

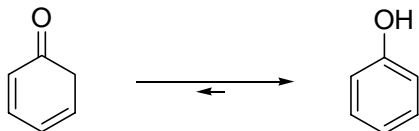
General Instructions. There are 5 pages of questions and 9 pages total, including this cover sheet and 3 scratch pages. Be sure you have them all. Read each question carefully so that you know what is being asked and what you need to write or draw. Your work on scratch pages will *not* be graded, so be sure everything you want graded is on the exam itself. Good luck!

PERIODIC CHART OF THE ELEMENTS

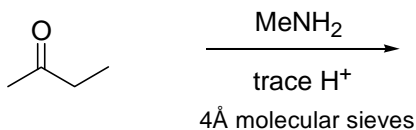
IA	IIA	IIIB	IVB	VB	VIB	VIIIB	VIII	IB	IIB	IIIA	IVA	VA	VIA	VIIA	INERT GASES		
1 H 1.00797														1 H 1.00797	2 He 4.0026		
3 Li 6.939	4 Be 9.0122										5 B 10.811	6 C 12.0112	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.183	
11 Na 22.9898	12 Mg 24.312										13 Al 26.9815	14 Si 28.086	15 P 30.9738	16 S 32.064	17 Cl 35.453	18 Ar 39.948	
19 K 39.102	20 Ca 40.08	21 Sc 44.956	22 Ti 47.90	23 V 50.942	24 Cr 51.996	25 Mn 54.9380	26 Fe 55.847	27 Co 58.9332	28 Ni 58.71	29 Cu 63.54	30 Zn 65.37	31 Ga 69.72	32 Ge 72.59	33 As 74.9216	34 Se 78.96	35 Br 79.909	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.905	40 Zr 91.22	41 Nb 92.906	42 Mo 95.94	43 Tc (99)	44 Ru 101.07	45 Rh 102.905	46 Pd 106.4	47 Ag 107.870	48 Cd 112.40	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.904	54 Xe 131.30
55 Cs 132.905	56 Ba 137.34	*57 La 138.91	72 Hf 178.49	73 Ta 180.948	74 W 183.85	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.09	79 Au 196.967	80 Hg 200.59	81 Tl 204.37	82 Pb 207.19	83 Bi 208.980	84 Po (210)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	+89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 ? (271)	111 ? (272)	112 ? (277)						

Provide short (2-3 sentences MAX) answers to each of the following questions (16 pts).

1a) Most ketones exist primarily in the *keto* form, but phenol exists exclusively in the *enol* form. Explain why.



1b) In the formation of an imine, we typically use a trace of a carboxylic acid and something called *molecular sieves*.

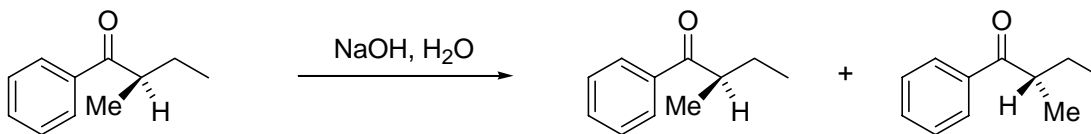


Draw the imine product that results from this reaction, then answer the following:

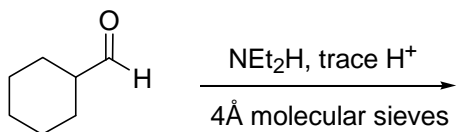
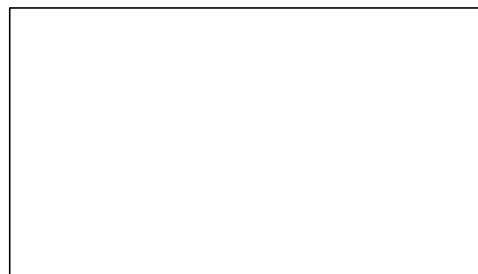
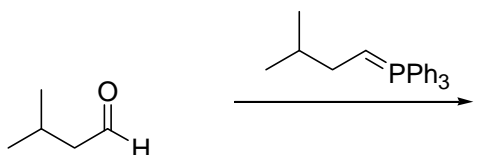
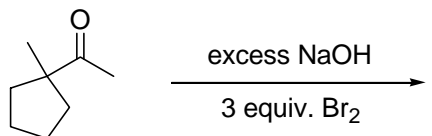
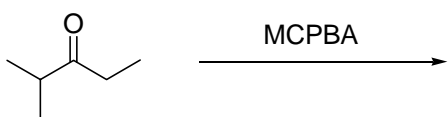
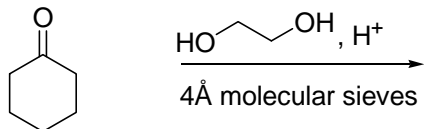
Why does the pH of the reaction have to be carefully controlled, *i.e.*, must be ≤ 5 ?

What is the purpose of the molecular sieves?

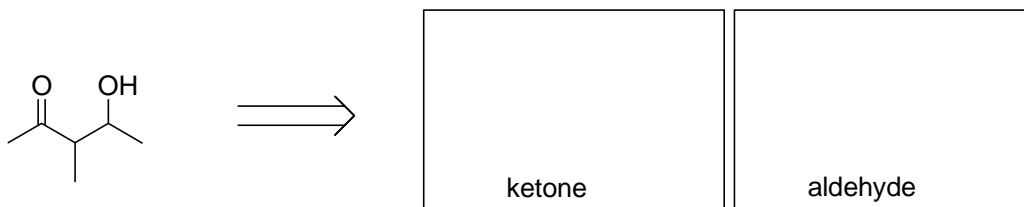
1c) Why does an optically active solution of (*R*)- α -methylbutyrophenone form a racemic mixture when aqueous base is added to the solution?



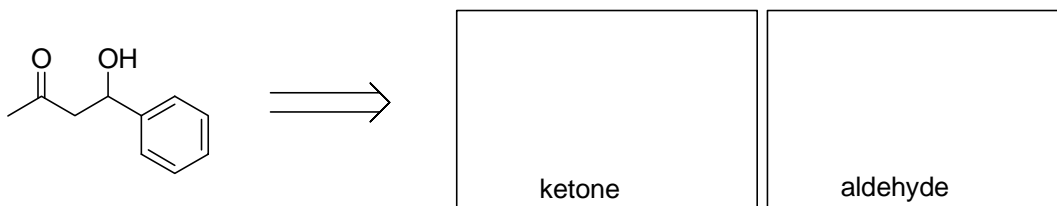
2) Predict the major organic product of each of the following reactions. Assume aqueous workup for all reactions. (20 pts).



3a) Indicate the starting aldehydes and ketones that reacted to form each of the aldol products shown and propose enolate formation conditions (base, equivalents, relative temperature, relative reaction time) that you would use in each case. (16 pts)

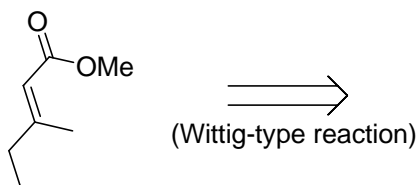
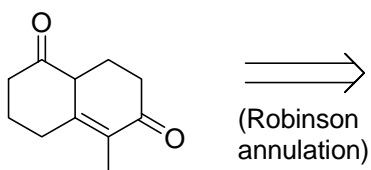


Enolate formation conditions:

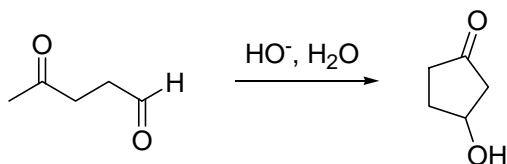


Enolate formation conditions:

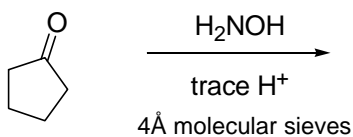
3b. Indicate how you would form the following molecules using the indicated reaction by showing the necessary starting materials. You do not have to draw any mechanisms or conditions.



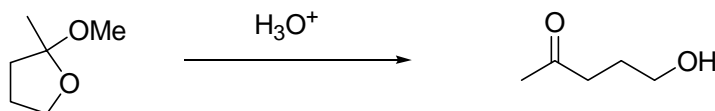
4a) Provide an arrow-pushing mechanism for the formation of the product in the following transformation. Show all necessary lone pairs, formal charges, and curved arrows to receive full credit (8 pts).



4b) Predict the product and provide an arrow-pushing mechanism for the formation of the product in the following transformation. Show all necessary lone pairs, formal charges, and curved arrows to receive full credit (8 pts).



4c) Draw an arrow-pushing mechanism for the following transformation. Show all bonds, arrows, formal charges and necessary lone pairs clearly to receive full credit (8 pts).



5) Propose multi-step syntheses of each of the following target molecules using the starting materials shown. You may use any inorganic reagents of your choice. Don't draw any mechanisms, just write the reagents needed for each step and the product of each step (24 pts).

