

3. Potassium sorbate, $\text{KC}_6\text{H}_7\text{O}_2$ (molar mass 150. g/mol) is commonly added to diet soft drinks as a preservative. A stock solution of $\text{KC}_6\text{H}_7\text{O}_2(aq)$ of known concentration must be prepared. A student titrates 45.00 mL of the stock solution with 1.25 M $\text{HCl}(aq)$ using both an indicator and a pH meter. The value of K_a for sorbic acid, $\text{HC}_6\text{H}_7\text{O}_2$, is 1.7×10^{-5} .

- (a) Write the net-ionic equation for the reaction between $\text{KC}_6\text{H}_7\text{O}_2(aq)$ and $\text{HCl}(aq)$.
- (b) A total of 29.95 mL of 1.25 M $\text{HCl}(aq)$ is required to reach the equivalence point. Calculate $[\text{KC}_6\text{H}_7\text{O}_2]$ in the stock solution.
- (c) The pH at the equivalence point of the titration is measured to be 2.54. Which of the following indicators would be the best choice for determining the end point of the titration? Justify your answer.

Indicator	$\text{p}K_a$
Phenolphthalein	9.3
Bromothymol blue	7.0
Methyl red	5.0
Thymol blue	2.0
Methyl violet	0.80

- (d) Calculate the pH at the half-equivalence point.
- (f) The pH of the soft drink is 3.37 after the addition of the $\text{KC}_6\text{H}_7\text{O}_2(aq)$. Which species, $\text{HC}_6\text{H}_7\text{O}_2$ or $\text{C}_6\text{H}_7\text{O}_2^-$, has a higher concentration in the soft drink? Justify your answer.