APPROACHING & DIAGNOSING PROBLEMS: CHEMISTRY

Stoichiometry & Thermodynamics

1. **Read** the question and **circle** any key words.

   ex. (bomb) calorimeter, heat of formation, closed system, energy, exothermic, fusion, temperature change, work

2. **Write** a *balanced* chemical equation where necessary (Include diagrams if applicable).
3. **Remove** significant values given by the question. Assign them each a variable. *

**Tip: Be as specific and organized as possible when there are multiple elements or energy transfers in question.*

4. **Convert** the given values to appropriate units of measurement.
5. **Define** the unknown variable and choose potential formula(s) that could be helpful.
6. **Evaluate** the selected formula(s) in relation to the key words and type of problem.
7. **Determine** any supplementary values that may be required for the formula.
8. **Apply** the formula to solve for the unknown variable. *

**Tip: Try to avoid substituting values for variables until the final step for greater precision*

9. **Evaluate** the calculated answer. Does it make logical sense based on the situation?

Quick Reference for Thermodynamic Question Diagnostic

Keyword	**Ask yourself…**	**Ask yourself…**	**Suggested Formula**
Initial/final temperature/specific heat capacity	Is the system is closed?	Is there one element in question?	$q= mc\Delta T$ $\Delta T=T_{final}-T_{intial}$
		Are there two elements in question?	$mc\Delta T + mc\Delta T= 0$
Fusion/fission/state change/total energy	Is there one element in question?	Is the system open?	$q_{total}= q_1+q_2+q_3…$
	Are there two elements in question?	Is the system is closed?	$q_1+q_2+…= 0$
Work/Transfer of energy	Is the reaction occurring under constant pressure?	Does it reference volume?	$W= -P \times \Delta V$
	Are there internal energy changes in system?	Does it reference heat?	$\Delta U= q+w$
Calorimetry/Enthalpy change	Does it mention constant pressure?	Is the reaction occurring in a coffee cup calorimeter?	$q_r + q_{solution}= 0$
	Does it mention constant volume?	Is the reaction occurring in a bomb calorimeter?	$q_r +q_{bomb}+q_{water}= 0$ $q_r +C_{water}\Delta T+mc\Delta T=0$
Enthalpy changes/ ($\Delta_r H°$)/ ($\Delta_f H°$)	Does it mention the enthalpy change for the reaction ($\Delta_r H°$)?	Is ($\Delta_r H°$) given?	Multiply $\Delta_r H°$ by mols OR Apply Hess' Law
		Does it reference enthalpies of formation ($\Delta_f H°$)?	$\Delta_r H°=\Sigma n\Delta_f H°$(products) - $\Sigma n\Delta_f H°$(reactants)