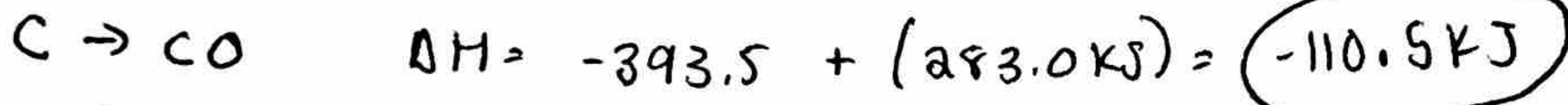
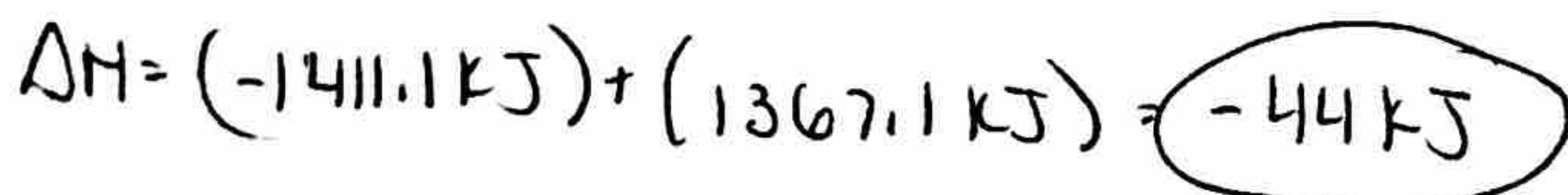
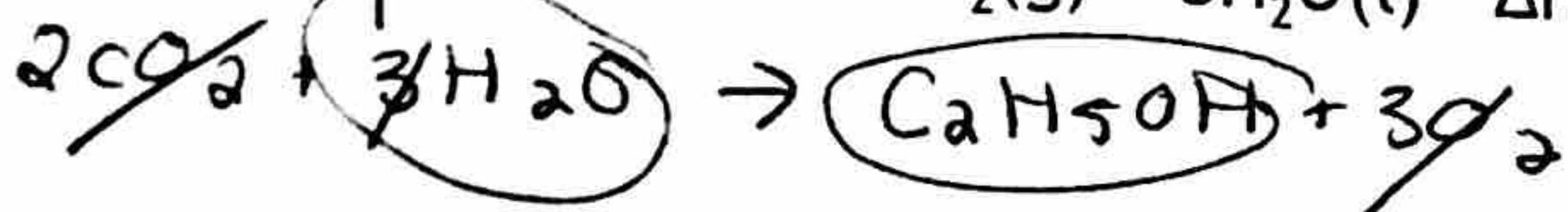
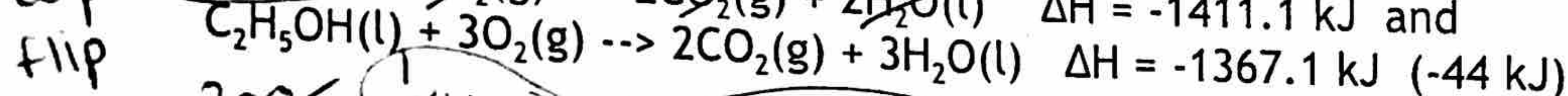
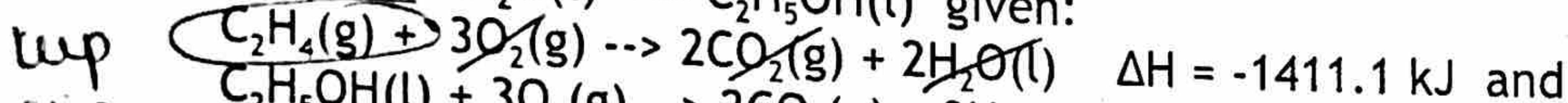
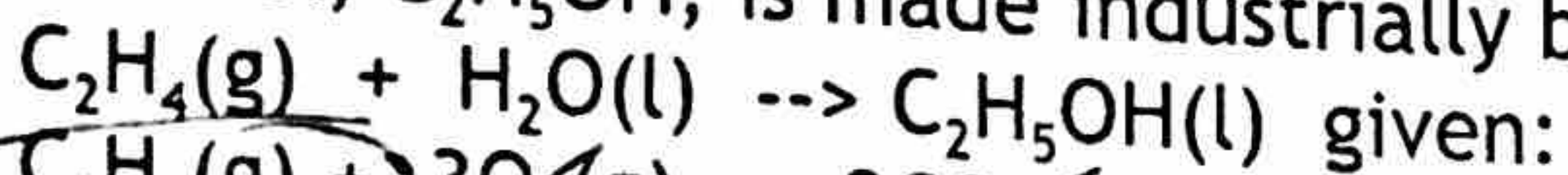


AP Chemistry: Hess's Law CW

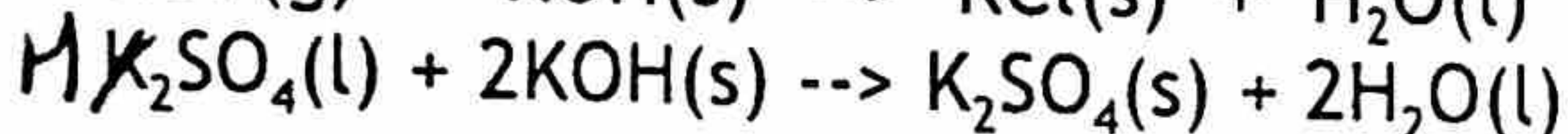
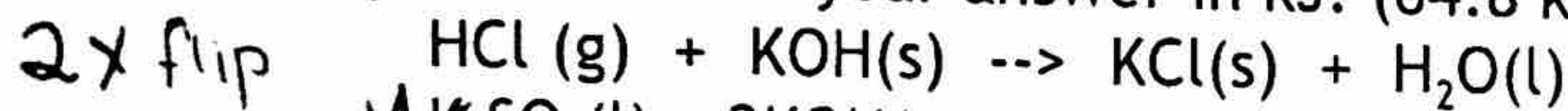
1. The heat of combustion of C to CO<sub>2</sub> is -393.5 kJ/mol of CO<sub>2</sub>, whereas that for combustion of CO to CO<sub>2</sub> is -283.0 kJ/mol of CO<sub>2</sub>. Calculate the heat of combustion of C to CO. (-110.5 kJ)



2. Ethanol, C<sub>2</sub>H<sub>5</sub>OH, is made industrially by the reaction of water with C<sub>2</sub>H<sub>4</sub>. Calculate ΔH° for:

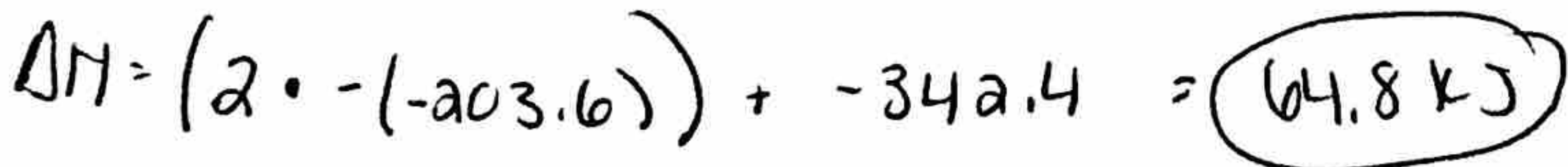
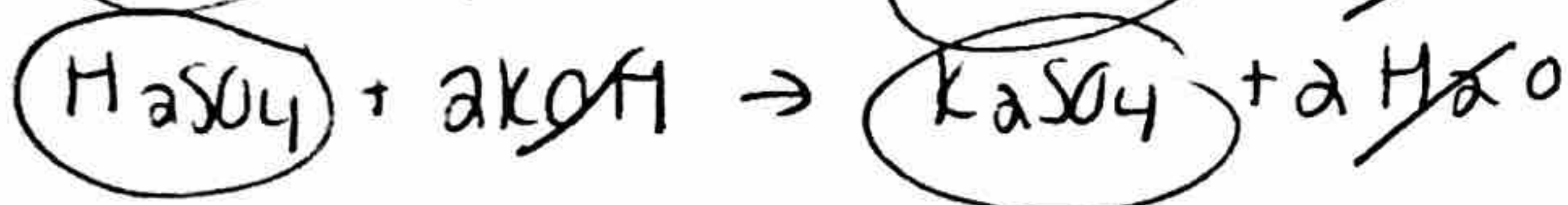
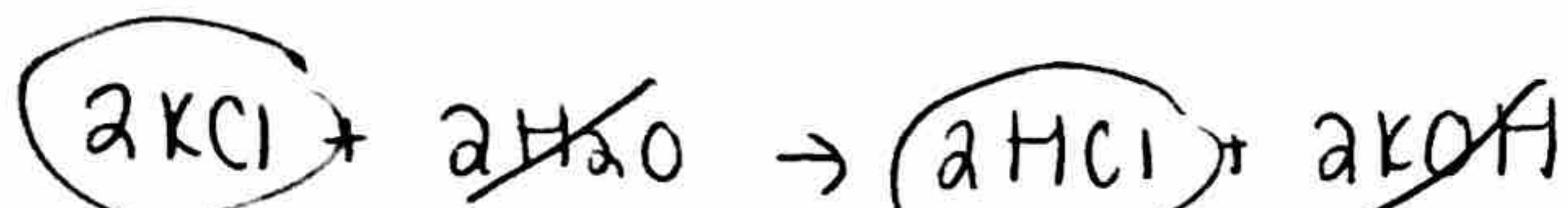


3. We can generate hydrogen chloride by heating a mixture of sulfuric acid and potassium chloride according to the following reaction:  $2KCl(s) + H_2SO_4(l) \rightarrow 2HCl(g) + K_2SO_4(s)$ . Calculate the change in enthalpy for this reaction from the following thermochemical equations. Give your answer in kJ. (64.8 kJ)

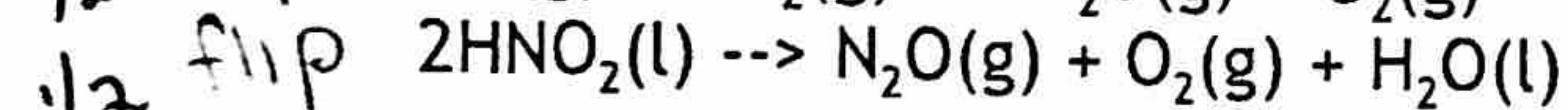
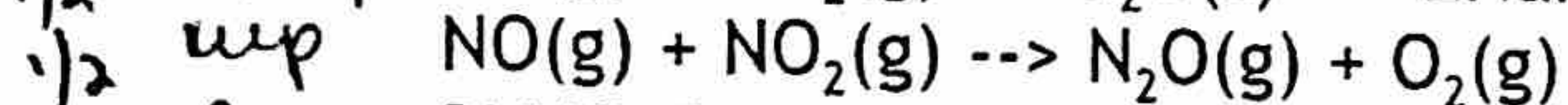
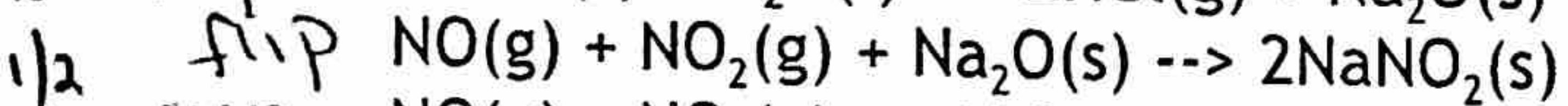
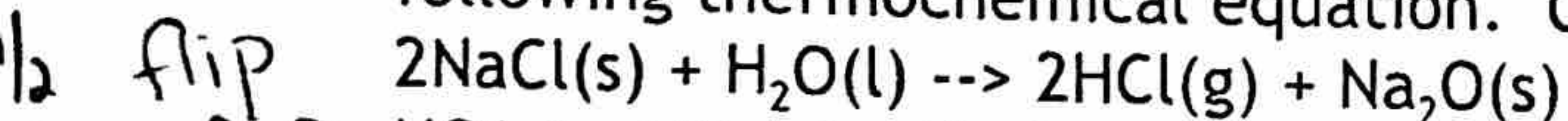


$\Delta H = -203.6 \text{ kJ}$

$\Delta H = -342.4 \text{ kJ}$



4. Calculate the change in enthalpy for the following reaction, which describes the preparation of an unstable, acid, HNO<sub>2</sub>, nitrous acid:  $HCl(g) + NaNO_2(s) \rightarrow HNO_2(l) + NaCl(s)$ . Use the following thermochemical equation. Calculate the answer in kJ (-78.60 kJ)



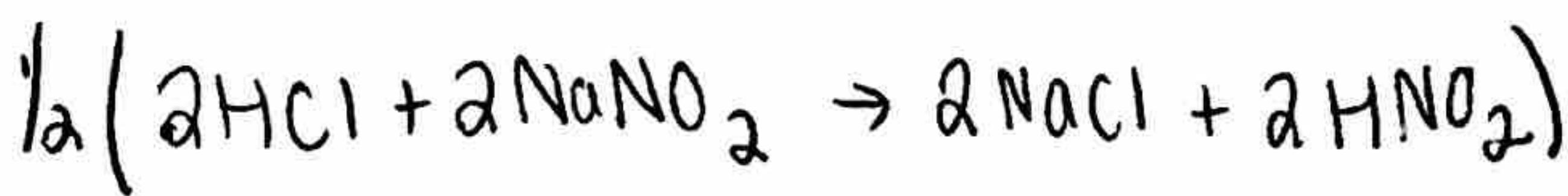
$\Delta H = +507.31 \text{ kJ} \rightarrow -507.31/2$

$\Delta H = -427.14 \text{ kJ} \rightarrow 427.14/2$

$\Delta H = -42.68 \text{ kJ} \rightarrow -42.68/2$

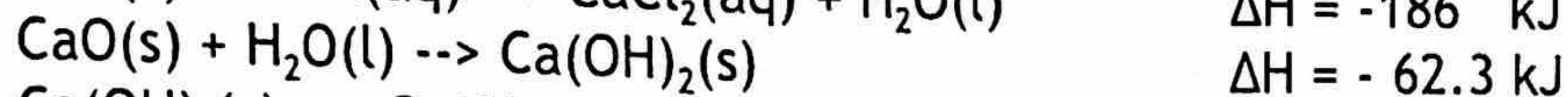
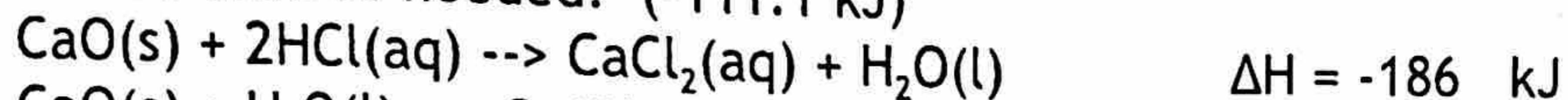
$\Delta H = +34.35 \text{ kJ} \rightarrow -34.35/2$

$\Delta H = -78.60 \text{ kJ}$

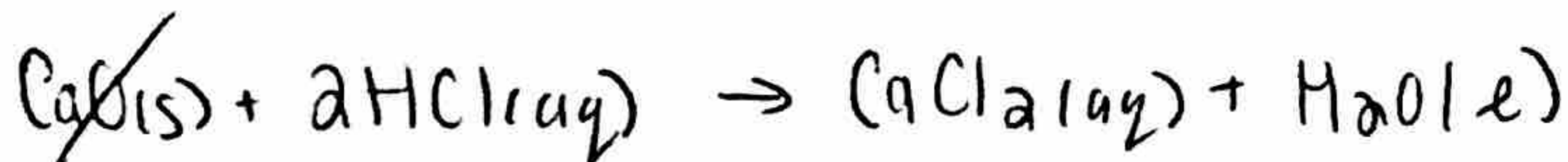




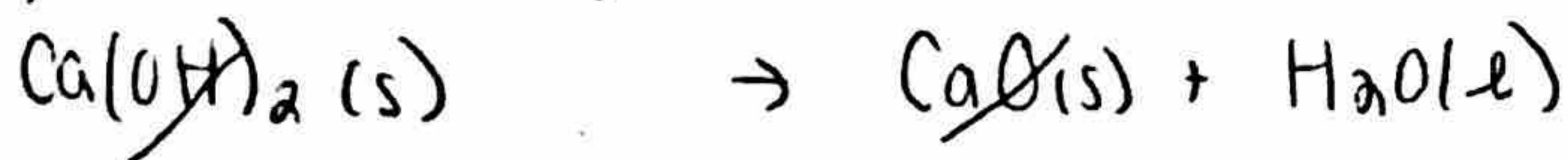
5. An aqueous solution of calcium hydroxide,  $\text{Ca(OH)}_2$ , is called limewater. It neutralizes hydrochloric acid,  $\text{HCl(aq)}$ , as follows:  $\text{Ca(OH)}_2(\text{aq}) + 2\text{HCl(aq)} \rightarrow \text{CaCl}_2(\text{aq}) + 2\text{H}_2\text{O(l)}$ . Calculate the change in enthalpy for this reaction. The following thermochemical equations can be used as needed. (-111.1 kJ)



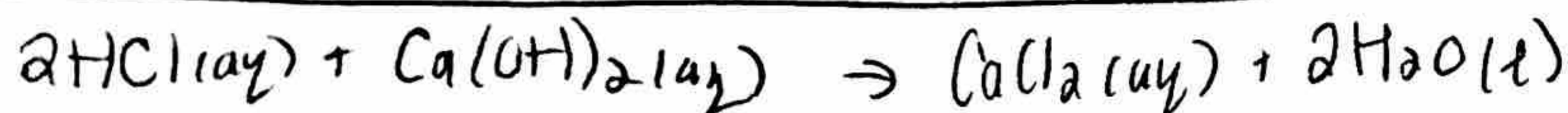
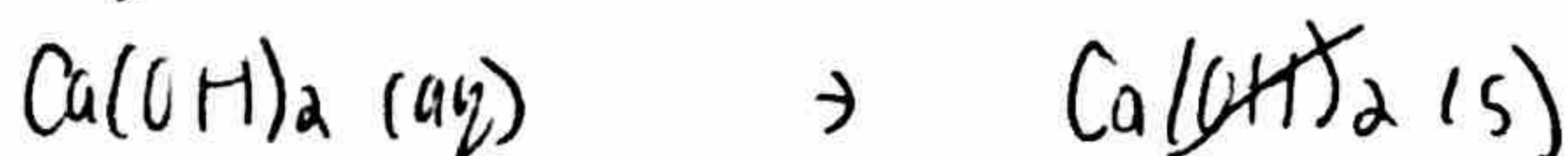
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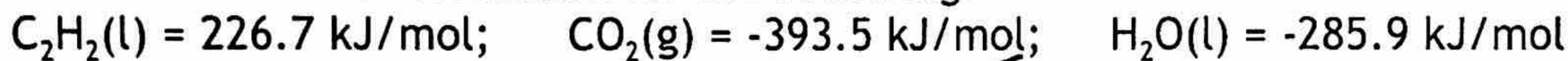
$$\Delta H = -186 + 62.3 + 12.6$$



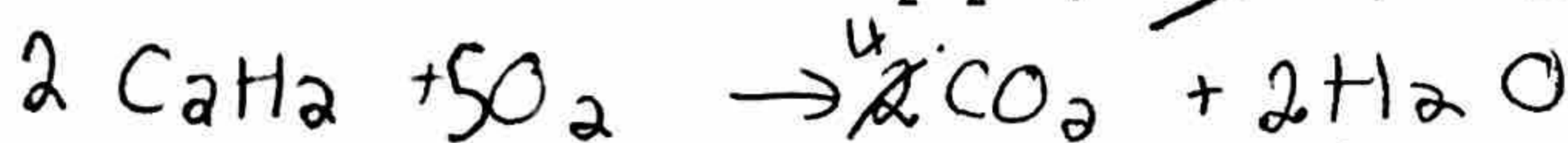
$$\Delta H = -111.1 \text{ kJ}$$



6. Given the heats of formation for the following:



Find the heat of combustion of  $\text{C}_2\text{H}_2$ . (-110.5 kJ)



$$\Delta H^\circ_{\text{rxn}} = \left( (4 \times -393.5) + (2 \times -285.9) \right) - \left( (2 \times 226.7) \right)$$

$$\Delta H^\circ_{\text{rxn}} = -2599 \text{ kJ/mol}$$

7. Calculate the change in enthalpy for each of the following reactions: (appendix four page A21 - A24) for  $\Delta H^\circ_f$  values



$$\Delta H^\circ_{\text{rxn}} = \left( \Delta H^\circ_f \text{NaCl} + \Delta H^\circ_f \text{H}_2\text{O} \right) - \left( \Delta H^\circ_f \text{HCl} + \Delta H^\circ_f \text{NaOH} \right)$$

$$\left( -411 + -286 \right) - \left( -92 + -427 \right)$$

$$\Delta H^\circ_{\text{rxn}} = -178 \text{ kJ}$$



$$\Delta H^\circ_{\text{rxn}} = \left( \Delta H^\circ_f \text{CO}_2 + \Delta H^\circ_f 2(\text{H}_2\text{O}) \right) - \left( \Delta H^\circ_f \text{CH}_4 \right)$$

$$\left( -393.5 + 2(-285.9) \right) - \left( -75 \right)$$

$$\Delta H^\circ_{\text{rxn}} = -890 \text{ kJ}$$