# Experiment 8. Dilution

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**Abstract**:

For this experiment, the goal was to find the the concentration of dilute sodium hydroxide and dilute potassium permanganate. The methods used to find the concentration is $M_cV_c=M_dV_d$ , where $M_c$ is the concentration of the concentrated solution and the absorbance A in Beer's law ( A= a b c). The result of the experiment should produce the $M_c$ of the sodium hydroxide and the A of the potassium permanganate.

**Introduction**:

In this experiment, sodium hydroxide and potassium permanganate will be diluted then their concentration will be sought after. To find the concentration of sodium hydroxide and potassium permanganate, $M_cV_c=M_dV_d$ and Beer's law must be used. $M_cV_c=M_dV_d$ is calculated to find the change in concentration of a solution. This can be used also to find the concentration of a concentrated solution. Beer's law is used to find the absorbance of a dilute colored solution at a particular wavelength of light. Absorbance is found using the formula A= abc, where A is Absorbance, a is the molar absorptivity, b is the path length in centimeters that the light has to to travel to get through the sample, and c is the molar concentration of the sample. Using the data that is obtained into the formulas, the goal of the experiment to find the concentration of the diluted sodium hydroxide and diluted potassium permanganate can be reached.

**Materials**:

- 1mL glass pipette
- 5 mL glass pipette
- 10 mL graduated cylinder
- 100 mL graduated cylinder
- Spectrometer
- Medium test tubes
- Test tube rack
- Labeling tape
- pH meter

**Methods**:

1. Cleaned test tubes, placed on rack and labeled each with labeling tape

2. Obtained the appropriate amount of NaOH (2.5mL) for the 1st test tube using the 5 mL glass pipette
3. Measured the appropriate amount of water (22.5 mL) needed for the first trial using the graduated cylinder, then placed in the test tube
4. Placed NaOH in the same test tube and mixed carefully
5. Repeated the same steps using the appropriate amount of NaOH and water for each test tubes
6. Set up the pH meter then used it to find the pH level in each test tube
7. Recorded pH levels into lab notebook
8. Obtained the appropriate amount of $KMnO_4$ (2.5 mL) for the 1st test tube using the 5 mL glass pipette
9. Measured the appropriate amount of water (22.5 mL) needed for the first trial using the 25 mL graduated cylinder, then placed in the test tube
10. Placed the $KMnO_4$ into the same test tube and mixed carefully
11. Repeated the same steps using the appropriate amount of $KMnO_4$ and water for each test tubes
12. Set up the spectrometer and had it calibrated
13. Then used it to find the absorbance of the test tubes and recorded the data into the lab notebook
14. Emptied all test tube into waste container provided by instructor and cleaned all test tubes out with water

**Results**:

| $M_c$(M) | $V_c$(mL) | $V_w$(mL) | $V_d$(mL) | $M_d$(M) |
|---|---|---|---|---|
| 0.020M | 2.5 | 22.5 | 25 | 0.002 |
| 0.002M | 1 | 9 | 10 | 0.0002 |
| 0.0002M | 5 | 5 | 10 | 0.0001 |
| 0.0001M | 5 | 5 | 10 | 0.00005 |

| $M_c$(M) | $V_c$(mL) | $V_w$(mL) | $V_d$(mL) | $M_d$(M) | Absorbance |
|---|---|---|---|---|---|
| 0.020M | 2.5 | 22.5 | 25 | 0.002 | 1.899 |
| 0.002M | 1 | 9 | 10 | 0.0002 | 0.349 |
| 0.0002M | 5 | 5 | 10 | 0.0001 | 0.213 |
| 0.0001M | 5 | 5 | 10 | 0.00005 | 0.110 |

**Calculations**:

A=abc    $1.899/((2.24*10^3)(1cm)) = c$    0.00085= c

**Discussion**:

      The results of the experiment should have produced the concentration of the dilute sodium hydroxide and the dilute potassium permanganate. The results that were obtained after the first second and third trial for the sodium hydroxide was 13.93 pH for the first, 12.91 pH for the second, and 12.85 pH for the third. The results obtained for the absorbance in potassium permanganate was 1.899 for the first trial, 0.349 for the second trial, 0.213 for the third trial, and 0.110 for the fourth trial.Then with the numbers obtained for absorbance, concentration could be found using Beer's law (A= abc). The concentration for the first trial was 0.00085, 0.00016 for the second trial, 0.00010 for the third trial, and 0.00004 for the fourth trial. A possible sources of error could have been adding too much or too little of the acid or water when making the dilute sodium hydroxide and dilute potassium permanganate. This could produce an invalid concentration because then the solution would not be diluted correctly. Another source of error could have occurred if the spectrometer wasn't calibrated before testing for the absorbance. This would then show invalid measurements for the absorbance for each trial.

**Conclusion**:

      In conclusion of the experiment, $M_cV_c=M_dV_d$ and Beer's law did produce the concentration of the dilute sodium hydroxide and potassium permanganate. Using the spectrometer found the pH level of the sodium hydrozide and then it found the absorbance of the potassium permanganate, which was later plugged into Beer's law to find the concentration by dividing absorbance by molar absorptivity times path length. An error that might have occurred during the experiment was the spectrometer wasn't calibrated when testing for the absorbance. This can be avoided by waiting the 90 seconds for the lamp to heat in the spectrometer when attempting to calibrate instead of not waiting.