1. Which of the following are aromatic. Draw "Frost Circles" that support your answers

- Octahedron: all bonding MO's are filled, aromatic
- Pentagon: although all electrons are in bonding orbitals, two bonding MO's are only half-filled, anti-aromatic
- Square with two double bonds: all bonding MO's are filled, aromatic
- Octagon with four double bonds: this is an interesting case: it is a 4n+2 molecule, and it is flat—characteristic of aromatic molecules. However, it has four electrons in non-bonding orbitals, so we might have considered this to be non-aromatic. So it comes down to how you define aromaticity. For now we will call it aromatic with a question mark.

2. Which of the following are aromatic. Use the Huckel rule to support your answer

- 14 electrons, aromatic
- 6 electrons, sp\(^3\) center, not conjugated and not aromatic
- 6 electrons, (filled sp\(^2\) on phosphorus), aromatic
- 6 electrons, (empty sp\(^2\) on boron), aromatic
- 10 electrons, aromatic
3. Compound 1 has an unusually large dipole moment for an organic hydrocarbon. Explain why (consider resonance structures for the central double bond)

We need to remember that for any double bond compound, we can draw two polar resonance structure. Normally, these resonance structures are unimportant

However, for 1 the story is different because there is a polar resonance form that has two aromatic components. In other words, 'breaking' the double bond gives rise to aromaticity, and therefore the polar resonance structure is important and leads to the observed dipole.

5. Provide a mechanism. This problem is easier than it looks!
4. Provide mechanisms for the formation of 2 and 3.

\[
\text{C}_6\text{H}_5 + \text{CO}_2\text{H} \xrightarrow{\text{AlCl}_3} \text{C}_6\text{H}_4\text{C} (= \text{O}) \text{CH}_2\text{CO}_2\text{H} \xrightarrow{\text{H}_3\text{PO}_4} \text{C}_6\text{H}_4\text{OH}
\]
6. Devise syntheses of the following, using benzene and any other materials containing 3 carbons or less.