Thermochemistry Review

1. Describe what the specific heat of a substance represents, utilizing units to support your answer.
2. Which substance would reach the highest temperature if exposed to 1300kJ of thermal energy?
3. Tin (Cp = 0.278 J/g˚C)
4. Gold (Cp = 0.129 J/g˚C)
5. Silver (Cp = 0.237 J/g˚C)
6. Zinc (Cp = 0.348 J/g˚C)
7. Iron (Cp = 0.312 J/g˚C)
8. Draw and energy diagram for the following scenarios.
9. The desk leg feels cold to your hand
10. Water evaporates on a lab bench.
11. Provide the sign of enthalpy (ΔH) for the following process and support with reasoning.

NaNO3 (s) NaNO3 (l)

1. Which of the following is false?
2. A reaction vessel will warm during an exothermic reaction
3. The KE of the molecules in an endothermic reaction always increases
4. Thermal energy is typically expressed as ethalpic energy.
5. Exothermic reactions are considered enthalpically favorable
6. The units for enthalpy are kJ/mol
7. Discuss the difference between heat and temperature by analyzing the following interaction: Gerald: “How hot is it today?” Francine: “It’s supposed to get up to 92F!”
8. Compare and contrast the utilization of heat energy during endothermic phase changes vs. during endothermic temperature changes.
9. Quantify the heat energy associated with the following processes: (ΔHf = 79.9 J/g, ΔHv = 2260 J/g, Cice = 2.018 J/g˚C, Cwater = 4.187 J/g˚C, Csteam = 1.996 J/g˚C)
10. 2.00L of water is vaporized in a humidifier.
11. A 250.0 g sample of water is cooled from 115˚C to -25˚C
12. Determine the following thermal variables in each question.
13. A block of red-hot iron (212˚C) is quenched in 100.0L of cool water (15.7˚C). If the temperature of the water after quenching is 76.8˚C, how large was the piece of iron quenched? (Cwater = 4.18 J/g˚C, Ciron = 0.450 J/g˚C)
14. 4.35 g of Cheetos are combusted in a bomb calorimeter, causing the 250mL of water surrounding the combustion vessel to increase from 21.6˚C to 27.8˚C. How many calories of energy does a 750 g bag of Cheetos contain?
15. Which of the following is true concerning the relation between heat and enthalpy?
16. Heat is the amount of enthalpy a system holds.
17. Enthalpy is the amount of heat a system holds.
18. Heat is an amount of thermal energy, enthalpy is an amount of thermal energy per mole of substance.
19. Enthalpy is an amount of thermal energy, heat is an amount of thermal energy per mole of substance.
20. Hydrogen peroxide, H2O2, is a colorless liquid whose solutions are used as a bleach and an antiseptic. What is the ΔH of formation for H2O2 from hydrogen and oxygen gas given the following data.

H2(g) + O2(g) H2O2(l)

Use the following reactions and enthalpy changes:

H2O2(l) H2O(l) + 1/2O2(g) ΔH = -98kJ/mol

2H2(g) + O2(g) 2H2O(l) ΔH = -571.6kJ/mol

1. Hydrazine, N2H4, is a colorless liquid used as a rocket fuel. What is the enthalpy change for the process in which hydrazine is formed from it elements?

N2(g) + 2H2(g) N2H4(l)

Use the following reactions and enthalpy changes:

N2H4(l) + O2(g) N2(g) + 2H2O(l) ΔH = -622.2kJ/mol

H2(g) + 1/2O2(g) H2O(l) ΔH = -285.8kJ/mol

1. Ammonia will burn in the presence of a platinum catalyst to produce nitric oxide, NO. What is the heat of reaction at constant pressure? Use the following thermochemical equations:

4NH3(g) + 5O2(g) 4NO(g) + 6H2O(g)

N2(g) + O2(g) 2NO(g) ΔH = 180.6kJ/mol

N2(g) + 3H2(g) 2NH3(g) ΔH = -91.8kJ/mol

2H2(g) + O2(g) 2H2O(g) ΔH = -483.7kJ/mol

1. Calculate the amount of heat transferred when 24.3g of water is formed by the following reaction:

H2(g) + 1/2O2(g) H2O(l) ΔH = -285.8kJ/mol

1. Calculate the enthalpy of reaction for the following reaction:
   1. Draw the Lewis Dot structures for the following reaction and determine the enthalpy of reaction. (C Ξ O = 1046 KJ, Cl – Cl = 242 KJ, C =O = 745 KJ, C-Cl = 339 KJ)

CO (g) + Cl2 (g) COCl2 (g)

* 1. Write out the reaction for the combustion of propane. Determine the enthalpy of formation for propane given the following. (ΔHCO2 = -393.5 KJ/mol, ΔHH2O = -285.3 KJ/mol, ΔHrxn = -2220.1 KJ/mol)

1. For the equation: (NH4)2Cr2O7 N2 + 4 H2O + Cr2O3

If 3 grams of (NH4)2Cr2O7 gives off 3.57 kJ of energy, calculate the ΔHrxn.

1. Which would have the highest bond dissociation energy? Support your answer with reasoning.
   1. C-O
   2. C-S
   3. C-C
   4. C=O
   5. C=S
   6. C=C
2. Explain the following statement: “Dissolving always results in a release of energy from the system”.
3. How can an endothermic dissolving process still be described as giving off energy?
4. Determine the ΔHsoln for magnesium chloride given the following calorimetry data.

Ti = 23.5˚C, Tf = 28.9˚C, msolute = 1.3g, msolvent = 48.7g, Caq = 4.18J/g˚C, Ccal = 18.7J/g˚C