ne, $O_2$, and Ar. Put them in order of their DECREASING rate of effusion.

[ Select ] > [ Select ] >

[ Select ] > [ Select ]

## Question 9

1 pts

Calculate the ratio of the rate of effusion of $CO_2$ to that of He.

- 0.30 : 1
- 11 : 1
- 12 : 1
- 3.3 : 1
- 0.090 : 1

## Question 10

1 pts

A sample of He gas and $O_2$ have the same temperature, pressure, and volume. Which gas has a greater number of collisions of gas molecules with the walls of the container?

- The $O_2$ gas since it has a higher average kinetic energy because it is more massive.

- They are the same since the pressure is the same.
- The $O_2$, since it has a higher average momentum as it is more massive.
- The He gas because it is less massive and moving with a higher average velocity.

## Question 11

2 pts

Nitric acid is produced commercially by the Ostwald process. In the first step, ammonia is oxidized to nitric oxide via the following reaction equation:

$4NH_3(g) + 5O_2(g) \longrightarrow 4NO(g) + 6H_2O(g)$

A sample of $NH_3$ gas in a 2.00 L container exerts a pressure of 0.500 atm. A sample of $O_2$ gas in a 1.00 L container exerts a pressure of 1.50 atm. If these two gasses are pumped into a 3.00 L container and allowed to react with one another (with proper catalysts), calculate the partial pressure of NO after the reaction is complete. Assume 100% yield for the reaction at a constant temperature.

- 0.250 atm
- 0.400 atm
- 1.50 atm
- 0.333 atm

## Question 12

2 pts

A 5.0 L flask containing $O_2$ at 2.00 atm is connected to a 3.0 L flask containing $H_2$ at 4.00 atm and the gases are allowed to mix. What is the mole fraction of $H_2$?

- 0.33
- 0.25
- 0.55

- 0.67

## Question 13

2 pts

A gas mixture being used to simulate the atmosphere of another planet at 23°C consists of 337 mg of methane, 148 mg of argon, and 210 mg of nitrogen. The partial pressure of nitrogen at 296 K is 19.0 kPa. Calculate the total pressure of the mixture.

- 29.1 kPa
- 109 kPa
- 81.6 kPa
- 165 kPa

## Question 14

1 pts

Calculate the volume of the mixture described in question 13.

- 0.226 L
- 0.902 L
- 9.58 mL
- 0.971 L

## Question 15

2 pts

When heated, solid mercury oxide (HgO) will decompose into mercury and oxygen gas according to following equation:

$2HgO(s) \longrightarrow 2Hg(g) + O_2(g)$

Starting with a container that has only solid HgO in it, the temperature is raised to 700 K and all of the solid decomposes. The total pressure in the container is 0.75 bar. What is the partial pressure of oxygen?

- 0.50 bar
- 0.75 bar
- 0.25 bar
- 0.125 bar

## Question 16

1 pts

All gases exhibit ideal behavior in low pressure situations because when the pressure is very low, the gas particles are...

- far apart and rarely interacting.
- experiencing a balance of kinetic and potential energy.
- slightly attracted to one another.
- undergoing only elastic collisions.
- moving very slowly.

## Question 17

2 pts

Deviations from ideal gas behavior can be modeled with other equations of state. One such equation that attempts to account for the repulsive interactions of gas particles is the hard sphere model:

$P(V-nb) = nRT$

A 1 mole sample of He gas at 1000 K and 500 bar has a volume of 0.176 L. Estimate the value of the constant 'b' in the hard sphere model for He.

- b = 0.01 L/mol
- 0.166 L/mol
- 0.176 L/mol
- b = 0.025 L/mol

## Question 18

1 pts

The ideal gas equation models the gas behavior observed in the world...

- perfectly for some gases, but not for others.
- perfectly for pressures under 20 atm.
- perfectly for temperatures under 1000 K.
- very well under some conditions, but shows large errors in others.
- very well under all conditions for most gases.

## Question 19

1 pts

Which of the following gases would you predict to have the largest value of the van der Waals coefficient, 'b?'

- $C_2F_6$
- $C_2F_2Cl_4$
- $CO_2$
- $Cl_2$
- $C_2FCl_5$

## Question 20

2 pts

Consider the following van der Waals coefficients:

| Gas | $a$ ($L^2 \cdot atm \cdot mol^{-2}$) | $b$ ($L \cdot mol^{-1}$) |
|---|---|---|
| ammonia | 4.17 | 0.0371 |
| chlorine | 6.49 | 0.0562 |
| helium | 0.034 | 0.0237 |
| neon | 0.211 | 0.0171 |
| water | 5.46 | 0.0305 |

Which of the following gases has the largest attractive forces?

- helium
- water
- neon
- ammonia
- chlorine

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