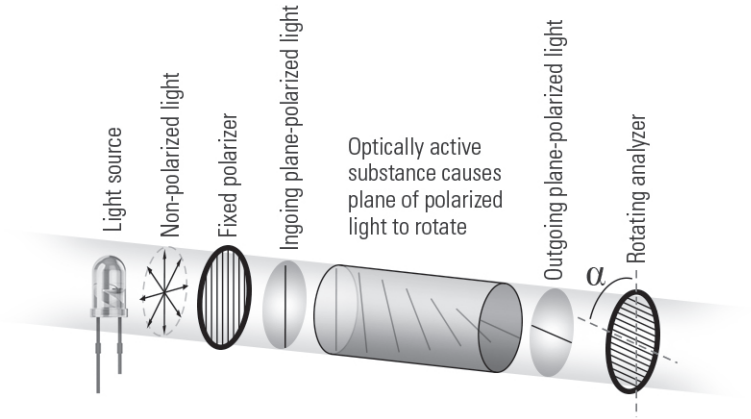
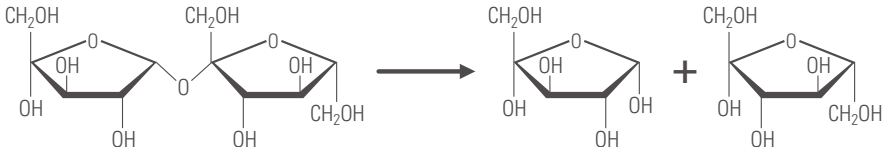
PASCO

Determine Concentration
THROUGH POLARIMETRY

A polarimeter is a scientific instrument used to measure the angle of rotation caused by passing polarized light through an optically active substance. As shown in the diagram, incoming non-polarized light is transmitted through a fixed polarizer that has thin slits in it. Only a certain orientation of light can pass through the very thin slits in the polarizer and enter the sample. As light is passed through the sample it is rotated at a unique angle. As the user rotates the analyzer, the light passing through the sample has a maximum intensity at a specific angle.





The angle of rotation for Glucose is 52.7° and for Fructose it is -92.0°. Dextro enantiomers rotate the plane of polarized light clockwise as seen by the detector. If an enantiomer rotates the plane counter-clockwise, it is considered to be levo. Glucose and Fructose are optically active molecules. They are enantiomers, which are molecules which lack symmetry and have a non-superimosable mirror image.

About one quarter of all prescription drugs are a mixture of enantiomers. The orientation of a molecule around the chiral center can have a significant effect on the way the drug is metabolized. For example, the drug Thalidomide was prescribed in the 50's and 60's as a suppressant to morning sickness. Even though the drug was tested, babies were born with severe birth defects due to the drug. The levo enantiomer caused birth defects and the dextro relieved morning sickness. After learning the lesson from this tragedy, laws surrounding new drugs became more stringent and now chiral synthesis and purification are a part of drug manufacturing.

Biot's Law: $$\alpha_{(standard)} = \frac{\alpha_{(observed)}}{l \times c}$$

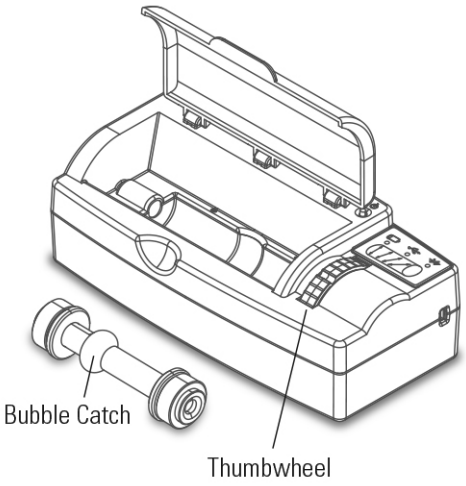
Biot's law is used to determine the specific rotation of the sample.
A compound will always have the same specific rotation under identical experimental conditions.

$\alpha_{(standard)}$ is the accepted value for the specific rotation in units of degrees.
The formal unit for specific rotation is degrees mL dm^{-1} g^{-1}, but scientific literature uses degrees.

$\alpha_{(observed)}$ is the measured optical rotation in units of degrees.

l is the length of the cell in units of dm. The cell that you will be using is 1 dm in length.

c is the sample concentration in units of grams per milliliter.



Objectives

- Become familiar with the use of the Polarimeter
- Calculate the concentration of known sugar samples using Biot's law

Materials

- Data Collection Device
- Polarimeter
- Polarimeter sample cell
- 50 mL volumetric flasks
- 10 mL graduated cylinder
- 50 mL beaker
- 10% D-Glucose
- 20% D-Glucose
- 30% D-Glucose

Procedure / Determining Concentration

1. Prepare 10 mL samples of 10%, 20%, and 30% solutions of D-Glucose in water.
2. Fill the cell with 10ml of distilled deionized water and place it into the polarimeter. Tilt the cell so that any remaining bubbles are caught in the Bubble Catch, which is the fat part of the cell.
3. Open the file named Polarimeter Introduction.
4. Start recording data. It is important to collect data for the peak closest to zero. Move the analyzer by rotating the wheel so that the peak closest to zero is collected. Make at least one complete cycle.
5. Stop recording data. Determine the angle where the intensity is at its maximum and record it in Data Table 1.
6. Fill the cell with 10ml of the 10% D-Glucose solution and place it into the polarimeter.
7. Start recording data and move the wheel as before.

Tables + Calculations

D-Glucose known value = 52.7°

Substance	Rotation (degrees)
Water (Reference)	
10% D-Glucose	
20% D-Glucose	
30% D-Glucose	

DATA TABLE 1

1. In order to use Biot's Law, the angle of rotation for the reference must be subtracted from the measured value for the D-Glucose solutions. Place the difference in the values in the chart below.

Substance	Difference from Reference (degrees)
Water (Reference)	
10% D-Glucose	
20% D-Glucose	
30% D-Glucose	

2. Use Biot's Law to determine the concentration in g/ml for each of the samples and place the values in the table below.

Substance	Concentration (g/mL)
10% D-Glucose	
20% D-Glucose	
30% D-Glucose	

3. How do your calculated values compare with the known values of 10%, 20% and 30%?