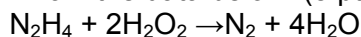


## Quiz 7 – October 28, 2016

Complete the following problems. Write your final answers in the blanks provided.

1. Determine the  $\Delta H^\circ$  for this reaction from the data below. (8 pts)

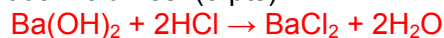


Reaction	$\Delta H^\circ$
$\text{N}_2\text{H}_4 + \text{O}_2 \rightarrow \text{N}_2 + 2\text{H}_2\text{O}$	-622.2 kJ
$\text{H}_2 + \frac{1}{2}\text{O}_2 \rightarrow \text{H}_2\text{O}$	-285.8 kJ
$\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}_2$	-187.8 kJ

$\text{N}_2\text{H}_4 + \text{O}_2 \rightarrow \text{N}_2 + 2\text{H}_2\text{O}$	-622.2 kJ
$2(\text{H}_2 + \frac{1}{2}\text{O}_2 \rightarrow \text{H}_2\text{O})$	2(-285.8 kJ)
$2(\text{H}_2\text{O}_2 \rightarrow \text{H}_2 + \text{O}_2)$	-2(-187.8 kJ)
$\text{N}_2\text{H}_4 + \text{O}_2 + 2\text{H}_2 + \text{O}_2 + 2\text{H}_2\text{O}_2 \rightarrow \text{N}_2 + 2\text{H}_2\text{O} + 2\text{H}_2\text{O} + 2\text{H}_2 + 2\text{O}_2$	-818.2 kJ
$\text{N}_2\text{H}_4 + 2\text{H}_2\text{O}_2 \rightarrow \text{N}_2 + 4\text{H}_2\text{O}$	<b>-818.2 kJ</b>

Answer **\_\_\_\_\_ -818.2 kJ \_\_\_\_\_**

2. In a constant-pressure calorimeter, 55.0 mL of 0.680 M  $\text{Ba}(\text{OH})_2$  was added to 55.0 mL of 0.680 M HCl. The reaction caused the temperature of the solution to rise from 21.97°C to 26.60°C. If the solution has the same density and specific heat as water (1.00 g/mL and 4.184 J/g·°C, respectively), what is  $\Delta H$  for this reaction (per mole of  $\text{H}_2\text{O}$  produced)? Assume that the total volume is the sum of the individual volumes. (9 pts)



How much  $\text{H}_2\text{O}$  is produced depends on limiting reactant:

$$0.0550 \text{ L} \times \frac{0.680 \text{ mol Ba}(\text{OH})_2}{1 \text{ L}} \times \frac{2 \text{ mol H}_2\text{O}}{1 \text{ mol Ba}(\text{OH})_2} = 0.0748 \text{ mol H}_2\text{O}$$

$$0.0550 \text{ L} \times \frac{0.680 \text{ mol HCl}}{1 \text{ L}} \times \frac{2 \text{ mol H}_2\text{O}}{2 \text{ mol HCl}} = 0.0347 \text{ mol H}_2\text{O}$$

So, HCl is the limiting reactant and 0.0347 mol  $\text{H}_2\text{O}$  are produced. How much heat energy is associated with this reaction?

$q_{\text{soln}} = mc\Delta T = (110 \text{ g})(4.184 \text{ J/g}^\circ\text{C})(26.60^\circ\text{C} - 21.97^\circ\text{C}) = 2131 \text{ J}$  are absorbed by the solution during the reaction

$$q_{\text{rxn}} = -q_{\text{soln}} = -n\Delta H$$

$$2131 \text{ J} = -(0.0347 \text{ mol H}_2\text{O})(\Delta H)$$

$$\Delta H = \frac{-2131 \text{ J}}{0.0347 \text{ mol H}_2\text{O}} = -56,976 \text{ J/mol H}_2\text{O} = -57.0 \text{ kJ/mol H}_2\text{O}$$

Answer **\_\_\_\_\_ -57.0 kJ/mol H<sub>2</sub>O \_\_\_\_\_**

3. The overall reaction that occurs in the photosynthesis of plants is  
 $6\text{CO}_2(\text{g}) + 6\text{H}_2\text{O}(\text{g}) \rightarrow \text{C}_6\text{H}_{12}\text{O}_6(\text{s}) + 6\text{O}_2 \quad \Delta H^\circ = +2803 \text{ kJ}$   
 Determine the standard enthalpy of formation for glucose,  $\text{C}_6\text{H}_{12}\text{O}_6(\text{s})$ . (8 pts)

$$\Delta H^\circ_{\text{rxn}} = +2803 \text{ kJ} = \Sigma(n\Delta H^\circ_{\text{f,products}}) - \Sigma(n\Delta H^\circ_{\text{f,reactants}})$$

$$+2803 \text{ kJ} = [1 \text{ mol}(\Delta H^\circ_{\text{f}}[\text{C}_6\text{H}_{12}\text{O}_6(\text{s})]) + 6 \text{ mol}(0 \text{ kJ/mol})] - [6 \text{ mol}(-393.5 \text{ kJ/mol}) + 6 \text{ mol}(-241.8 \text{ kJ/mol})]$$

$$+2803 \text{ kJ} = (\Delta H^\circ_{\text{f}}[\text{C}_6\text{H}_{12}\text{O}_6(\text{s})]) - [-3811.8 \text{ kJ}].$$

$$\text{So, } (\Delta H^\circ_{\text{f}}[\text{C}_6\text{H}_{12}\text{O}_6(\text{s})]) = -1008.8 \text{ kJ/mol } \text{C}_6\text{H}_{12}\text{O}_6(\text{s})$$

**Answer -1009 kJ/mol C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>(s)**

#### Possibly Useful Information

$\text{KE} = \frac{1}{2}mv^2$	$\text{K} = ^\circ\text{C} + 273.15$	$q_{\text{lost}} = -q_{\text{gained}}$
$q = mc\Delta T$	$q = n_{\text{LR}}\Delta H_{\text{rxn}}$	$q = m\Delta H$

Substance	$\Delta H^\circ_{\text{f}}$ (kJ/mol)
C(g)	+716.7
C(graphite)	0
CO(g)	-110.5
CO <sub>2</sub> (g)	-393.5
H(g)	+218.0
H <sub>2</sub> (g)	0
H <sub>2</sub> O(g)	-241.8
H <sub>2</sub> O(l)	-285.8
O(g)	+249.2
O <sub>2</sub> (g)	0
O <sub>3</sub> (g)	+142.7

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1A	2A	3B	4B	5B	6B	7B	8	8B	1B	2B	3A	4A	5A	6A	7A	8A	
<sup>1</sup> H 1.00794	<sup>4</sup> Be 9.01218	<sup>12</sup> Mg 24.3050	<sup>20</sup> Ca 40.078	<sup>23</sup> V 50.9415	<sup>24</sup> Cr 51.9961	<sup>25</sup> Mn 54.9381	<sup>26</sup> Fe 55.847	<sup>27</sup> Co 58.9332	<sup>28</sup> Ni 58.693	<sup>29</sup> Cu 63.546	<sup>30</sup> Zn 65.39	<sup>13</sup> Al 26.9815	<sup>14</sup> Si 28.0855	<sup>15</sup> P 30.9738	<sup>16</sup> S 32.066	<sup>17</sup> Cl 35.4527	<sup>18</sup> Ar 39.948
<sup>3</sup> Li 6.941	<sup>11</sup> Na 22.9898	<sup>19</sup> K 39.0983	<sup>37</sup> Rb 85.4678	<sup>55</sup> Cs 132.905	<sup>87</sup> Fr (223)	<sup>21</sup> Sc 44.9559	<sup>39</sup> Y 88.9059	<sup>41</sup> Nb 92.9064	<sup>43</sup> Tc (98)	<sup>75</sup> Re 186.207	<sup>105</sup> Db (262)	<sup>31</sup> Ga 69.723	<sup>32</sup> Ge 72.61	<sup>33</sup> As 74.9216	<sup>34</sup> Se 78.96	<sup>35</sup> Br 79.904	<sup>36</sup> Kr 83.80
<sup>3</sup> Li 6.941	<sup>40</sup> K 39.0983	<sup>88</sup> Ra 226.025	<sup>104</sup> Rf (261)	<sup>105</sup> Db (262)	<sup>106</sup> Sg (266)	<sup>107</sup> Bh (264)	<sup>108</sup> Hs (277)	<sup>109</sup> Mt (268)	<sup>110</sup> Ds (271)	<sup>111</sup> Rg (272)	<sup>80</sup> Hg 200.59	<sup>81</sup> Tl 204.383	<sup>82</sup> Pb 207.2	<sup>83</sup> Bi 208.980	<sup>84</sup> Po (209)	<sup>85</sup> At (210)	<sup>86</sup> Rn (222)
<sup>56</sup> Ba 137.327	<sup>57</sup> *La 138.906	<sup>89</sup> †Ac 227.028	<sup>72</sup> Hf 178.49	<sup>73</sup> Ta 180.948	<sup>74</sup> W 183.84	<sup>75</sup> Re 186.207	<sup>76</sup> Os 190.23	<sup>77</sup> Ir 192.22	<sup>78</sup> Pt 195.08	<sup>79</sup> Au 196.967	<sup>80</sup> Hg 200.59	<sup>81</sup> Tl 204.383	<sup>82</sup> Pb 207.2	<sup>83</sup> Bi 208.980	<sup>84</sup> Po (209)	<sup>85</sup> At (210)	<sup>86</sup> Rn (222)
<sup>58</sup> Ce 140.115	<sup>59</sup> Pr 140.908	<sup>90</sup> Th 232.038	<sup>104</sup> Rf (261)	<sup>105</sup> Db (262)	<sup>106</sup> Sg (266)	<sup>107</sup> Bh (264)	<sup>108</sup> Hs (277)	<sup>109</sup> Mt (268)	<sup>110</sup> Ds (271)	<sup>111</sup> Rg (272)	<sup>65</sup> Tb 158.925	<sup>66</sup> Dy 162.50	<sup>67</sup> Ho 164.930	<sup>68</sup> Er 167.26	<sup>69</sup> Tm 168.934	<sup>70</sup> Yb 173.04	<sup>71</sup> Lu 174.967
*Lanthanide series		†Actinide series									<sup>65</sup> Tb 158.925	<sup>66</sup> Dy 162.50	<sup>67</sup> Ho 164.930	<sup>68</sup> Er 167.26	<sup>69</sup> Tm 168.934	<sup>70</sup> Yb 173.04	<sup>71</sup> Lu 174.967
											<sup>97</sup> Bk (247)	<sup>98</sup> Cf (251)	<sup>99</sup> Es (252)	<sup>100</sup> Fm (257)	<sup>101</sup> Md (258)	<sup>102</sup> No (259)	<sup>103</sup> Lr (262)

Copyright © 2007 Pearson Prentice Hall, Inc.