Polypropylene:



Is the above notation representative of the structure? Or can the methyl group be located at another position? Radical (electron deficient species) forms at most highly substituted carbon (most alkyl groups) due to **inductive electron donating effect** 



<u>Aside</u>: C<sub>6</sub>H<sub>5</sub> is a very common aromatic substituent in organic chemistry. It is called a **phenyl group** (not to be confused with benzyl which is C<sub>7</sub>H<sub>7</sub> and has an extra CH<sub>2</sub>). The phenyl group has multiple notations: Ph or  $\Phi$ )



Polystyrene:



styrene

polystyrene

Cationic Polymer



A strong acid acid, such as sulfuric acid, is required to catalyze this reaction. The mechanism can be found on the following page.



Another way to draw this polymer is shown below (it is a sticky gum-like substance):



# 4.II. Conjugated System and Resonance

### A. Conjugated Molecules and Intermediates

Conjugated means "Separated by one single bond from a double bond"

Intermediates - Often non-stable molecules that occur during reactions for short periods of time (ex. cation, anion, radical)

Review of alkene nomenclature and examples



The two molecules below are stereoisomers, and both are conjugated.





E-1,3-pentadiene

Z-1,3-pentadiene

The two molecules below are constitutional (structural) isomers. 1,4-pentadiene is not conjugated. It has double bonds separated by 2 single bonds.

/

$$\sim$$

1,4-pentadiene

E-1,3-pentadiene

NOT conjugated

1,2-pentadiene, shown below is NOT conjugated. It has cumulated double bonds. This molecule is an allene and is a structural isomer with respect to the above 1,3-pentadienes.



Styrene

### **B.** Allyl Radical, Cation & Anion Stabilization and Resonance

## Nomenclature of Allyl and Vinyl Groups

(the squiggly line represents attachment to any group)

Allyl Group

Example

Vinyl Group

Example









vinyl chloride

allyl bromide





Allyl anion

Allyl radical

Has 7 e<sup>-</sup> at C C is neutral but reactive



Has 6 e<sup>-</sup> at C C is positive

Has 8 e<sup>-</sup> at C C is negative

Allyl cation

All are conjugated intermediates. The excess or deficient electrons at the carbon atom are conjugated to the double bond.

All are stabilized through resonance structures.



#### **Review of Reactions (Addition Reaction of Dienes)**

(Note: Reaction will frequently be abbreviated as "rxn" in this course)

Addition:



Mechanism:





These are structural isomers.

The product 3-bromobutene is a **1,2-addition** product, whereas 1-bromo-2-butene is the product of an **1,4-addition** reaction. The numbers (**1,2-** or **1,4-**) indicate the position where the H and Br added to the 1,3-butadiene.