

Predicting molecular shape, bond angles and polarity

Chemistry grades 11-12 (A Level · IB · Class 11-12) · Lab

Name: _____ Date: _____ Class: _____

Can you tell whether a liquid is polar without any instrument but a plastic rod? In this lab you bend thin streams of five liquids with a charged rod and link the size of the deflection to molecular shape and bond polarity.

Level: Chemistry grades 11-12 (A Level · IB · Class 11-12) · **Curriculum:** IB S2.2

Aim

To compare the polarity of five liquids by measuring how far a thin stream of each is bent by a charged rod.

Equipment

- Burette (50 cm³) with a clamp and stand
- Beaker to catch the liquid
- Plastic rod and a dry cloth
- Ruler
- Water, ethanol, propanone, hexane and cyclohexane, 15 cm³ of each
- Safety goggles

Safety

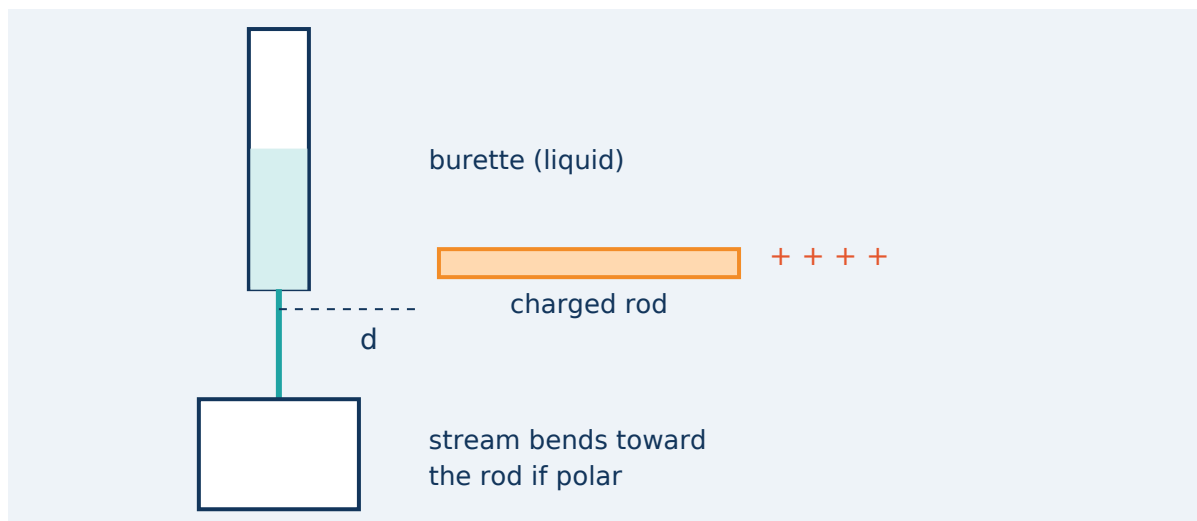
Safety

Propanone, hexane, cyclohexane and ethanol are highly flammable and their vapours are harmful: no flames or sparks, work in a ventilated area, wear goggles and keep the containers closed. Do not pour liquids down the sink.

Method

1. Clamp the burette above the beaker and fill it with the first liquid.
2. Rub the plastic rod hard with the cloth to charge it.
3. Open the tap to give a thin, steady stream and hold the rod beside the stream about 3 cm below the tap.
4. Measure with the ruler how far the stream moves sideways, d, in cm. Repeat three times.

5. Rinse the burette with a little of the next liquid and repeat for each liquid.



A thin stream of liquid is bent by a charged rod if its molecules are polar. The distance d is measured.

Results

Kofi in Accra recorded the sideways movement d of the stream (cm).

Liquid	Trial 1	Trial 2	Trial 3	Mean d / cm
Water	1.4	1.5	1.6	1.50
Propanone	1.5	1.7	1.6	1.60
Ethanol	1.0	1.2	1.1	1.10
Hexane	0.0	0.0	0.1	0.03
Cyclohexane	0.0	0.1	0.0	0.03

Analysis questions

Question 1 Mean for water

Calculate the mean deflection of water and the range of its three results.

Question 2 Classifying the liquids

Use 0.5 cm as the dividing line. Classify each liquid as polar or non-polar from the means.

Question 3 Why a polar stream is deflected

Explain, using partial charges, why a stream of polar molecules is attracted toward a charged rod.

Question 4 Shape of water

Draw (describe) the shape of the H_2O molecule and explain why it is polar.

Question 5 Hexane

Hexane has C-H bonds that are slightly polar. Explain why hexane is not deflected.

Question 6 Ethanol compared with water

Ethanol is deflected less than water. Suggest two reasons, and say how far the data justify a ranking.

Question 7 Controlling variables

State three variables that must be kept constant for a fair comparison.

Question 8 Improvement

Suggest one improvement that would make the measurement of d more reliable.