3. Potassium sorbate, $KC_6H_7O_2$ (molar mass 150. g/mol) is commonly added to diet soft drinks as a preservative. A stock solution of $KC_6H_7O_2(aq)$ of known concentration must be prepared. A student titrates 45.00 mL of the stock solution with 1.25 M HCl(aq) using both an indicator and a pH meter. The value of K_a for sorbic acid, $HC_6H_7O_2$, is 1.7×10^{-5}.

   (a) Write the net-ionic equation for the reaction between $KC_6H_7O_2(aq)$ and HCl(aq).

   (b) A total of 29.95 mL of 1.25 M HCl(aq) is required to reach the equivalence point. Calculate $[KC_6H_7O_2]$ 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	pK_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.

GO ON TO THE NEXT PAGE.

(e) The initial pH and the equivalence point are plotted on the graph below. Accurately sketch the titration curve on the graph below. Mark the position of the half-equivalence point on the curve with an X.

Volume of 1.25 M HCl Added (mL)
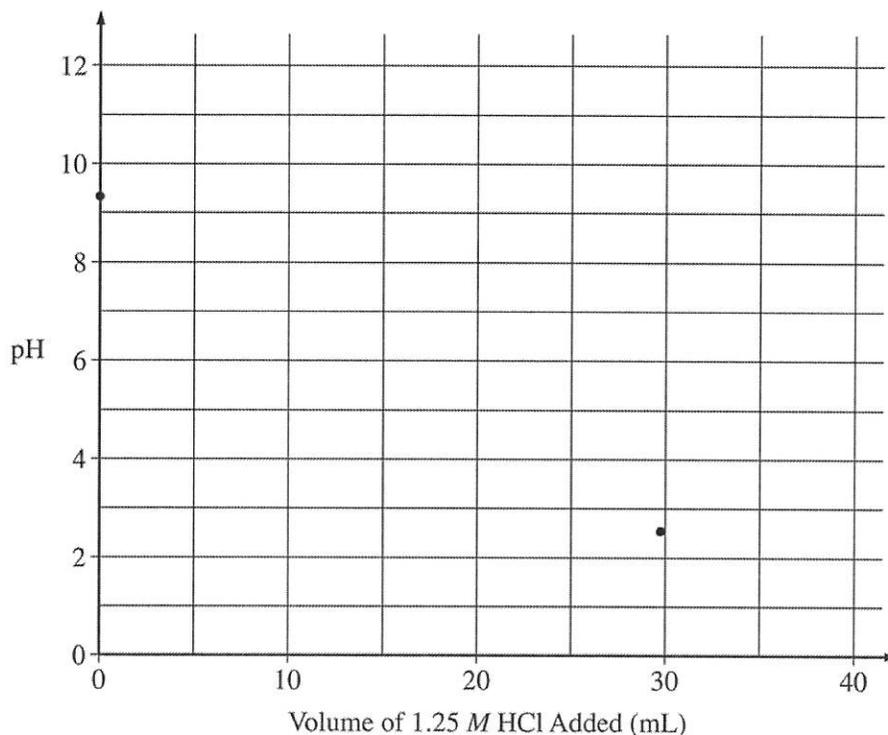
(f) The pH of the soft drink is 3.37 after the addition of the $KC_6H_7O_2(aq)$. Which species, $HC_6H_7O_2$ or $C_6H_7O_2^-$, has a higher concentration in the soft drink? Justify your answer.