Lecture 9

‘Synthesis problems’ including functional group interconversions

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Reference textbook

- “Organic Chemistry” by Paula Yurkanis Bruice, 8th Edn.
- This lecture – Chapter 18, in particular 18.10, 18.16, 18.17, 18.18
- **We are going to cover a few examples of designing a synthesis in this lecture, but you should read the other examples in sections 18.16, 18.17, 18.18**

Learning Objectives – Lecture 9

Section 3– Functional group interconversion, Section 6 – synthesis problems

Propose potential syntheses of aromatic target molecules from given starting materials, using the reactions covered in this lecture course
Approach synthesis problems retro synthetically (i.e. work backwards from the target molecule to commonly available materials)
Plus a lot of other LOs from the Module, now applied to a synthetic problem

Proposing a synthesis

Faced with the question – how do I synthesise THAT?

Working backwards from the product is a **RETROSYNTHESIS**

refer to page 344, Bruice,

The double open ended arrow indicates the LHS is made from the RHS….

B $\Longrightarrow$ A

'B' can be made from 'A'

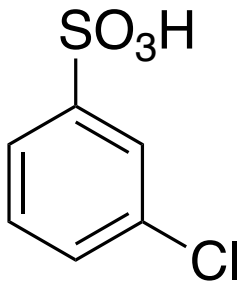
A $\longrightarrow$ B

'A' undergoes a reaction to give 'B'

- There is usually more than one option/synthetic route that can be taken
  …. for an exam there is usually more than one answer that will score 100%.
- There can be pros and cons for different routes.
- Consider number of steps, usually shorter is better.

Proposing a synthesis – example 1

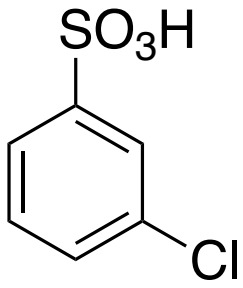
Example 1, *decide what **order** substituents should be installed in*



target compound
m-chlorobenzenesulfonic acid

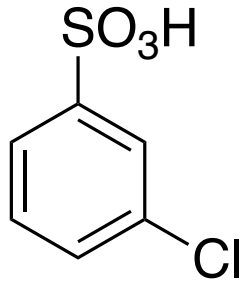
What reaction could install each substituent?

In what order should these reactions be done?



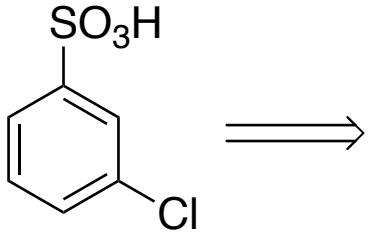
Proposing a synthesis – example 1

Example 1, *decide what order substituents should be installed in*

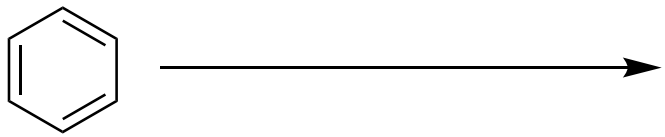


target compound

Design the retrosynthesis -

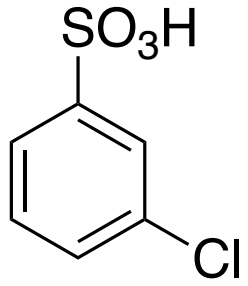


Write as a synthesis -



Proposing a synthesis – example 1

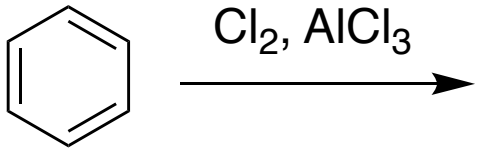
Example 1, *decide what order substituents should be installed in*



target compound

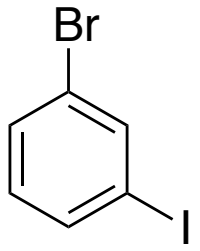
Consider what would happen if chlorination was done first …..

(….. which would not lead to the desired product)



Proposing a synthesis – example 2

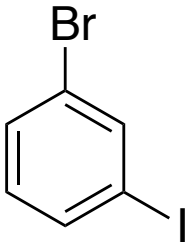
Example 2, *reaction order and functional group interconversion*



target compound
m-bromoiodobenzene

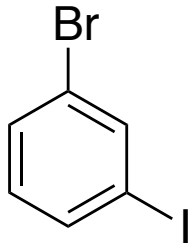
What reaction **could** install each substituent?

But will direct instalment of each halogen work in this case?



Proposing a synthesis – example 2

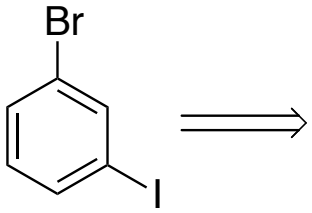
Example 2, *reaction order and functional group interconversion*



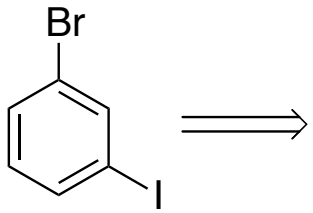
target compound

- Maybe a functional group interconversion could be carried out….
- Whatever is installed first needs to direct the second substituent to ……

Design the retrosynthesis -

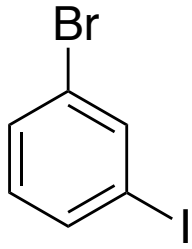


or



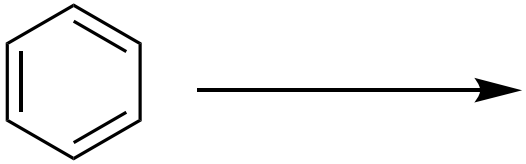
Proposing a synthesis – example 2

Example 2, *reaction order and functional group interconversion*



target compound

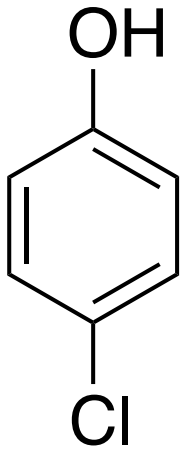
Design the synthesis, and show reagents



Proposing a synthesis – example 3

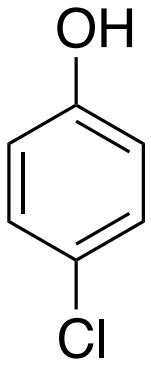
Example 3, *reaction order and functional group interconversion*

target compound
para-chlorophenol



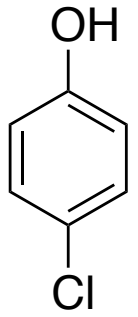
- What's a good way to synthesise a phenol?

- Whatever is installed first needs to direct the second substituent to **.....**



Proposing a synthesis – example 3

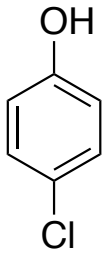
Example 3, *reaction order and functional group interconversion*



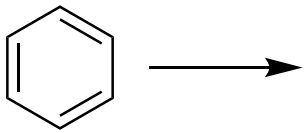
target compound

- As for most target compounds, there are many synthetic routes that could work
- To demonstrate this, let's go through a few possibilities for this target…..

Option 1 retrosynthesis

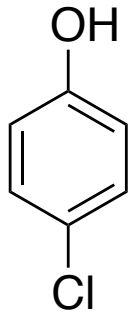


Option 1 synthesis



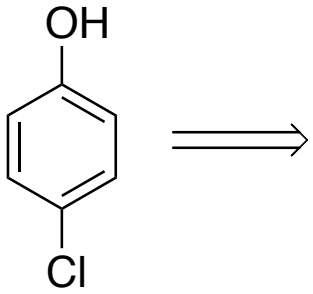
Proposing a synthesis – example 3

Example 3, *reaction order and functional group interconversion*

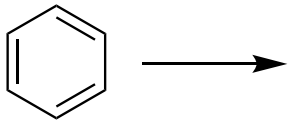


target compound

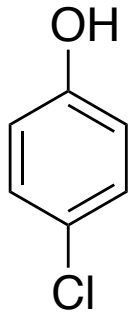
Option 2 retrosynthesis



Option 2 synthesis



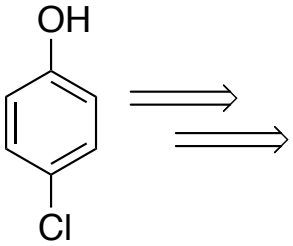
Proposing a synthesis – example 3



target compound

Example 3, *reaction order and functional group interconversion*

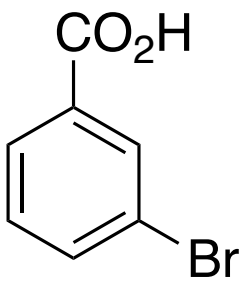
Option 3
retrosynthesis

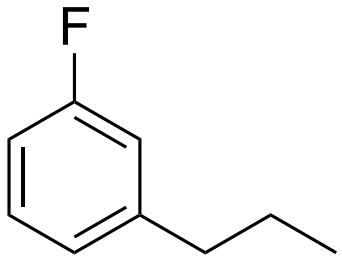


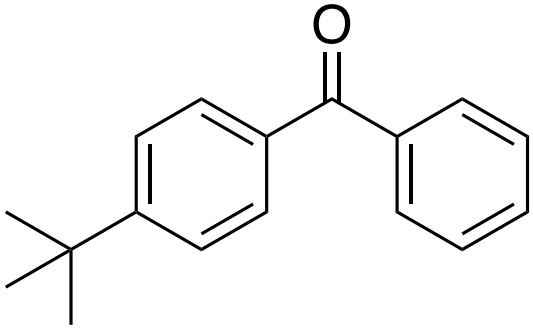
Write out the forwards synthesis yourself and fill in all the reagents

Proposing a synthesis – homework examples

Other targets to synthesise -



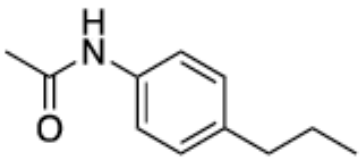




From the 2020 exam…

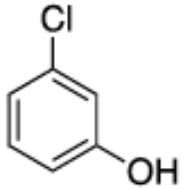
(c) Design a synthesis for **ONE** of the following compounds (i) **OR** (ii). Start from benzene and show the reagents you would use for each step. Assume that *ortho* and *para* products can be separated, noting when both may form. No mechanisms are required.

[5 marks]



(i)

OR



(ii)

The End of Module 2 lectures (!)

- Material revision and exam study, the text book is very useful -
  - We haven't covered EVERYTHING in Chapter 18, so what do you need to know?

    - Refer back to the 4 page PDF Learning objectives for the module

- The text book has some summary sections (both text and reaction summaries) and also some great questions (at the end of Chapter 18) to test your knowledge.

Use the past exams for CHEM202 to study – learning objectives the same

This afternoon you will be emailed a teaching evaluation for this module
Please take the time to fill in – all feedback much appreciated