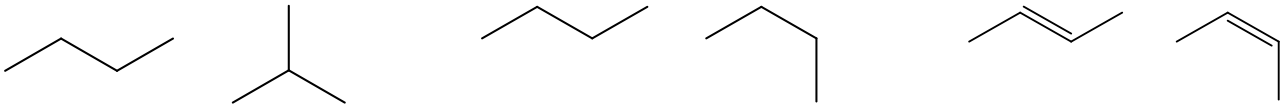
# CHEM1102 Worksheet 2: Isomerism and Reactions

## Model 1: Isomerism

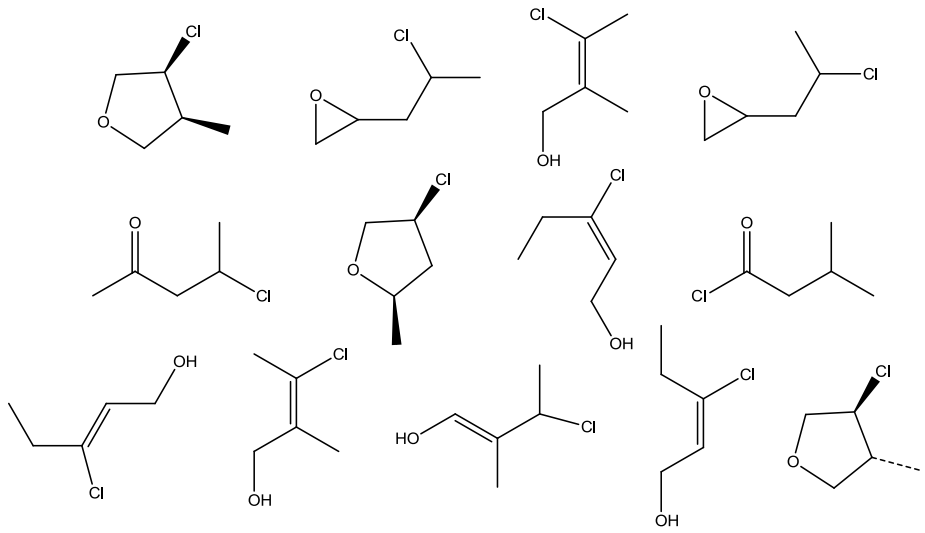
There are three broad classes of isomers.



Constitutional Conformational Configurational

- **Constitutional** isomers have the same formula but different connectivity.
- **Conformational** isomers differ only by rotation about a single bond. They interconvert freely at all but extremely low temperatures (ie they are identical).
- **Configurational** isomers (**Stereoisomers**) have the same connectivity but cannot be interconverted through single bond rotation. Bond breaking and bond formation are required for interconversion.

Here are some molecules all with the formula $C_5H_9ClO$




## Critical thinking questions

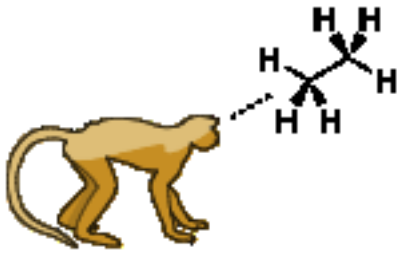
1. Circle at least 7 constitutional isomers

2. Identify and *draw* two pairs of conformational isomers

3. Identify and *draw* three pairs of configurational isomers. Assign them as *E*/*Z* or *cis*/*trans*.

4. **Extension:** How many different functional groups can you identify?

5. To understand conformers, it helps to look at the molecule from different angles. Imagine you (or in this case, a monkey) were looking at ethane along the central C-C bond:



Sketch what you would see. By doing this explain what you think might be meant by the term *staggered conformation*.

6. Can you draw a conformation of ethane that might be higher in energy? What might you call this?

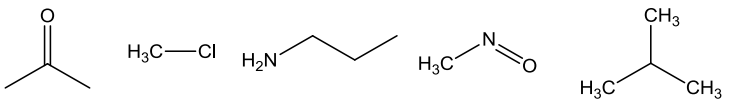
These drawings of molecules obtained by looking along the bonds like this are called *Newman projections*.

## Model 2: Polar Reactions

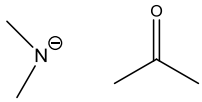
In many covalent bonds, the electrons are not distributed evenly due differences in the electronegativity of the two atoms involved. We use partial charges ($\delta^+$, $\delta^-$) to denote the resultant polarisation of the bond.

## Critical thinking questions

1. Determine the partial charges on the following molecules. In each case, do you expect the polarization effect to be large or small?



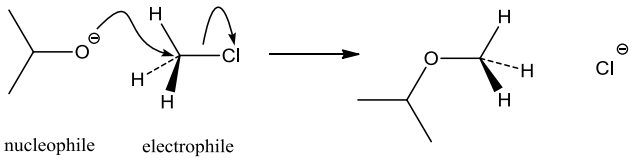

2. We know that there is an attractive force between positively and negatively charged objects. With this in mind, it would seem sensible that the negatively charged nitrogen below would react with the slightly positive carbon of the carbonyl.



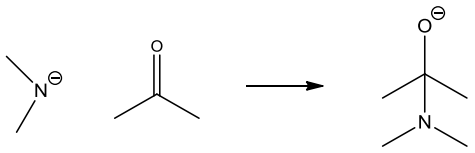

We know from Worksheet 1 that carbon typically forms four bonds. If we form a new bond between the nitrogen and the carbonyl carbon what else needs to happen?

3. Which bond most is likely to break and why?

Chemists use "curly arrows" to track the movement of electrons in a reaction. Convention has it that the arrow starts at the source of the electrons (a lone pair or a bond) and finishes where the electrons end up (in a bond or as a lone pair on an atom).




4. Try using curly arrows to describe the movement of electrons in Q2.



This is an example of a polar reaction, the most common type of reaction in organic chemistry (and the only kind you will see this year). Polar reactions always involve the interaction between an electron rich component (**nucleophile**) and an electron deficient component (**electrophile**).

5. Identify the electrophile and the nucleophile in two schemes above.

*If you can identify the potential electrophiles and nucleophiles in a reaction, you can almost always work out what the outcome of the reaction should be. No memorization required!*

## Exercises

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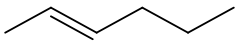
- Consider the compound **J** below.



**J**

What is the systematic name for compound **J**. **Marks**

**1**

Draw a constitutional isomer of **J**.

**1**

Draw a configurational isomer of **J**.

**1**

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- Complete the following mechanism by adding curly arrows to illustrate the bonding changes that take place. **Marks 2**