Polarimetry

1 Objective

Study the phenomenon of optical rotation caused by different concentrations of glucose solutions.

2 Prelab Questions

1. What is light polarisation?
2. Provide a brief explanation of optical activity, listing examples of optically active media.
3. What is meant by *chiral* molecules?

3 Principles

Light from a light source with a discrete spectrum is directed towards a polariser. The light is then passed through an optically active medium where its plane of polarisation undergoes rotation and is analysed.

4 Apparatus

- Polarimeter.

- Sugar (glucose).
- Distilled water.
- Scales.
- Various beakers.

5 Precautions

1. Be careful not to spill the solution onto the equipment.
2. The end plates (small glass inserts) for the cell (glass tube) are *very* sensitive and should be handled with care.

6 Experimental Steps

6.1 Measuring θ_0 for distilled water:

1. Carefully remove the cell from the Polarimeter.
2. Wash the cell carefully and dry it completely.
3. Fill the cell with distilled water, keeping it vertical, and cap it off using the end plate.
4. Carefully fit the tube back into the Polarimeter, and switch on the light source.
5. Look through the telescope and observe the resultant shape.
6. Rotate the analyser until you can observe a clear silhoutte to determine θ_0.

6.2 Preparing the glucose solution:

1. For a 60% concentration, weigh 60g of sugar using the scales.
2. Using a beaker, measure 100ml of distilled water.
3. Pour the sugar into the water and mix it very well, making sure that it dissolves completely.

6.3 Measuring θ for the 60% glucose solution:

1. Carefully remove the cell from the Polarimeter.
2. Empty the cell into the sink and fill it up with the 60% solution, capping it off using the end plates.
3. Carefully fit the tube back into the Polarimeter.
4. Look through the telescope and observe the resultant shape.
5. Rotate the analyser until you can observe a clear silhoutte to determine θ_{60}.

6.4 Measuring θ for different concentrations:

1. Dilute the solution using the description in the subsection [6.5] below to obtain a different concentration.
2. Calculate θ for the new concentration using the same steps as above.
3. Repeat the process several times, calculating θ for a concentration of: 50%, 40%, 30%, 20% and 10%.

6.5 Diluting X% solutions:

1. Using the general equation of dilution, calculate V_f for the desired concentration:

$$V_i C_i = V_f C_f \tag{1}$$

   Where V_i and C_i are the initial volume and concentration respectively, and V_f and C_f are the final volume and desired concentration after dilution.

2. Using the value of V_f, subtract V_i to obtain ΔV.
3. Measure a quantity of distilled water equivalent to ΔV and pour that into your initial solution.
4. Mix the resultant mixture well to incorporate ΔV into V_i. The solution you created now is of concentration C_f.

7 Evaluation

1. Plot the concentration C onto the x-axis and the angle of rotation θ on the y-axis.
2. Using the slope of the resultant line, calculate the specific rotation of glucose using the equation:

$$S = \frac{10}{L} \times \frac{\theta}{C} \tag{2}$$

Where L is the length of the cell.