Measuring the optical rotation of the plane of polarisation of light using optically active liquids

Apparatus

A simple polarimeter can be made using copper or plastic pipe 20 cm long and about 2 cm internal diameter. The pipe must be sealed at both ends using transparent windows made from microscope slides and glued in place using Araldite. Two, approximately 1 cm, holes need to be drilled in the one side of the tube, **see figure 1**, to enable solutions to be poured into the pipe and removed from it.

Also required:

Two Polaroid squares, 25 mm x 25 mm, act as the polariser (A) and analyser (B) respectively as shown in **figure 1**.

A colour filter to limit the light source to one colour or the Photonics Explorer laser.

A sugar solution concentration in the range from 0.2 to 0.8 kg per litre. This gives a good range for the angle of rotation. 10g in 100ml gives ~ 12° rotation of the plane of polarisation of the light.



Light detector

**Figure 1**

Theory

For a given wavelength of light, the relationship between angle of rotation (θ), the concentration of the solution (c), the length of the copper pipe (l) and the specific rotation for the solution (α) is given by:

Θ = α c l

With no solution in the pipe rotate B until the light intensity transmitted through A, the copper pipe and B is a minimum. If a laser is used, the beam must not be viewed directly. Use a ground glass screen or similar, or a light detector. Guidance on using lasers safely is given on the SSERC website: http://www.sserc.org.uk/images/Bulletins/231/Laser\_Guidance.pdf

Pour a known concentration of sugar solution into the tube and measure the angle through which Polaroid sheet B must be rotated to return to minimum transmission for the light through B.

Repeat for different concentrations of solution.

Plot an appropriate graph.

Other possible investigations:

* Repeat with a different optically active solution, for example fructose, glucose, maple syrup, corn syrup.
* Repeat using a different wavelength of light.
* Change the length of optically active solution the light passes through by changing the length of the pipe.