

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 C 12.011		Atomic number Symbol Atomic mass																						
Groups	1A																	VIIIA						
Periods	1																	2						
	H																	He						
	1.00079																	4.00260						
	3	4																	5	6	7	8	9	10
	Li	Be																	B	C	N	O	F	Ne
	6.941	9.01218																	10.81	12.011	14.0067	15.9994	18.998403	20.179
	11	12																	13	14	15	16	17	18
	Na	Mg																	Al	Si	P	S	Cl	Ar
	22.98977	24.305																	26.98154	28.0855	30.97376	32.06	35.453	39.948
	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36						
	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr						
	39.0963	40.08	44.9559	47.90	50.9415	51.996	54.9380	55.847	58.9332	58.70	63.546	65.38	69.72	72.59	74.9216	78.96	79.904	83.80						
	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54						
	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe						
	85.4678	87.62	88.9059	91.22	92.9064	95.94	(98)	101.07	102.9055	106.4	107.868	112.41	114.82	118.69	121.75	127.60	126.9045	131.30						
	55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86						
	Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn						
	132.9054	137.33	138.9055	178.49	180.9479	183.85	186.207	190.2	192.22	195.09	196.9665	200.59	204.37	207.2	208.9804	(209)	(210)	(222)						
	87	88	89	104	105	106																		
	Fr	Ra	Ac	Unq	Unp	Unh																		
	(223)	226.0254	227.0278	(261)	(262)	(263)																		

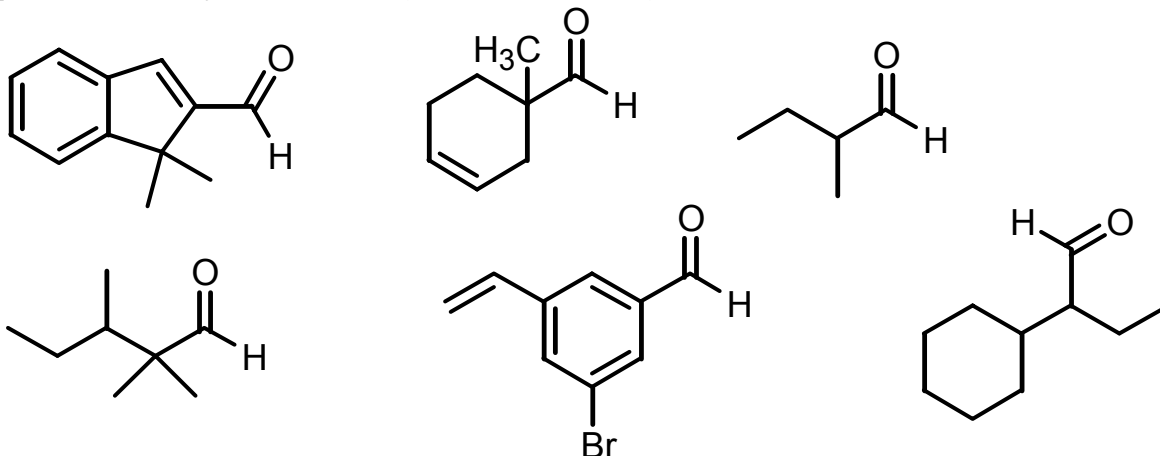
\*Lanthanide series

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

†Actinide series

90	91	92	93	94	95	96	97	98	99	100	101	102	103
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
232.038	231.0359	238.029	237.0482	(244)	(243)	(247)	(247)	(251)	(252)	(257)	(258)	(259)	(260)

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.



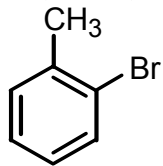
# of possible aldol products  $\longrightarrow$

12

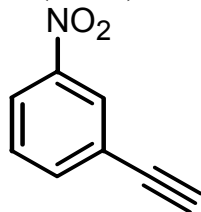
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Question 2. (5 points) Nomenclature. Name the following.

a. (20.8b)



b. (20.8f)



Draw the following.

c. (20.9i) 1-phenylcyclopropanol

d. (20.9l) benzylbromide

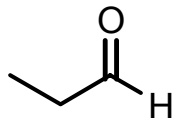
e. (20.9n) 3-phenyl-2-propene-1-ol

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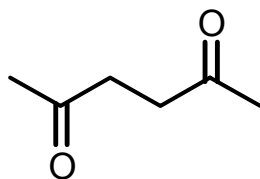
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Question 3. (8 points) ALDOLS. Draw structural formulas of the products from an aldol reaction of the following compounds. Show the beta-hydroxy aldehyde or ketone product and the alpha,beta-unsaturated aldehyde or ketone resulting from dehydration.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

a) 19.18a



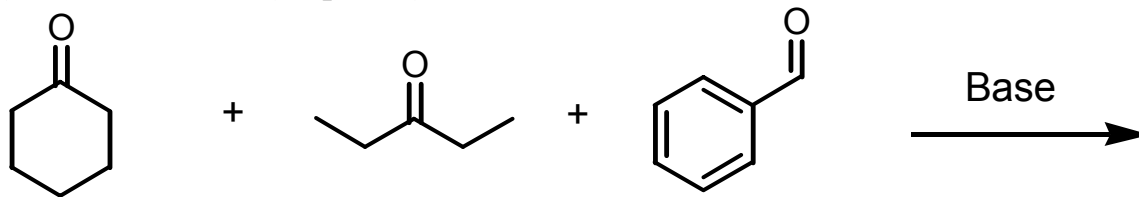
b) show only the intramolecular product. 19.18c



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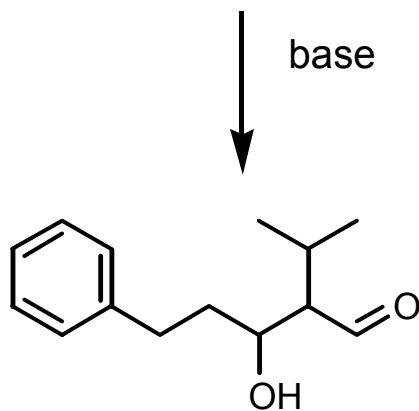
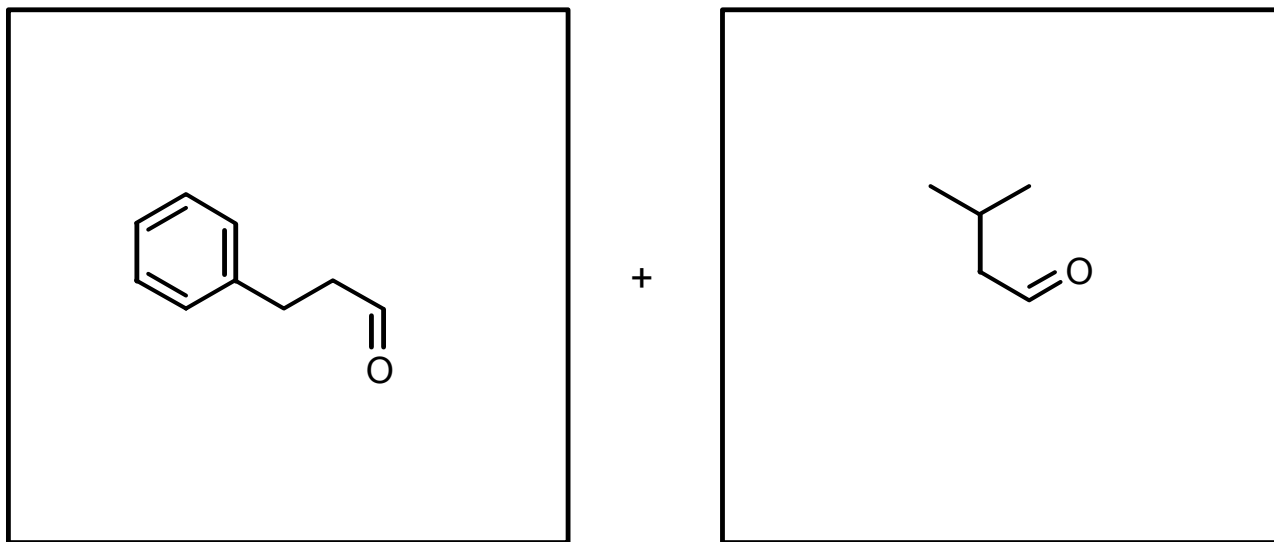
c) homework 3, ii (12 points)



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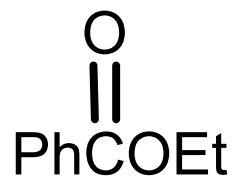
Question 4. (4 points) Aldol Reactions. The following molecule was one of several different structures isolated from an aldol condensation reaction. What were the starting materials?



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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. (19.33b)

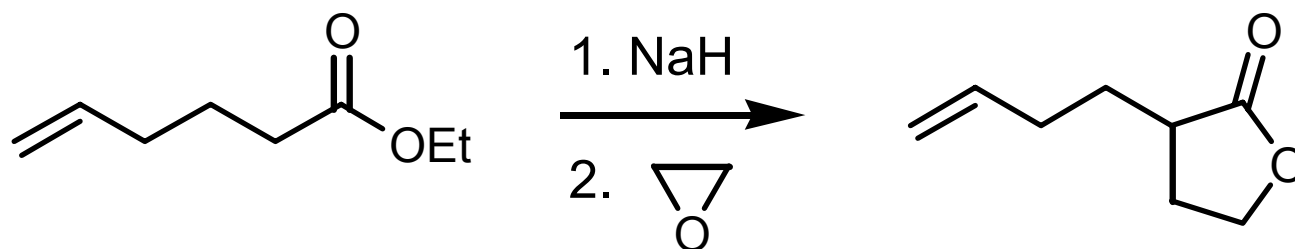




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Question 6. (4 points) Propose a mechanism for the following conversion. (19.38)

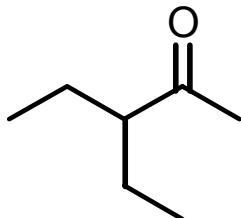


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Question 7. Show how to synthesize the following compounds using either the malonic ester synthesis or the acetoacetic ester synthesis. (24 points)

a. (19.48a)

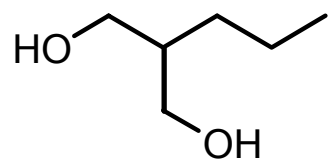


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b. (19.48d)

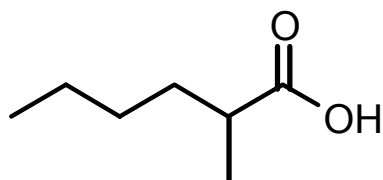


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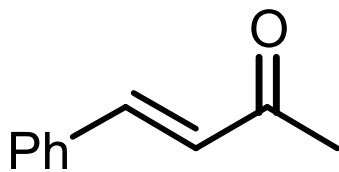
c. (19.48b)



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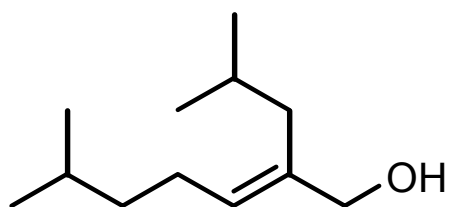
Question 8. (4 points). Synthesis. Show how to prepare the alpha,beta-unsaturated ketone by an aldol reaction followed by dehydration. (19.21a)



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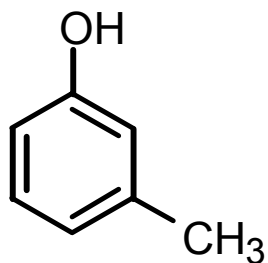
Question 9. (6 points) Propose a synthesis of the following compound using any reagents you like with the only restriction that each reagent can only add six carbons or less to the target molecule. (homework 3, 1b)



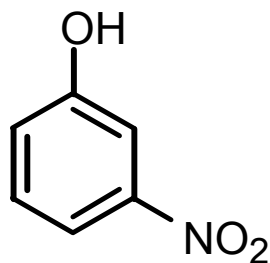
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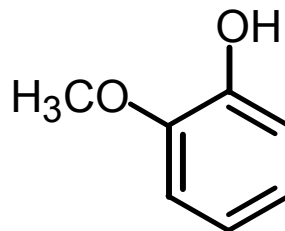
Question 10.(9 points) Acidity of phenols. In the box below each structure estimate the pKa of each phenol. For each phenol show important resonance structures of the phenoxide anion that are important in influencing phenol acidity. (Extra space on next page)



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9



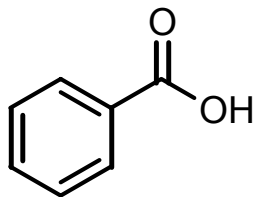
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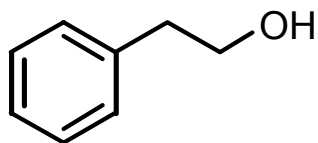
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Question 11. (12 points) Using only ethylbenzene as the only aromatic starting material, show how to synthesize the following compounds. You may use any other necessary organic or inorganic chemicals.

a. (20.49a)



b. (20.49d)

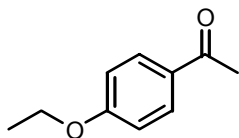




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Question 12. (7 points) Determine the structure of a compound formula  $C_{10}H_{12}O_2$  based on the  $^{13}C$  and  $^1H$  NMR spectra. Show work for partial credit. (Spectra on next page).



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