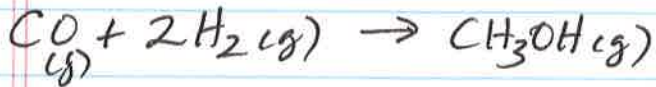
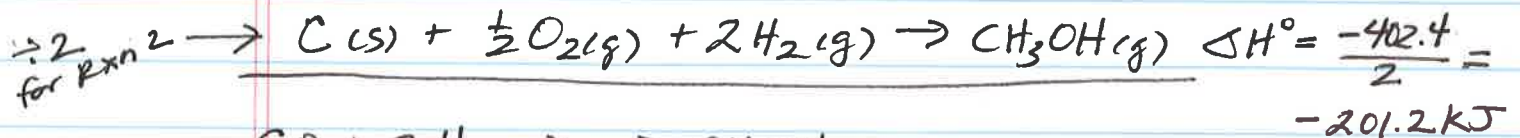
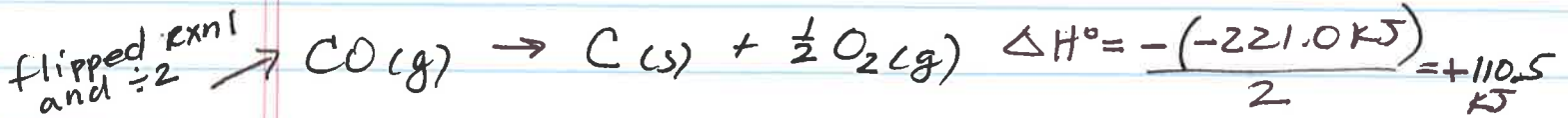


PS 4 Key

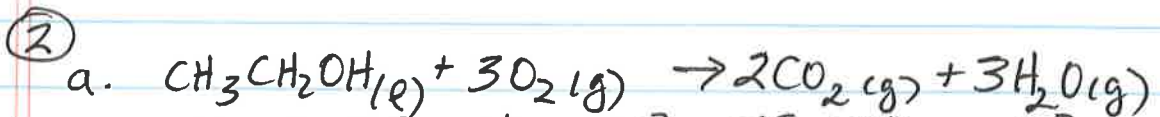


$\Delta H_{\text{rxn}}^\circ = +110.5 \text{ kJ} + (-201.2 \text{ kJ}) = -90.7 \text{ kJ}$

for forming 1 mole $\text{CH}_3\text{OH(g)}$

$100.0 \text{ g CH}_3\text{OH} \left(\frac{1 \text{ mol}}{32.042 \text{ g}} \right) = 3.1209 \text{ mol CH}_3\text{OH}$

$3.1209 \text{ mol} \left(\frac{-90.7 \text{ kJ}}{1 \text{ mol}} \right) = \boxed{-283.1 \text{ kJ released}}$



b. $\Delta H_{\text{rxn}}^\circ = \sum [n \Delta H_f^\circ (\text{prod.})] - \sum [n \Delta H_f^\circ (\text{react.})]$

Subst.	ΔH_f° (kJ/mol)
$\text{CO}_2\text{(g)}$	-393.5
$\text{H}_2\text{O(g)}$	-241.8
$\text{O}_2\text{(g)}$	0
$\text{CH}_3\text{CH}_2\text{OH(l)}$	-277.7

$\Delta H_{\text{rxn}}^\circ = [(2 \text{ mol})(-393.5 \frac{\text{kJ}}{\text{mol}}) + (3 \text{ mol})(-241.8 \frac{\text{kJ}}{\text{mol}})] - [(1 \text{ mol})(-277.7 \frac{\text{kJ}}{\text{mol}}) + 0]$

$\Delta H_{\text{rxn}}^\circ = -1512.4 \text{ kJ} - (-277.7 \text{ kJ})$

$\Delta H_{\text{rxn}}^\circ = -1234.7 \text{ kJ}$

$\Delta H^\circ < 0 \rightarrow$ Exothermic

③ a. $q_{\text{soda}} = m C_s \Delta T$ $m = (1.0 \text{ g/mL}) (350 \text{ mL}) = 350 \text{ g}$
 $q_{\text{soda}} = (350 \text{ g}) (4.184 \text{ J/g}^\circ\text{C}) (37.0 - 5.0^\circ\text{C})$ $T_i = 5.0^\circ\text{C}; T_f = 37.0^\circ\text{C}$
 $q_{\text{soda}} = +46861 \text{ J}$ $C_s = 4.184 \text{ J/g}^\circ\text{C}$
 $q_{\text{body}} = -q_{\text{soda}} \rightarrow q_{\text{body}} = -46861 \text{ J}$
 $q_{\text{body}} = -47 \text{ kJ}$ of energy expended

b. Add energy inputs and outputs with appropriate signs to find the overall heat input or output to the body.

$q_{\text{in}} = +1 \text{ Cal} = +4184 \text{ J}$
 $q_{\text{out}} = -46861 \text{ J}$ [from (a)]
 $q_{\text{total}} = 4184 \text{ J} + (-46861 \text{ J}) = -42677 \text{ J}$
 $= -10.2 \text{ Cal output}$ $= -43 \text{ kJ net output of energy}$

④ Refer to molar heat capacities, Table 9.3, p. ~~375~~ ³⁸⁵

Substance	C_m ($\text{J/mol}^\circ\text{C}$)
* Al(s)	24.2
Pb(s)	26.7
Air (g)	29.1
H ₂ O(l)	75.3

* Highest T_f

Heat capacity is a measure of how much heat it takes to raise the temp. of a substance by 1°C . Since Al(s) has the lowest heat capacity, its temperature will increase the most. You can also rationalize this from the equation $q = n C_m \Delta T \rightarrow \Delta T = \frac{q}{n C_m}$

For the same q and n , the substance with the smallest C_m will have the greatest change in temp.

$$⑤ -q_{\text{Cu}} = +q_{\text{H}_2\text{O}}$$

$$- [m_{\text{Cu}} C_{s,\text{Cu}} (T_f - T_{i,\text{Cu}})] = + [m_{\text{H}_2\text{O}} C_{s,\text{H}_2\text{O}} (T_f - T_{i,\text{H}_2\text{O}})]$$

$$- [(192\text{g})(0.385\text{J/g}\cdot^\circ\text{C})(T_f - 100^\circ\text{C})] = + [(751\text{g})(4.184\text{J/g}\cdot^\circ\text{C})(T_f - 40^\circ\text{C})]$$

$$-73.92 T_f + 7392 = 3142.184 T_f - 12568.7$$

$$19961 = 3216.1 T_f$$

$$6.2^\circ\text{C} = T_f$$

$$⑥ \text{ a. } q_{\text{rxn}} = -q_{\text{soln}}$$

$$q_{\text{rxn}} = - [m_{\text{soln}} C_{s,\text{soln}} \Delta T_{\text{soln}}] \quad m_{\text{soln}} = 106.5\text{g}$$

$$q_{\text{rxn}} = - [(106.5\text{g})(4.184\text{J/g}\cdot^\circ\text{C})(37.8^\circ\text{C} - 21.6^\circ\text{C})]$$

$$q_{\text{rxn}} = -7219\text{J} \left(\frac{1\text{kJ}}{1000\text{J}} \right) = -7.22\text{kJ}$$

Heat released.

$$\text{ b. } \Delta H_{\text{rxn}} = q_{\text{rxn}} @ \text{ const. } P$$

$$\Delta H_{\text{rxn}} = -7.22\text{kJ for } 6.50\text{g of NaOH reacted.}$$

$$\text{ Find } \Delta H \text{ in } \frac{\text{kJ}}{\text{mol NaOH}}$$

$$6.50\text{g} \left(\frac{1\text{mol NaOH}}{40.00\text{g}} \right) = 0.1625\text{mol NaOH}$$

$$\frac{-7.22\text{kJ}}{0.1625\text{mol}} = -44.4 \frac{\text{kJ}}{\text{mol NaOH}}$$