Demonstration to investigate polarity in various liquids.

Theory

The hydrogen molecule, $\text{H}_2$, is formed from identical atoms and there is equal sharing of the bond pair of electrons between both atoms. Other molecules such as $\text{F}_2$ and $\text{Cl}_2$ are similar, and these molecules are referred to as being non-polar covalent. However, most covalent bonds are polar, due to an uneven distribution of charge caused by one atom attracting the bonding electrons more strongly than the other. This is the case in the hydrogen chloride molecule, $\text{H} – \text{Cl}$, where the chlorine atom has a stronger attraction for the bond pair of electrons than the hydrogen atom. The chlorine atom develops a partial negative charge, represented by $\delta^-$, while the hydrogen develops a partial positive charge, represented by $\delta^+$.

\[
\begin{align*}
\delta^+ & \quad \delta^- \\
\text{H} & \quad \text{Cl}
\end{align*}
\]

If a liquid contains molecules that exhibit polarity, a steady flow from a burette containing the liquid should be attracted to a charged polythene (or similar insulator) rod, resulting in the flow bending.

Chemicals

Water
Cyclohexane
Methylbenzene
Methanol
Ethanol
Propan-2-ol
Ethanal
Methanoic acid
Ethanoic acid
Propanone
Ethyl ethanoate
If available, a chlorinated alkane such as 2-chloro-2-methyl propane.
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Apparatus

50 or 25 cm$^3$ burettes
Polythene (or similar insulator) rod
Dry cloth
Funnel
100 cm$^3$ beakers
250 cm$^3$ beaker
Retort stand

Procedure

1. Add 20 cm$^3$ of the liquid under investigation to the clamped burette.
2. Place the 250 cm$^3$ beaker under the jet.
3. Charge the polythene rod with the cloth by rubbing it.
4. Open the burette tap.
5. Bring the charged rod within 3 cm of the liquid stream.
6. Note any observation in the table below.
7. Repeat the procedure for the other liquids.

Results

<table>
<thead>
<tr>
<th>LIQUID NAME</th>
<th>BENDING YES/NO</th>
<th>POLAR OR NON-POLAR</th>
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Teacher Material

1. Since these liquids are to be reused in this demonstration yearly, it might be worthwhile keeping a small quantity of each liquid in labelled reagent bottles for this sole purpose. The advantages are that the liquid does not have to be returned to stock with the fear of possible contamination nor does one have to consider disposal procedures. **However from the safety aspect it is recommended good practice to dispose of such chemicals after 3 years. This disposal can be carried out following the procedure outlined in “Safety in the School Laboratory” (The Green Book).**

2. About 20 cm³ of each liquid is sufficient in the burette.

3. Use a separate burette set-up for each liquid under investigation. A selection of about 4 liquids should be adequate.

4. The cloth and rod must be perfectly dry to ensure a build-up of static charge.

Preparation of reagents

None

Procedure hazard notes

- Wear safety coat and glasses.
- Use a funnel and avoid spillage when filling the burette.
- Use a fume cupboard if disposing of liquids.
Waste disposal

<table>
<thead>
<tr>
<th>LIQUID NAME</th>
<th>WASTE DISPOSAL</th>
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<tbody>
<tr>
<td>Water</td>
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<tr>
<td>2-chloro-2-methyl propane</td>
<td>A small quantity (10 cm³) may be emulsified with detergent and flushed to foul water drain.</td>
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<tr>
<td>Cyclohexane</td>
<td>Small amounts (20 cm³) may be evaporated in a fume cupboard.</td>
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<tr>
<td>Methylbenzene</td>
<td>Small amounts (50 cm³) may be evaporated in a fume cupboard.</td>
</tr>
<tr>
<td>Methanol</td>
<td>Add a small quantity (50 cm³) to water (1 litre) and flush to foul water drain.</td>
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<tr>
<td>Ethanol</td>
<td>Add a small quantity (50 cm³) to water (1 litre) and flush to foul water drain.</td>
</tr>
<tr>
<td>Propan-2-ol</td>
<td>Add a small quantity (50 cm³) to water (3 litres) and flush to foul water drain.</td>
</tr>
<tr>
<td>Ethanal</td>
<td>Small amounts (50 cm³) may be evaporated in a fume cupboard.</td>
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<tr>
<td>Methanoic acid</td>
<td>Add dropwise to water (250 cm³ to 10 litres water) and wash to foul water drain. Use fume cupboard.</td>
</tr>
<tr>
<td>Ethanoic acid</td>
<td>Add dropwise to water (250 cm³ to 10 litres water) and wash to foul water drain. Use fume cupboard.</td>
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<tr>
<td>Propanone</td>
<td>May be flushed to foul water drain with large volumes of water.</td>
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<tr>
<td>Ethyl ethanoate</td>
<td>Small amounts may be evaporated in a fume cupboard. Toxic by inhalation.</td>
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