Key

Heat in Reactions worksheet #2

1. You are on a diet that calls for eating no more than 1200 Cal/day. How many Joules is this?

1200 Cal = 1,200,000 cal | 4.184 J / 1 kcal = 5,020,800 J

2. One beaker contains 156 g of water at 22°C, and a second beaker contains 85.2 g of water at 95°C. The water in the 2 beakers is missed. What is the final temperature of the combined water?

cold — $-q = 156(4.184)(T_f - 22)$

cold — $q = 85.2(4.184)(T_f - 95)$

$-85.2(4.184)(T_f - 95) = 156(4.184)(T_f - 22)$

$-85.2T_f + 8094 = 156T_f - 3432$

$T_f = 47.8\,°C$

3. A 237 g piece of molybdenum, initially at 100°C, is dropped into 244 g of water at 10°C. When the system reaches thermal equilibrium, the temperature is 15.3°C. What is the specific heat capacity of molybdenum?

Moly: $q = 237(C_p)(15.3 - 100)$

H_2O: $q = 244(4.184)(5.3)$

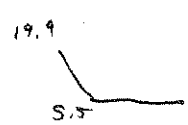
$q = 5410.75\,J$

$-5410.75\,J = 237(C_p)(-84.7)$

$C_p = .27\ J/g\cdot°C$

4. A 25 mL sample of benzene at 19.9°C was cooled to its melting point (5.5°C) and then frozen. How much heat was given off in this process? The density of benzene is 0.80 g/mL, its specific heat capacity is 1.74 J/g*K, and its heat of fusion is 127 J/g.

25 mL | .8 g / 1 mL = 20 g



19.9 → 5.5 $q = 20(1.74)(-14.4) = -501.12\,J$

$20(-127) = -2540$

$-3041.12\,J$

5. What is the standard enthalpy for the reaction between magnesium metal and hydrochloric acid? (H° for Magnesium = 0)

$Mg_{(s)} + 2HCl_{(aq)} \rightarrow MgCl_2 + H_{2(g)}$

0   -167.159   -641.62   0

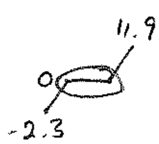
-641.62 - (-167.159)2 = ~~-474.46 kJ~~ ~~ΔH°rxn~~

= -307.302 kJ = ΔH°rxn

6. If 6.87 grams of magnesium were used in the above reaction, how much energy would be involved. Would the energy be released or absorbed?

6.87 g Mg / 24.3 g Mg × 1 mol Mg × 307.302 kJ (~~474.46 kJ~~) / 1 mol Mg = 86.88 kJ released

7. How much magnesium would be required to react with excess HCl to raise the temperature of a beaker of 14 grams of ice from -2.3 °C to 11.9°C?



-2.3 → 0   q = 14(2.06)(2.3) = 66.332 J

14(333) = 4662 J

0 → 11.9   q = 14(4.184)(11.9) = 697.0544

5425.3864 J → 5.425 kJ

5.425 kJ / 307.302 kJ × 1 mol Mg × 24.3 g / 1 mol Mg = .43 g Mg

8. The reaction below is the last step in the commercial production of sulfuric acid. How much heat is transferred if 200 kg of sulfuric acid are produced?

$SO_3(g) + H_2O(l) \rightarrow H_2SO_4(aq)$ ΔH = -227 kJ

200,000 g H_2SO_4 / 98.1 g H_2SO_4 × 1 mol H_2SO_4 × 227 kJ / 1 mol H_2SO_4 = 462,793 kJ

9. 10 grams of iron are reacted with 2 grams of oxygen according to the equation below. How much heat will be transferred? Will the heat be absorbed or released?

$$4Fe(s) + 3O_2 \rightarrow 2Fe_2O_3(s) \qquad \Delta H = -1652 \text{ kJ}$$

10 g   2 g

10 g Fe / 1 mol Fe / 55.8 g Fe = .179 mol Fe / 3 mol / 4 mol = .134

2 g O_2 / 1 mol O_2 / 32 g O_2 = .0625 mol O_2 LR

.0625 mol O_2 / 1652 kJ / 3 mol O_2 = 34.42 kJ released

10. Given the following data:

~~$C_2H_2 + 5/2O_2 \rightarrow 2CO_2 + H_2O$~~   ~~$\Delta H = -1300$ kJ~~

$2CO_2 + H_2O \rightarrow C_2H_2 + \frac{5}{2}O_2$ 1300

x2 ~~$C + O_2 \rightarrow CO_2$~~   ~~$\Delta H = -394$ kJ~~

$2C + 2O_2 \rightarrow 2CO_2$ −788

$H_2 + 1/2O_2 \rightarrow H_2O$ $\Delta H = -286$ kJ

Calculate ΔH for the following reaction   ΔH = +226 kJ

$$226\text{ kJ} + 2C + H_2 \rightarrow C_2H_2$$

28 g   10 g

How much heat will be transferred if 28 grams of carbon are reacted with 10 grams of hydrogen?

28 g C / 1 mol C / 12 g C = 2.33 mol C LR

2.33 mol C / 226 kJ / 2 mol C = 263.67 kJ absorbed

10 g H_2 / 1 mol / 2 g = 5 mol H