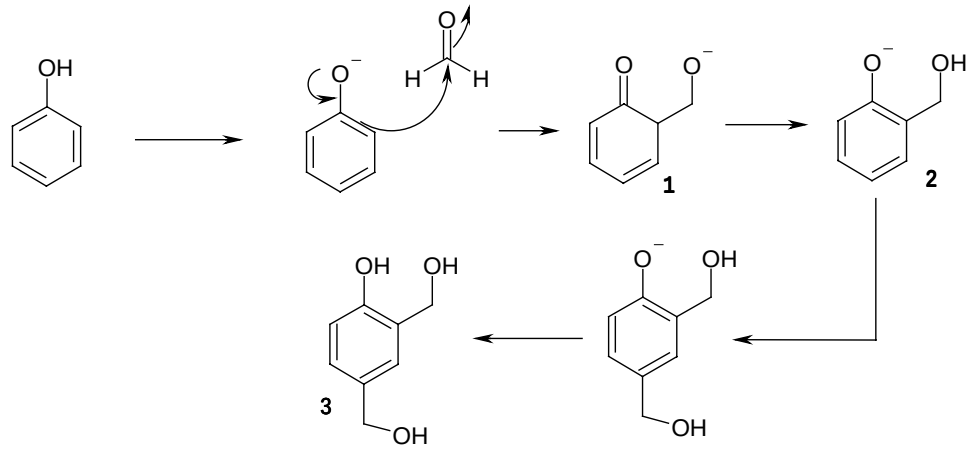
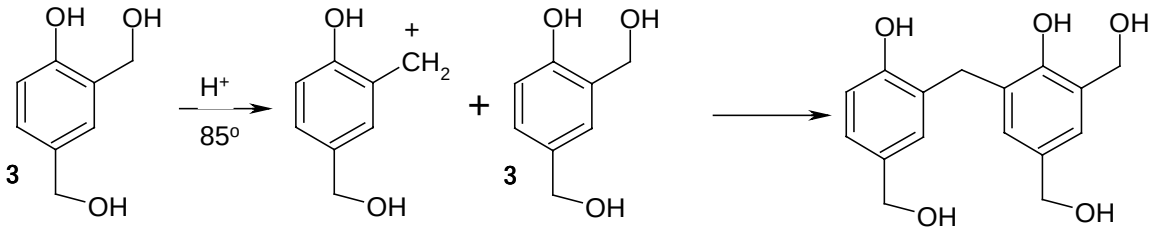
Bakelite

Bakelite is one of the earliest commercial plastics. When made with this procedure, it is often an amber clear solid. To make it stronger and to make more of it, filler such as sawdust is often added.

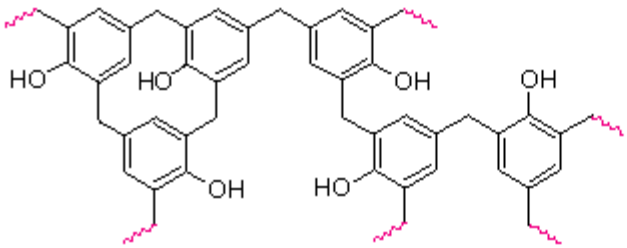
The mechanism:
The first step is an nucleophilic aromatic substitution adding formaldehyde to the phenol. This can occur at the ortho and para positions.



After protonation, under acidic conditions, electrophilic aromatic substitution takes place.



Many of these substitutions can occur:



Bakelite (a cross-linked solid)

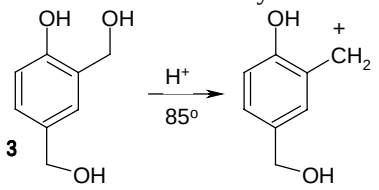
Procedure:

In a long fat test tube, place 3 grams of phenol and 10 ml of a 37% by weight aqueous formaldehyde solution. The formaldehyde solution is stabilized by 10-15% methanol to keep it from polymerizing. Add 1.5 ml of a concentrated ammonia and reflux for 5 minutes beyond the point at which the solution becomes cloudy, at least 10 minutes. Draw off the upper layer. Pour the lower layer into a smaller test tube and immediately clean the original test tube with acetone. Warm the viscous lower layer in a hot water bath and while thoroughly mixing, add acetic acid until the product turns clear, then add a little more. The product should be clear even upon cooling to room temperature. Drop the temperature on the water bath to between 60 and 65 °C and heat the mixture for 30 minutes. Add a stick if you like and then heat the product in a drying oven overnight. Break the test tube to remove your polymer.

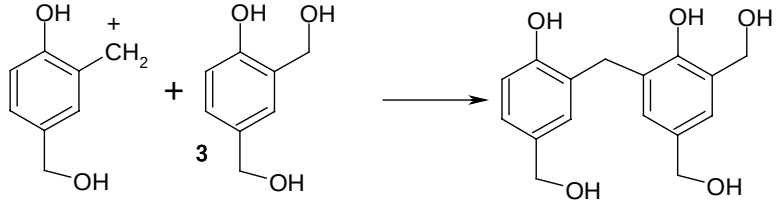
Assuming that all the phenol and formaldehyde react, what was your % yield?

Post Lab Questions:

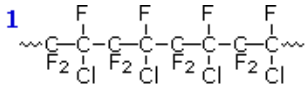
1. What is the role of the ammonia in the reaction?
2. What is the mechanism for the carbocation formation of the benzylic alcohol?



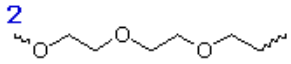
3. What is the mechanism for the electrophilic aromatic substitution?



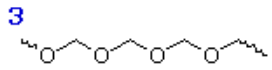
4. Please match a monomer with the each polymer



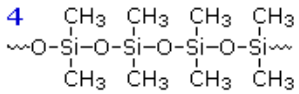
Kel-F



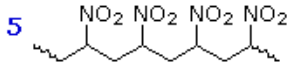
Carbowax

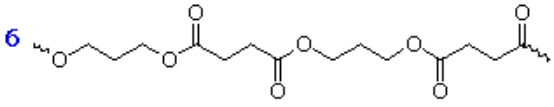


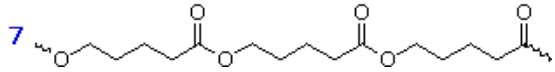
Deldrin

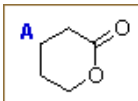
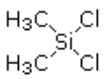
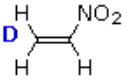
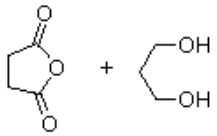
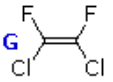
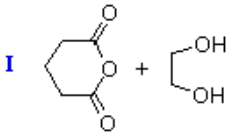


Silicone







A 	B 	C  + H_2O & KOH
D 	E 	F 
G 	H 	I 
J 	K $H-C\equiv C-NO_2$	L $SiO_2 + CH_3-I$