

First Name _____ Last Name (Surname) _____

This exam is worth 100 points. There are five questions.

1. (20 points) Calculate the pH of 0.15 M NH_4Cl . The K_b for $\text{NH}_3 = 1.8 \times 10^{-5}$.

2. (20 points) Determine the pH of 1.30 M H_2SO_4 . The K_a values for H_2SO_4 are as follows:

$$K_{a1} = \text{large} \quad K_{a2} = 1.2 \times 10^{-2}$$

3. (20 points) Determine the pH of the solution that results from combining 40.0 mL of 2.00 M H_3PO_4 with 120.0 mL of 0.900 NaOH. The K_a values for H_3PO_4 are as follows:

$$K_{a1} = 7.5 \times 10^{-3} \quad K_{a2} = 6.2 \times 10^{-8} \quad K_{a3} = 4.8 \times 10^{-13}$$

4. (20 points) Determine the equilibrium concentration of H_2AsO_4^- in 0.0950 M NaH_2AsO_4 .

$$\text{For } \text{H}_3\text{AsO}_4: \text{p}K_{a1} = 2.55 \quad \text{p}K_{a2} = 6.77 \quad \text{p}K_{a3} = 11.60$$

5. (20 points) H_2In is an acid-base indicator with $\text{p}K_{a1} = 2.00$ and $\text{p}K_{a2} = 6.00$. H_2In is red, HIn^- is yellow, and In^{2-} is blue. Calculate the pH of 0.500 M $(\text{NH}_4)_2\text{In}$ and predict the color of the solution. (Note: NH_4^+ is colorless and has a $K_a = 5.6 \times 10^{-10}$.)