Note: Your exam should consist of 5 pages including this cover sheet. Skim the entire exam and solve the easiest problems first.

DO NOT OPEN THIS EXAM UNTIL INSTRUCTED TO DO SO
1. Write down a chemical structure and a thumbnail sketch of the chemistry behind one of the following: BPA, DDT, Agent Orange, or PCBs. (10 pts)

BPA - plastics component with adverse developmental health effects.

DDT - anti-arthropod agent that saved many WWII lives but was then broadly applied and presented an environmental dilemma - identified as such by Rachel Carson in her book “Silent Spring.”

2. Phenol and acetone are mass-produced from benzene and propene using the cumene process. Demonstrate your understanding of this chemistry by writing five contiguous mechanistic steps involved in the process. (10 pts)

3. Provide a mechanism for the following reaction. (5 pts)

4. How might the starting material in 3 be prepared? (5 pts)

5. An unknown compound (C₁₀H₁₄O) is soluble in dilute NaOH but is insoluble in dilute bicarbonate solution. The compound reacts with bromine in water to yield a dibromo product, C₁₀H₁₂Br₂O. The product’s IR spectrum shows an intense broad absorption at 3250 cm⁻¹; the product’s ¹H NMR spectrum consists of the following: 1.35 ppm (9H, s), 5.35 (1H, s), 7.38 (1H, s), 7.63 (1H, s). What is the structure of the unknown compound? (10 pts)

NMR suggests aromatic protons; t-Bu group.

too symmetric!
6. Identify the reactants & reagents you would use to prepare the following dye via an azo coupling reaction. 10 pts

\[
\text{HO}_3\text{SO}\text{N} \quad \text{EAS} \quad \text{H}_3\text{SO}\text{N} \\
\text{N} \quad \text{S} \quad \text{S} \\
\text{NH}_2 \quad \text{NH}_2
\]

7. Suggest reasonable mechanisms for the following transformations. Identify, by name, any key intermediates. 15 pts

\[
\begin{align*}
\text{R} & \quad \text{NH}_2 \\
\text{OH} & \quad \text{Br}_2, \text{NaOH}, \text{H}_2\text{O} \\
\text{R} & \quad \text{C} \quad \text{O} \\
\text{H} & \quad \text{H}_2\text{O} \\
\text{R} & \quad \text{C} \quad \text{N} \quad \text{Br} \\
\text{H} & \quad \text{O} \quad \text{OH} \\
\text{R} & \quad \text{N} \quad \text{C} \quad \text{O} \\
\text{OH} & \quad \text{Br} \\
\text{R} & \quad \text{O} \quad \text{Br} \\
\end{align*}
\]

8. Rank the nitrogen atoms in order of increasing basicity, left to right. 5 pts.

\[
\begin{align*}
\text{A} & \quad \text{NH}_2 \\
\text{B} & \quad \text{NH}_2 \\
\text{C} & \quad \text{N} \\
\text{D} & \quad \text{HO} \quad \text{N} \\
\end{align*}
\]

increasing basicity
10. A plant biologist friend who studies nitrogen fixation needs access to a supply of pure gaseous nitrogen (N\textsubscript{2}) with molecular weight 29. Propose a synthesis of this molecule and specify the chemical source of the \textsuperscript{15}N isotope (assume that nitrogen is mostly found as the \textsuperscript{14}N isotope). **Provide a detailed mechanism for your proposed process.** (10 pts)

Nitrogen was seen as a by-product of diazonium salt decomposition in both aryl and alkylamines. We studied the aryl case, so...

![Chemical Reaction Diagram]

11. Pomona/Pitzer degree in hand, you happily accept a $100,000/yr job with the Oscar Mayer Corporation in the "hot dog development lab." Your first assignment is to work with another new hire and devise a better dog. Your partner hits the additives book while you review the existing ingredient list. Several days pass by. Your partner presents an idea at a group meeting: use Gesundheitamine (an anti-sneeze agent) as an additive: "this way, people who are allergic to hot dogs won't ever even know it", he says. Several minutes pass by as an uncomfortable silence descends upon the room. Out of the corner of your eye you realize the boss is nodding and smiling, somehow impressed with this outlandish proposal. You want no part of it, and can provide sound chemical reasoning as to why Gesundheitamine is not an appropriate additive. Start with the ingredient list and provide a detailed **mechanism**, incorporating other chemicals likely to be encountered in the stomach (pH 1.5-2.0), to substantiate your reasoning. This is not an essay question. **It is a mechanism question.** (10 pts)

**Existing Ingredients:** beef, sodium erythorbate, sodium phosphate, sodium nitrite, artificial flavoring.

![Chemical Reaction Diagram]
Chemistry 110b
FOURTH EXAM
April 11, 2012

Name (print)______________________________

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