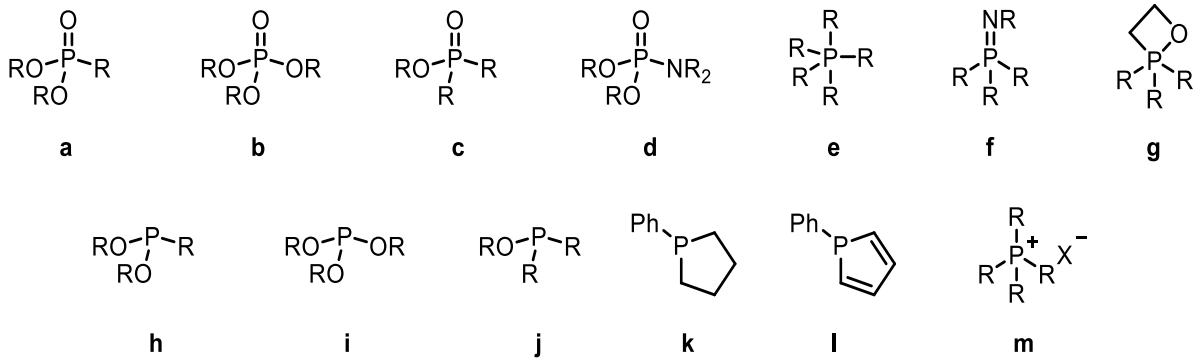
Problem Session 19/02/19 (Dean and Rhydian)

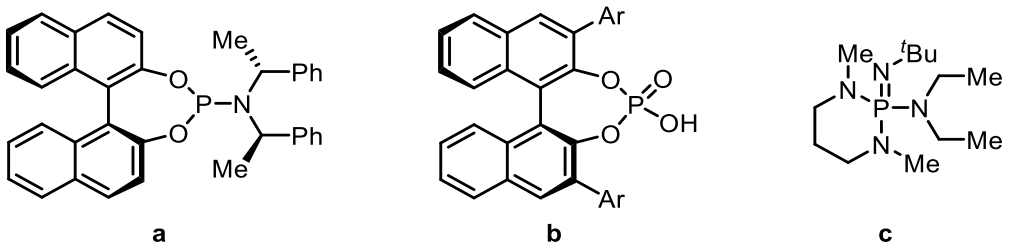
1) Give the names for the following functional groups.



2a) Name the following functional groups.

b) Give examples of a and b being used in asymmetric catalysis. (Preferably intermolecular reactions)

c) What is the pK_aH of **c**?



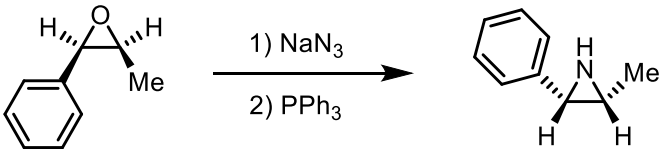
3a) Amines undergo rapid pyramidal inversion, and cannot be resolved into room-temperature stable *N*-stereogenic enantiomers. Using the data below, what is the half life for pyramidal inversion of ammonia.

b) By contrast, pyramidal inversion for phosphines is much slower. Explain why.

ΔG^{TS}_{inv} = 5.8 Kcal/mol for ammonia

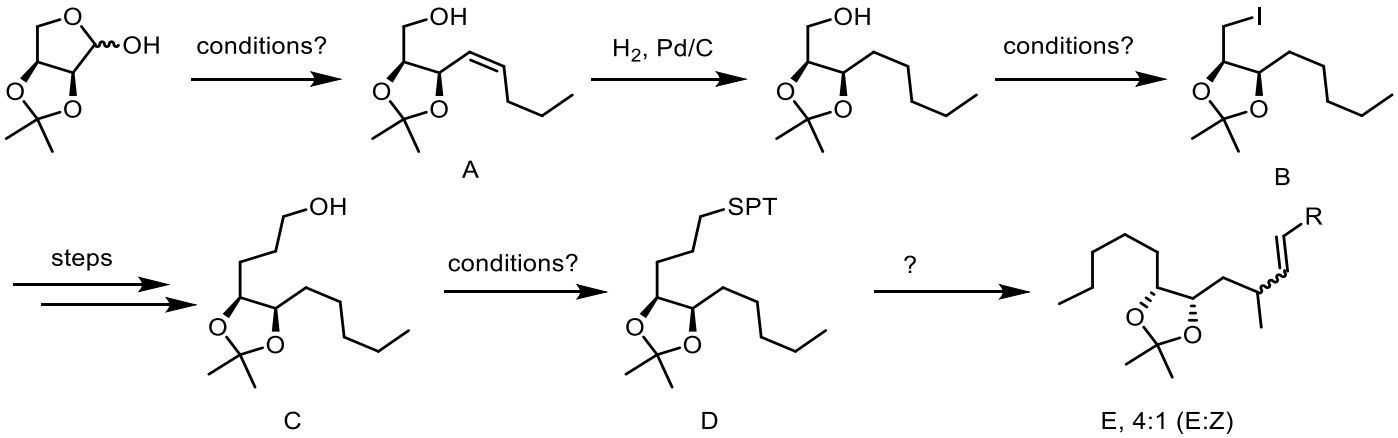
ΔG^{TS}_{inv} = 31.5 Kcal/mol for phosphine

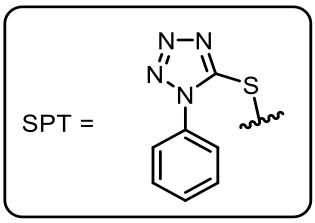
4) Give a mechanism of the following transformation, accounting for the stereochemistry.



5a) Suggest conditions to form A, B and D using only organophosphorus-mediated methods. Provide a mechanism for each of these reactions.

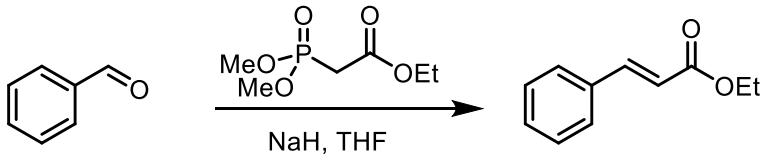
B) For the synthesis of E from D, why might a Julia-Kocienski reaction be preferred to a traditional Julia reaction? Provide a mechanism for this reaction.





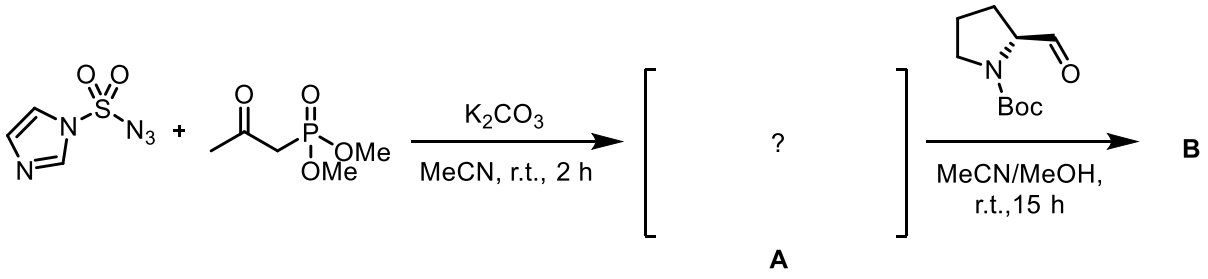
6a) Why do Wittig reactions generally go with E-selectivity for stabilized ylides and Z-selectivity for non-stabilised yides?

b) For the following Horner-Wadsworth-Emmons reactions, how might we change the regioselectivity to obtain the Z-alkene?

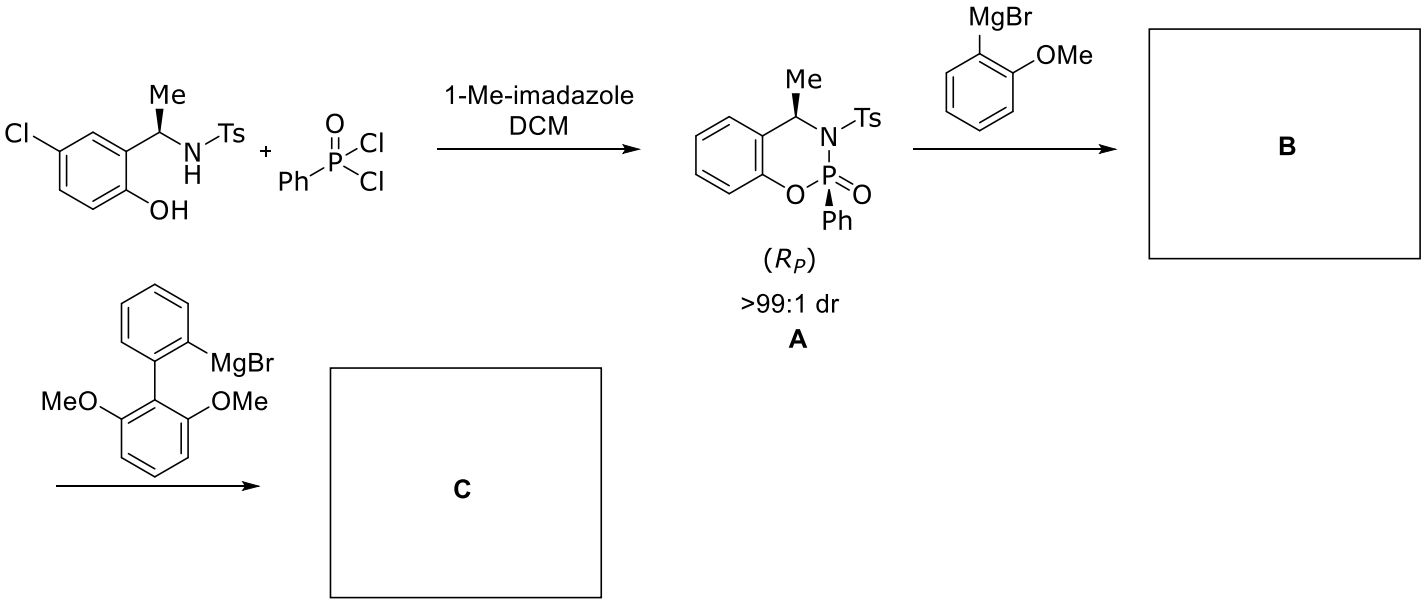


7a) Identify intermediate **A**. Give the mechanism of its formation.

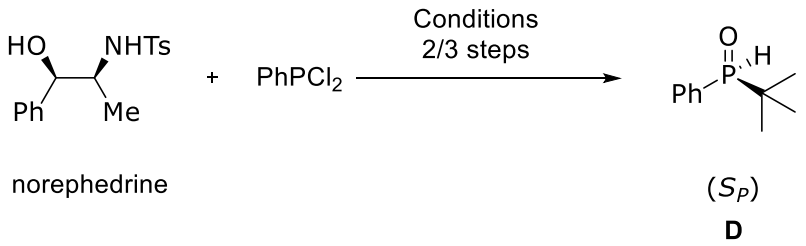
b) Identify product **B** and provide a reaction mechanism.



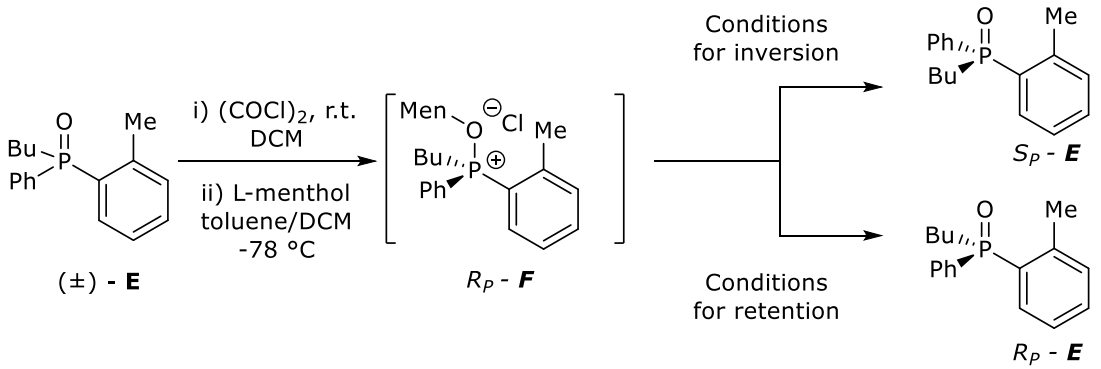
8a) 1,3,2-oxazaphospholidine-2-oxide A has been used as a chiral auxiliary to synthesise chiral phosphine oxides. Identify intermediate B, including the correct stereochemistry at phosphorus. Also identify product C including stereochemistry at the phosphorus centre.



b) Norephedrine has also been used as an auxiliary in a similar manner to above. Can you suggest conditions to synthesise phosphorus species, **D**, from norephidrine (it should be a 2 or 3 step synthesis). Predict any key components of the ^{1}H and ^{13}C NMR for compound D.



c) Enentiopure chlorophosphonium salt **F** can be formed from a racemic mixture of the corresponding phosphine oxide, **E**, *via* a dynamic resolution. A chiral resolution of intermediate, **F**, can be achieved with either retention or inversion to R_p or S_p phosphine oxide **E**, respectively. Please suggest conditions to synthesise the R_p and the S_p phosphine oxide from the common phosphonium salt F.



9) Suggest some conditions for the reduction of phosphine oxide **a** with retention, inversion and racemisation of stereochemistry.