

Name: \_\_\_\_\_

Chem 2113

Test 2

Fall 2002

Questions are worth 25 points each. OMIT ONE QUESTION by clearly writing OMIT in the space provided for your work. If you fail to mark OMIT on a question I will omit the last question of the test. Show your work and circle your answers for full credit.

1. Calculate the pH of the following mixtures:

a) 20.0 mL of 0.150 M HBr mixed with 40.0 mL of water

1.30

b) 25.0 mL of 0.100 M HNO<sub>3</sub> mixed with 35.0 mL of 0.200 M NH<sub>3</sub>

9.50

c) 25.0 mL of 0.150 M HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> mixed with 30.0 mL of 0.125 M NaOH

8.80

d) 25.0 mL of 0.200 M H<sub>2</sub>C<sub>2</sub>O<sub>4</sub> mixed with 40.0 mL of 0.125 M NaOH

2.70

e) 20.0 mL of 0.186 M HClO<sub>4</sub> mixed with 30.0 mL of 0.124 M NaOH

7.00

2. Consider the titration of 50.0 mL of 0.10 M sodium chloroacetate with 0.10 M  $\text{HClO}_4$ . Calculate the pH of the solution at the following points along the titration curve:

a) Before any titrant is added;

7.91

b) After 15.0 mL of titrant is added;

3.19

c) After 25.0 mL of titrant is added;

2.82

d) After 50.0 mL of titrant is added;

2.10 (and NOT 2.06!)

e) After 60.0 mL of titrant is added.

2.04

3. Consider the titration of 25.0 mL of 0.20 M malic acid with 0.20 M NaOH. Calculate the pH of the solution at the following points along the titration curve:

a) Before any titrant is added;

2.05

b) After 12.5 mL of titrant is added;

3.40

c) After 25.0 mL of titrant is added;

4.22

d) After 37.5 mL of titrant is added;

5.05

e) After 50.0 mL of titrant is added.

8.94

4. A sample is analyzed for protein content using the Kjeldahl method. A 2.18 g sample of the sample was analyzed, with the products of the digestion of the sample being distilled into 100.0 mL of 0.0341 M HCl. The excess HCl was back titrated with 17.24 mL of 0.114 M NaOH. Assuming a gravimetric factor of 6.25 for the protein relative to the nitrogen content (which translates to 16.0% nitrogen in the protein), calculate the percent protein in the sample.

5.80% protein

5. Consider a mixture that may contain NaOH (39.997), Na<sub>2</sub>CO<sub>3</sub> (105.989) and NaHCO<sub>3</sub> (84.007). a 4.376 g sample of an unknown was dissolved and diluted to 500.0 mL. A 125.0 mL aliquot of this solution titrated to a phenolphthalein endpoint, which required 46.76 mL of titrant. A second 50.00 mL aliquot was titrated to a bromocresol green endpoint with 37.41 mL of the titrant. If the acid was 0.1016 M, determine the identity of the active component(s), and calculate the percentage (of each) present in the original mixture.

Only sodium carbonate is present.

The unknown is 46.03% sodium carbonate by mass.