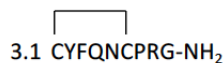
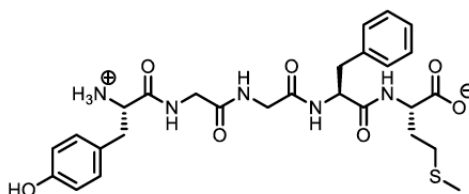


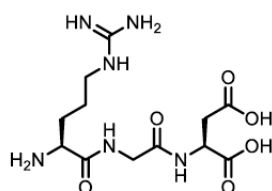
1. (6 points) (a) Draw the structures and explain the difference of the pKa-values of the hydroxyl groups of Serine, Threonine and Tyrosine. What are the names of the different functional groups?
 (b) Draw the structures and explain the difference of the pKa-values of the side chain functional groups of Lysine, Arginine and Histidine. What are their names?
 (c) Fill in the missing information for the following peptides: 1-letter code, 3-letter code, and structure.



3.3



3.4

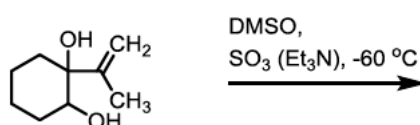
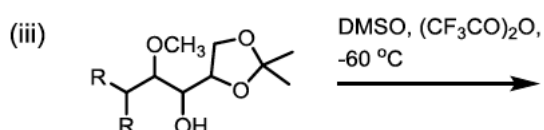
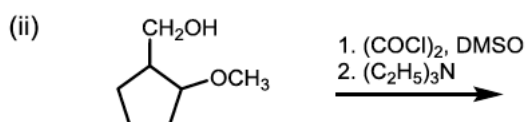
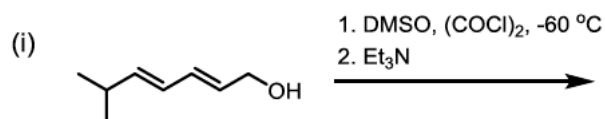


2. (5 points) The Swern oxidation is a mild, metal-free method for the oxidation of _____ to _____ or _____ without over oxidation to _____.

(a) Give the common reagents (in order of addition) and conditions required for the Swern oxidation.

- 1.
- 2.
- 3.
- 4.

(b) Work out what the aldehyde formed from the following reactions and give the mechanism for the first two examples.

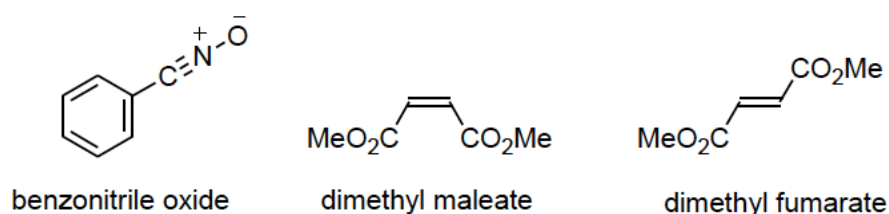


3. (3 points) Identify the functional groups by matching the structures and names.

(NB there are more names than structures)

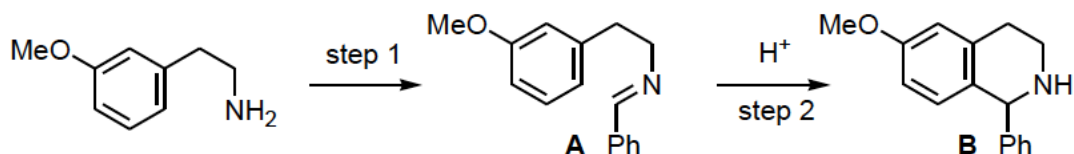
tributylphosphate	triphenylphosphine
ethanethiol	ethanesulfenic acid
diethyl sulfoxide	ethanesulfinic acid
tributylphosphite	ethanesulfonic acid
diethyl sulfide	methyl triphenylphosphonium iodide
diethyl sulfone	diethyl phenylphosphonate
triphenylphosphate	ethyl diphenylphosphine oxide
	diethyl xanthate

4. (4 points) The structure of benzonitrile oxide is given below.



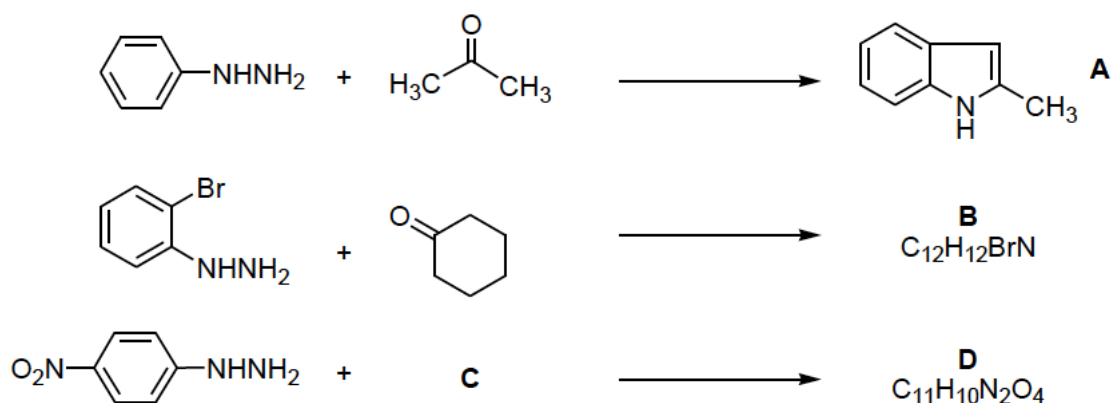
- Give the reagents that are needed to make benzonitrile oxide from benzaldehyde.
- Work out the cycloaddition product of benzonitrile oxide with dimethyl maleate **and** dimethyl fumarate showing clearly the stereochemistry in each case.

5. (4 points) Consider the scheme below:



- Give the reactant and reagent needed in step 1.
- Show the mechanism for step 2.
- What would happen to the rate of reaction of step 2 if the methoxy group in **A** was replaced by a nitro group? Explain your answer.
- In step 2 an alternative product to **B** may be formed in theory. Draw this product and explain why it is not formed in practice.

6. (4 points) (a) In the Fischer indole synthesis acetone and phenylhydrazine (PhNHNH₂) react to give 2-methylindole (**A**). Using this fact, work out the structures of **B**, **C** and **D**.



(b) Explain why the reaction of phenylhydrazine with butan-2-one may lead to two isomeric indoles. A full mechanism of the Fischer indole synthesis is not required, though you should give the key intermediates to explain your answer.

7. (4 points) Draw the diastereoisomer (*erythro* or *threo*) for the formation of the corresponding alkene isomer. (NB drawing Newman projections helps you *work out* the product rather than relying on remembering which isomer gives which alkene under which conditions).

