

1<sup>st</sup> Letter of Last  
Name

**NAME:**

## 610B Exam Cover Page

To be eligible for a regrade, the exam must be written in *ink*.

**No calculators of any sort allowed.**

You have 3 hours to complete the exam.

CHEM 610B, 50995

Exam 3

Fall 2003

Instructor: Dr. Brian Pagenkopf

Email: \_\_\_\_\_

NAME: \_\_\_\_\_

<b>Page</b>	<b>Points</b>
<b>3</b>	<b>2</b>
<b>4</b>	<b>5</b>
<b>5</b>	<b>8</b>
<b>6</b>	<b>12</b>
<b>7</b>	<b>4</b>
<b>8</b>	<b>3</b>
<b>9</b>	<b>4</b>
<b>10</b>	<b>8</b>
<b>11</b>	<b>8</b>
<b>12</b>	<b>8</b>
<b>13</b>	<b>4</b>
<b>14</b>	<b>6</b>
<b>15</b>	<b>9</b>
<b>16</b>	<b>12</b>
<b>17</b>	<b>7</b>
	<b>100</b>

**PERIODIC TABLE OF THE ELEMENTS**

Atomic masses are based on  $^{12}\text{C}$ . Atomic masses in parentheses are for the most stable isotope.

6 <b>C</b> 12.011																		2 <b>He</b> 4.00260																																	
1 <b>H</b> 1.00079																		10 <b>Ne</b> 20.179																																	
3 <b>Li</b> 6.941		4 <b>Be</b> 9.01218																		5 <b>B</b> 10.81		6 <b>C</b> 12.011		7 <b>N</b> 14.0067		8 <b>O</b> 15.9994		9 <b>F</b> 18.998403		18 <b>Ar</b> 39.948																					
11 <b>Na</b> 22.98977		12 <b>Mg</b> 24.305		13 <b>Al</b> 26.98154		14 <b>Si</b> 28.0855		15 <b>P</b> 30.97376		16 <b>S</b> 32.06		17 <b>Cl</b> 35.453		18 <b>Ar</b> 39.948		19 <b>K</b> 39.0963		20 <b>Ca</b> 40.08		21 <b>Sc</b> 44.9559		22 <b>Ti</b> 47.90		23 <b>V</b> 50.9415		24 <b>Cr</b> 51.996		25 <b>Mn</b> 54.9380		26 <b>Fe</b> 55.847		27 <b>Co</b> 58.9332		28 <b>Ni</b> 58.70		29 <b>Cu</b> 63.546		30 <b>Zn</b> 65.38		31 <b>Ga</b> 69.72		32 <b>Ge</b> 72.59		33 <b>As</b> 74.9216		34 <b>Se</b> 78.96		35 <b>Br</b> 79.904		36 <b>Kr</b> 83.80	
37 <b>Rb</b> 85.4678		38 <b>Sr</b> 87.62		39 <b>Y</b> 88.9059		40 <b>Zr</b> 91.22		41 <b>Nb</b> 92.9064		42 <b>Mo</b> 95.94		43 <b>Tc</b> (98)		44 <b>Ru</b> 101.07		45 <b>Rh</b> 102.9055		46 <b>Pd</b> 106.4		47 <b>Ag</b> 107.868		48 <b>Cd</b> 112.41		49 <b>In</b> 114.82		50 <b>Sn</b> 118.69		51 <b>Sb</b> 121.75		52 <b>Te</b> 127.60		53 <b>I</b> 126.9045		54 <b>Xe</b> 131.30																	
55 <b>Cs</b> 132.9054		56 <b>Ba</b> 137.33		57 <b>La</b> 138.9055		58 <b>Ce</b> 140.12		59 <b>Pr</b> 140.9077		60 <b>Nd</b> 144.24		61 <b>Pm</b> (145)		62 <b>Sm</b> 150.4		63 <b>Eu</b> 151.96		64 <b>Gd</b> 157.25		65 <b>Tb</b> 158.9254		66 <b>Dy</b> 162.50		67 <b>Ho</b> 164.9304		68 <b>Er</b> 167.26		69 <b>Tm</b> 168.9342		70 <b>Yb</b> 173.04		71 <b>Lu</b> 174.967																			
87 <b>Fr</b> (223)		88 <b>Ra</b> (226)		89 <b>Ac</b> (227)		90 <b>Th</b> 232.038		91 <b>Pa</b> 231.0359		92 <b>U</b> 238.029		93 <b>Np</b> 237.0482		94 <b>Pu</b> (244)		95 <b>Am</b> (243)		96 <b>Cm</b> (247)		97 <b>Bk</b> (247)		98 <b>Cf</b> (251)		99 <b>Es</b> (252)		100 <b>Fm</b> (257)		101 <b>Md</b> (258)		102 <b>No</b> (259)		103 <b>Lr</b> (260)																			

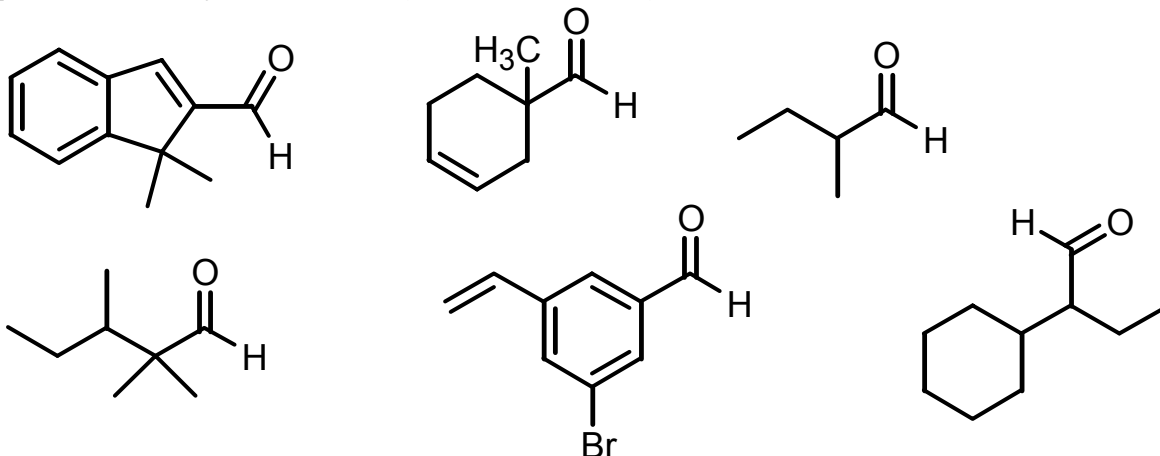
\*Lanthanide series

58 <b>Ce</b> 140.12	59 <b>Pr</b> 140.9077	60 <b>Nd</b> 144.24	61 <b>Pm</b> (145)	62 <b>Sm</b> 150.4	63 <b>Eu</b> 151.96	64 <b>Gd</b> 157.25	65 <b>Tb</b> 158.9254	66 <b>Dy</b> 162.50	67 <b>Ho</b> 164.9304	68 <b>Er</b> 167.26	69 <b>Tm</b> 168.9342	70 <b>Yb</b> 173.04	71 <b>Lu</b> 174.967
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† Actinide series

90 <b>Th</b> 232.038	91 <b>Pa</b> 231.0359	92 <b>U</b> 238.029	93 <b>Np</b> 237.0482	94 <b>Pu</b> (244)	95 <b>Am</b> (243)	96 <b>Cm</b> (247)	97 <b>Bk</b> (247)	98 <b>Cf</b> (251)	99 <b>Es</b> (252)	100 <b>Fm</b> (257)	101 <b>Md</b> (258)	102 <b>No</b> (259)	103 <b>Lr</b> (260)
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Question 1. (2 points). How many different aldol condensation products (as  $\beta$ -hydroxy aldehydes) are possible from the following mix of aldehydes, even if expected to be a minor product? Put your answer (a whole number) in the box.



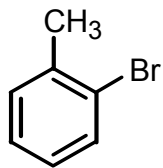
# of possible aldol products  $\longrightarrow$

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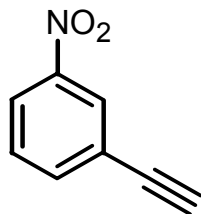
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Question 2. (5 points) Nomenclature. Name the following.

a.



b.



Draw the following.

c. 1-phenylcyclopropanol

d. benzylbromide

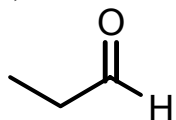
e. 3-phenyl-2-propene-1-ol

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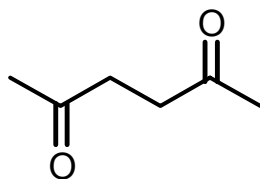
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Question 3. (8 points). Draw the products from an aldol reaction of the following compounds. Show the beta-hydroxy aldehyde or ketone product and the alpha,beta-unsaturated aldehyde or ketone resulting from dehydration. Only show aldol products between two molecules.

a)



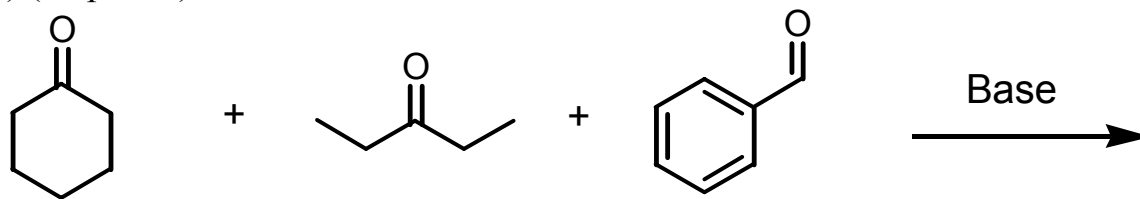
b) show only the intramolecular product.



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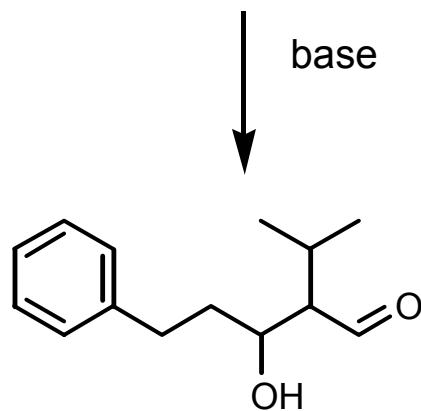
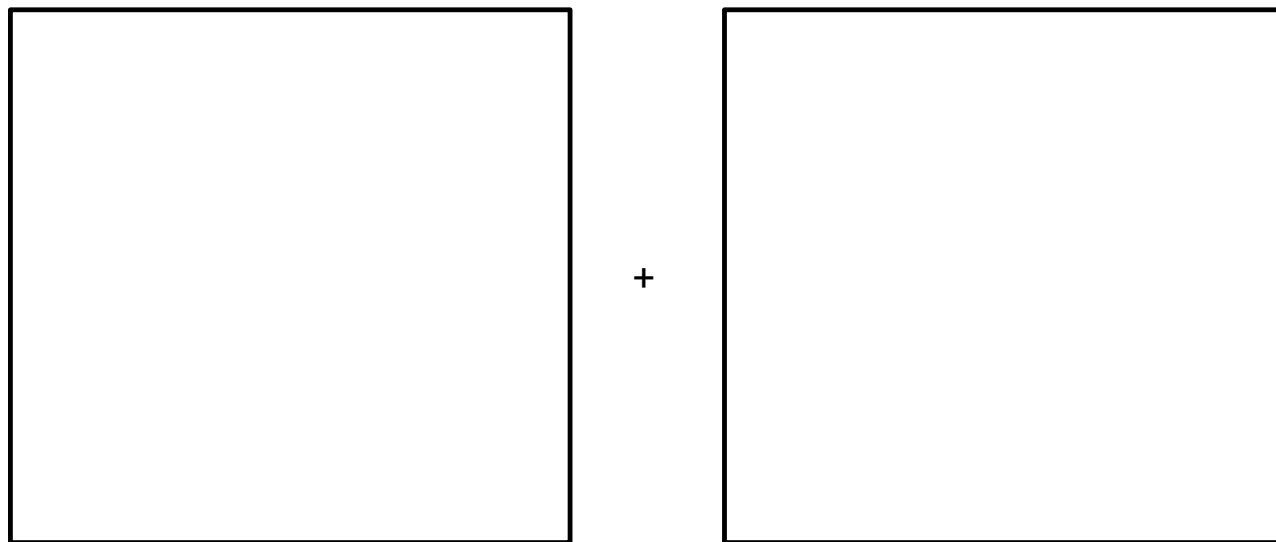
c) (12 points)



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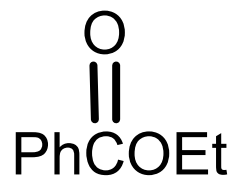
Question 4. (4 points) Aldol Reactions. The following molecule was one of several different structures isolated from an aldol condensation reaction. What were the starting materials?



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Question 5. (3 points) Draw the structural formula of the beta-ketoester formed by Claisen condensation of ethyl propanoate with the following ester.

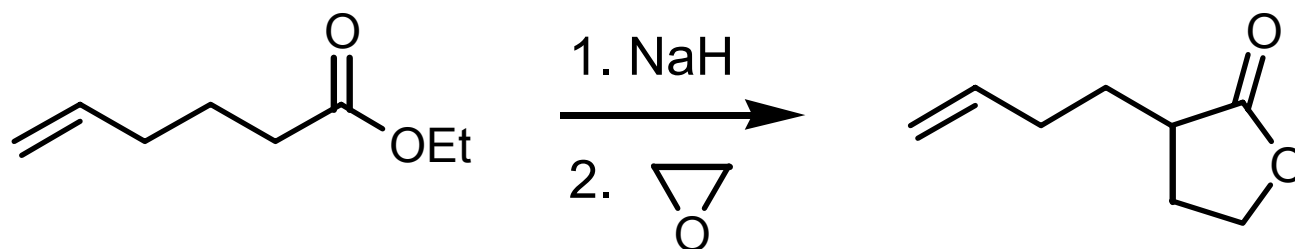




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Question 6. (4 points) Propose a mechanism for the following conversion.

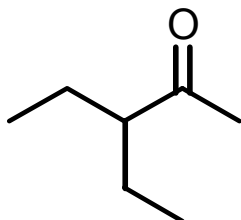


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Question 7. Show how to synthesize the following compounds using either the malonic ester synthesis or the acetoacetic ester synthesis. (24 points)

a.

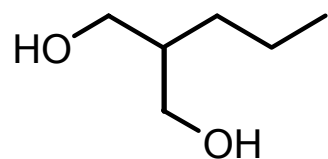


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b.

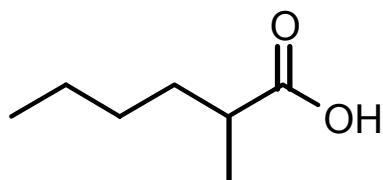


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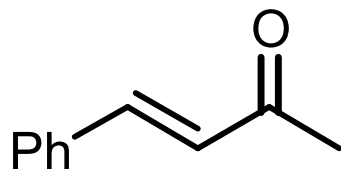
c.



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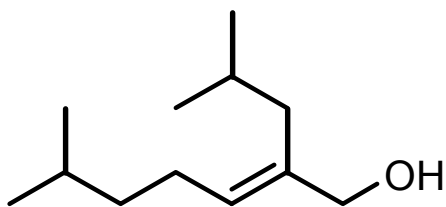
Question 8. (4 points). Synthesis. Show how to prepare the alpha,beta-unsaturated ketone by an aldol reaction followed by dehydration.



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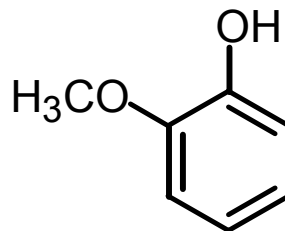
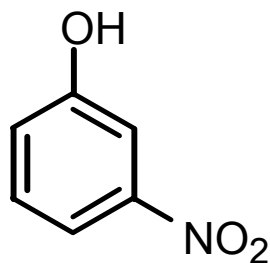
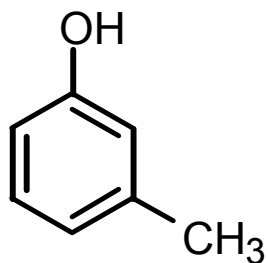
Question 9. (6 points) Propose a synthesis of the following compound using any reagents you like with the only restriction that each reagent can only add six carbons or less to the target molecule.



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Question 10.(9 points) Acidity of phenols. In the box below each structure estimate the pKa of each phenol. For each phenol show important resonance structures of the phenoxide anion that are important in influencing phenol acidity. (Extra space on next page)

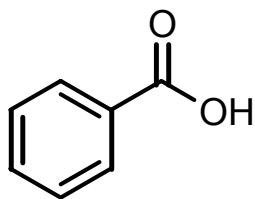


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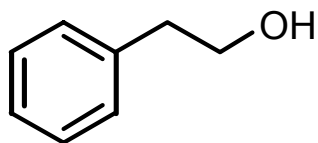
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Question 11. (12 points) Using only ethylbenzene as the only aromatic starting material, show how to synthesize the following compounds. You may use any other necessary organic or inorganic chemicals.

a.



b.





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Question 12. (7 points) Determine the structure of a compound formula  $C_{10}H_{12}O_2$  based on the  $^{13}C$  and  $^1H$  NMR spectra. Show work for partial credit. (Spectra on next page).

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