



**NAMIBIA UNIVERSITY  
OF SCIENCE AND TECHNOLOGY**

**FACULTY OF HEALTH AND APPLIED SCIENCES**

**DEPARTMENT OF NATURAL AND APPLIED SCIENCES**

<b>QUALIFICATION:</b> BACHELOR OF SCIENCE HONOURS	
<b>QUALIFICATION CODE:</b> 08BOSH	<b>LEVEL:</b> 8
<b>COURSE CODE:</b> AOC811S	<b>COURSE NAME:</b> ADVANCED ORGANIC CHEMISTRY
<b>SESSION:</b> JUNE 2019	<b>PAPER:</b> THEORY
<b>DURATION:</b> 3 HOURS	<b>TOTAL MARKS:</b> 100

<b>FIRST OPPORTUNITY EXAMINATION QUESTION PAPER</b>	
<b>EXAMINER(S)</b>	DR. MARIUS MUTORWA
<b>MODERATOR:</b>	DR. RENATE HANS

<b>INSTRUCTIONS</b>	
<ol style="list-style-type: none"><li>1. Answer ONLY FIVE OF THE SIX questions.</li><li>2. Write clearly and neatly.</li><li>3. Number the answers clearly</li><li>4. All written work must be done in blue or black ink and sketches can be done in pencil</li><li>5. No books, notes and other additional aids are allowed</li></ol>	

**PERMISSIBLE MATERIALS**

Non-programmable Calculators

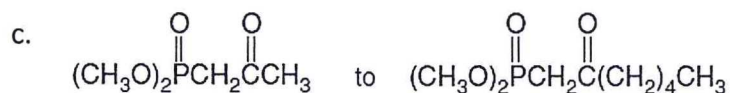
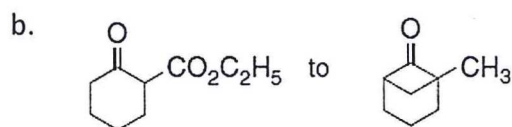
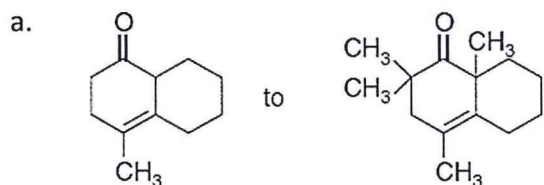
**ATTACHMENTS**

Solvent Chart, pKa Chart and Periodic Table

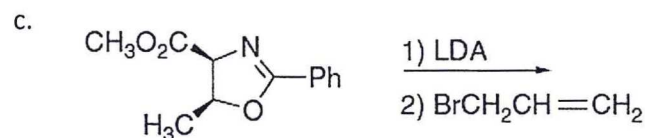
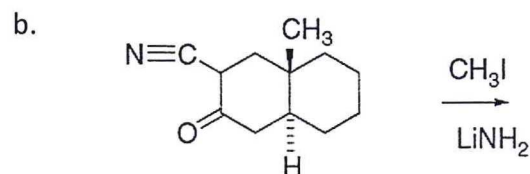
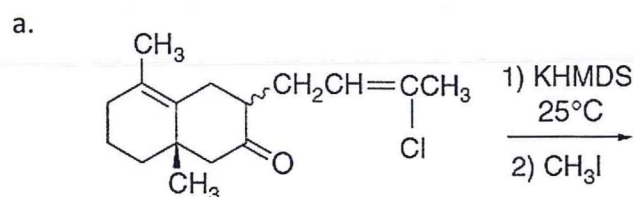
**THIS QUESTION PAPER CONSISTS OF 8 PAGES**  
(Including this front page and attachments)

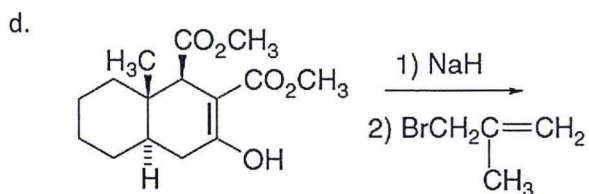
**QUESTION 1:****[20]****Question type: Enolates and Carbon Nucleophiles**

1.1) Suggest reagents and reaction conditions that involve enolate chemistry that would be suitable for the conversion of the following starting materials to the desired products. Limit the number of reaction steps to less than five (5) if more than one step is needed to achieve the transformation. (10)



1.2) Analyse the factors that you expect to control stereochemistry of the following reactions and draw the expected major products. Clearly indicate the configuration of the new stereochemical centre created upon alkylation. (10)



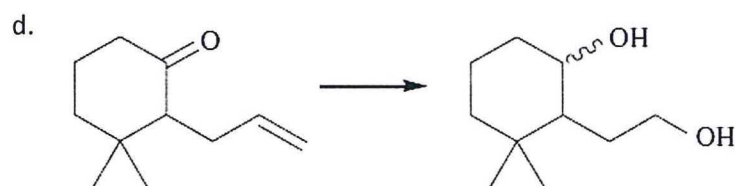
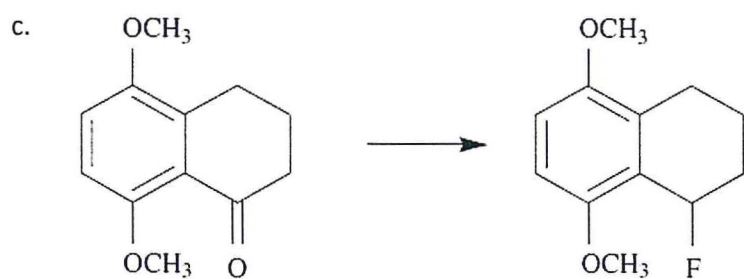
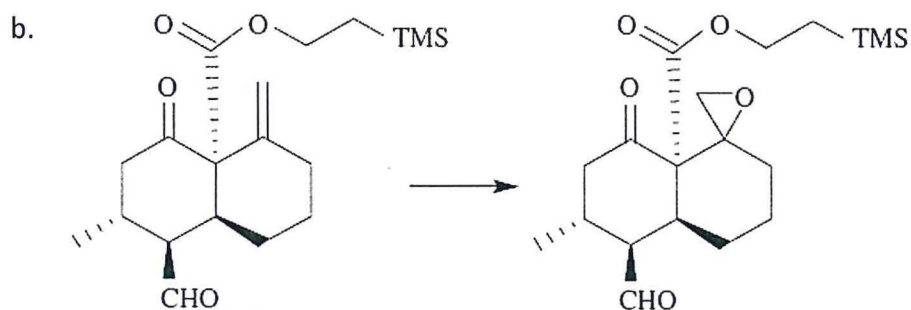
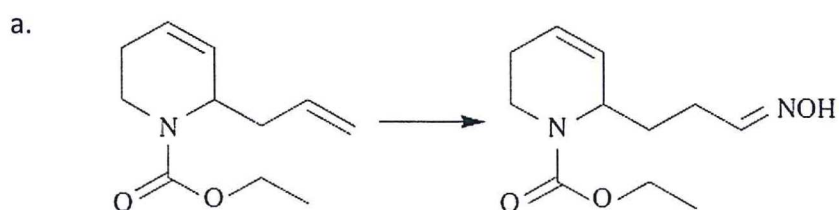


**QUESTION 2:**

[20]

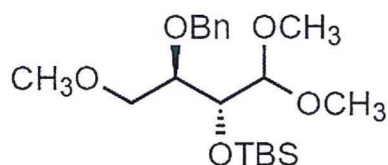
Question type: Functional Group Interconversions

Show how you would prepare the following products from the given starting materials. Where more than one step is required, show each step distinctly. (20)



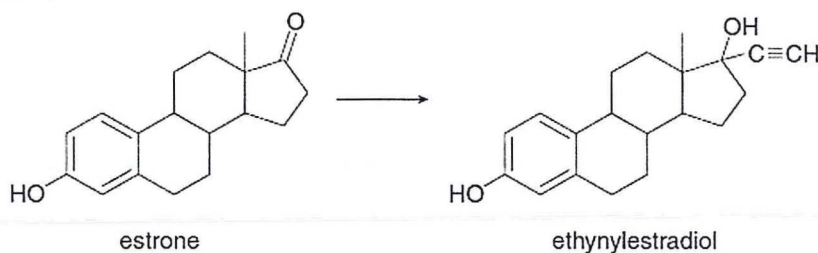
**QUESTION 3:****[20]****Question type: Protection/Deprotection of functional Groups**

3.1) Predict the major product expected when the given compound below is treated with each of the following reagent(s). If no reaction is expected, indicate as such. (15)

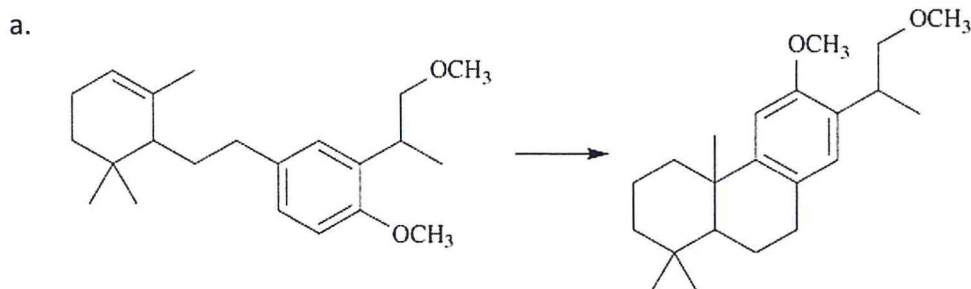


- H<sub>2</sub>, Pd
- (1) PhMgBr; (2) NH<sub>4</sub>Cl
- H<sub>3</sub>O<sup>+</sup> (pH 1)
- Bu<sub>4</sub>N<sup>+</sup>F<sup>-</sup>
- LDA

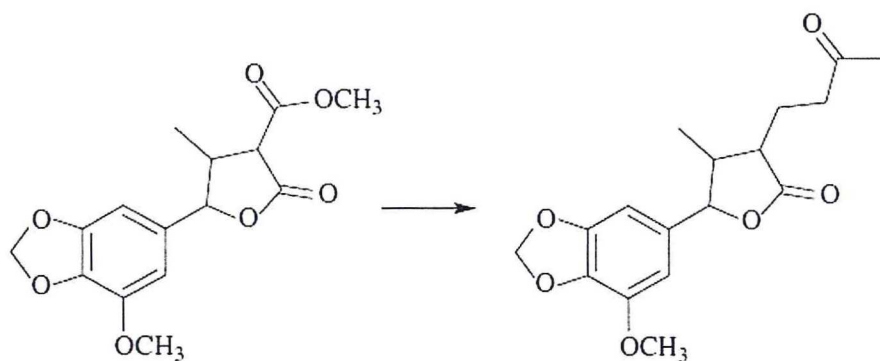
3.2) Using a protection strategy, show how estrone can be converted to ethynylestradiol, a widely used oral contraceptive. (5)

**QUESTION 4:****[20]****Question type: Carbon-Carbon bond formation**

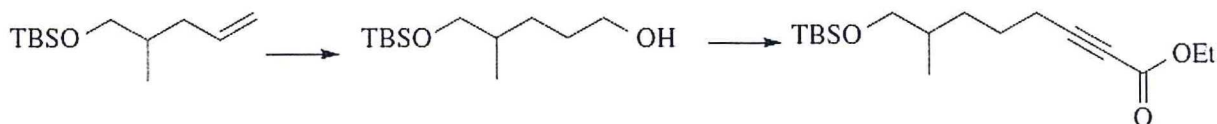
The following products are made through carbon-carbon bond forming reactions. Show how you would prepare each of the products below. Where more than one step is involved, show each step distinctly. (20)



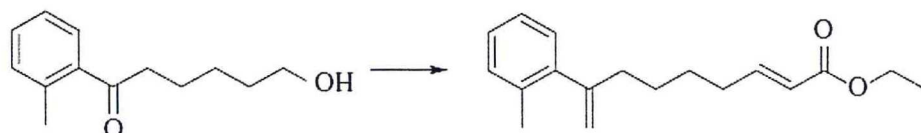
b.



c.



d.

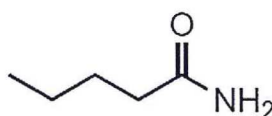


### QUESTION 5:

[20]

Question type: Retrosynthesis and Multi-step Synthesis

5.1) Consider the following product below. Provide a retrosynthetic analysis of the compound such that one of the starting materials required to achieve the synthesis is 1-propanol. (8)



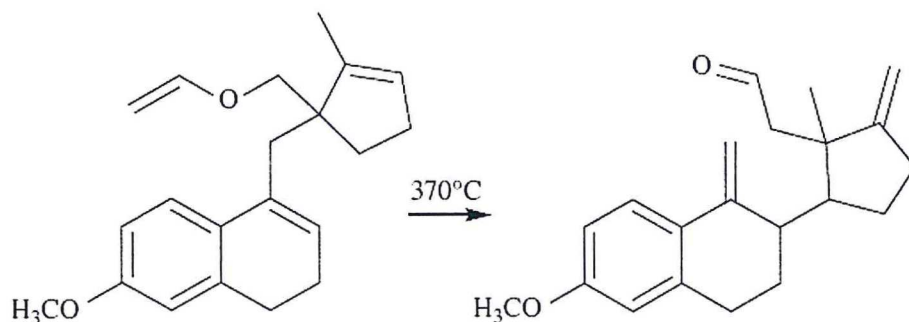
5.2) Based on the retrosynthetic analysis you devised in question 5.1, provide the necessary reagents to transform 1-propanol into the desired product. (12)

### QUESTION 6:

[20]

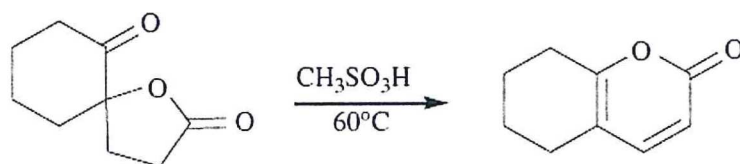
Question type: Pericyclic Reactions and Mechanisms

6.1) Draw a detailed mechanism to explain how the following product is formed and indicate the types of pericyclic reactions that are occurring. (6)





6.2) Draw a detailed mechanism for the transformation below. In order to receive full marks, show the flow of electrons with appropriate arrows and all the intermediates. (14)



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SOLVENT PHYSICAL PROPERTIES CHART

Solvent	Density (g/ml)	mp (°C)	bp (°C)	MW (g/mol)	Polarity index	Water solub. (g/100g)
Acetic acid	1.049	16.6	118.0	60.05	6.2	Miscible
Acetone	0.786	-94.3	56.3	58.08	5.1	Miscible
Acetonitrile	0.786	-46.0	81.6	41.05	5.8	Miscible
Benzene	0.879	5.5	80.1	78.11	2.7	0.18
Carbon tet.	1.594	-22.4	76.7	153.82	1.6	0.08
Chloroform	1.498	-63.7	61.7	112.56	4.1	0.795
Cyclohexane	0.779	6.6	80.7	84.16	0.2	<0.1
DCM	1.326	-96.7	39.8	84.93	3.1	1.32
Diethyl ether	0.713	-116.3	34.6	74.12	2.8	7.5
DMF	0.944	-61.0	153.0	73.09	6.4	Miscible
DMSO	1.092	18.4	189.0	78.13		25.3
Ethanol	0.789	-114.1	78.5	46.07	5.2	Miscible
Ethyl acetate	0.895	-83.6	77.0	88.11	4.4	8.7
Grease	-	-	-	-	-	-
Heptane	0.684	-90.6	98.0	100.20	0	0.01
Hexane	0.659	-95.0	69.0	86.18	0	0.014
HMPA	1.03	7.2	232.5	179.20		Miscible
Methanol	0.791	-98.0	64.6	32.04	5.1	Miscible
Pentane	0.626	-129.7	36.1	72.15	0	0.04
Petroleum ether	0.656	-40.0	30-60	-	0	-
2-Propanol	0.785	-88.5	82.4	88.15	3.9	Miscible
Pyridine	0.982	-41.6	115.2	79.10		Miscible
Silicone grease	-	-	-	-	-	-
THF	0.886	-108.4	66.0	72.11	4	30
Toluene	0.867	-93.0	110.6	92.14	2.4	0.05
Triethylamine	0.728	-114.7	88.9	101.19	-	0.02
Water	0.998	0.0	100.0	18.02	-	Miscible





