The effect of hydrogen bonding on resisting flow

THE EFFECT OF HYDROGEN BONDING ON RESISTING FLOW Design Investigating a factor affecting the viscosity of a mixture of liquid Research Question The effect of hydrogen bonding on resisting flow of five different liquids Background Theory Viscosity is the resistance of a fluid to flow, either within itself, or to moving past an objects moving through it. A liquid with high viscosity is thick and flows slowly. A liquid with a low viscosity is thin and flows quickly. Different liquids have different viscosities.

Factors, which affect viscosity of a liquid, are: Size of a molecule: Spherical molecules provide less resistance therefore less viscosity compared to oval shaped or disc-like molecule which provide a greater resistance in the flow of liquid. The more spherical molecule is, the lower the viscosity of a liquid. Temperature: When a solid or liquid is heated, most of the bonds are being broken between particles. In viscosity, the bonds are closer together and they resists the flow, so when the liquid is heated, the bonds are being broken.

The liquids with broken bonds flow faster than before. Intermolecular force: There are three types of intermolecular force between molecules: Hydrogen bonding, van der Waal’s forces and permanent dipole force. Hydrogen bonding is the strongest bond and also has the highest attraction in terms of intermolecular forces. The attraction between molecules is high; the viscosity of a liquid is high. In this investigation, the purpose is to compare the viscosities of five different liquids and to interpret the results in terms of hydrogen bonding.

Controlled experiment: In this experiment there should be only one variable, which is varied. In this investigation, the varied variable is five different liquids. To make the experiment as accurate and reliable as possible the following will be done: The volume of liquid used will be kept constant. The liquid will be measured accurately using a marked line on the side of the beaker. The stopwatch will be used to measure how long it takes for the marble to sink.

The whole experiment will be repeated and the results will be recorded into a table, from the recordings of the time taken an average will be calculated. Hypothesis The liquids, which have more hydrogen bonding will have higher viscosity and flow slowly. Test a liquid’s viscosity by timing how long it takes for the marble to sink. Variables 1. Independent variable - The different liquids, which refer to the different number of hydrogen bonding. 2. Dependent variable - The time that marbles takes to sink in each of the liquids. . Controlled variables | Variable controlled | Why it needs to be controlled | How it will be controlled | | Room temperature | The lower the temperature, the higher the viscosity. | Use an AC or thermometer, set the same | | | Therefore, room temperature can affect the viscosity | temperature in every time you drop the marble. | | | and the time marble sinks. | | Volume of liquid | The more volume the liquid contained, the faster the | Use a ruler, every liquid in a beaker should be | | | marble sinks. | in the same height. | | | | Use a marked line on the side of the beaker to | | | | measure the same volume. | Materials Chemicals and Formula | Glassware | Equipment | | | | | | Water | H2O | 5 tall-form glass beaker (100cm3) | Disposable gloves | | Octane | C8H18 | | Safety spectacles | | Ethanol | C2H5OH | | 5 marbles | |

Glycerin | C3H5 (OH) 3 | | Stopwatch | | Fructose | C6H12O6 | | Ruler | |(Use Honey) | | | | Risk Assessments Chemical | Hazards/Risks | Precautions | First Aid | Disposal | | Octane | Eye irritation. Skin | Wear safety spectacles| Eye contact: Immediately flush eye with | Chemical waste generators must | | | irritation. Ingestion. | and gloves. | running water for at least 15 minutes, keeping| determine whether a discarded | | | Inhalation. | Keep away from heat, | eyelids open. | chemical is classified as a | | | | sparks and flame. | Skin contact: Wash immediately with water and | hazardous waste. Moreover, waste| | | | | non-abrasive soap. generators must consult state | | | | | Inhalation: Allow victim rest in a | and local hazardous waste | | | | well-ventilated area. Seek for medical | regulations to ensure complete | | | | attention. | and accurate classification. | | | | Ingestion: Loosen tight clothing. If not | | | | | | breathing, perform mouth-to-mouth | | | | | resuscitation.

Seek immediately medical | | | | | attention. | | | Ethanol | Eye irritation. | Wear safety spectacles| Eye contact: Lift eyelids and flush | Chemical waste generators must | | | Skin irritation. | and gloves. | continuously with water. | determine whether a discarded | | | Ingestion | Keep away from heat, | Skin Contact: Get medical aid. Wash clothing | chemical is classified as a | | | (gastrointestinal | sparks and flame. | before reuse. Flush skin with plenty of soap | hazardous waste. Moreover, waste| | | irritation). | | and water. generators must consult state | | | Inhalation (cause nervous| | Ingestion: If victim is conscious and alert, | and local hazardous waste | | | system). Chronic Exposure| | give 2-4 cupfuls of milk or water. Never give | regulations to ensure complete | | |(cause reproductive and | | anything by mouth to an

unconscious person. | and accurate classification. | | | fetal effects) | | Get medical aid. | | | | | Inhalation: Remove from exposure and move to | | | | | fresh air immediately.

If not breathing, give | | | | | artificial respiration. If breathing is | | | | | difficult, give oxygen. Get medical aid. Do | | | | | NOT use mouth-to-mouth resuscitation. | | | Glycerin | Slightly hazardous in | Wear safety spectacles| Eye contact: Lift eyelids and flush | Waste must be disposed of in | | | case of skin contact, of | and gloves. | continuously with water. accordance with federal, state | | | eye contact, of | Keep away from heat, | Skin Contact: Wash with soap and water. Cover | and local environmental control | | | ingestion, of inhalation. | sparks and flame. Keep| the irritated skin with an emollient. Get | regulations. | | | away from | medical attention if irritation develops. | | | | incompatibles such as | Inhalation: remove to fresh air. If not | | | | | oxidizing agents. | breathing, give artificial respiration.

If | | | | | breathing is difficult, give oxygen. | | | | | Ingestion: Do NOT induce vomiting unless | | | | | directed to do so by medical personnel. Loosen| | | | | tight clothing. Get medical attention if | | | | | symptoms appear. | | Method 1.

In each of five beakers, put about 95cm3 of water, octane, ethanol, glycerin and fructose (we use honey in this experiment). 2. Use a ruler, measure about 2cm over the beaker. 3. Slowly drop a marble in water. 4. Record the exact time the marble takes to sink. 5. Do the same procedure with other liquids (octane, ethanol glycerin and fructose) and record the exact time it takes for marble to sink. 6. After recording the length of the marble takes to

sink the first time, takes the marble out of the beaker. 7. Full fill each beaker until they reach 95cm3 with the same liquid. 8. Repeat the procedure 4 times. Uncertainties | Common errors in data collection and | Reasons for making errors | How to minimize? | processing | | | | Incomplete definition | Measurement is not always clearly defined and | Carefully consider and specify the | | | therefore, affects the precision of the measurements. | conditions that could affect the | | | | measurement. | | Environment factor | Introduced by immediate working environment. | See controlled variable above. | | Instrument resolution | Finite precision of instruments can limit the ability | Null difference method. | | | to resolve small measurement differences. | | Parallax | Occur when there is some distance between measuring | Carefully read the measuring scale. Be | | | scale. | aware that it might be too high or too | | | | low. | Estimating uncertainty in repeated measurements: Whenever possible, repeat a measurement several times and average the results. This average is the best way to reduce uncertainty of the measurements. The more repetitions you make of a measurement, the better this estimate will be.