Due: Friday, 7-October-2005 at the beginning of class. Show all work clearly. Remember that this is to be your own work.

1) Given the following data, calculate the $\Delta H$ for the reaction:

$$\text{P}_4\text{H}_{10(s)} + 6\text{PCl}_5(g) \rightarrow 10\text{Cl}_3\text{PO}(g)$$

$\text{P}_4(s) + 6\text{Cl}_2(g) \rightarrow 4\text{PCl}_3(g)$

$\Delta H = -1225.6 \text{ kJ}$

$\text{P}_4(s) + 5 \text{O}_2(g) \rightarrow \text{P}_4\text{O}_{10(s)}$ 

$\Delta H = -2967.3 \text{ kJ}$

$\text{PCl}_3(g) + \text{Cl}_2(g) \rightarrow \text{PCl}_5(g)$

$\Delta H = -84.2 \text{ kJ}$

$\text{PCl}_3(g) + \frac{1}{2} \text{O}_2(g) \rightarrow \text{Cl}_3\text{PO}(g)$

$\Delta H = -285.7 \text{ kJ}$

2) The composition of a particular natural gas sample, expressed on a mole fraction basis, is: CH$_4$, 0.820; C$_2$H$_6$, 0.102, C$_3$H$_8$, 0.078. A 215-L sample of this natural gas, measured at 24.5 $^\circ$C, and 744 mm Hg, is burned in an excess of oxygen. How much heat is evolved in the combustion? (The $\Delta H^\circ_f$(C$_3$H$_8$) = -103.85 kJ/mol.)

3) A coffee-cup calorimeter contains 150 g of water at 24.6$^\circ$C. A 110 g block of molybdenum metal is heated to 100$^\circ$C and then placed in the water in the calorimeter. The temperature of the water rises to 28.0$^\circ$C, at which point it stops rising. What is the specific heat of the molybdenum metal? Ignore the heat capacity of the coffee-cup. (Hint: think about what the final temperature of the molybdenum metal is. Also, recall what we know about heat flow.)

4) A rebreathing mask contains potassium superoxide, KO$_2$, which reacts with moisture in the breath to give oxygen:

$$4\text{KO}_2(s) + 2\text{H}_2\text{O}(l) \rightarrow 4\text{KOH}(s) + 3 \text{O}_2(g)$$

Estimate the grams of potassium superoxide required to supply a person's oxygen needs for one hour. Assume a person requires 1.50 x 10$^2$ kcal of energy for this time period. Further assume that this energy can be equated to the heat of combustion of a quantity of glucose, C$_6$H$_{12}$O$_6$, to CO$_2(g)$ and H$_2$O(l). From the amount of glucose required to give 1.50 x 10$^2$ kcal of heat, calculate the amount of oxygen consumed and hence the amount of KO$_2(s)$ required. The $\Delta H^\circ_f$ for glucose$_{(s)}$ is -1273 kJ/mol.

5) Does a negative $\Delta H_{rxn}$ mean that the heat can be thought of as a reactant or as a product? Explain your choice.