**CHE1031 Lecture 8 HW**

Problems must be solved, or written out, in their entirety with all work shown on engineering graph paper. You must label each set in the upper left hand corner with your name, the date and the chapter. Problems must be identified by number and all work must be shown with answers boxed. Be sure your handwriting is legible.

**8.1: Kinetic & Potential Energy**

1. Many engineers express heat changes in Btu (British thermal units). One Btu is the amount of heat required to raise the temperature of 1 lb of water by 1°F. How many Joules in a Btu?

**8.2: Transferring energy as heat & work**

2. Identify the force present *and* explain whether work is done when a positively charged particle moves in a circle at a fixed distance from a negatively charged magnet.

**8.3: System vs. surroundings**

3. Each closed box represents a system, and the arrows show changes to that system.

Arrow length represents the magnitude of change.

1. Which is endothermic?
2. For which process, if any, is ΔE < 0?
3. In which process, if any, does the system experience a net gain in ΔE?

**q**

**w**

**w**

**q**

**w**

***i***

***ii***

***iii***

4. What is a “closed system”?

5. What do we call that part of the universe that is not part of the system?

**8.4: First law of thermodynamics**

6. State the first law of thermodynamics.

7. Calculate ΔE. Is this process endo- or exothermic? A balloon is cooled by removing 0.655 kJ of heat. It shrinks as it cools and the atmosphere does 382 J of work on the balloon.

8. Calculate ΔE. Is this process endo- or exothermic? A 100.0-g bar of gold is heated from 25C to 50C absorbing 322 J of heat in the process. Assume that the bar’s volume remains constant.

**8.5: Enthalpy**

9. Under what conditions will the change in enthalpy equal the amount of heat transferred in or out of a system?

10. During a constant pressure process the system releases heat to the surroundings. Does enthalpy increase or decrease?

11. Ozone, O3(g), is a form of elemental oxygen that is important in absorption of ultraviolet radiation in the stratosphere. O3 decomposes to O2(g) at room temperature and pressure according to this thermochemical reaction:

2O3(g) 🡪 3O2(g) ΔH = -284.6 kJ

1. What is the enthalpy change for this reaction per mole of O3(g)?
2. Which has the higher enthalpy under these conditions, 2O3(g) or 3O2(g)?

12. At one time, a common means of forming small quantities of oxygen gas in the lab was to heat KClO3:

2KClO3(s) 🡪 2KCl(s) + 3O2(g) ΔH = - 89.4 kJ

1. Calculate ΔH for the formation of 1.36 mol of O2.
2. Calculate ΔH for the formation of 10.4 g of KCl.
3. Decomposition is spontaneous when heat is provided. Do you think the reverse reaction is likely under ordinary conditions? Explain your answer.

13. Liquid benzene (C6H6) can be decomposed to gaseous acetylene (C2H2):

C6H6(l) 🡪 3C2H2(g) ΔH = + 630 kJ

1. What is the enthalpy change for the reversed reaction?
2. What is ΔH for the formation of 1 mol of acetylene?
3. Which is thermodynamically favored, the forward or reverse reaction?
4. If C6H6(g) were used as reactant instead of the liquid benzene, would the magnitude of ΔH increase, decrease or stay the same?

14. Given these reactions:

N2(g) + O2(g) 🡪 2NO(g) ΔH = + 180.7 kJ

2NO(g) + O2(g) 🡪 2NO2(g) ΔH = - 113.1 kJ

2N2O(g) 🡪 2N2(g) + O2(g) ΔH = - 163.2 kJ

Use Hess’s law to calculate the ΔH of this reaction:

N2O(g) + NO2(g) 🡪 3NO(g)

**8.6: Calorimetry**

15. What are the units of specific heat?

16. If you know the specific heat of copper, what other information do you need to know to calculate the heat capacity of a piece of copper pipe?

17. Water:

1. What is the specific heat of liquid water?
2. What is the molar heat capacity of liquid water?
3. What is the heat capacity of 185 g of liquid water?
4. How many kJ of heat are needed to raise the temperature of 10.00 kg of liquid water from 24.6 C to 46.2 C?

18. When a 4.25-g sample of solid ammonium nitrate dissolves in 60.0 g of water in a coffee-cup calorimeter (constant pressure), the temperature drops from 22.0 C to 16.9 C.

a. Calculate ΔH (kJ/mol (NH4)(NO3)) for the solution process below, assuming the same specific heat as water.

(NH4)(NO3)(s) 🡪 NH4+1(aq) + NO3-1(aq)

1. Is the process endothermic or exothermic?

**~~8.7: Enthalpy of Formation~~**

~~19. Many portable gas heaters and grills use propane, C3H8(g) as a fuel. Using standard enthalpies of formation, calculate the amounts of heat produced when 10.0 g of propane is completely combusted in air under standard conditions.~~

~~20. Calcium carbide (CaC2) reacts with water to form acetylene (C2H2) and Ca(OH)2. From the following enthalpy of reaction data and data in Appendix C, calculate the enthalpy of formation of CaC2:~~

~~CaC2(s) + 2H2O(l) 🡪 Ca(OH)2(s) + C2H2(g) ΔH = -127.2 kJ~~

~~21. How many grams of protein provide the same fuel value as 25 g of fat?~~