While sitting in the Chem 112 class and mentally desperately thrashing around for ways to pass the time before you get rescued by the bell, you wind up thinking about the possibility of making diamonds from methane. The reaction is straightforward enough:

$$\text{CH}_4(g) + \text{O}_2(g) \rightarrow \text{C}_{(\text{diamond})} + 2\text{H}_2\text{O}(l)$$

The only trick to this is HOW to accomplish this; the Standard State of Carbon is graphite, not diamond, so this is a difficult reaction to accomplish, if not to write, but, in a moment of sheer genius, you come up in your mind with a “secret plan” by which you can make this reaction work and which will insure your fortune so that you’ll not have to fool with this course any more. The only remaining question you face is whether or not this reaction liberates heat or not, and, if it does liberate heat, how much heat is liberated? This is important because it’ll influence the reaction vessel you choose. Further thinking convinces you that you need to CALCULATE beforehand if this reaction liberates heat or not, because you’re not about to show the world your “secret scheme” by running this reaction solely for the purpose of measuring its $\Delta H_{\text{rxn}}$, and thereby perhaps letting others see the secret.

Searching through a book, you find the following information:

RXN I  $\text{CH}_4(g) + 2\text{O}_2(g) \rightarrow \text{CO}_2(g) + 2\text{H}_2\text{O}(l)$  $\Delta H_{\text{rxn}} = -212.8$ Kcal

RXN II  $\text{C}_{(\text{graphite})} + \text{O}_2(g) \rightarrow \text{CO}_2(g)$  $\Delta H_{\text{rxn}} = -94.0$ Kcal

RXN III  $\text{C}_{(\text{graphite})} \rightarrow \text{C}_{(\text{diamond})}$  $\Delta H_{\text{rxn}} = +0.45$ Kcal

RXN IV  $2\text{H}_2(g) + \text{O}_2(g) \rightarrow 2\text{H}_2\text{O}(l)$  $\Delta H_{\text{rxn}} = -136.6$ Kcal

1. a) Show CLEARLY how you will go about calculating the $\Delta H_{\text{rxn}}$ for the reaction which will convert methane, $\text{CH}_4(g)$ into diamond, $\text{C}_{(\text{diamond})}$.
b) What is the value for $\Delta H_{\text{rxn}}$ for the reaction which will convert methane, $\text{CH}_4(\text{g})$ into diamond, $\text{C}(\text{diamond})$?

c) Does the reaction liberate heat or absorb heat? How do you know?

d) What property does $\Delta H$ possess that makes it possible for you to employ the combination of the book values for the given RXNS in permitting you to calculate the desired $\Delta H_{\text{rxn}}$ in the first place?

2. a) In the information above, the term Standard State was used. What is meant by the Standard State for a substance?

b) What is the relationship between Standard State and the Heat of Formation? (It’ll work best if you define the Heat of Formation before you try to answer the question)

c) From which, IF ANY, of the equations above (I, II, III, or IV) can you determine the Heat of Formation for one or more substances? What are the Heat of Formation values you come up with?

I have neither given nor received any unacknowledged aid on this quiz.
SIGNED__________________________________________________