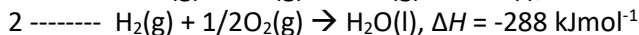
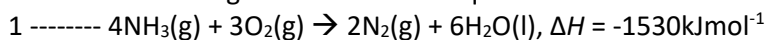


Friday worksheet 9 Hess' Law and enthalpy

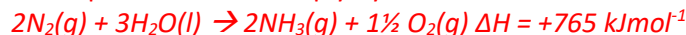
Name

1. Given the following thermochemical equations



Calculate the enthalpy of formation of ammonia.

Reverse equation 1 and multiply by $\frac{1}{2}$.



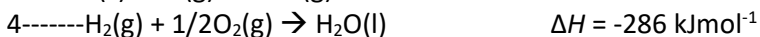
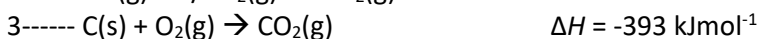
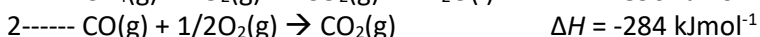
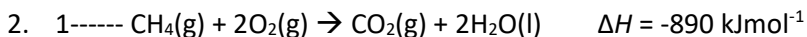
Multiply equation 2 by 3



Add the two equations together



-



- a) Given the thermochemical equations above write balanced thermochemical equations for the :

- i. formation of methane

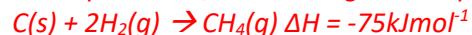
Reverse equation 1



Multiply equation 4 by 2



Add equations 5, 6 and 3 to get the equation below



- ii. formation of carbon monoxide

Reverse equation 2



Add equation 3 to the equation above to get the equation below

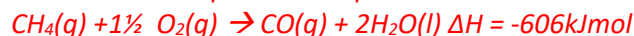


- iii. combustion of methane in limited oxygen to form carbon monoxide and liquid water.

Reverse equation 2

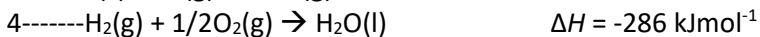
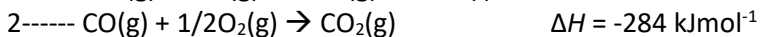
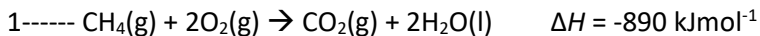
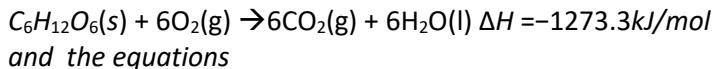


Add the above equation to equation 1

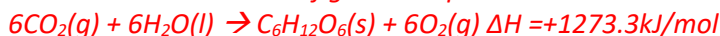


- b) Calculate the enthalpy of formation of glucose according to the equation below
 $6C(s) + 6H_2(g) + 3O_2(g) \rightarrow C_6H_{12}O_6(s) \Delta H = ?$

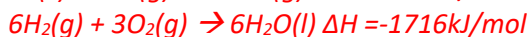
Given



Reverse the combustion of glucose equation above.



Multiply equations 3 and 4 by 6

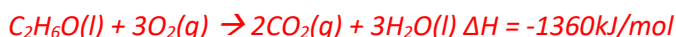


Now add the three equations together

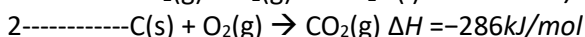


3. When ethanol burns in oxygen under standard conditions CO_2 and liquid water are produced.

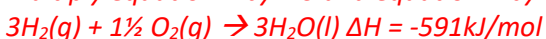
a. Write a balanced thermochemical equation for the complete combustion of ethanol using information from the Data Booklet .



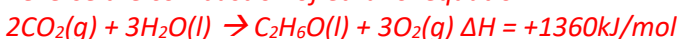
b. Calculate the enthalpy of formation of ethanol given the equations below.



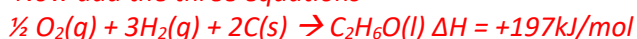
Multiply equation 1 by 1.5 and equation 2 by 2



Reverse the combustion of ethanol equation.



Now add the three equations



4. A 5.30 gram sample of pure solid ammonium nitrate is dissolved in 50.0 mL of pure water at 25.0 °C. If the temperature of the water was finally measured at 15.5 °C calculate the ΔH of the equation $NH_4NO_3(s) \rightarrow NH_4^+(aq) + NO_3^-(aq) \Delta H = 23 \text{ kJ/mol}$

Step 1 – find the mol of NH_4NO_3

$\Rightarrow 5.30/62.0 = 0.0855 \text{ mol}$

Step 2 – find the mass of water

$\Rightarrow (50.0 \times 0.997) = 49.85 \text{ g}$

Step 3 – find the amount of energy removed from water

$\Rightarrow E(J) = 4.18 \times 49.85 \times 9.5 = 1.98 \text{ kJ}$

Step – find the amount of energy removed from the water per mol = $1.98 \text{ kJ}/0.0855 \text{ mol} =$

$\Rightarrow 23 \text{ kJ/mol}$ (2 sig figs)