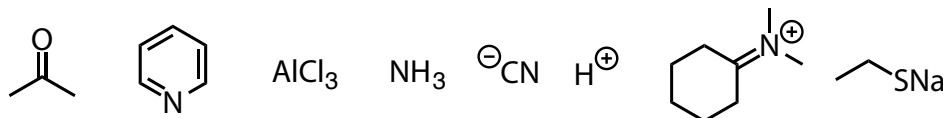


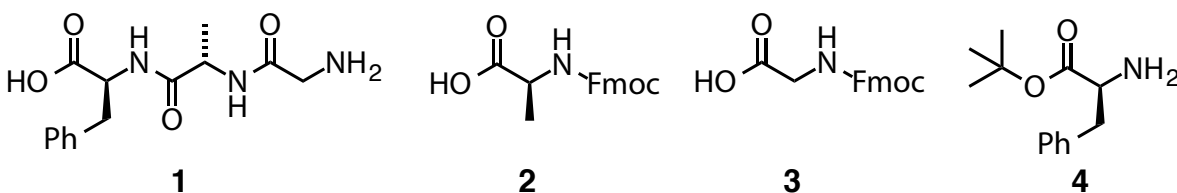
Organic Chemistry

Exercise 12

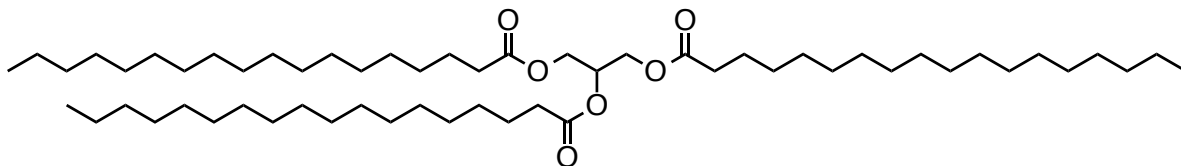
1. Which of the depicted molecules or molecular fragments are nucleophiles, which are electrophiles? If applicable, indicate the nucleophilic/electrophilic center.



2. Phenolphthalein is an important dye molecule that serves as a pH indicator.
- Formulate the complete mechanism for the synthesis of phenolphthalein starting from phthalic anhydride and phenol. Use arrows to indicate the attack of the nucleophile and draw relevant resonance structures for the intermediates.
 - Transfer:* Phenolphthalein changes color to red when a pH below 0 is reached. What are the structural changes that occur? Sketch an absorption spectrum of phenolphthalein at $\text{pH} = -2$.
3. Peptides are a very important class of molecules.
- Propose a multi-step synthetic pathway that yields the tripeptide **1** starting from Fmoc-L-alanine **2**, Fmoc-L-glycine **3**, and *t*BuO-L-phenylalanine **4**. Include all required reagents for each step.



- Formulate the complete reaction mechanism for one of the peptide coupling steps. Use arrows to indicate the attack of the nucleophile on the electrophilic center.
4. The structure of glyceryl tristearate is given below. To what class of compounds does it belong? Show how glyceryl tristearate can be chemically converted into sodium stearate and glycerin.



5. Give one example and the structure for an ionic and a non-ionic surfactant. Indicate which parts of the molecules are hydrophilic and hydrophobic.
6. What is the definition of a polymer according to Staudinger? Give three examples of different homopolymer architectures and three examples of copolymer architectures!
7. Give the mathematical definition of the number-average molecular weight and the weight-average molecular weight! Calculate both averages for the following mixture: 1 molecule 1000 g/mol, 3 molecules 2000 g/mol, 6 molecules 3000 g/mol, 4 molecules 4000 g/mol, 2 molecules 5000 g/mol, 1 molecules 6000 g/mol.
8. Formulate the complete reaction mechanism of the polycondensation of ethylene glycol (1,2-ethanediol) and terephthalic acid (1,4-benzenedicarboxylic acid)! What class of polymers does the product belong to (in terms of the name of the chemical functional groups linking together the repeating units)? How is this polycondensation performed on a technical scale (to circumvent the limitations of the Carothers equation)?
9. Formulate the complete mechanism of the free radical polymerization of methyl methacrylate using AIBN (azobis(isbutyronitrile)) as the initiator! Include the decomposition of the initiator, the initiation of the chain growth, the propagation, as well as a termination step.
10. Draw the chemical structure of PA-6,12 (poly(hexamethylene dodecamide)) and Kevlar (poly(para-phenylene terephthalamide)). Which one has the higher glass transition temperature? Explain why based on their structure. What is the main difference in the industrial synthesis of aliphatic (like PA 6,12) and aromatic polyamides (like Kevlar)?