

Chemical reactions of alkanes and alkenes

Purpose: 1) to demonstrate that different classes of organic molecules undergo different characteristic reactions, 2) To compare the reactivity of a single bond vs. a double bond.

- ▽ Cyclohexane, cyclohexene, and bromine are pungent and toxic. Proper ventilation is necessary. Handle these chemicals, as much as possible, directly under the fume hood. Thus, when you need to add chemicals to cyclohexane and cyclohexene leave the test tubes under the fume hood and get the necessary chemical(s) from the front of the room. Return chemicals immediately after use so that other students will not have to look around for them.
- ▽ These chemicals can stain clothing & skin. If you get any chemicals on your skin wash with soap & water.
- ▽ At the end of the lab all chemicals should be placed in the organic waste container provided.

Procedure:

1. Get a 50 mL beaker and an eyedropper (note: this eyedropper is only to be used for dispensing distilled water). Add some distilled water to the beaker.
2. Get 8 test tubes with stoppers from the front of the room: 4 containing cyclohexane and 4 containing cyclohexene. Be careful not to mix up the tubes since the entire lab hinges on comparing the reactions of cyclohexane versus cyclohexene. Place the tubes in a test tube rack. Using tape and a ballpoint pen label the tubes ANE1, ANE2, ANE3, ANE4, ENE1, ENE2, ENE3, and ENE4.
3. Place 10 drops of distilled water in ANE1 and 10 drops of distilled water in ENE1. Stopper and shake each. Record the solubility of the chemicals in water (as soluble or insoluble) in the chart below. Take note of where the water phase is (top vs. bottom) and where the cyclohexene phase is.
4. Add 10 drops of distilled H₂O to both ANE2 and ENE2. Have your instructor add 3 drops of concentrated H₂SO₄. Stopper and shake. Record your observations in the chart.
5. Add 10 drops of bromine water, Br₂(aq), to ANE3 and to ENE3. Stopper and shake (for about 15 seconds). Record the colour of the Br₂(aq) before and after.
6. To ANE4 and ENE4 add 5 drops of KMnO₄(aq). Stopper and shake. Allow the reaction to proceed for approximately 15 seconds. Record the colour of the KMnO₄(aq) before and after it was added.
7. Dump all reagents into the organic waste container at the front of the room. Place tape in the trash.
8. Wash all test tubes following this procedure: 1) Add cleaning solution to each tube. Stopper and shake tubes for 30 seconds. Dump the used solution into the organic waste container at the front of the room. 2) Add cleaning solution to the test tubes. Return to your lab station to clean the tubes with a small test tube brush. This time, dump the used solution down the drain. Rinse the tubes well with tap water. Shake water out of test tubes and return all equipment (test tube racks go back to your lab station).

	Cyclohexane	Cyclohexene
1. Polarity (polar or non-polar)	Non-polar	Non-polar
2. Physical properties	Colourless liquid (b.p. 81°C)	Colourless liquid (b.p. 83°C)
3. Solubility in H ₂ O (soluble or insoluble)		
4. Reaction with H ₂ SO ₄ and H ₂ O		
5. Br ₂ (aq) colour before adding		
Br ₂ (aq) colour after shaking		
6. KMnO ₄ (aq) before adding		
KMnO ₄ (aq) after shaking		

Questions: Read "Properties of Alkenes and Alkynes" on pages 548 – 550.

1. Hydrocarbons are only held together by weak London forces. This results in them having _____ solubility in water, and _____ boiling and melting points. (Place "high" or "low" in blank spaces.)
2. In simple terms, what is the difference between "saturated" and "unsaturated" hydrocarbons.
3. Draw structural diagrams for cyclohexane & cyclohexene. Which is saturated? Which is unsaturated?
4. Based on your observations, was it alkanes or alkenes that were generally nonreactive (did not react with Br₂, KMnO₄, etc.). Which group, alkanes or alkenes, is most reactive?
5. a) What colour is Br₂? b) What kind of reaction occurs when Br₂ and cyclohexene are mixed (choose either "addition" or "substitution")? c) The reaction of ethene is shown in the textbook. Draw the reaction that cyclohexene underwent (keep in mind that when Br₂ adds to the molecule all but one of the bonds in a multiple bond will be broken. In other words, the ring structure is left intact). d) Why did the orange colour disappear when Br₂ was added to cyclohexene? e) Which would discolour more Br₂: one mole of ethene or one mole of ethyne?