CHM110H5F Midterm Exam 2 – Practice Exam

Question 1 – (10 Marks)

Consider the titration of 100.0 mL of 0.100 M acetic acid ($K_a = 1.8 \times 10^{-5}$). When 50.00 mL of 0.100 M NaOH is added to the acetic acid solution, calculate the pH of the resulting mixture. Use the simultaneous equations method, showing the derivation of the final equation you used to calculate pH and justify any assumptions made in your derivation.

$$AcOH = AH, AcO^- = A^-$$

Reaction Equations:

$$AH_{(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+{}_{(aq)} + A^-{}_{(aq)}$$

$$A^-{}_{(aq)} + H_2O_{(l)} \rightleftharpoons OH^-{}_{(aq)} + AH_{(aq)}$$

$$2\,H_2O_{(l)} \rightleftharpoons H_3O^+{}_{(aq)} + OH^-{}_{(aq)}$$

$$NaOH_{(aq)} \rightleftharpoons Na^+{}_{(aq)} + OH^-{}_{(aq)} \quad or \quad NaOH_{(aq)} \rightarrow Na^+{}_{(aq)} + OH^-{}_{(aq)}$$

Species of Interest:

$$H_3O^+, OH^-, AH, A^-, Na^+$$