## AP Chemistry Exam Review

## Free Response Practice \#4

2016 \#2, shortened (5 points)

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\mathrm{NaHCO}_{3}(s)+\mathrm{HC}_{2} \mathrm{H}_{3} \mathrm{O}_{2}(a q) \rightarrow \mathrm{NaC}_{2} \mathrm{H}_{3} \mathrm{O}_{2}(a q)+\mathrm{H}_{2} \mathrm{O}(l)+\mathrm{CO}_{2}(g)
$$

A student designs an experiment to study the reaction between $\mathrm{NaHCO}_{3}$ and $\mathrm{HC}_{2} \mathrm{H}_{3} \mathrm{O}_{2}$. The reaction is represented by the equation above. The student places 2.24 g of $\mathrm{NaHCO}_{3}$ in a flask and adds 60.0 mL of $0.875 \mathrm{M} \mathrm{HC}_{2} \mathrm{H}_{3} \mathrm{O}_{2}$. The student observes the formation of bubbles and the flask gets cooler as the reaction proceeds.
a. Identify the reaction represented above as an acid-base reaction, precipitation reaction, or redox reaction. Justify your answer.
b. The student observes that the bubbling is rapid at the beginning of the reaction and gradually slows as the reaction continues. Explain this change in the reaction rate in terms of the collisions between reactant particles.
c. In thermodynamics terms, a reaction can be driven by enthalpy, entropy, or both.
i. Considering that the flask gets cooler as the reaction proceeds, what drives the chemical reaction between $\mathrm{NaHCO}_{3}(\mathrm{~s})$ and $\mathrm{HC}_{2} \mathrm{H}_{3} \mathrm{O}_{2}(\mathrm{aq})$ ? Answer by drawing a circle around one of the choices below.

$$
\text { Enthalpy only } \quad \text { Entropy only } \quad \text { Both enthalpy and entropy }
$$

ii. Justify your selection is part (d)(i) in terms of $\Delta \mathrm{G}^{\circ}$.

