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Email: _____

The exam must be written in ink. No calculators of any sort allowed. You have 3 hours to complete the exam.

CHEM 610B; Final Exam; Spring 2002; Instructor: Dr. Brian Pagenkopf

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(10 points) Nomenclature. Provide a structure for each of the following.

a. propyl ethanoate

b. butanoyl chloride

c. butylmagnesium bromide

d. 2,4,6-trinitrotoluene

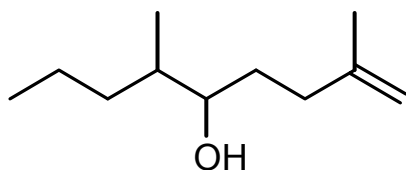
e. 4-bromo-1,2-diethylbenzene

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(8 points) Both of the following reactions can be used to prepare the alcohol shown below.

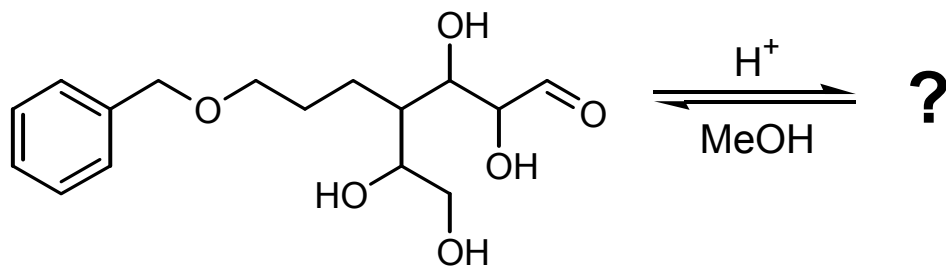
- a) epoxide + organometallic reagent \rightarrow alcohol
- b) aldehyde or ketone + organometallic reagent \rightarrow alcohol

Propose two syntheses for the following molecule starting from a) an epoxide and b) an aldehyde or ketone. Don't forget sterics in designing your answer.



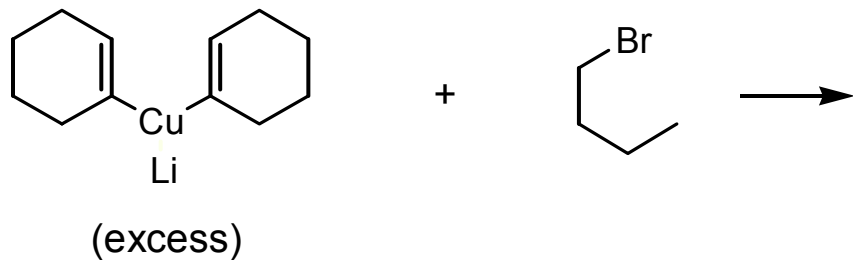
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(4 points) Draw the most stable (thermodynamic) *acetal* for the following molecule. You may ignore stereochemistry.

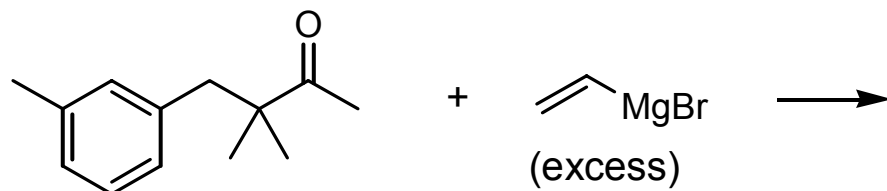


(45 points) Show the expected products from the following reactions. You may assume the reaction is finished with a standard workup if needed. Show any product(s) that contains a carbon atom.

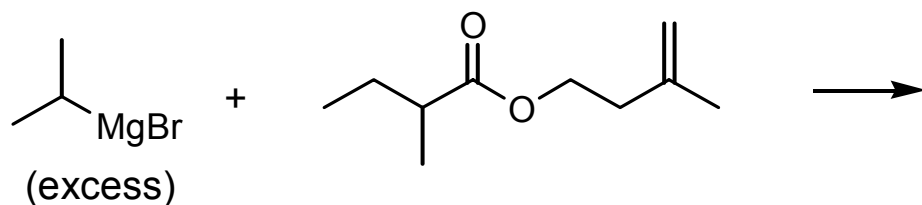
a.



b.



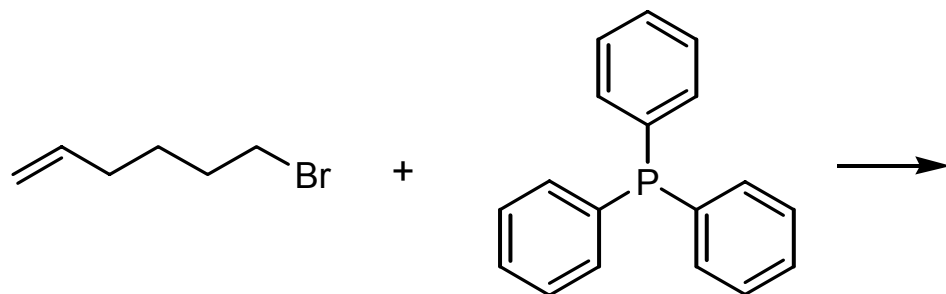
c.



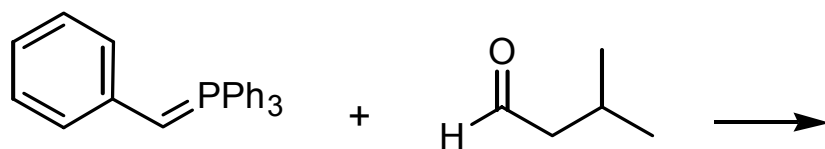
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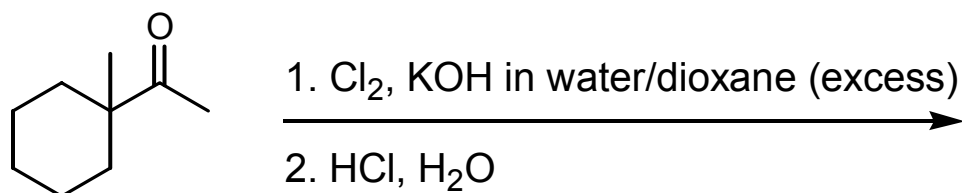
d.



e.

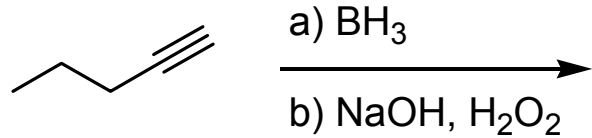


f.

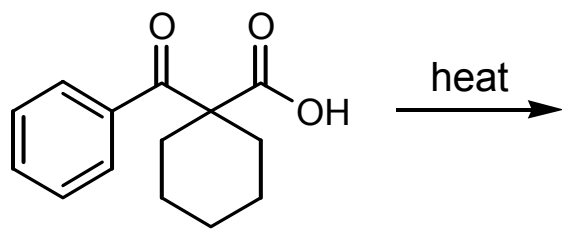


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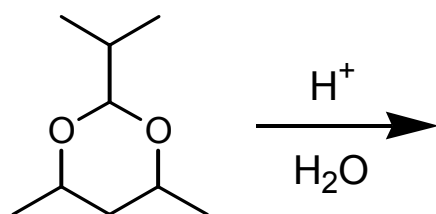
g.



h.

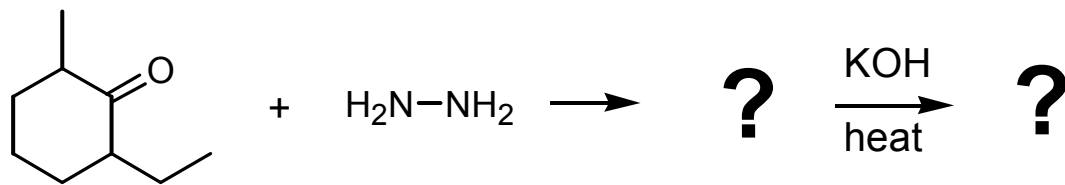


i.

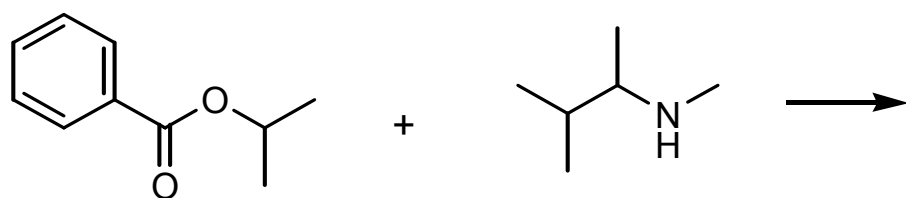


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j. & k.

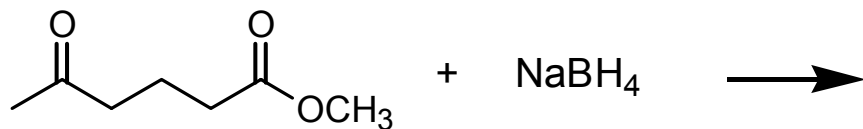


l.

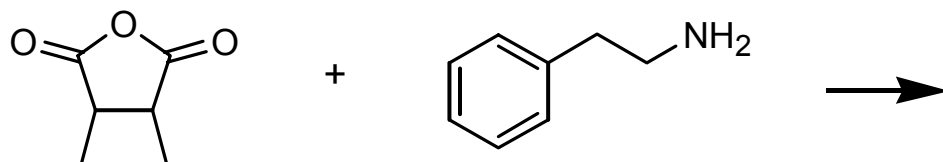


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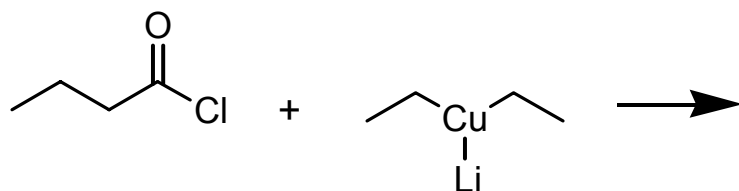
m.



n.

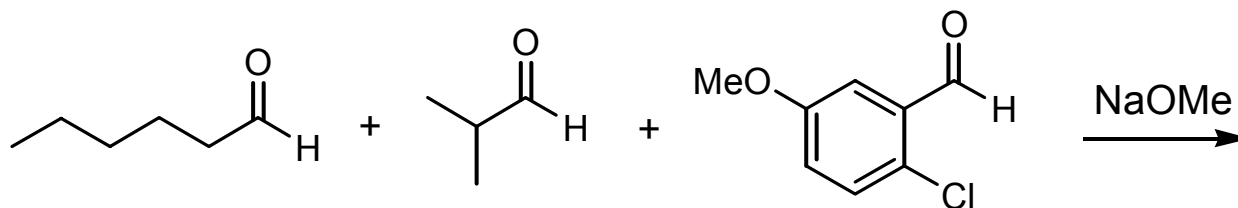


o.



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(24 points). Show all the possible aldol products (as β -hydroxy carbonyl compounds) from the following reaction mixture:



Where possible, dehydrate the above products and show the corresponding α,β -unsaturated compounds. (There's additional space on the next page).

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No question this page.

PERIODIC TABLE OF THE ELEMENTS

Atomic masses are based on ¹²C. Atomic masses in parentheses are for the most stable isotope.

6 C 12.011																		2 He 4.00260											
1 H 1.00079												5 B 10.81		6 C 12.011	7 N 14.0067	8 O 15.9994	9 F 18.998403	10 Ne 20.179											
3 Li 6.941		4 Be 9.01218												13 Al 26.98154	14 Si 28.0855	15 P 30.97376	16 S 32.06	17 Cl 35.453	18 Ar 39.948										
11 Na 22.98977		12 Mg 24.305		19 K 39.0963	20 Ca 40.08	21 Sc 44.9559	22 Ti 47.88	23 V 50.9415	24 Cr 51.996	25 Mn 54.9380	26 Fe 55.847	27 Co 58.9332	28 Ni 58.70	29 Cu 63.546	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.80								
37 Rb 85.4678		38 Sr 87.62	39 Y 88.9059	40 Zr 91.22	41 Nb 92.9064	42 Mo 95.94	43 Tc (99)	44 Ru 101.07	45 Rh 102.9055	46 Pd 106.4	47 Ag 107.868	48 Cd 112.41	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.9045	54 Xe 131.30											
55 Cs 132.9054		56 Ba 137.33	57 La 138.9055	72 Hf 178.49	73 Ta 180.9478	74 W 183.85	75 Re 186.207	76 Os 190.2	77 Ir 192.22	78 Pt 195.09	79 Au 196.9665	80 Hg 200.59	81 Tl 204.37	82 Pb 207.2	83 Bi 208.9804	84 Po (209)	85 At (210)	86 Rn (222)											
87 Fr (223)		88 Ra (226)	89 Ac (227)	104 Unq (261)	105 Unp (262)	106 Unh (263)											101 Tm 168.9342	102 Yb 173.04	103 Lu 174.967										

*Lanthanide series

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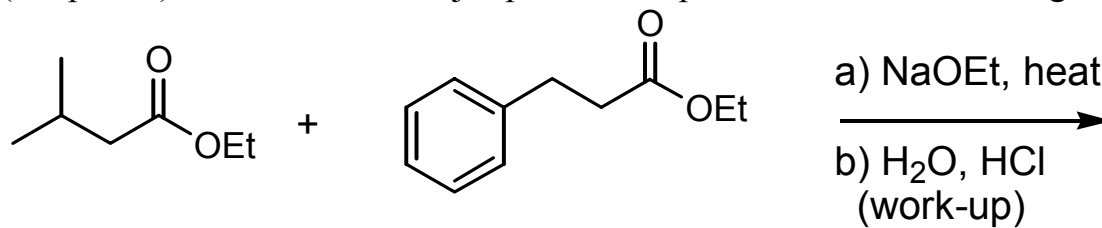
†Actinide series

90 Th 232.038	91 Pa 231.0369	92 U 238.029	93 Np 237.0482	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)
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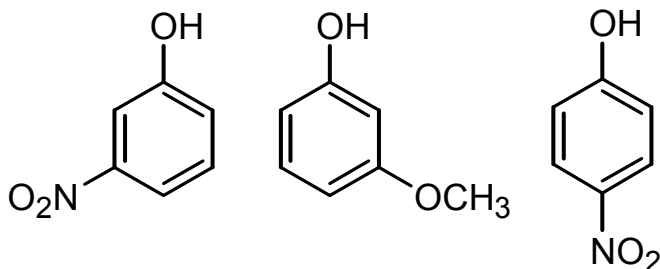
(16 points). Draw the four major products expected from the following Claisen reaction.



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(6 points). For the following series, a) circle the most acidic phenol, and then b) for the structure you circled, show the most important resonance structure that helps explain the increased acidity. If you write more than one resonance structure, then draw a box around the **one** structure you want graded.

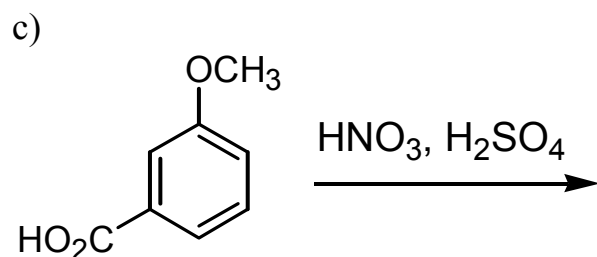
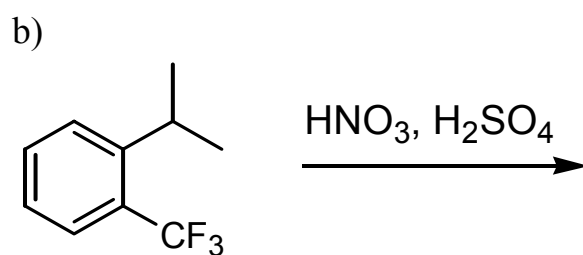
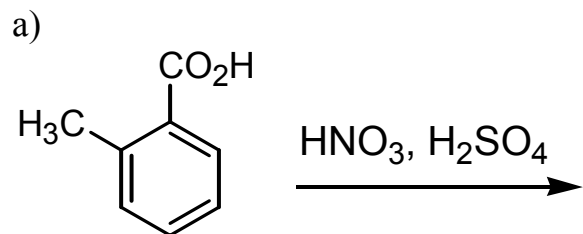


(8 points). An old reagent bottle labeled only “chlorinated benzene” was found in a chemical storage cabinet. Tests showed that the bottle contained a pure compound, and the ¹³C NMR spectrum showed only two peaks. There are several possibilities for the identity of the compound, and given the information provided you can not be sure which one it is (so there are several right answers to this question). Propose **one** structure for what is in the bottle. If you draw more than one structure, then draw a box around the one structure you want graded.

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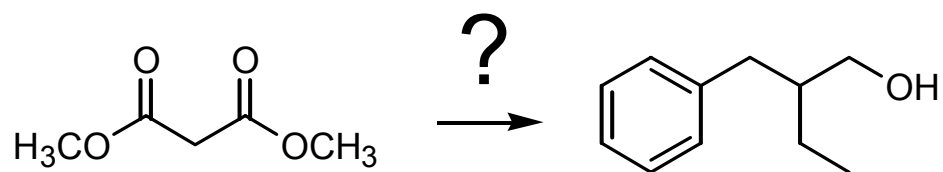
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(15 points). Electrophilic aromatic substitution reactions. Draw the major product expected from each of the following reactions. For each nitration reaction, add only one nitro group to the aromatic ring.



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(10 points) Synthesis. Show how to convert dimethyl malonate into the product shown.



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(10 points) Propose a synthesis of the following molecule starting from anything with 6 carbons or less. You may use any reagents you wish provided they add only 6 carbons or less to the final product.

