501
version

last name

first name

signature

McCord CH301
49970 / 49975

Exam 1

Fall 2016

Remember that the bubble sheet has many conversion factors and constants on the back.

$R = 0.08206$ L atm/mol K

$R = 62.36$ L torr/mol K

$R = 0.08314$ L bar/mol K

$R = 8.314$ J/mol K

$N_A = 6.022 \times 10^{23}$ mol^{-1}

1 atm = 1.01325 $\times 10^5$ Pa

1 atm = 760 torr

1 atm = 14.7 psi

1 bar = 10^5 Pa

1 in = 2.54 cm

1 lb = 453.6 g

1 gal = 3.785 L

$\rho_{water} = 1.00$ g/mL

$\rho_{mercury} = 13.6$ g/mL

NOTE: Please keep your Exam copy intact (all pages still stapled). You must turn in your exam copy plus your bubble sheet, and scratch paper.

This print-out should have 25 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001 4.0 points

Under what conditions is a gas most likely to deviate from ideal behavior?

1. when considering noble gases

2. high temperatures

3. low density

4. high pressure

002 4.0 points

A 50/50 mix (by mass) of nitrogen gas and carbon dioxide is made. What is the mole fraction of nitrogen in this mixture?

1. 0.50

2. 0.61

3. 0.27

4. 0.44

5. 0.56

6. 0.73

7. 0.39

003 4.0 points

A vessel contains 0.1 mol H_2 gas, 0.1 mol N_2 gas, and 0.3 mol NH_3 gas. The total pressure is 1000 torr. What is the partial pressure of the H_2 gas?

1. 200 torr

2. 500 torr

3. 800 torr

4. 100 torr

5. 1000 torr

004 4.0 points

All of the following statements, except one, are important postulates of the kinetic-molecular theory of ideal gases. Which one is not a part of this kinetic molecular theory?

1. The average kinetic energy of the molecules is inversely proportional to the absolute temperature.

2. The time during which a collision between two molecules occurs is negligibly short compared to the time between collisions.

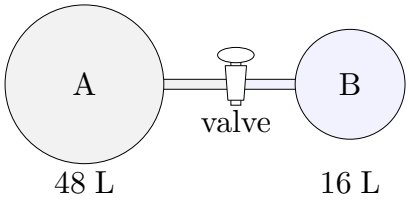
3. The volume of the molecules of a gas is very small compared to the total volume in which the gas is contained.

4. There are no attractive nor repulsive forces between the individual molecules.

5. Gases consist of large numbers of particles in rapid random motion.

005 4.0 points

Consider the diagram shown below of two glass bulbs connected through a valve. The volume for each gas (A and B) is shown under the bulbs and the gases also happen to be at the same temperature (337K) and pressure (420 torr).



After the valve is opened, the two gases mix completely. What is the partial pressure of gas B in this new (opened valve) state?

1. 168 torr

2. 140 torr

3. 210 torr

4. 84 torr

5. 420 torr

6. 525 torr

7. 280 torr

8. 105 torr

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006 4.0 points

Consider

$$2\,Al(s) + 6\,HCl(\ell) \rightarrow 2\,AlCl_3(s) + 3\,H_2(g)\,,$$

the reaction of 4.5 mol Al with excess HCl to produce hydrogen gas. What is the pressure of $H_2(g)$ if the hydrogen gas collected occupies 14L at 300K?

1. 0.0763 atm

2. 11.9 atm

3. 1.07 atm

4. 7.9 atm

5. 0.233 atm

6. 5.28 atm

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007 4.0 points

A 6.00 L sample of $C_2H_4(g)$ at 2.00 atm and 293 K is burned in 6.00 L of oxygen gas at the same temperature and pressure to form carbon dioxide gas and liquid water. If the reaction goes to completion, what is the final volume of all gases at 2.00 atm and 293 K?

1. 12.00 L

2. 6.00 L

3. 2.00 L

4. 2.66 L

5. 8.00 L

6. 4.00 L

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008 4.0 points

What is the root mean square speed of carbon dioxide molecules at 98°C?

1. 153 $m \cdot s^{-1}$

2. 45.6 $m \cdot s^{-1}$

3. 574 $m \cdot s^{-1}$

4. 459 $m \cdot s^{-1}$

5. 236 $m \cdot s^{-1}$

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009 4.0 points

Balance the equation

$$?\,Al_2(SO_4)_3 + ?\,NaOH \rightarrow ?\,Al(OH)_3 + ?\,Na_2SO_4\,,$$

using the smallest possible integers. What is the sum of the coefficients in the balanced equation?

1. ten

2. fourteen

3. eight

4. six

5. twelve

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010 4.0 points

Consider the following statements:

I) Real gases act more like ideal gases as the temperature increases.

II) When n and T are constant, a decrease in P results in a decrease in V.

III) At 1 atm and 273 K, every molecule in a sample of a gas has the same speed.

IV) At constant T, CO_2 molecules at 1 atm and H_2 molecules at 5 atm have the same average kinetic energy.

Which of these statements is true?

1. I and IV only

2. I and II only

3. II and IV only

4. III and IV only

5. II and III only

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011 4.0 points

Consider two balloons filled with gas and arranged so that P, V, T are the same in both. The number of molecules in each balloon

1. must be the same.

2. would be the same only if the filling gases are the same.

3. could be different if the filling gases are different.

4. must be different.

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012 4.0 points

The density of a gas is 1.96 g/L at STP. What would the mass of 2.00 moles of the gas be at STP?

1. 0.0875 g

2. There is not enough information to solve.

3. 87.8 g

4. 44.8 g

5. 0.510 g

6. 43.9 g

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013 4.0 points

NO gas exhibits a density of 12 g/L in a closed container at STP. What would be the density of N_2 gas under the same conditions?

1. about double 12 g/L

2. a little less than 12 g/L

3. about half 12 g/L

4. a little more than 12 g/L

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014 4.0 points

Consider a situation in which two solid reactants are mixed together to generate an unknown gaseous product. The vapor from the gas effuses at a rate that is 1.77 times slower than the same amount of carbon dioxide (CO_2) under the same temperatures and pressures. What is the molar mass of this unknown gas?

1. 87.7 g/mol

2. 138 g/mol

3. 102 g/mol

4. 156 g/mol

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015 4.0 points

The root mean square speed of nitrogen molecules in air at 20°C is 511 m/s in a certain container. If the gas is allowed to expand to twice its original volume, the root mean square velocity of nitrogen molecules drops to 325 m/s. Calculate the temperature after the gas has expanded.

1. −154°C

2. −45.1°C

3. 154°C

4. 347°C

5. −347°C

6. −261°C

7. 261°C

8. 45.1°C

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016 4.0 points

A 6.35 L sample of carbon monoxide is collected at 55.0°C and 0.892 atm. What volume will the gas occupy at 1.05 atm and 59.0°C?

1. 4.82 L

2. 6.68 L

3. 1.96 L

4. 5.46 L

5. 6.10 L

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017 4.0 points

Calculate the mass of NH_3 that can be produced from 30.0 g N_2 and 5.0 g H_2 in the following reaction.

$$N_2(g) + 3\,H_2(g) \rightarrow 2\,NH_3(g)$$

1. 36.4 g

2. 42.5 g

3. 63.8 g

4. 18.2 g

5. 28.3 g

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018 4.0 points

	a (L^2 bar/mol^2)	b (L/mol)
Acetonitrile	17.81	0.117
Butane	14.66	0.123
Freon	10.78	0.0998

Which gas molecule do you expect to be the largest? (a and b are Van der Waals constants.)

1. Acetonitrile

2. Butane

3. Freon

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019 4.0 points

A chemist prepares a sample of helium gas at a certain pressure, temperature and volume and then removes all but a fourth of the gas molecules (only a fourth remain). How must the temperature be changed (as a multiple of T_1) to keep the pressure and the volume the same?

1. None of these

2. $T_2 = \frac{1}{4}\,T_1$

3. $T_2 = 2\,T_1$

4. $T_2 = 4\,T_1$

5. $T_2 = 16\,T_1$

6. $T_2 = \frac{1}{16}\,T_1$

7. $T_2 = \frac{1}{2}\,T_1$

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020 4.0 points

An ideal gas occupies 42.0 L at 953 torr and 48.2°C.

What volume would it occupy at STP?

1. 48.3 L

2. 0.0161 L

3. 57.5 L

4. 0.0223 L

5. 22.4 L

6. 102 L

7. 27.3 L

8. 44.8 L

9. 62.0 L

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021 4.0 points

Consider two separate 1 L gas samples, both at the same temperature and pressure. The two gases have different molar masses. Which is true?

1. The particles in both gas samples have the same average kinetic energies.

2. You would need more information to be able to compare the average kinetic energies of these two gas samples.

3. The particles in both gas samples have different average kinetic energies.

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022 4.0 points

A gas is showing a considerable amount of attractive forces. What is the likely value for the compressibility factor?

1. It will be slightly above one.

2. It will be equal to one.

3. It will be slightly below one.

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023 4.0 points

Consider the Maxwell-Boltzmann distribution plots for a series of gases with different molar masses but with identical temperatures. Which of the statements below is a correct description of the shape and position of the plot as it pertains to the relative mass of the gas.

1. Heavier molecules tend to have much broader ranges of velocities and larger average velocities.

2. Lighter molecules tend to have much narrower ranges of velocities and larger average velocities.

3. Heavier molecules tend to have much narrower ranges of velocities and smaller average velocities.

4. Lighter molecules tend to have much broader ranges of velocities and smaller average velocities.

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024 4.0 points

Determine the molecular weight of a compound given the gas phase data: mass of 27.64 g, temperature of 18.4°C, pressure of 956 torr, volume of 14.32 L.

1. 279 g/mol

2. 24.9 g/mol

3. 191 g/mol

4. 0.046 g/mol

5. 36.7 g/mol

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025 4.0 points

Which of the following is NOT true about gases?

1. Gases can expand without limit.

2. The gas is at STP if it is at 273 K and 1 atm.

3. The volume a gas occupies is directly proportional to its molecular weight.

4. The density of a gas can be increased by applying increased pressure.

5. Gases exert pressure on their surroundings.