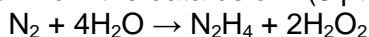


## Quiz 7 – October 27, 2017

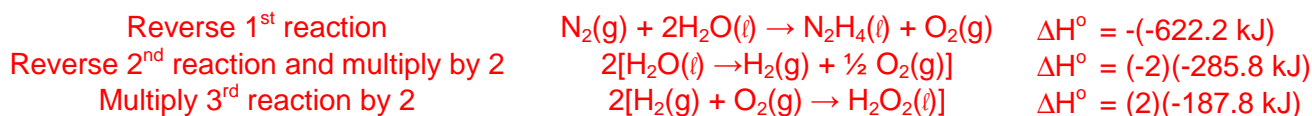
Complete the following problems. Write your final answers in the blanks provided.

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

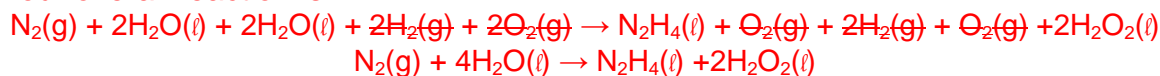


Reaction	$\Delta H^\circ$
$\text{N}_2\text{H}_4 + \text{O}_2 \rightarrow \text{N}_2 + 2\text{H}_2\text{O}$	-622.2 kJ
$\text{H}_2 + \frac{1}{2}\text{O}_2 \rightarrow \text{H}_2\text{O}$	-285.8 kJ
$\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}_2$	-187.8 kJ

We need to re-write the reactions so that we end up with the appropriate reactants and products, with the correct stoichiometry, and do the same things to the  $\Delta H$ 's that we do to the reactions.



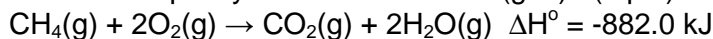
Now our overall reaction is:



And the  $\Delta H^\circ = (-1)(-622.2 \text{ kJ}) + (-2)(-285.8 \text{ kJ}) + (2)(-187.8 \text{ kJ}) = +818.2 \text{ kJ}$

Answer           +818.2 kJ          

2. You are planning to deep fry some Oreos by heating cooking oil in a pan on a natural gas stove. Your source of heat will be the combustion of natural gas (methane, molar mass 16.04 g/mol), shown below. What mass of methane must burn to heat 2.02 kg of cooking oil from 72°F (22.2°C) to 375°F (190.6°C) to make some delicious treats? The specific heat capacity of the cooking oil is 1.75 J/(g°C), the specific heat capacity of water is 4.184 J.(g°C). (9 pts)



$$q_{\text{rxn}} = -q_{\text{oil}}$$

$$n_{\text{rxn}}\Delta H^\circ_{\text{rxn}} = -m_{\text{oil}}C_{\text{oil}}\Delta T_{\text{oil}}$$

$$n(-882.0 \text{ kJ/mol CH}_4) = -(2.02 \text{ kg})(1.75 \text{ J/g}^\circ\text{C})(190.6 - 22.2^\circ\text{C})$$

$$n(-882.0 \text{ kJ/mol CH}_4) = -595.3 \text{ kJ}$$

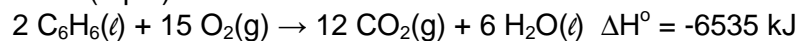
$$n = -595.3 \text{ kJ}/(-882.0 \text{ kJ/mol CH}_4)$$

$$n = 0.675 \text{ mol CH}_4$$

$$0.675 \text{ mol CH}_4 \times \frac{16.04 \text{ g CH}_4}{1 \text{ mol CH}_4} = 10.8 \text{ g CH}_4$$

Answer           10.8 g CH<sub>4</sub>

3. The overall reaction for the combustion of benzene ( $C_6H_6$ ) is shown below. Use the data in the table at the right to calculate  $\Delta H_f^\circ$  of benzene. (8 pts)



Substance	$\Delta H_f^\circ$ (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

$$\Delta H^\circ_{\text{rxn}} = -6535 \text{ kJ} = \Sigma(n\Delta H^\circ_{f,\text{products}}) - \Sigma(n\Delta H^\circ_{f,\text{reactants}})$$

$$-6535 \text{ kJ} = [12 \text{ mol}(-393.5 \text{ kJ/mol}) + 6 \text{ mol}(-285.8 \text{ kJ/mol})] - [2 \text{ mol}(\Delta H^\circ_f[C_6H_6(\ell)]) + 6 \text{ mol}(0 \text{ kJ/mol})]$$

$$-6535 \text{ kJ} = -6437 \text{ kJ} - 2 \text{ mol}(\Delta H^\circ_f[C_6H_6(\ell)])$$

$$-98 \text{ kJ} = -2 \text{ mol}(\Delta H^\circ_f[C_6H_6(\ell)])$$

$$\text{So, } (\Delta H^\circ_f[C_6H_6(\ell)]) = +49 \text{ kJ/mol } C_6H_6(\ell)$$

Answer       +49 kJ/mol C<sub>6</sub>H<sub>6</sub>(ℓ)      

#### Possibly Useful Information

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