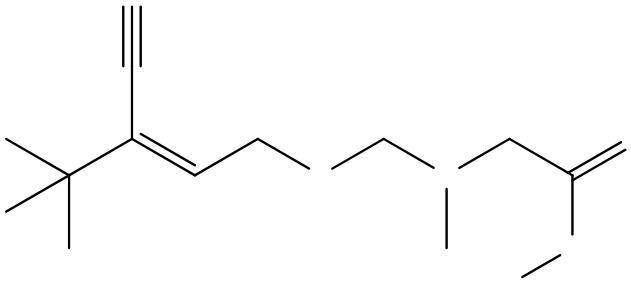
Lesson 2 For Organic Chemistry

Revision Exercise and Extra Knowledge --- For Hybridization Theory and Resonance Concept

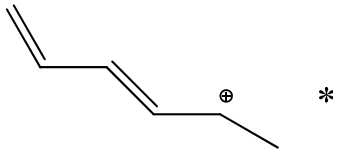
1. Please state the hybridization state of all the atoms with a *.



Hint : There are ___ lone pair electrons left on the oxygen atoms and also ___ on the nitrogen atom.

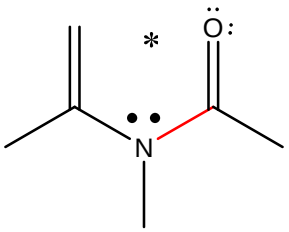
2. Please draw the resonance structures for the following species and answer the questions.

a)



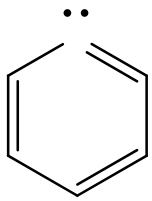
Qu: Which of the carbon atom (s) doesn't carry a positive charge? ___ , ___ and ___

b)



Qu : Can the amide bond in red be rotated easily? ___. It is because it bears _____ bond character.

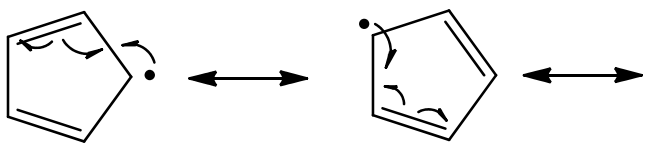
c)



. It is called **pyridine**, which is a b_____.

As you should know, resonance structures can be drawn for those c_____ systems in neutral state, positively or negatively charged state. This resonance effect can stabilize the compounds in terms of e_____ aspect. Actually, a 'radical' species can also be stabilized by resonance.

e.g

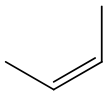


Isomerism

Isomers are those compounds with the same molecular formula but different structures in space. Generally, all atoms in different isomers have the _____ bonding connectivity. Isomersim is a complicated topic; but we only need to focus on the **geometrical isomerism** and **stereoisomerism** only.

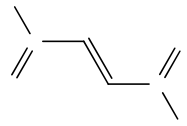
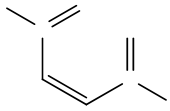
1. Geometrical Isomerism

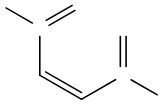
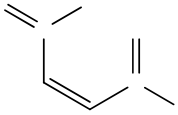
Most importantly, we need to differentiate the two forms of geometrical isomers : ___ and _____.

For example,  is called ____ but-2-ene;  is called _____ but-2-ene. Also, you should know that the cis isomer can be made into trans isomer by **breaking and reforming** the ___ bonds, or vice versa. (HKAL 2009-2010)

Simply speaking, geometrical isomers have the ____ chemical properties. However, when we compare some physical properties such as melting point/ boiling point, they **may not** be the same.

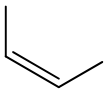
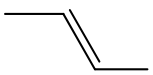
Illustration 1: Comparison of boiling point

Explain the fact that  has a **higher** boiling point than  ?

→ Note that  is the same as  . _____molecular hydrogen bonds are formed. In other words, the chance for the cis form to form _____molecular hydrogen bonds d_____. For the trans-form, there are **extensive** formation of _____molecular hydrogen bonds. Hence, the result follows.

→ How about their difference in **acidity**?

Illustration 2 : Comparison of boiling point

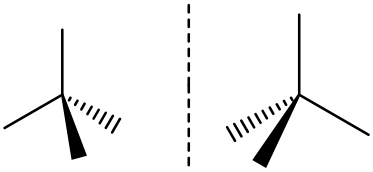
Explain the fact that  has a **higher** boiling point than  ?

→ The main difference between the cis/trans isomers in this case is their **polarity**. Cis-isomer has a **permanant** dipole moment and hence it is a p_____ molecule. However, the trans form is not polar because there is a **cancellation** of dipole moment. Thus, there are _____-_____ interactions between cis form molecules and more energy is required to separate the stronger interaction to boil it.

→ How about their **melting point**?

2. Enantiometric Isomerism

It is talking about the relationship between a compound (molecule) and its mirror image. What is called mirror image? Actually, every compounds has its mirror image. It can be drawn by a simple **reflection** as :



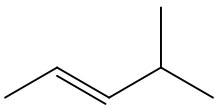
. But, if the compound is enantiomeric, the compound should be imsuper_____ to its mirror image.

Usually, if a tetrahedral atom (sp^3 hybridized) has ___ different bonding groups, the molecule formed will likely be enantiomeric. It is because the molecule contains a c_____ centre. But you should be careful that when the compound contains **more than 1** chiral _____, it may **not** be a chiral molecule anymore. So, the presence of chiral centre(s) is **not** an absolute indication for the occurrence of enantiomerism. A compound ___ be chiral if it contains even **no** chiral centre. However, a simple rule can be stated as :

Enantiomerism occurs when a compound cannot super_____ on its mirror image.

Exercise For Isomerism

a) Please draw the **isomers** for the following compounds.



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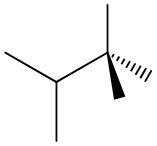
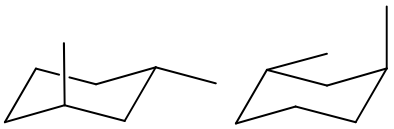
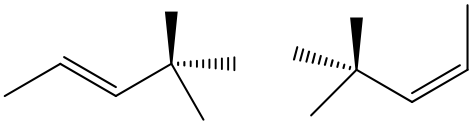


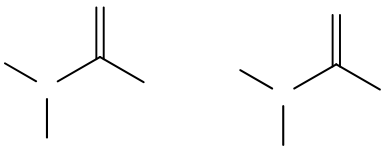
b) Please state the relationship (Identical, geometric or enantiomer) between the following pairs of compounds.



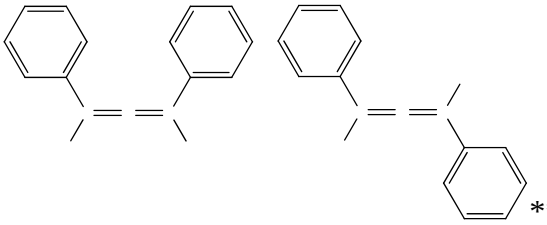
_____;



_____



They are the _____ after a simple r_____. They are called **rotamer**.



** _____ as there is **no internal plane of symmetry**.

2. Enantiometric Isomerism

Regarding the pair of enantiomer, they should have the _____ **physical** properties except for the direction of rotation of the plane of polarized light. It is because they have the **opposite optical activity**. The ability to interact with the plane polarized light is called _____ activity.

→ A **chiral** and **non-racemic** compound can rotate the plane of polarized light since they have optical activity. But for a pair of enantiomer, they will have the o_____ optical activity.

→ If we mix a **1:1** ratio of enantiomer, the solution formed will show ___ optical activity. This solution is called racemic mixture, which is an important term in the organic chemistry later.

→ The racemate (= _____ mixture) may have **different** values In terms of boiling point/melting point from those of a **single** enantiomer.

Just to mention, enantiomers also have the _____ **chemical** properties, except when interacting with another c____ compounds. (Like some enzymatic reactions happen in our body)

Important Terms For Organic Chemistry

1. Acid and Base : Organic compounds can be an acid (a _____ donor) or a base (a proton a_____).

→ The reaction between an acid and a base is called A____ B_____ reaction.

→ This concept leads to the comparison of Acidity and Basicity.

2. Nucleophiles and Electrophiles : Nucleophiles are those compounds which are **nucleus loving**. They usually bear lone pair of electrons and _____ charged; Electrophiles are those compounds which are **electron loving.** They usually are _____-deficient.

→ The reaction between a nucleophile and an electrophile is called I_____ reaction.

→ This concept leads to the comparison of Nucleophilicity and Electrophilicity.

3. Intermediate : A s_____ lived and very un_____ species that form along the reaction pathway. Usually, in HKAL, we should be familiar with the c_____ intermediate.

→ Note that intermediate is **not** the same as t_____ state.

4. Stability : It is the term relating to the energy of the species. If the species has a _____ energy, it is said to be relatively s_____.

5. Electron-donating and Electron-withdrawing groups : Electron-donating groups are those group which can _____ electrons; Electron-withdrawing groups are those which can _____ electrons.

→ This concept leads to the Inductive effect (through space) and Resonance effect (more powerful).

6. Reaction mechanism : It is the detailed and step-by-step description of the pathway by which reactants are converted to _____. (Frequently asked)