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Name_____

Boning Up on Calcium

Pre-Lab Questions

Read the background information and answer the following questions.

1. Name three reasons why calcium is an essential element for good nutrition and good health.

2. What features of the EDTA molecule allow it to form stable complexes with metal ions?

3. Describe in general terms how a microscale titration reaction is carried out.

4. (a) What is the purpose of adding sodium hydroxide to milk for the EDTA titration of calcium ion?

   (b) Describe the safety hazards and precautions associated with the use of NaOH solution.

5. What method is used to determine when all of the calcium in milk has been used up in its reaction with added EDTA?

Materials

Calcium chloride solution, $CaCl_2$, 0.05 M, 1 mL
Ethylenediaminetetraacetic acid, disodium salt solution (EDTA), 0.04 M, 5–10 mL
Hydroxynaphthol blue (HNB), 0.2 g
Skim milk, 5 mL
Sodium hydroxide solution, NaOH, 6 M, 2 mL
Beakers or small test tubes, 5
Beral-type pipets, graduated, 5
Distilled water
Microscale reaction plate, 24-well
Spatula, micro
Toothpicks, 5
White paper

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Data Table. *Microscale Titration*

Reaction Well	**1**	**2**	**3**	**4**	**5**
Solution	**Control** *Distilled Water*	**Test Sample A** *Skim Milk*	**Test Sample B** *Skim Milk*	**Test Sample C** *Skim Milk*	**Reference** $CaCl_2$
Initial color with HNB indicator					
Number of drops of EDTA added					
Corrected volume of EDTA	NA				
Millimoles of calcium	NA				
Milligrams of calcium	NA				

Calculations

Show work below and record the results in the Data Table.

1. For each sample in wells 2–5, subtract the number of drops of EDTA added to the control solution from the number of drops of EDTA added to each test or reference solution, respectively. This is the "corrected volume of EDTA" required to titrate the calcium in each test or reference sample.

2. Use the following equation to calculate the number of millimoles of calcium ion present in each of the test and reference solutions, respectively. The equation assumes that 25 drops of EDTA solution are equal to 1 mL.

$$\left[\begin{array}{c}\text{Millimoles}\\ \text{of calcium}\end{array}\right] = \left[\begin{array}{c}\text{Corrected volume}\\ \text{of EDTA added}\\ \text{(drops)}\end{array}\right] \times \left[\frac{1\ \text{mL}}{25\ \text{drops}}\right] \times \left[\begin{array}{c}\text{Molarity of EDTA}\\ \text{(millimoles/mL)}\end{array}\right]$$

3. Use the atomic mass of calcium to calculate the number of milligrams of calcium present in each of the test and reference solutions, respectively. (*Hint:* The units for atomic mass are grams per mole, which can also be expressed as milligrams per millimole).

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Post-Lab Questions

1. Based on the results for the number of milligrams of calcium in 1 mL of each of the milk test solutions A, B, C, calculate the amount of calcium in milligrams that would be present in 1 cup (240 mL) of skim milk. Report both the individual values for the three samples and the mean (average value).

2. Calculate the individual deviations from the mean amount of calcium for each test sample: A, B, C. Average these individual deviations to determine the average deviation also.

3. Report the amount of calcium in 1 cup of milk in the following form:

   (mean) ± (average deviation). Don't forget the units and the number of significant figures.

4. The average deviation is an indicator of the precision of an experimental procedure. Comment on the precision of your experimental results.

5. The federal government has set a Recommended Daily Allowance (RDA) for calcium of 1200 mg per day for adolescents and young adults. Based on your results, what percent of the daily requirement would one cup of milk provide? Compare this result with the value reported on the nutritional label for the carton of skim milk.

6. The accuracy of an experimental procedure is determined by comparing the results obtained versus an actual or known value for a reference sample. The amount of calcium in the reference solution (0.050 *M* $CaCl_2$) is 2.0 mg per mL. Comment on the accuracy of this method for determining the amount of calcium in a sample.

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