Inspect your final answer and indicate significant figures where appropriate - even if the problem does not involve solving for significant figures. If you run out of time, show how you would complete the problem - you will get partial credit. Use the reverse side of the paper if you need more space.

Q.1. (20 points) Mg(OH)\(_2\) is sparingly soluble in water at 25\(^{\circ}\) C and is a strong base. If you prepare a solution containing 4.0 \times 10^{-8} \text{ M Mg(OH)}\(_2\), what would be the pH and pMg of the solution? Note: you cannot ignore the dissociation of water.

Q.2. (20 points) Hydrocyanic acid (HCN) is a weak acid and is extremely toxic. The pK\(_a\) for HCN is 9.21. Answer the following:
   a) Calculate the pH of a 0.0100 M solution of HCN
   b) Write down the charge balance and mass balance equations for this solution.
   c) What would be the pH of a 4.0 \times 10^{-9} \text{ M solution of HCN}?

Q.3. (20 points) Explain or define the following. In your explanation or definition, be as precise as possible and include any appropriate equations
   a) The difference between the equivalence point and the end point in a titration
   b) How the adsorption indicator method works in the Fajans titration method for determination of Cl\(^-\) using AgNO\(_3\) as the titrant.
   c) Back titration
   d) Primary standard for a titration method

Q.4. (20 points) Which of the following solutions made by mixing the components listed are buffer solutions and which are not. Explain your reasoning.
   a) 0.005 M HCl/0.005 M NaCl
   b) 0.050M HOCl/0.050 M NaOCl
   c) 0.100 M CH\(_3\)COOH/0.050 M Na(CH\(_3\)COO)
   d) 0.100M benzoic acid/0.05 M HCl
   e) 0.100 M benzoic acid/0.050 M NaOH

Q.5. (20 points) A buffer solution is made starting with TRIS hydrochloride (pKa = 8.075). The buffer is made by adding 0.100 mol TRIS hydrochloride to water and then adding NaOH solid until the pH of the solution reached 8.300. The solution was then made up to 1.00 L. Answer the following:
   a) How many mol NaOH were added to the solution to give a pH of 8.300?
   b) What are the concentrations of TRIS and TRIS hydrochloride (TRISH\(^+\)) in the final buffer solution?
   c) If 1.0x10^{-3} \text{ mol HCl were added to 1.00 L of the buffer, what would be the change in pH?}