



PAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF HEALTH AND APPLIED SCIENCES

DEPARTMENT OF NATURAL AND APPLIED SCIENCES

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

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

<p style="text-align: center;">INSTRUCTIONS</p> <ol style="list-style-type: none">1. Answer ONLY FIVE OF THE SIX 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
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PERMISSIBLE MATERIALS

Non-programmable Calculators

ATTACHMENTS

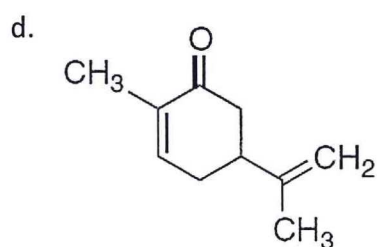
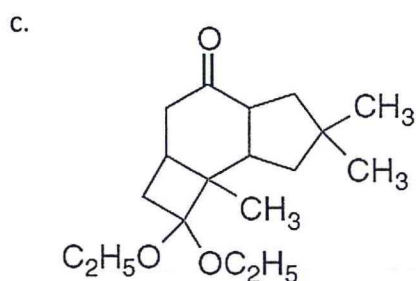
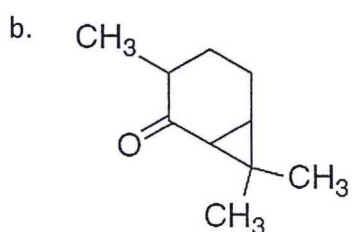
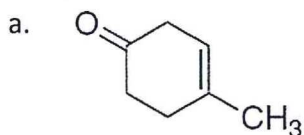
Solvent Chart, pKa Chart and Periodic Table

THIS QUESTION PAPER CONSISTS OF 8 PAGES

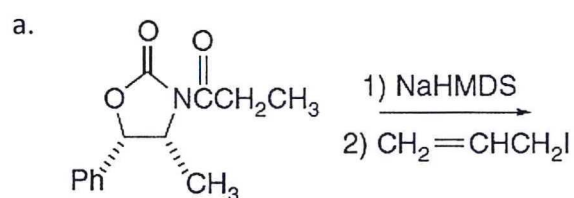
(Including this front page and attachments)

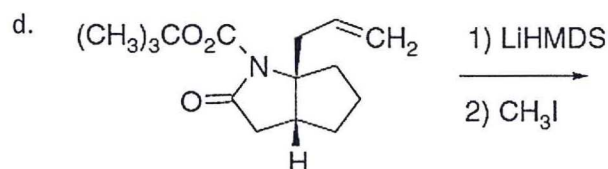
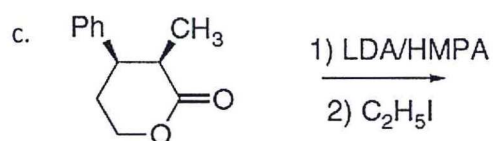
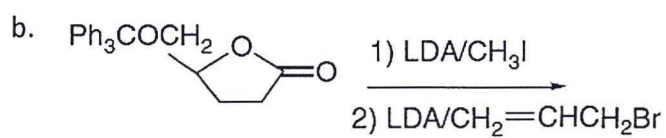
QUESTION 1:**[20]****Question type: Enolates and Carbon Nucleophiles**

1.1) Write the structures of all the possible enolates for each ketone. Indicate which you expect to be favoured in a kinetically controlled deprotonation and which you would expect to be the most stable. (12)



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. (8)



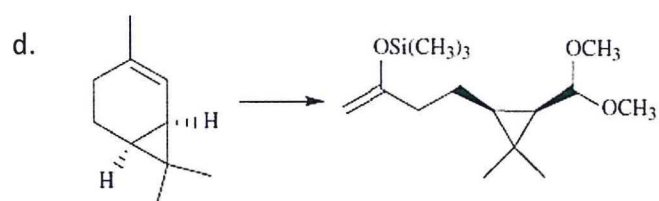
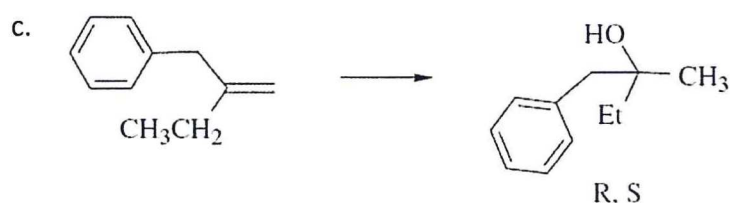
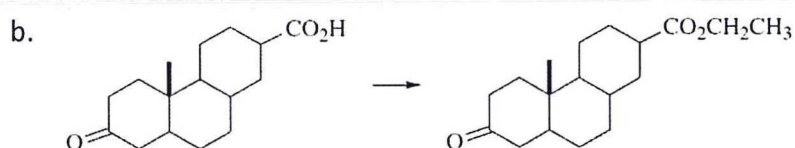
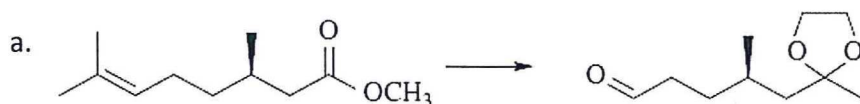


QUESTION 2:

[20]

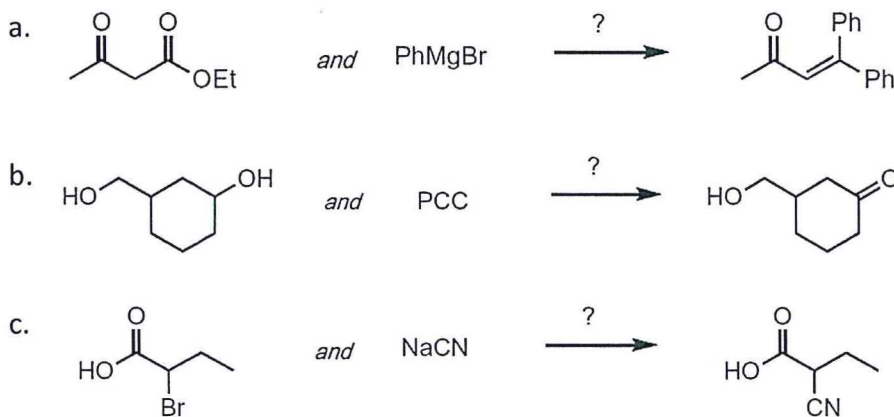
Question type: Functional Group Interconversions

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)

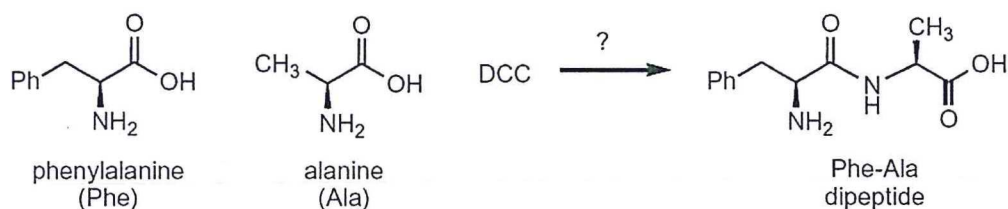


QUESTION 3:**[20]****Question type: Protection/Deprotection of functional Groups**

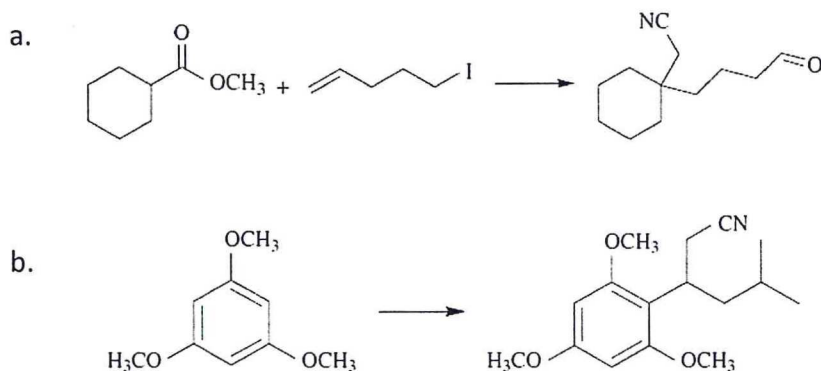
3.1) Provide the reaction steps needed to accomplish each of the following transformations, using the starting materials and reagents given, along with any reagents needed for the installation and removal of required protective groups. (18)

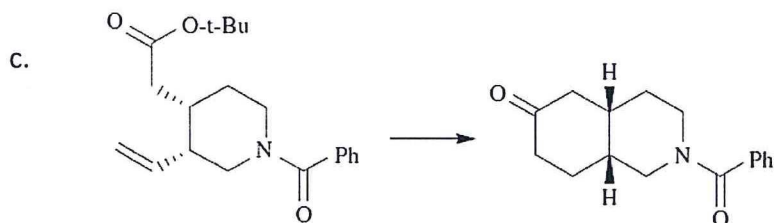


3.2) Show how protecting groups can be used to prepare the following dipeptide from the given amino acids. (2)

**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)



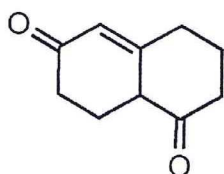


QUESTION 5:

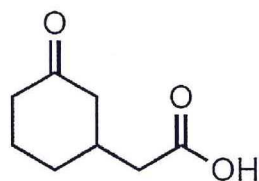
[20]

Question type: Retrosynthesis and Multi-step Synthesis

5.1) Propose a possible disconnection/retrosynthesis for each the following target molecule. Consider the pattern of functional groups when determining the best site for a disconnection. (8)



5.2) Starting with cyclohexanone, provide both a retrosynthetic analysis and synthetic strategy for the following target molecule. (12)

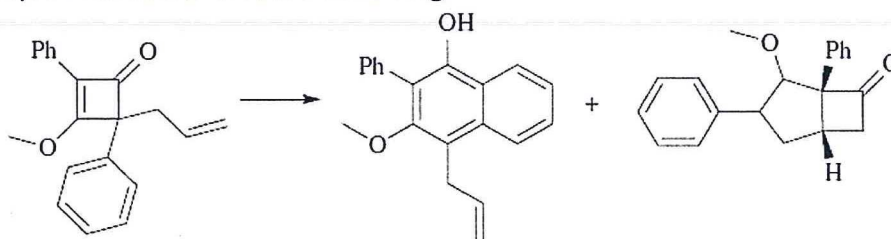


QUESTION 6:

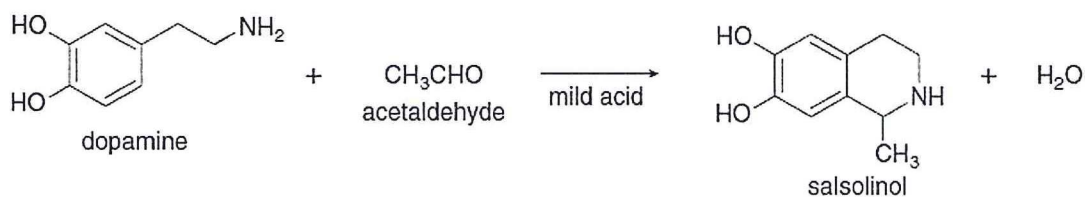
[20]

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. (8)



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. (10)







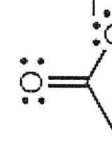
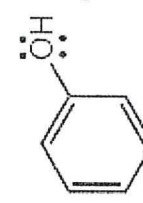
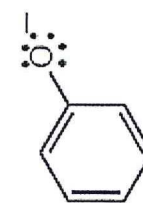
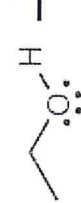
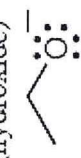
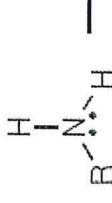





**THE END
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SOLVENT PHYSICAL PROPERTIES CHART

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

pKa Chart

<u>conjugate acid</u>	\longrightarrow	<u>conjugate base</u>	
sulfuric acid H_2SO_4	\longrightarrow	HSO_4^-	
hydroiodic acid HI	\longrightarrow	I^-	
hydrobromic acid HBr	\longrightarrow	Br^-	
hydrochloric acid HCl	\longrightarrow	Cl^-	
carbocations 	\longrightarrow		
protonated alcohol 	\longrightarrow		
hydronium ion 	\longrightarrow	H_2O	
nitric acid HNO_3	\longrightarrow	NO_3^-	
hydrofluoric acid HF	\longrightarrow	F^-	
carboxylic acids 	\longrightarrow		
-10		hydrogen cyanide $\text{H}-\text{C}\equiv\text{N}$	\longrightarrow <u>conjugate base</u> $:\text{C}\equiv\text{N}^-$ (cyanide) 9.1
-9		phenols 	\longrightarrow  10
-8		water $\text{H}-\text{O}-\text{H}$	\longrightarrow $^-:\text{O}-\text{H}$ 15.7
-7		primary alcohols 	\longrightarrow  (hydroxide) 16
-3		alkynes $\text{C}\equiv\text{C}-\text{H}$	\longrightarrow $\text{C}\equiv\text{C}^-$ (acetylide anions) 26
-2.4		hydrogen $\text{H}-\text{H}$	\longleftarrow $:\text{H}^-$ (hydride) 35
-1.7		ammonia/amines 	\longrightarrow  (amide bases) 36
-1.3		alkanes 	\longrightarrow  ~60
3.2			
4.8			

hydrogen 1 H 1.0079	beryllium 4 Be 9.0122	helium 2 He 4.0026	lithium 3 Li 6.941	magnesium 12 Mg 24.305	neon 10 Ne 20.180	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	argon 18 Ar 39.948	potassium 19 K 39.098	calcium 20 Ca 40.078	krypton 36 Kr 83.80	sodium 11 Na 22.990	strontium 38 Sr 87.62	xenon 54 Xe 131.29	aluminum 13 Al 26.982	yttrium 39 Y 88.906	zinc 30 Zn 65.39	barium 56 Ba 137.33	radon 86 Rn [222]	aluminium 13 Al 26.982	gallium 31 Ga 69.723	cadmium 48 Cd 112.41	tin 50 Sn 118.71	polonium 84 Po [209]	silicon 14 Si 28.086	germanium 32 Ge 72.61	lead 82 Pb 207.2	astatine 85 At [210]	phosphorus 15 P 30.974	arsenic 33 As 74.922	bismuth 83 Bi 208.98	iodine 53 I 126.90	ununquadium 114 Uuq [289]	unubium 112 Uub [277]	ununnium 111 Uun [271]	ununoctium 110 Uuo [272]	ununseptium 109 Uus [268]	ununhexium 108 Uuh [269]	ununpentium 107 Uup [264]	ununquadium 106 Uuq [266]	ununquadium 105 Uuq [262]	ununquadium 104 Uuq [261]	ununquadium 103 Uuq [262]	ununquadium 102 Uuq [261]	ununquadium 101 Uuq [261]	ununquadium 100 Uuq [261]	ununquadium 99 Uuq [261]	ununquadium 98 Uuq [261]	ununquadium 97 Uuq [261]	ununquadium 96 Uuq [261]	ununquadium 95 Uuq [261]	ununquadium 94 Uuq [261]	ununquadium 93 Uuq [261]	ununquadium 92 Uuq [261]	ununquadium 91 Uuq [261]	ununquadium 90 Uuq [261]	ununquadium 89 Uuq [261]	ununquadium 88 Uuq [261]	ununquadium 87 Uuq [261]	ununquadium 86 Uuq [261]	ununquadium 85 Uuq [261]	ununquadium 84 Uuq [261]	ununquadium 83 Uuq [261]	ununquadium 82 Uuq [261]	ununquadium 81 Uuq [261]	ununquadium 80 Uuq [261]	ununquadium 79 Uuq [261]	ununquadium 78 Uuq [261]	ununquadium 77 Uuq [261]	ununquadium 76 Uuq [261]	ununquadium 75 Uuq [261]	ununquadium 74 Uuq [261]	ununquadium 73 Uuq [261]	ununquadium 72 Uuq [261]	ununquadium 71 Uuq [261]	ununquadium 70 Uuq [261]	ununquadium 69 Uuq [261]	ununquadium 68 Uuq [261]	ununquadium 67 Uuq [261]	ununquadium 66 Uuq [261]	ununquadium 65 Uuq [261]	ununquadium 64 Uuq [261]	ununquadium 63 Uuq [261]	ununquadium 62 Uuq [261]	ununquadium 61 Uuq [261]	ununquadium 60 Uuq [261]	ununquadium 59 Uuq [261]	ununquadium 58 Uuq [261]	ununquadium 57 Uuq [261]	ununquadium 56 Uuq [261]	ununquadium 55 Uuq [261]	ununquadium 54 Uuq [261]	ununquadium 53 Uuq [261]	ununquadium 52 Uuq [261]	ununquadium 51 Uuq [261]	ununquadium 50 Uuq [261]	ununquadium 49 Uuq [261]	ununquadium 48 Uuq [261]	ununquadium 47 Uuq [261]	ununquadium 46 Uuq [261]	ununquadium 45 Uuq [261]	ununquadium 44 Uuq [261]	ununquadium 43 Uuq [261]	ununquadium 42 Uuq [261]	ununquadium 41 Uuq [261]	ununquadium 40 Uuq [261]	ununquadium 39 Uuq [261]	ununquadium 38 Uuq [261]	ununquadium 37 Uuq [261]	ununquadium 36 Uuq [261]	ununquadium 35 Uuq [261]	ununquadium 34 Uuq [261]	ununquadium 33 Uuq [261]	ununquadium 32 Uuq [261]	ununquadium 31 Uuq [261]	ununquadium 30 Uuq [261]	ununquadium 29 Uuq [261]	ununquadium 28 Uuq [261]	ununquadium 27 Uuq [261]	ununquadium 26 Uuq [261]	ununquadium 25 Uuq [261]	ununquadium 24 Uuq [261]	ununquadium 23 Uuq [261]	ununquadium 22 Uuq [261]	ununquadium 21 Uuq [261]	ununquadium 20 Uuq [261]	ununquadium 19 Uuq [261]	ununquadium 18 Uuq [261]	ununquadium 17 Uuq [261]	ununquadium 16 Uuq [261]	ununquadium 15 Uuq [261]	ununquadium 14 Uuq [261]	ununquadium 13 Uuq [261]	ununquadium 12 Uuq [261]	ununquadium 11 Uuq [261]	ununquadium 10 Uuq [261]	ununquadium 9 Uuq [261]	ununquadium 8 Uuq [261]	ununquadium 7 Uuq [261]	ununquadium 6 Uuq [261]	ununquadium 5 Uuq [261]	ununquadium 4 Uuq [261]	ununquadium 3 Uuq [261]	ununquadium 2 Uuq [261]	ununquadium 1 Uuq [261]
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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]

* Lanthanide series

** Actinide series