Name **Student Number**

03-59-3310/3315 Final Exam 17/04/19 (3 hrs)

Fill out your name on each page. Make sure all pages are handed in at the end.

Hint: There are questions of varying difficulty. Read through the exam and answer the easy ones first!

The distribution of marks for the questions is approximate, and may change. You may use the back of any page for additional space or rough work.

Q1	/20
Q2	/12
Q3	/16
Q4	/10
Q5	/15
Q6	/20
Q7	/12
Q8	/10
Q9	/6
Q10	/24
Total	/145

Name: _____

1. Quick fire round! [2 marks] each, unless otherwise stated

   a) Grignard reagents can be made from chlorides, bromides and iodides. Why not fluorides?

   b) Why are Weinreb amides useful substrates for Grignard addition reactions? Why can't esters be used for this?

   c) BRIEFLY describe the characteristics of a "soft" nucleophile

   d) BRIEFLY describe the characteristics of a "hard" nucleophile

   e) Fill in the blanks:

   A kinetic enolate is formed using a _____ *base and* _____ *temperature.*

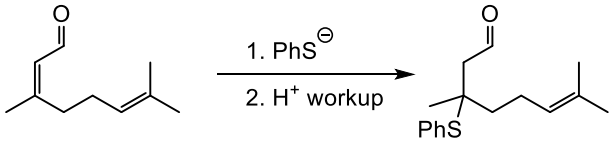
   STRONG or WEAK HIGH or LOW

Name: _____

f) Which type of enolate equivalent should you use when you are seeking to use a tertiary alkyl halide as the alkylating agent? [1 mark]

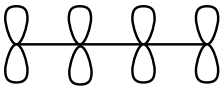
g) What are TWO possible problems with alkylation of a standard enolate?

h) Draw a mechanism for the following reaction, explaining any selectivity. [3 marks]

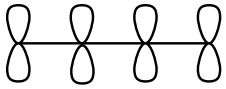


i) Shade the following diagrams to represent the HOMO and LUMO of butadiene, respectively.

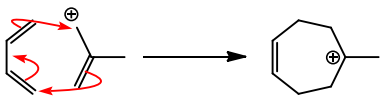
HOMO



LUMO



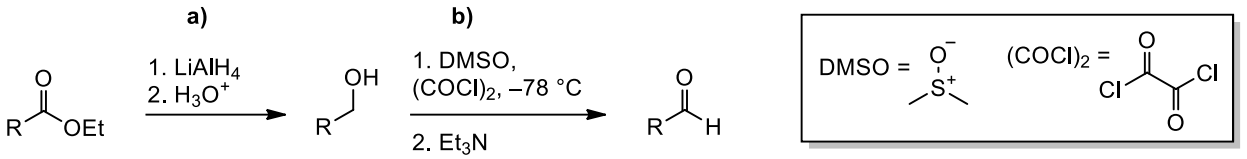
j) Is the following cycloaddition allowed under thermal conditions? BRIEFLY explain your answer



ALLOWED or NOT ALLOWED

Name: _____

2. Consider the conversion of an ester into an aldehyde shown below:



a) Mechanism for the reduction? [4 marks]

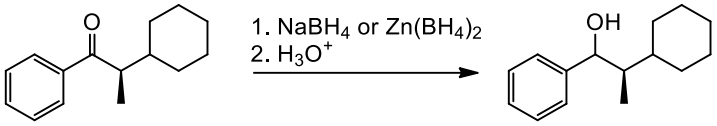
b) Mechanism for the oxidation? [6 marks]
(***Hint***: Remember the first step(s) are DMSO + (COCl)2 → Me_2S^+–Cl + Cl^- + CO + CO_2)

c) Suggest a reagent for the direct conversion for an ester to an aldehyde. Briefly explain why this reagent "stops" at the aldehyde, unlike $LiAlH_4$? [2 marks]

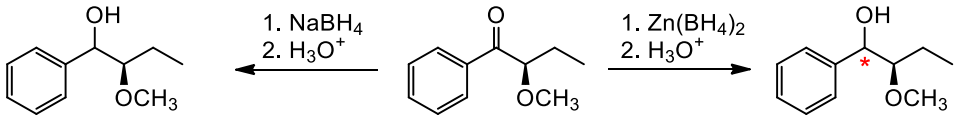
Name: _____

3.

a) Using a mechanism and the Felkin-Anh model, predict the stereochemistry of the major diastereomer in this reduction. [5 marks]



b) When the following ketone is treated with $NaBH_4$ or $Zn(BH_4)_2$, different diastereomers are produced.

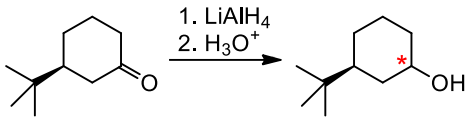


i) Provide a mechanism for and predict the stereochemistry of **the $Zn(BH_4)_2$ reaction.** [5 marks]

ii) BRIEFLY explain why the electronegative group is considered the "large" group in the *polar* Felkin-Anh model. [2 marks]

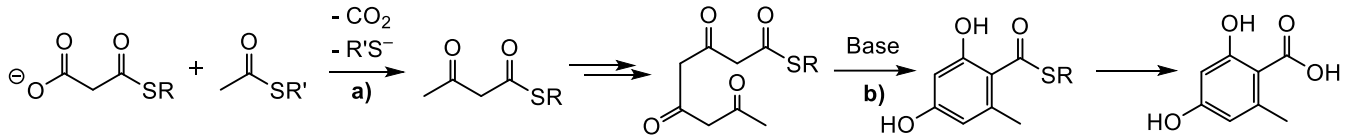
Name: _____

c) Using a clear conformational diagram, predict the stereochemistry of the major product of the following reduction: [4 marks]



Name: _____

4. We discussed the biosynthesis of orsellinic acid in class. (RS, R'S are enzyme-bound thiols)



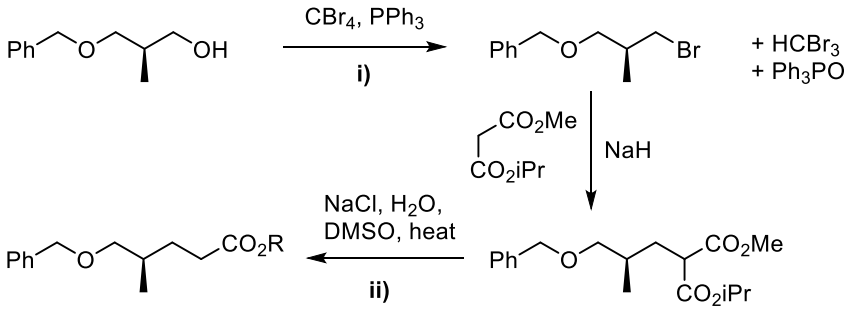
a) Provide a mechanism for the Claisen condensation that initiates the biosynthesis. [4 marks]

b) Provide a mechanism for the cyclisation to give the orsellinic acid core [6 marks]

Name: _____

5.

a) Consider the following sequence:



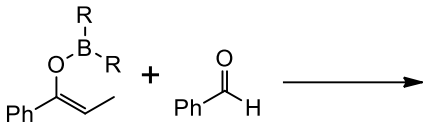
i) Provide a mechanism for the first step [5 marks]

ii) Provide a mechanism for the 3rd step. What is the R group? Why? [5 marks]

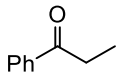
Name: _____

b)

i) Using the appropriate model (and mechanism), predict the stereochemistry of the product of the following aldol reaction: [4 marks]



ii) How would you make the isomeric *trans* boron enolate from the ketone? [1 mark]

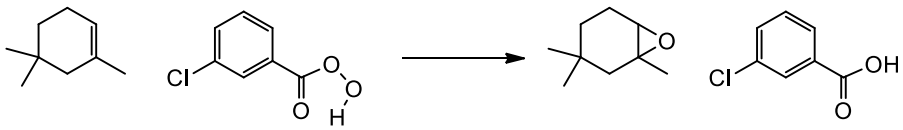


Name: _____

6.

a) You saw epoxidation of alkenes with *m*CPBA in class (and in 59-230); this is sometimes called the *Prilezhaev reaction*.

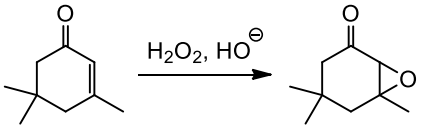
i) Provide a mechanism for this reaction: [3 marks]



meta-chloroperbenzoic acid, *m*CPBA

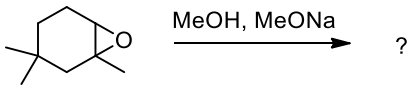
ii) When an α,β-unsaturated compound is exposed to *m*CPBA there is no reaction. Suggest why this is the case? [2 marks]

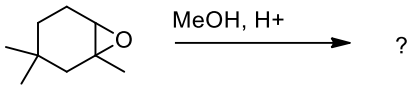
b) α,β-unsaturated compounds CAN be epoxidized, but this requires the use of basic hydrogen peroxide, in what is sometimes called the *Weitz-Scheffer oxidation*. Mechanism? (reminder: the pK_a of H_2O_2 is 11.6). [5 marks]



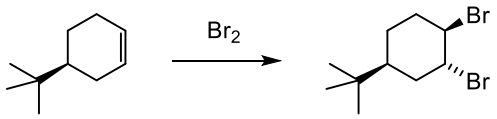
Name: _____

c) Predict the product (including any relative stereochemistry) from the following reactions and briefly explain your answer [2 marks each]

i) 

ii) 

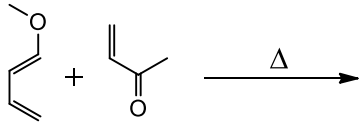
d) Provide a mechanism for the following reaction and explain the stereochemistry of the major isomer (shown). [6 marks]
(Hint: Bromonium ion opening is analogous to epoxide opening…!)



Name: _____

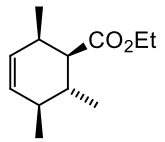
7.

a) Predict the product (including stereochemistry) of the following Diels-Alder reaction. Explain everything! Transition state diagram etc. [6 marks]

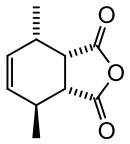


b) Which diene and dienophile pairings would you need to make these Diels-Alder products? Include appropriate double bond geometries. Would any of these reactions be difficult or low-yielding? Explain your answers. [3 × 2 marks]

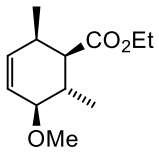
i)



ii)

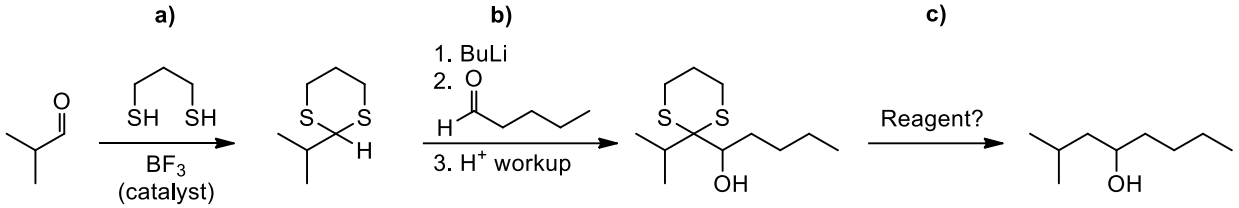


iii)



Name: _____

8. Dithianes are useful compounds that we used as umpolung reagents (d_1) and are also useful in the Mozingo process.



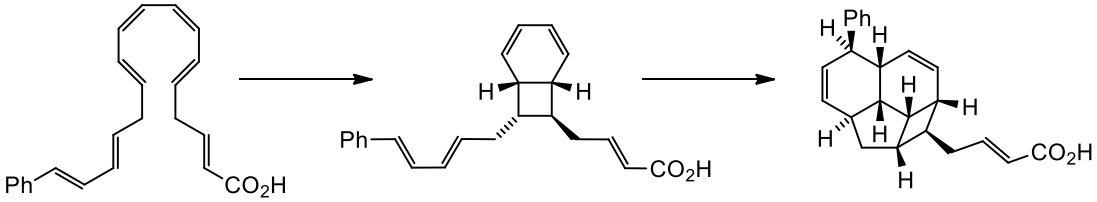
a) Mechanism for 1st step? [5 marks]

b) Mechanism for 2nd step? [4 marks]

c) What reagent is needed for the 3rd step? [1 mark]

Name: _____

9. The endiandric acids are a group of racemic natural products biosynthesised by thermal pericyclic reactions from the same poly-alkene precursor. Shown below is the proposed biosynthesis of endiandric acid B.



Polyene precursor | Endiandric acid F | Endiandric acid B

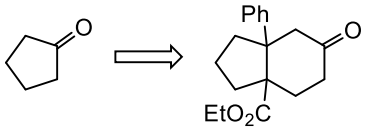
a) Provide a mechanism for the formation of endiandric acid F from the polyene precursor. You should explain the stereochemical outcome of the reaction(s). Count electrons etc!
[4 marks]

b) Endiandric acid B is formed by an intramolecular Diels-Alder reaction of F. Is it *endo* or *exo*? Suggest why. [2 marks]

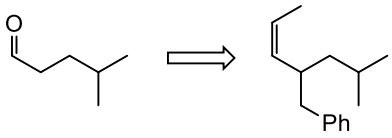
Name: _____

10. Propose syntheses of **THREE** the following molecules from the indicated starting materials.
BONUS QUESTION: Do all 4! [8 marks each]

a)

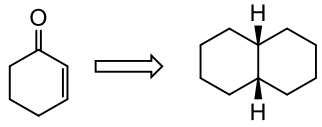


b)



Name: _____

c)



d)