CH301 Worksheet 13b answer key—Internal Energy

1. Define open, closed, or isolated systems. If you use an open system as a calorimeter, what is the state function you can calculate from the temperature change. If you use a closed system as a calorimeter, what is the state function you can calculate from the temperature?

2. Rank, from greatest to least, the types internal energy found in a chemical system:

3. Internal energy is a state function. Work and heat (w and q) are not. Explain.

4. What are the two types of work most commonly associated with chemical processes?

5. Calculation from the text on the most famous kind of expansion work NOT done by a gas:

Water expands when it freezes. How much work does 100 g of water do when it freezes at 0°C and bursts a water pipe that exerts an opposing pressure of 1070 atm? The densities of water and ice at 0°C are 1.00 $g\cdot cm^{-3}$ and 0.92 $g\cdot cm^{-3}$, respectively.

6. Name the two phase changes for which significant work is done on the system?

7. Distinguish heat capacity, specific heat and molar heat capacity and provide typical examples of units?

8. Rank the following in terms of increasing heat capacity. Water, ice, copper, air.

9. A calorimetry calculation from the text:

Potassium perchlorate, $KClO_4$, is used as an oxidizer in fireworks. Calculate the heat required to raise the temperature of 10.0 g of $KClO_4$ from 25°C to an ignition temperature of 900.°C. The specific heat capacity of $KClO_4$ is 0.8111 $J\cdot K^{-1}\cdot g^{-1}$.

10. The change is internal energy is found by measuring the amount of heat or work that enters or leaves the system. Use this fact to perform the following calculation from the text:

An automobile engine does 520. kJ of work and loses 220. kJ of energy as heat. What is the change in the internal energy of the engine? Treat the engine, fuel, and exhaust gases as a closed system.

11. Were it not for the fact that most thermochemistry in real life is done in open systems at constant external atmospheric pressure, we would be happy to use ΔU to account for energy changes in a system. But in the real world, ΔH is the more practical unit of energy change in a system. Given the definition of $H = U + PV$, derive the fact that a calorimeter in at open system at constant external pressure has $\Delta H = q_p$.

12. Apply what you know about the relationship between H and U to perform the following calculation from the text:

In an exothermic reaction at constant pressure, 50. kJ of energy left the system as heat and 20. kJ of energy left the system as expansion work. What are the values of (a) ΔH and (b) ΔU for this process?