1. The warm weather climates necessary for citrus orchards (like peaches) generally minimize the risk of frost conditions. Nevertheless, occasionally measures are needed to protect the trees and their fruit from freezing temperatures. Citrus crops become threatened when temperatures fall below 28°F for 4 hours or more.

Heating is the most effective protection against frost, and farmers often use heaters to warm the air temperature in the orchard. However, spraying the crops with water at conditions where freezing occurs also provides sufficient protection from the cold temperatures.

a. Using the following information, explain why spraying citrus crops with water at conditions where freezing occurs is successful for protecting the crops from cold temperatures.

- The pressure in the orchard is constant (i.e., assume that atmospheric pressure does not change during the spraying of water and the formation of frost).
- The enthalpy of fusion for water is equal to -6.01 kJ/mol.
- The temperature of the water that is sprayed is about 32°F (i.e., \( T_{\text{water}} \approx 32^\circ\text{F} \)).

b. Would spraying the crops with warm water (i.e., \( T_{\text{water}} > 32^\circ\text{F} \)) be a more effective or less effective way to protect the crops from cold temperatures? Why? *Hint: the heat capacity for liquid water at 20°C is 4.2 J g\(^{-1}\) K\(^{-1}\).*

2. Explain why the standard heat of fusion (\( \Delta H_{\text{fus}}^\circ \)) is less than the standard heat of vaporization (\( \Delta H_{\text{vap}}^\circ \)) for most substances.

3. Describe the difference between a “homolytic bond dissociation energy” and a “heterolytic bond dissociation energy”. In most cases, for a given type of chemical bond, the homolytic bond dissociation energy is less than the heterolytic bond dissociation energy. Explain.

4. One common definition of “buffer capacity” is the amount of acid or base needed to cause a change of one pH unit for 1.0 L of buffer solution. For a buffer solution prepared from acetic acid (CH\(_3\)COOH) and sodium acetate (CH\(_3\)COONa), how much would the concentrations of acetic acid and/or acetate ion have to change (i.e., as a result of added acid or base) in order for the pH of the buffer solution to change by one pH unit? Explain your reasoning.

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\text{CH}_3\text{COOH}(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{CH}_3\text{COO}^-(aq)
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