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(Please Print)

Chem 104 - Section 1
Hour Examination I
Sample Test

This test consists of six (6) pages, including this cover page. Be sure your copy is complete before beginning your work. If this test packet is defective, ask for another one.

☛ **You must show work in the spaces provided that leads to your answers to problems 2, 3, and 4. Answers without such work receive no credit.**

Ideal Gas Law Constant = $R = 0.08206 \text{ L}\cdot\text{atm}/\text{K}\cdot\text{mol} = 8.314 \text{ J}/\text{K}\cdot\text{mol}$

Molar volume of an ideal gas at STP = $22.4 \text{ L}/\text{mol}$

$\text{K} = ^\circ\text{C} + 273.15$

DO NOT WRITE BELOW THIS LINE

This is a copy of a typical first test in Chem 104. Your test will be different. This test is being posted to give you a sense of the format, style, scope, and level of a typical test on this material. This test may have questions on topics that will not be covered on the test you take. Moreover, your test may have questions on topics that are not covered on this test. Posting this test in no way limits the format, style, scope, or level of the test that you will take. **Do not limit your preparation to the material on this sample test.**

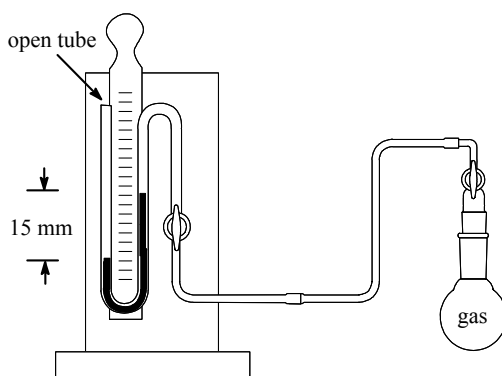
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1. (60 points; 4 points each) Circle the best answer to each of the following.

a. If c is a constant, the equation that represents both Avogadro's Hypothesis and the Law of Gay-Lussac is

$$V = c/P \quad V = cn \quad P = cT \quad V = cP \quad V = cT$$

b. The pressure of a gas sample is measured with an open-ended manometer, as shown below.



The mercury level in the outer arm is lower than the level of the inner arm by 15 mm. A barometer in the laboratory reads 756 mm Hg. What is the pressure of the gas sample in mm Hg?

$$15 \text{ mm Hg} \quad 741 \text{ mm Hg} \quad 756 \text{ mm Hg} \quad 771 \text{ mm Hg} \quad 760 \text{ mm Hg}$$

c. A gas sample in a piston chamber at 25 °C and 1.20 atm occupies 8.00 L. What is the pressure if the piston is moved inward to make the volume 3.20 L?

$$0.333 \text{ atm} \quad 0.450 \text{ atm} \quad 3.00 \text{ atm} \quad 4.80 \text{ atm} \quad 21.3 \text{ atm}$$

d. A sample of gas in a steel tank at 25 °C has a pressure of 2.80 atm. The tank is submerged in boiling water and attains a temperature of 100 °C. What is the pressure inside the heated tank?

$$0.700 \text{ atm} \quad 2.24 \text{ atm} \quad 3.50 \text{ atm} \quad 3.83 \text{ atm} \quad 11.2 \text{ atm}$$

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- e. In 3.00 hours, 0.400 mol $\text{CH}_4(g)$ (m.w. = 16.0) effuses from a certain apparatus. How many moles of $\text{SO}_2(g)$ (m.w. = 64.0) should effuse in the same time under identical conditions?

1.60 mol 0.800 mol 0.100 mol 0.200 mol 0.400 mol

- f. Of the following gases, which would be expected to behave *least* like an ideal gas?

He H_2O CH_4 Ne N_2

- g. Which of the following is most likely to be soluble in carbon tetrachloride, $\text{CCl}_4(l)$?

HF H_2O Na_2CO_3 $\text{CH}_3\text{CO}_2\text{H}$ I_2

- h. The molar mass of $\text{CF}_4(g)$ is 88.0 g/mol. Assuming ideal behavior, what is the expected density of $\text{CF}_4(g)$ at STP?

0.255 g/L 1.00 g/L 3.60 g/L 3.93 g/L 88 g/L

- i. Which of the following is *not* a factor in producing the pressure of a gas sample?

Temperature

Molecular collisions with the container walls

The identity of the gas

The amount of gas

Volume of the container

- j. Which of the following has the highest boiling point?

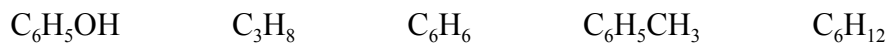
H_2 HF HCl HBr HI

- k. Which of the following solids has the lowest melting point?

SiO_2 NaCl Fe Al_2O_3 Na

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- l. Which of the following probably has the lowest vapor pressure at room temperature?



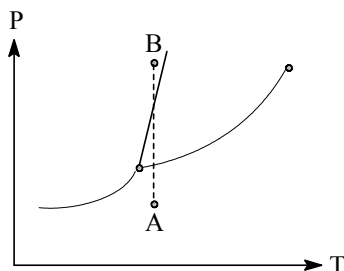
- m. At 20 °C the vapor pressure of pure benzene is 74.7 torr. What is the expected vapor pressure in torr above a solution prepared by mixing 0.232 mol of a nonvolatile organic compound with 0.928 mol of benzene?

14.9 torr 17.3 torr 18.7 torr 59.8 torr 69.3 torr

- n. At 25 °C, what is the osmotic pressure in atmospheres of a 0.0125 M solution of $CaCl_2(aq)$?

0.306 atm 0.611 atm 0.917 atm 31.0 atm 92.9 atm

- o. Consider the phase diagram shown below.



Which one of the following describes the sequence of phase changes that would occur when raising the pressure at constant temperature, as indicated by the dotted line from A to B?

- liquid→solid→vapor liquid→vapor→solid vapor→liquid→solid
 solid→liquid→vapor vapor→solid→liquid

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4. (18 points) While on a field trip, Ms. Smith's seventh-grade science class notices a gas bubbling up through the water near the edge of a pond. Using an empty mayonnaise jar from their lunch, they collect the gas by water displacement and seal the sample with the jar's lid. They bring the sealed jar to the University's Chemistry Department, where it is determined that the mass of the collected gas sample is 0.3088 g and that the volume of the mayonnaise jar is 477 mL. From the weather report, it is known that the temperature at the pond was 29.0 °C and that the barometric pressure was 756 torr. The vapor pressure of water at 29.0 °C is 30.0 torr.

a. (12 points) How many moles of the unknown gas does the sample contain?

b. (6 points) From the given data, you could calculate that the amount of water vapor in the jar is 0.0137 g. Given this and the mass of the gas sample, calculate the molecular weight of the unknown gas.

BONUS (5 points) Identify the unknown gas, justifying your answer on the basis of the results of your calculations above.