Name ___________________________________ Ch. 16 Thermochemistry

1. Exothermic vs. Endothermic

2. $Q = m\,c\,\Delta T$

3. Enthalpy of a reaction (ΔH)

4. How does the energy of the **products** of a reaction system compare with the energy of the **reactants** when the reaction is
    a. Endothermic
    b. Exothermic

5. How much energy is needed to raise the temperature of a 55 g sample of aluminum from 22.4˚C to 94.6˚C? (The specific heat of aluminum is 0.897 Joules/g ˚C)

$94.6 - 24.2 = 72.2\ ^\circ C$

$Q = m\,c\,\Delta T$

$55\,g\left(.897\ \frac{J}{g^\circ C}\right)\left(72.2\,^\circ C\right) = 3562\ J$ or $3.6\ kJ$

6. If 3.5 kJ of energy are added to a 28.2 g sample of iron at 20˚C, what is the final temperature of the iron? (Specific heat of iron is 0.449 Joules/g ˚C)

$\Delta T = \frac{Q}{m\,c} = \frac{3.500\ J}{28.2\,g\ 0.449\ \frac{J}{g^\circ C}} = 276.42\ ^\circ C$

$+ 20\ ^\circ C$

$= 296\ ^\circ C$

s.f. $300^\circ C$

7. You need 70.2 J to raise the temperature of 34.0 g of ammonia, $NH_3(g)$, from 23.0˚C to 24.0˚C. Calculate the specific heat of ammonia.

$c = \frac{Q}{m\,\Delta T} = \frac{70.2\ J}{34.0\,g\,(1.0\,^\circ C)} = 2.06 = 2.1\ \frac{J}{g^\circ C}$

8. For each equation listed below, determine if the reaction is endothermic or exothermic.

a. Carbon + Oxygen gas → carbon dioxide gas + 393.51 kJ exo.

b. $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$ + 890.31 kJ exo.

c. $CaCO_3(s)$ + 176 kJ → $CaO(s) + CO_2(g)$ endo.

d. $H_2O(g) \rightarrow H_2O(l)$ + 44.02 kJ exo.

9. Rewrite each equation below with the ΔH value included with either the reactants or the products, **and** identify the reaction as endothermic or exothermic.

a. $H_2(g) + O_2(g) \rightarrow H_2O(l)$; ΔH^0= -285.83 kJ exo. $H_{2(g)} + O_{2(g)} \rightarrow H_2O(l)$ + 285.83 kJ

b. $2Mg(s) + O_2(g) \rightarrow 2MgO(s)$; ΔH^0= -1200 kJ exo. $2Mg_{(s)} + O_{2(g)} \rightarrow 2MgO_{(s)}$ + 1200 kJ

c. $I_2(s) \rightarrow I_2(g)$; ΔH^0= +62.4 kJ endo. $I_2(s)$ + 62.4 kJ → $I_2(g)$

d. $3CO(g) + Fe_2O_3(s) \rightarrow 2Fe(s) + 3CO_2(g)$; ΔH^0=-24.7 kJ exo

$3CO_{(g)} + Fe_2O_{3(s)} \rightarrow 2Fe_{(s)} + 3CO_{2(g)}$ + 24.7 kJ

10. $Sn(s) + Cl_2(g) \rightarrow SnCl_2(s)$; ΔH= -325.1 kJ , $SnCl_2(s) + Cl_2(g) \rightarrow SnCl_4(s)$; ΔH= -186.2 kJ

$Sn(s) + 2Cl_2(g) \rightarrow SnCl_4(l)$; ΔH= **?** -511.3 kJ

11. The standard enthalpy of formation for sulfur dioxide gas from sulfur and oxygen gas is -296.8 kJ/mol. Calculate the amount of energy given off in kJ when 30.0 g of $SO_2(g)$ is formed from its elements.

$S_{(s)} + O_{2(g)} \rightarrow SO_{2(g)}$ + 296.8 kJ/mol

$$\frac{30.0\ g\ SO_2 \mid mol\ SO_2}{\mid 64\ g\ SO_2} = .46875\ mol\ SO_2 \;\Big|\; \frac{296.8\ kJ}{1\ mol\ SO_2} = 139\ kJ$$