Name: ________________ Class: Chem 1B ________________ Date: ________________ ID: A

CHEM 1B Exam I (form B)

Multiple Choice

Identify the letter of the choice that best completes the statement or answers the question. (3 pts. each)

____ 1. At 298 K, the average velocity of a hydrogen molecule is 1.92×10^3 m/s. What is the average velocity of a chlorine molecule (Cl_2) at the same temperature?
- a. 1.55 m/s
- b. 54.6 m/s
- c. 98.4 m/s
- d. 324 m/s
- e. 821 m/s

____ 2. Sulfur dioxide reacts with oxygen to form sulfur trioxide.

$$2\ SO_2(g) + O_2(g) \rightarrow 2\ SO_3(g)$$

In a 1.00 L flask, 2.00 atm of SO_2 react with 5.00 atm of O_2. Assuming that the temperature remains constant, what is the final pressure in the flask?
- a. 5.00 atm
- b. 6.00 atm
- c. 7.00 atm
- d. 8.00 atm
- e. 9.00 atm

____ 3. If 1.35 g of water is sealed in an evacuated 2.00-L flask and heated to 373 K, what is the pressure in the flask?
- a. 20.7 mm Hg
- b. 705 mm Hg
- c. 760 mm Hg
- d. 872 mm Hg
- e. 912 mm Hg

____ 4. A 1.00 L flask at 298 K contains a mixture of He and O_2 with a total pressure of 1.00 atm. If the mole fraction of O_2 is 0.50, what is the mass fraction of O_2?
- a. 0.11
- b. 0.32
- c. 0.37
- d. 0.50
- e. 0.89

____ 5. Which is the dominant intermolecular force present in acetic acid, $CH_3CO_2H(\ell)$?
- a. London dispersion
- b. ionic bonding
- c. dipole/induced dipole
- d. dipole-dipole
- e. hydrogen bonding

____ 6. Calculate the density (in g/L) of Ar at 305 K and 342 mm Hg. ($R = 0.08206$ L·atm/mol·K)

a. 0.0180 g/L
b. 0.718 g/L
c. 1.39 g/L
d. 3.19 g/L
e. 487 g/L

____ 7. Which of the following relationships are true for gases?

1. The volume of a gas is directly proportional to its pressure in mm Hg.
2. The pressure of a gas in inversely proportional to its temperature in kelvin.
3. The moles of a gas are directly proportional to the gas constant R.

a. 1 only
b. 2 only
c. 3 only
d. 2 and 3
e. none are true

____ 8. At 0.966 atm, the height of mercury in a barometer is 734 mm. If the mercury was replaced with water, what height of water (in meters) would be supported at 0.966 atm? The densities of Hg and H_2O are 13.5 g/cm^3 and 1.00 g/cm^3, respectively.

a. 3.19 m
b. 9.91 m
c. 13.0 m
d. 18.4 m
e. 29.2 m

____ 9. Arrange KCl, CH_3CH_2OH, C_3H_8, and He in order of increasing boiling point.

a. $C_3H_8 < He < CH_3CH_2OH < KCl$
b. $C_3H_8 < He < KCl < CH_3CH_2OH$
c. $He < KCl < C_3H_8 < CH_3CH_2OH$
d. $He < C_3H_8 < CH_3CH_2OH < KCl$
e. $KCl < He < C_3H_8 < CH_3CH_2OH$

____ 10. Which intermolecular forces are present in $CH_3F(s)$?

1. London dispersion
2. dipole-dipole
3. hydrogen bonding

a. 1 only
b. 2 only
c. 3 only
d. 1 and 2
e. 1, 2, and 3

____ 11. What volume of O_2, measured at 27.2°C and 735 mm Hg, will be produced by the decomposition of 5.22 g $KClO_3$? (R = 0.08206 L·atm/mol·K)

$2\ KClO_3(s) \rightarrow 2\ KCl(s) + 3\ O_2(g)$+

a. 0.0983 L
b. 1.09 L
c. 1.63 L
d. 199 L
e. 133 L

____ 12. The lid is tightly sealed on a rigid flask containing 2.00 L O_2 at 15°C and 0.723 atm. If the flask is heated to 55°C, what is the pressure in the flask?

a. 0.230 atm
b. 0.465 atm
c. 0.635 atm
d. 0.723 atm
e. 0.823 atm

____ 13. If 3.25 g N_2 gas is introduced into an evacuated 1.50 L flask at 325 K, what is the pressure inside the flask? (R = 0.08206 L·atm/mol·K)

a. 0.330 atm
b. 0.485 atm
c. 1.29 atm
d. 2.06 atm
e. 57.8 atm

____ 14. Which of the following gases can be liquefied at 25°C?

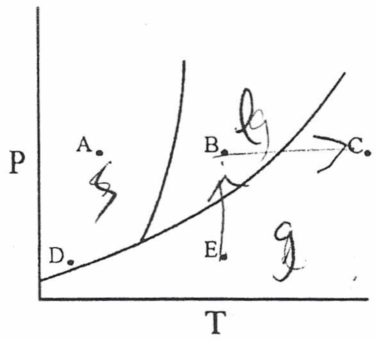
Gas	boiling pt.	critical temp.
N_2	-196°C	-147°C
Cl_2	-34°C	144°C
O_2	-183°C	-119°C

a. N_2 only
b. Cl_2 only
c. O_2 only
d. Cl_2 and O_2
e. N_2 and O_2

____ 15. Non-ideal behavior for a gas is most likely to be observed under conditions of

a. high temperature and high pressure.
b. low temperature and high pressure.
c. low temperature and low pressure.
d. standard temperature and pressure.
e. high temperature and low pressure.

____ 16. A line drawn between which two points results in a phase transition from gas to liquid?



a. A to B
b. B to C
c. E to B
d. E to D
e. B to A

____ 17. Which one of the following substances will exhibit dipole-dipole intermolecular forces?

a. Kr
b. N_2
c. CO_2
d. CCl_4
e. CO

____ 18. Avogadro's law states that equal volumes of gases under the same conditions of temperature and pressure have equal ________.

a. masses
b. numbers of molecules
c. molar masses
d. densities
e. velocities

3. Gaseous iodine pentafluoride, IF_5, can be prepared by the reaction of solid iodine and gaseous fluoride: $I_2(s) + 5F_2(g) \rightarrow 2IF_5(g)$

A 5.00 L flask containing 10.0 g I_2 is charged with 10.0 g F_2, and the reaction proceeds until one of the reagents is completely consumed. After the reaction is complete, the temperature in the flask is 125 °C. a) What is the partial pressure of IF5 in the flask? b) What is the mole fraction of IF_5 in the flask? (10 pts.)

$(10.0\,g\ I_2)\left(\frac{1\ mol\ I_2}{253.8\,g}\right) = 0.0394\ mol\ I_2 / 1 = 0.03$ $\therefore I_2 = LR.$

$(10.0\,g\ F_2)\left(\frac{1\ mol\ F_2}{38\,g}\right) = 0.2631\ mol\ F_2 / 5 = 0.05$

$(0.0394\ mol\ I_2)\left(\frac{2\ IF_5}{1\ mol\ I_2}\right) = 0.0788\ mol\ IF_5$

$PV = nRT.$

$P = \frac{nRT}{V} \Rightarrow \frac{(0.0788\ mol\ IF_5)(0.08206\ \frac{L\,atm}{mol\,K})(398\,K)}{(5.0\,L)}$

a) $\therefore$ Partial Pressure $IF_5 \approx 0.514\ atm.$

b) $X_{IF_5} = \frac{0.0788}{0.0394 + 0.2631 + 0.0788} \approx 0.206$

+6

4. Hydrogen gas is produced when zinc reacts with sulfuric acid:

$$Zn\,(s) + H_2SO_4\,(aq) \rightarrow ZnSO_4\,(aq) + H_2\,(g)$$

If 159 mL of wet H_2 is collected over water at 24°C and a barometric pressure of 738 torr, how many grams of zinc have been consumed? (The vapor pressure of water is 22.38 torr. (8 pts.)

$159\,mL\ H_2 = 0.159\,L\ H_2.$

$PV = nRT$

$n_{H_2} = \frac{PV}{RT} \Rightarrow \frac{(0.97\,atm)(0.159\,L)}{(0.08206\ \frac{L\,atm}{mol\,K})(297.15\,K)} = 0.00633\ mol\ H_2.$

$(0.00633\ mol\ H_2)\left(\frac{1\ mol\ Zn}{1\ mol\ H_2}\right)$

$= (0.00633\ mol\ Zn)\left(\frac{65.39\,g}{1\ mol\ Zn}\right) = 0.4140\,g\ Zn.$

+5

5. The volume of a sample of gas is compressed at constant temperature. How does this change in volume affect the following? Answer as: Increases, decreases, or no change. (6 pts.)

V↓ P↑

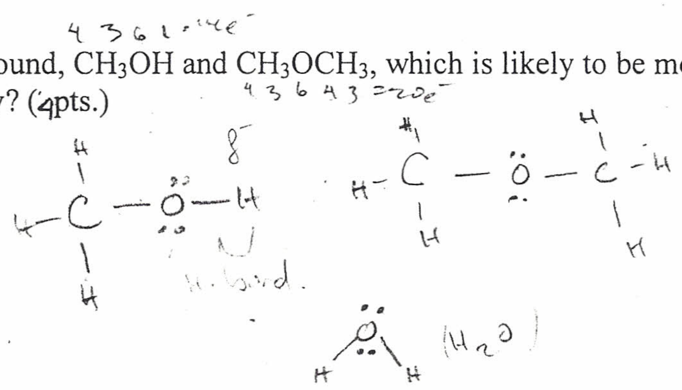
a) Average Kinetic energy of the molecules: ___increases___

b) Average speed of the molecules: ___no change___

C) Number of collisions of the gas molecules with the containers walls per unit

11 Time: ___Increases___

6) Of the two compound, CH_3OH and CH_3OCH_3, which is likely to be more soluble in water and why? (4pts.)



CH_3OH is more likely to be soluble in water because of its polar nature. As we know water is highly polar and also that, "like & like" will mix together. CH_3OCH_3 on the other hand is a non-polar substance and would likely repel water because of this difference in polarity.

Chem 1B, Key Equations:

Gases

$PV = nRT$	$d = PM/RT$	; M = molecular weight
$P_1V_1 = P_2V_2$	$M = dRT/P$	
$V_1/T_1 = V_2/T_2$	$P_T = p_1 + p_2 + p_3 + \ldots$	$R = 0.0821$ L-atm/mol.K
$P_1V_1/T_1 = P_2V_2/T_2$	$p_1 = P_T . X_1$	$R = 8.314$ J/mol.K
$n_1/V_1 = n_2/V_2$	$q = m . c_p . \Delta t$	1J = 4.184 cal