1. How many vinylic and allylic hydrogens are present in each of the following molecules?

2. (a) What is the (p + r) value for a molecule with formula C4H4?

(b) Draw as many possible isomers as you can for C4H4.

3. Classify each of the following alkenes as symmetrical or unsymmetrical.
4. Use curved arrows to show the flow of electrons in each of the following chemical transformations:

\[
\begin{align*}
\overset{\ominus}{H-O-H} + \overset{\hat{\cdot}}{H}C-C-\overset{\cdot}{OCH}_3 & \rightarrow \overset{\hat{\cdot}}{H}C-C-\overset{\cdot}{OCH}_3 + H_2O \\
\overset{\hat{\cdot}}{CH}_3CH=CH_2 + \overset{\cdot}{H}-\overset{\cdot}{Cl} & \rightarrow \overset{\hat{\cdot}}{CH}_3CHCH_3 + :\overset{\cdot}{Cl}: 
\end{align*}
\]

5. Draw a reaction coordinate diagram for a single-step (i.e. concerted) reaction where overall the transformation is exergonic and where $\Delta G$ is about twice as much as the magnitude of $\Delta G^\circ$.

6. On the following reaction coordinate diagram: (a) Indicate all intermediates and transition states; (b) Which step is rate-limiting?