



NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY
FACULTY OF HEALTH, NATURAL RESOURCES AND APPLIED SCIENCES

SCHOOL OF NATURAL AND APPLIED SCIENCES
DEPARTMENT OF BIOLOGY, CHEMISTRY AND PHYSICS

QUALIFICATION: BACHELOR OF SCIENCE HONOURS	
QUALIFICATION CODE: 08BOSH	LEVEL: 8
COURSE CODE: AOC811S	COURSE NAME: ADVANCED ORGANIC CHEMISTRY
SESSION: JUNE 2023	PAPER: THEORY
DURATION: 3 HOURS	TOTAL MARKS: 100

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

INSTRUCTIONS	
<ol style="list-style-type: none">1. Answer ALL the questions.2. Write clearly and neatly.3. Number the answers clearly4. All written work must be done in blue or black ink and sketches can be done in pencil5. No books, notes and other additional aids are allowed	

PERMISSIBLE MATERIALS

Non-programmable Calculators

ATTACHMENTS

pKa Chart and Periodic Table

THIS QUESTION PAPER CONSISTS OF 7 PAGES
(Including this front page and attachments)

QUESTION 1:

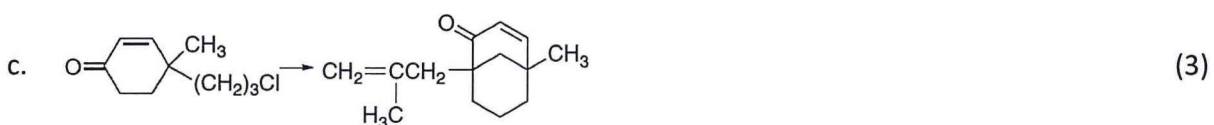
[21]

Question type: Enolates and Carbon Nucleophiles

1.1) Analyse the factors that you expect to control stereochemistry of the following reactions and draw the expected major products. Where applicable, clearly indicate the configuration of the new stereo-chemical centre created.

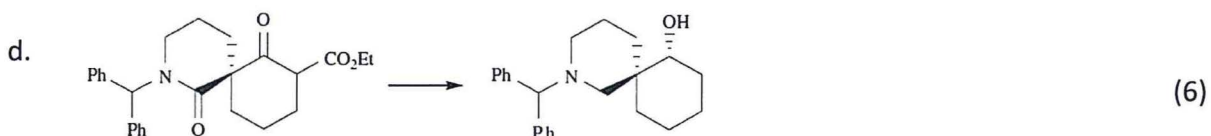
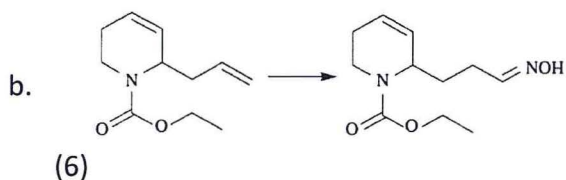


1.2) Indicate reagents and approximate reaction conditions that could be used to effect the following transformations. More than one step may be required.

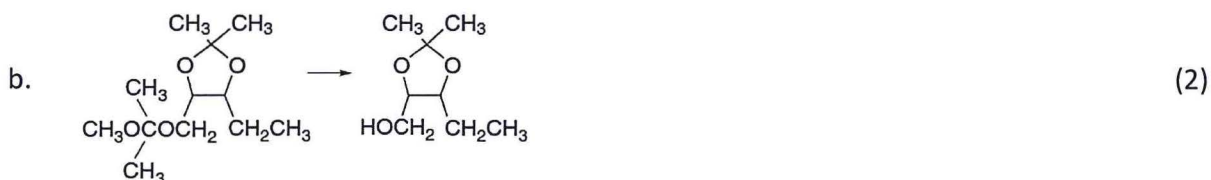


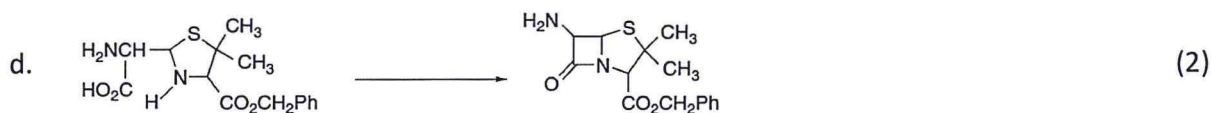
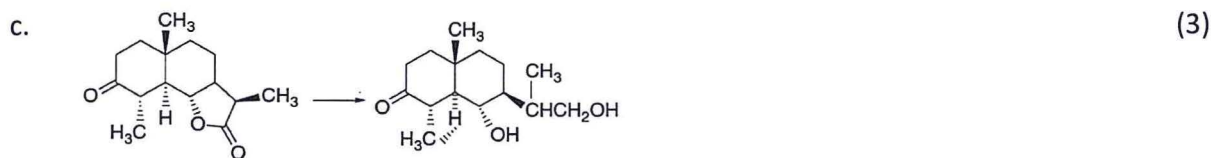
QUESTION 2:**[26]****Question type: Functional Group Interconversions**

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

**QUESTION 3:****[16]****Question type: Protection/Deprotection of functional Groups**

3.1) Show how the introduction or removal of protecting groups can be used to achieve the following transformations.





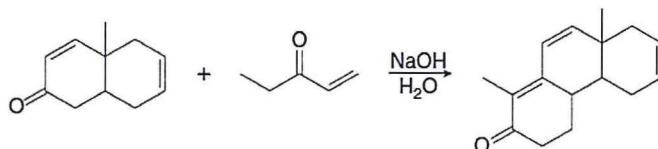
3.2) Using a protection group strategy, design a synthesis for the following multi-step transformation. Show all the necessary reagents, reaction conditions and intermediates. (7)



QUESTION 4: [16]

Question type: Mechanisms

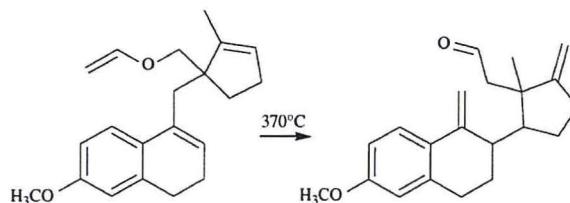
Draw a full detailed mechanism for the enolate-based reaction below which results in the formation of a new six-membered ring.



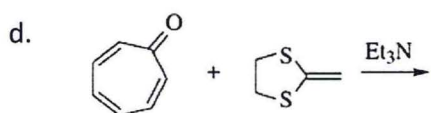
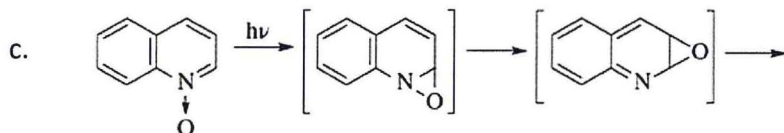
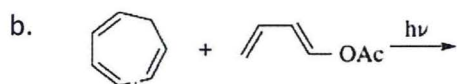
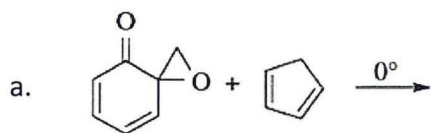
QUESTION 5: [21]

Question type: Pericyclic Reactions

5.1) Draw a detailed mechanism to explain how the following products are formed and indicate the types of pericyclic reactions that are occurring. (8)

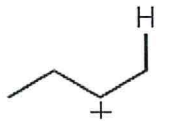
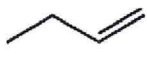
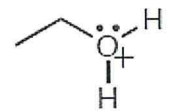
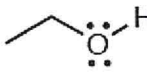
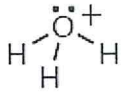
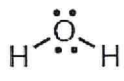
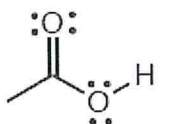
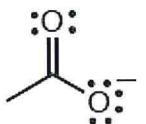


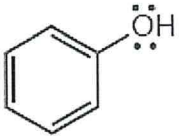
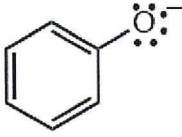

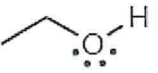
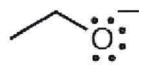
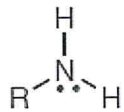
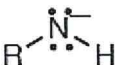
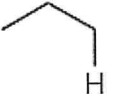

5.2) The series of reactions below demonstrates a number of pericyclic reactions. For each reaction, draw the product and indicate the type of reaction and the number of electrons involved. (13)



THE END

pKa Chart

	<u>conjugate acid</u>	<u>conjugate base</u>	
sulfuric acid	H_2SO_4	HSO_4^-	-10
hydroiodic acid	HI	I^-	-9
hydrobromic acid	HBr	Br^-	-8
hydrochloric acid	$\text{HCl}:$	$:\text{Cl}^-$	-7
carbocations			-3
protonated alcohol			-2.4
hydronium ion			-1.7
nitric acid	HNO_3	NO_3^-	-1.3
hydrofluoric acid	HF	F^-	3.2
carboxylic acids			4.8

	<u>conjugate acid</u>	<u>conjugate base</u>	
hydrogen cyanide	$\text{H}-\text{C}\equiv\text{N}:$	$:\text{C}\equiv\text{N}^-$ (cyanide)	9.1
phenols			10
water		$^-:\text{O}-\text{H}$ (hydroxide)	15.7
primary alcohols		 (alkoxides)	16
alkynes	$\text{C}\equiv\text{C}-\text{H}$	$\text{C}\equiv\text{C}^-$ (acetylide anions)	26
hydrogen	$\text{H}-\text{H}$	$:\text{H}^-$ (hydride)	35
ammonia/amines		 (amide bases)	36
alkanes			~60

hydrogen 1 H 1.0079																						helium 2 He 4.0026
lithium 3 Li 6.941	beryllium 4 Be 9.0122											boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180					
sodium 11 Na 22.990	magnesium 12 Mg 24.305											aluminum 13 Al 26.982	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.948					
potassium 19 K 39.098	calcium 20 Ca 40.078		scandium 21 Sc 44.956	titanium 22 Ti 47.867	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.39	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80				
rubidium 37 Rb 85.468	strontium 38 Sr 87.62		yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.94	technetium 43 Tc [93]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	palladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29				
caesium 55 Cs 132.91	barium 56 Ba 137.33	57-70 *	lutetium 71 Lu 174.97	hafnium 72 Hf 178.49	tantalum 73 Ta 160.95	tungsten 74 W 183.84	rhenium 75 Re 186.21	osmium 76 Os 190.23	iridium 77 Ir 192.22	platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	thallium 81 Tl 204.38	lead 82 Pb 207.2	bismuth 83 Bi 208.98	polonium 84 Po [209]	astatine 85 At [210]	radon 86 Rn [222]				
francium 87 Fr [223]	radium 88 Ra [226]	89-102 * *	lawrencium 103 Lr [262]	rutherfordium 104 Rf [261]	dubnium 105 Db [262]	seaborgium 106 Sg [266]	bohrium 107 Bh [264]	hassium 108 Hs [269]	meitnerium 109 Mt [268]	ununnilium 110 Uun [271]	unununium 111 Uuu [272]	ununbium 112 Uub [277]		ununquadium 114 Uuq [289]								

* Lanthanide series

** Actinide series

lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04
actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]