Name: KEY

**Chemistry 121**
**Test 4**
**Spring 2007**

You have 75 minutes to complete this 100 point test. Please mark each answer clearly and show all work. You may use a simple scientific calculator. NO GAPHING CALCULATORS.

**I. Fill in the blank**

1. (1 pt) The weakest intermolecular forces are called London Forces.

2. (1 pt) The phase change that occurs when going from a gas directly to a solid is referred to as deposition.

3. (1 pt) Boyle's Law inversely relates pressure to volume at constant temperature and amount.

4. (2 pts) A non-ideal gas (real gas) occurs under conditions of high pressure and low temperature.

5. (1 pt) Diffusion is the mixing of gases due to their molecular motion.

6. (1 pt) Macromolecular carbohydrates that store large amounts of energy are called polysaccharides.

7. (2 pts) All amino acids contain a(n) amine functional group and a(n) carboxylic acid functional group.

8. (1 pt) The building blocks of nucleic acids are termed nucleotides.

**II. Calculations: Clearly show all work for full credit.**

1. (10 pts) A 35.8 L sample of Ar is allowed to expand to 1875 L. If the temperature is held constant and the final pressure is 721 mmHg, what must have been the original pressure of the gas?

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$V_1 = 35.8\ L$ $\quad V_2 = 1875\ L$

$P_1 = ??\ mmHg$ $\quad P_2 = 721\ mmHg$

$$P_1 = \frac{P_2 \cdot V_2}{V_1} = \frac{(721\ mmHg)(1875\ L)}{35.8\ L} = 3.78 \times 10^4\ mmHg$$

2. (15 pts) $PH_3$ is used in the manufacture of flame-retardant chemicals.

a. What is the mass of this gas (in mg) if a 27.6 mL is collected at STP? (MM of $PH_3$ = 33.99 g/mol) $T = 273\,K$ $P = 1.00\,atm$

$PV = nRT$ $\quad V = 27.6\,mL \times \frac{1\,L}{1000\,mL} = 0.0276\,L$

$$n = \frac{PV}{RT} = \frac{(1.00\,atm)(0.0276\,L)}{(0.0821\,\frac{L\,atm}{mol\,K})(273\,K)} = 0.00123\ mol\ PH_3$$

$$0.00123\ mol\ PH_3 \times \frac{33.99\,g\,PH_3}{1\ mol\ PH_3} \times \frac{1000\,mg}{1\,g} = \boxed{41.8\ mg\ PH_3}$$

b. How many molecules of $PH_3$ are present? (MM of $PH_3$ = 33.99 g/mol)

$$0.00123\ mol\ PH_3 \times \frac{6.02 \times 10^{23}\ molecules\ PH_3}{1\ mol\ PH_3} = \boxed{7.40 \times 10^{23}\ molecules\ PH_3}$$

3. (15 pts) What volume of propane gas, $C_3H_8$, is generated by the reaction of 2.0 g of CO with 7.0 g of $H_2$ if the propane is collected at 15°C and 745 mmHg? (MM of CO = 28.01 g/mol; MM of $H_2$ = 2.016 g/mol)

Limiting Reactant Problem

| $3\,CO$ | + | $7\,H_2$ | → | $C_3H_8$ | + | $3\,H_2O$ |
|---|---|---|---|---|---|---|
| 2.0 g | | 7.0 g | | ?? L | | |

$15°C + 273 = 288\,K$

$$745\,mmHg \times \frac{1\,atm}{760\,mmHg} = 0.980\,atm$$

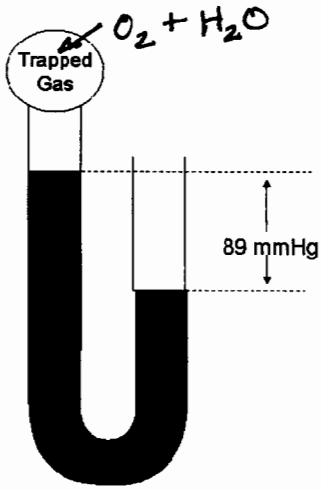
$$2.0\,g\,CO \times \frac{1\ mol\ CO}{28.01\,g\,CO} \times \frac{1\ mol\ C_3H_8}{3\ mol\ C_3H_8} = 0.0238\ mol\ C_3H_8$$

$$7.0\,g\,H_2 \times \frac{1\ mol\ H_2}{2.016\,g\,H_2} \times \frac{1\ mol\ C_3H_8}{7\ mol\ H_2} = 0.496\ mol\ C_3H_8$$

$PV = nRT$

$$V = \frac{nRT}{P} = \frac{(0.0238\ mol)(0.0821\,\frac{L\,atm}{mol\,K})(288\,K)}{(0.980\,atm)} = 0.574\,L\,C_3H_8$$

4. (10 pts) A sample of $O_2$ gas was collected in a u-tube over water at 30°C. Given the diagram below, calculate the partial pressure of $O_2$ (in atm) gas if the atmospheric pressure is 748 mmHg and the vapor pressure of water at 30°C is 31.83 mmHg.



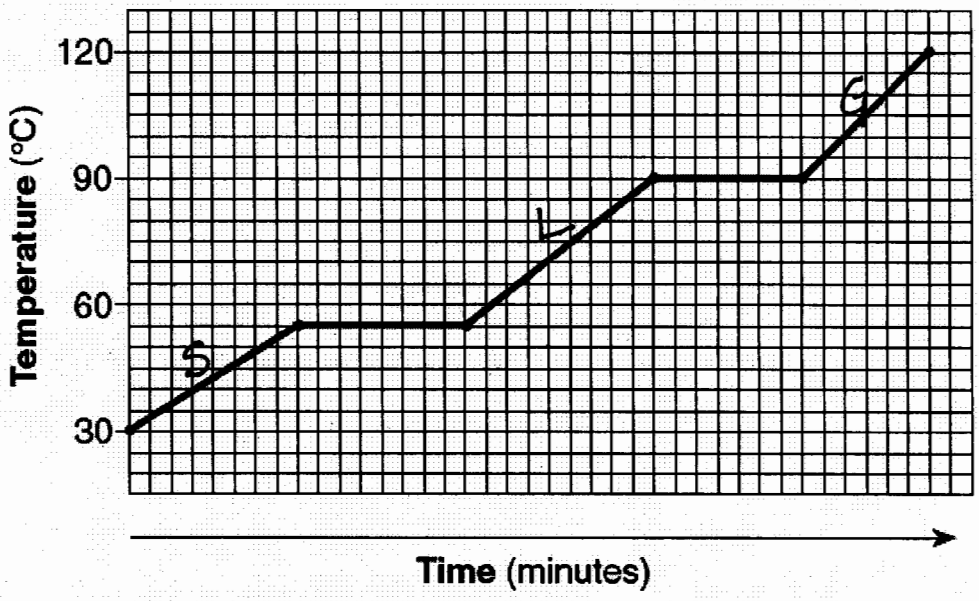

$P_{O_2} = P_{atm} - P_{H_2O} - P_{mmHg}$

$= 748\,mmHg - 31.83\,mmHg - 89\,mmHg$

$= 627\,mmHg \times \frac{1\,atm}{760\,mmHg} = \boxed{0.825\,atm}$

**III. Phase Changes and Trends**

1. (10 pts) Use the graph below to answer the following questions:
   a. This graph is a representation of a(n) heating curve
   b. On the graph, clearly indicate the regions that correspond to the three phases: solid, liquid and gas using a S, L and G.
   c. According to the curve, the compound boils at 90 °C.




2. (10 pts) Rank the following gases in order of rates of diffusion from slowest to fastest: $N_2$, $O_2$, $SO_2$, $F_2$ and $NO_2$.

28 32
64 38 46

$SO_2 < NO_2 < F_2 < O_2 < N_2$

3. (4 pts) In the following groups, circle the compound with the highest boiling point:
   a. $C_3H_8$ or (circled) $C_4H_{10}$
   b. $Cl_2$ or (circled) $SO_3$

4. (6 pts) Rank the three main types of intermolecular forces from weakest to strongest.

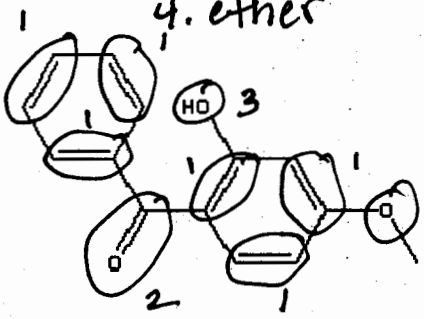
London Forces < Dipole-Dipole < Hydrogen Bonding

**IV. Organic Compounds, Biochemicals and Forces**

1. (7 pts) Circle and identify the important functional groups in the following molecules

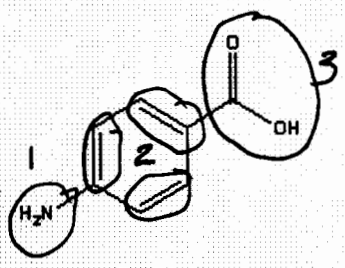
a.

1. alkene
2. ketone
3. alcohol
4. ether



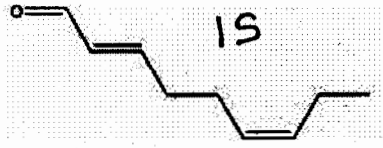

b.

1. amine
2. alkene
3. carboxylic acid




2. (3 pts) State if the following molecules are soluble (SOL) or insoluble (IS) in water.

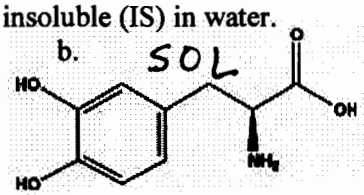
a.



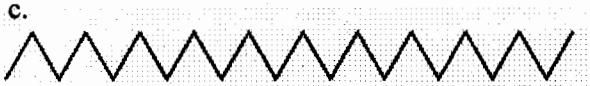

IS

b.

SOL




c.



IS

3. (6 pts) Identify the following segment as DNA or RNA and write the complementary base paring.

a. AAGCTTA DNA
TTCGAAT

b. UUAACCC RNA
AAUUGGG

4. (4 pts) Place a circle around the terminal amine group and a triangle around the terminal carboxylic acid group in the following peptide chain.

Lys – Ala – Ala – Ser – Arg – Tyr – Cys – Cys – Gly