

Chemistry 125 Sixth Examination  
February 28, 2011

Name \_\_\_\_\_

The exam budgets 50 minutes, but you may have 60 minutes to finish it. Good answers can fit in the space provided. Question values correspond to allotted time. Don't waste too much time on cheap questions.

1. (4 min) Specify REAGENTS for converting 2-butene into the corresponding epoxide by two completely different reaction paths. [Reagents only; no need to show curved arrows]

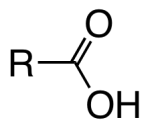
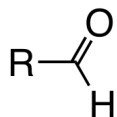
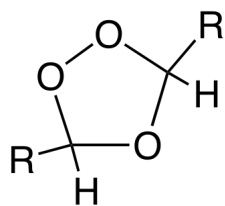
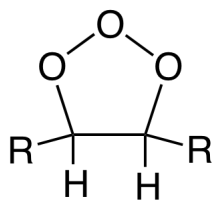
Reagent(s) for Path 1:

Reagent(s) for Path 2:

2. (4 min) EXPLAIN how vulcanization achieves the apparently opposite goals of keeping rubber from being brittle when cold AND from flowing when warm.

3. (5 min) Addition of HCl to methylacetylene is much slower than its addition to an alkene. Reaction for a limited time yields two products in similar amounts (54 and 46% yield). Draw structures of these two products and explain how they show that the influence of Cl on the second reaction is curious.

4. (10 min) Treating  $R-CH=CH-R$  first with  $O_3$  and then with  $H^+$  and  $HOOH$  in water yields the carboxylic acid  $RCOOH$  through a series of reactions involving the following intermediates. Draw clear curved-arrow mechanisms for **TWO (2 only)** of these three transformations. Several steps may be involved in each transformation.



5. (5 min) Draw curved arrows to show the mechanism for metal-catalyzed polymerization of an alkene involving oxidative addition and reductive elimination (several steps will be required)

6. (4 min) Explain in terms of the mechanism above whether the following catalyst should convert propylene to isotactic, syndiotactic, or atactic polymer.

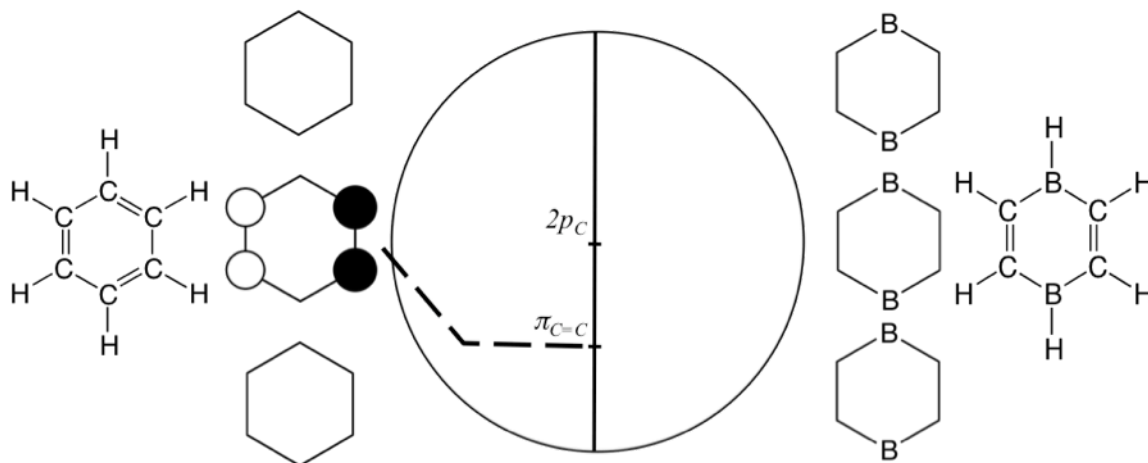


7. (6 min) Cite **SPECIFIC, QUANTITATIVE, EXPERIMENTAL** evidence to support the statement:

“Resonance stabilization is more important in an allylic intermediate than in a conjugated diene.”

[You need not cite more evidence than is necessary to support the statement, but it should be solid.]

8. On the far left and right below are shown the structures of benzene and of an analogous compound in which two carbon atoms have been replaced by boron.



- A. (5 min) Next to each compound are three hexagons on which you are to **DRAW FILLED OR OPEN CIRCLES** to denote the positive or negative top lobe of  $2p$  orbitals of the **PROPER SIZES AND SIGNS** to display the **LOWEST THREE**  $\pi$  MOs of each molecule. A few explanatory words may help.  
[The middle  $\pi$  MO of benzene has been shown as an example.]
- B. (5 min) Draw a dashed line to show the **ENERGY** of each of your MOs by connecting it to the vertical line in the middle where the energy of a  $2p$  AO of carbon and a  $\pi_{C=C}$  are indicated by horizontal marks. Be as precise as you can. A few explanatory words may help.  
[Again the middle  $\pi$  MO of benzene has been shown as an example.]
- C. (2 min) Explain whether Hückel would consider the ring with two boron atoms to be aromatic or anti-aromatic.