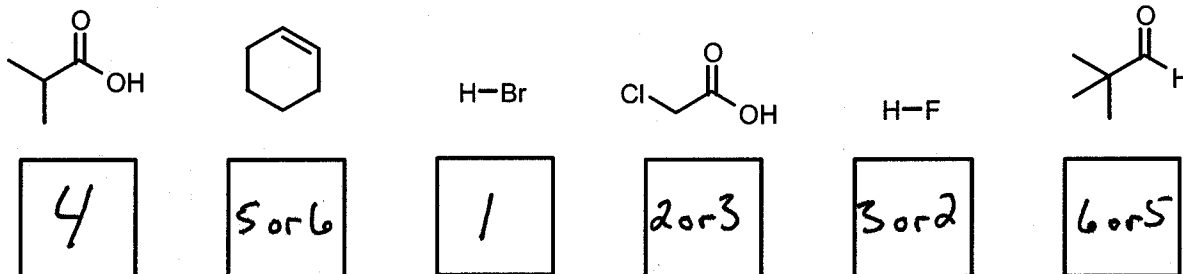
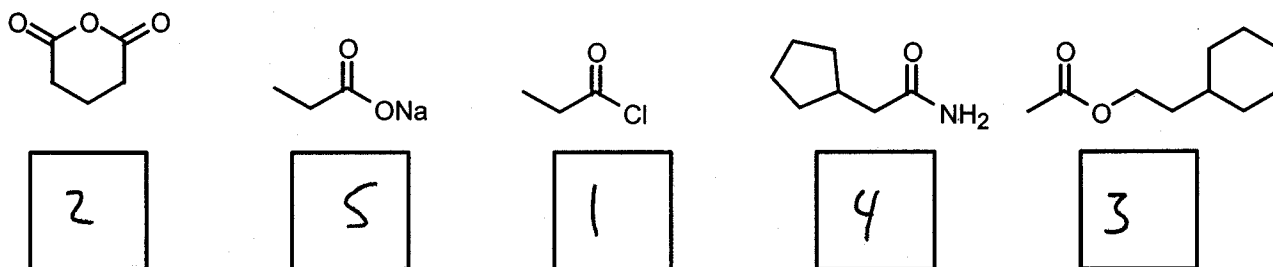


Question 1. (4 points) Miscellaneous.

a. (2 points). Rank the following molecules in order of increasing acidity (which is the same as decreasing pKa). Write a 6 in the box for the least acidic, a 1 in the box under the most acidic, and so on.



b. (2 points). Rank the following molecules in order of increasing reactivity toward nucleophilic attack. Write a 5 in the box under the least reactive, a 1 for the most reactive, and so on.



PERIODIC TABLE OF THE ELEMENTS

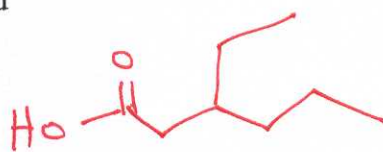
Atomic masses are based on ¹²C. Atomic masses in parentheses are for the most stable isotope.

6 — Atomic number C — Symbol 12.011 — Atomic mass																			
Groups																		VIII A	
Periods	1A											IIA							2
	1											2							10
	H											He							4.00260
	1.00079																		
	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					
	232.0381	231.0359	238.029	237.0462	(244)	(243)	(247)	(247)	(251)	(252)	(257)	(258)	(259)	(260)					

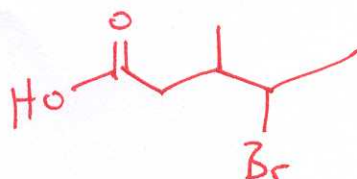
NAME: _____

Question 2. (5 points) Nomenclature. Provide a structure for each of the following.

a. 3-ethylhexanoic acid



b. 4-bromo-3-methylpentanoic acid

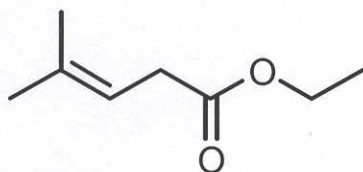


c. propyl ethanoate



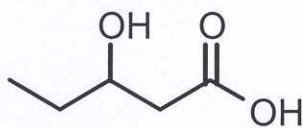
Provide a name for each of the following.

d.



Ethyl-4-methyl-3-pentenoate

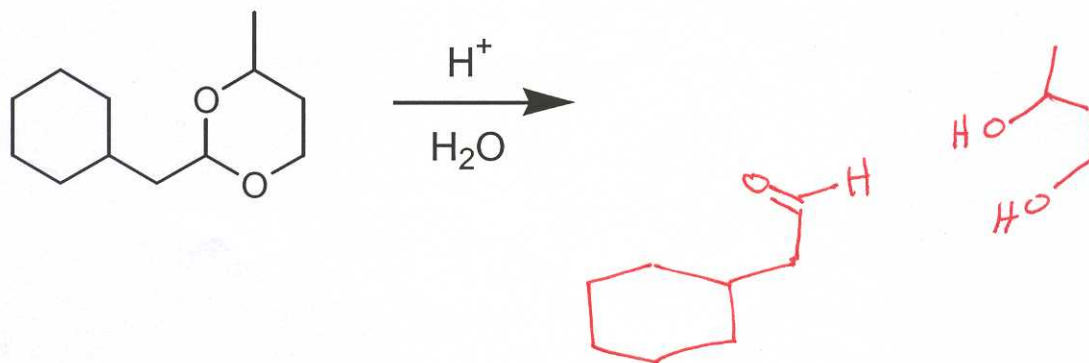
e.



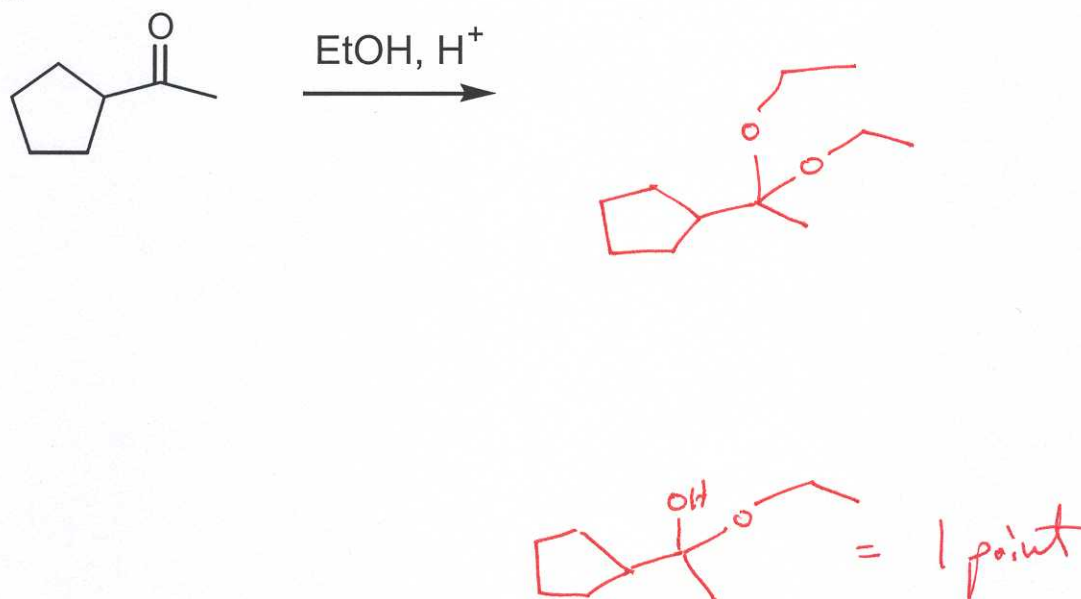
3-hydroxy-pentanoic acid

Question 3. (6 points) Acetals and hemi-acetals. Draw all organic product(s) from the following reactions.

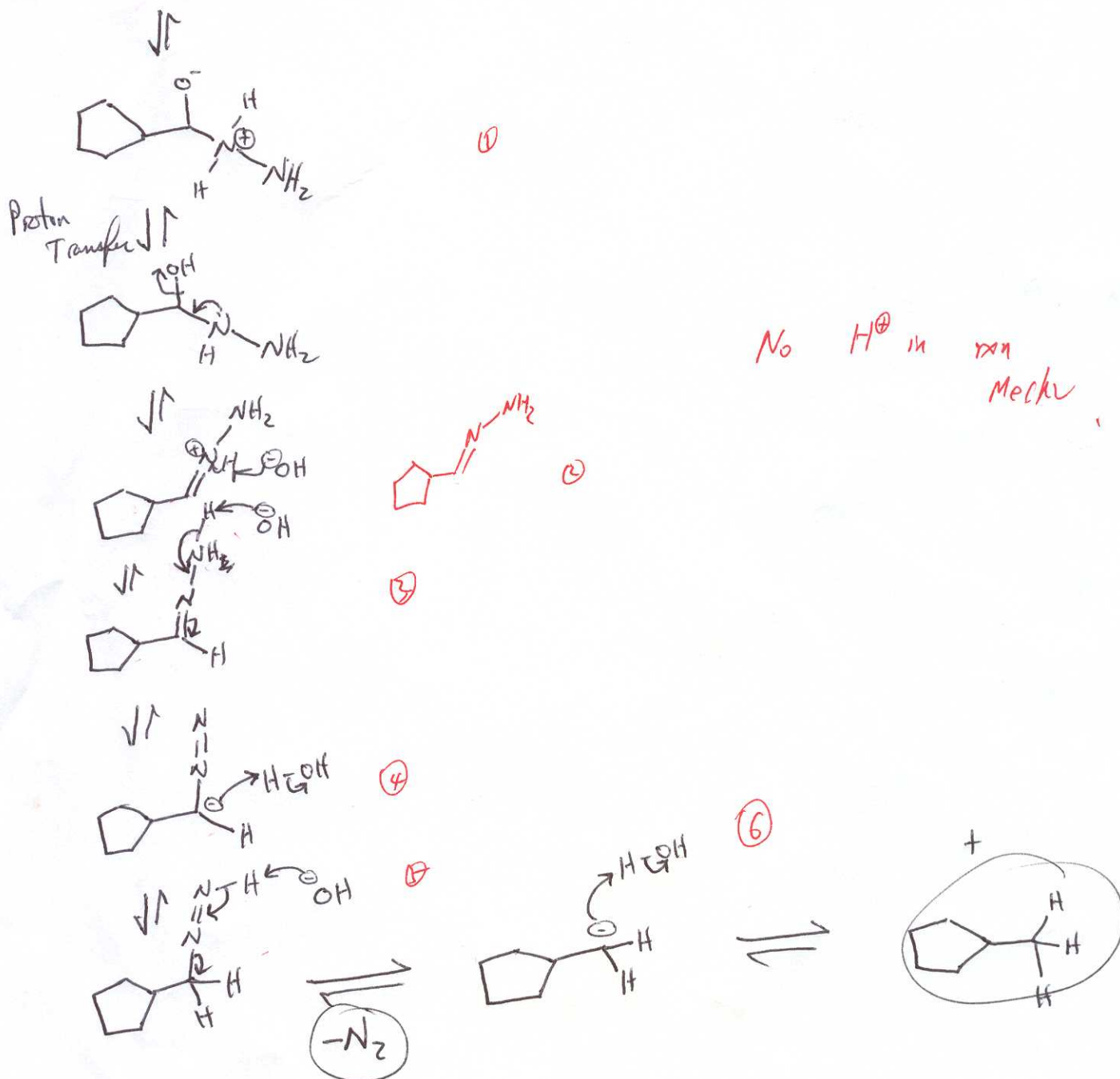
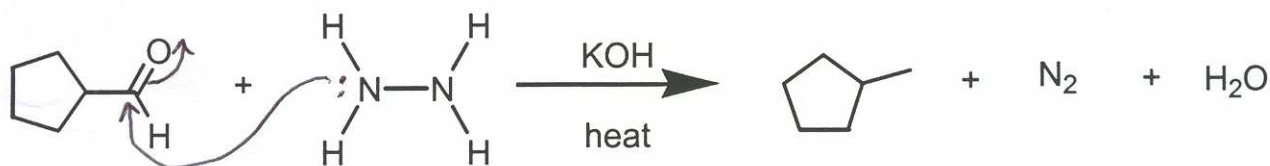
a.



b.

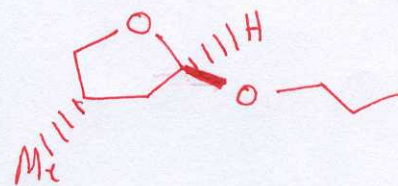
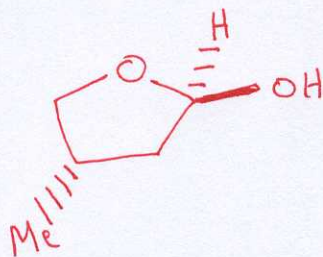
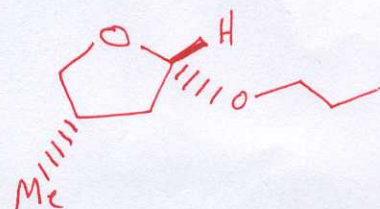
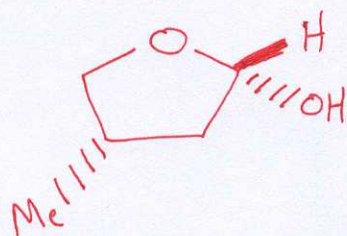
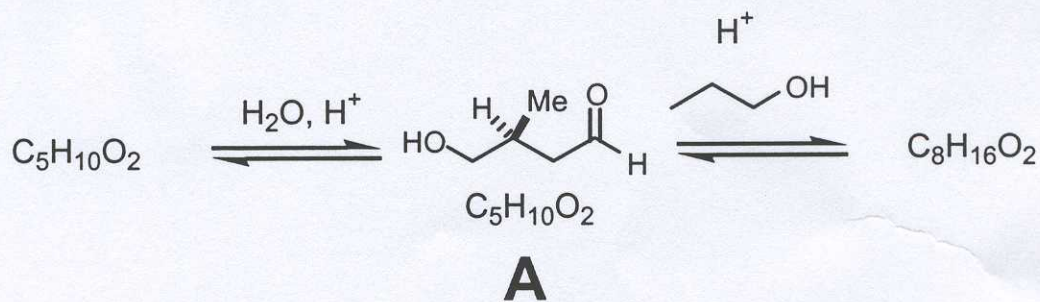


Question 5. (6 points) Provide the mechanism for the Wolff-Kishner Reduction shown below.



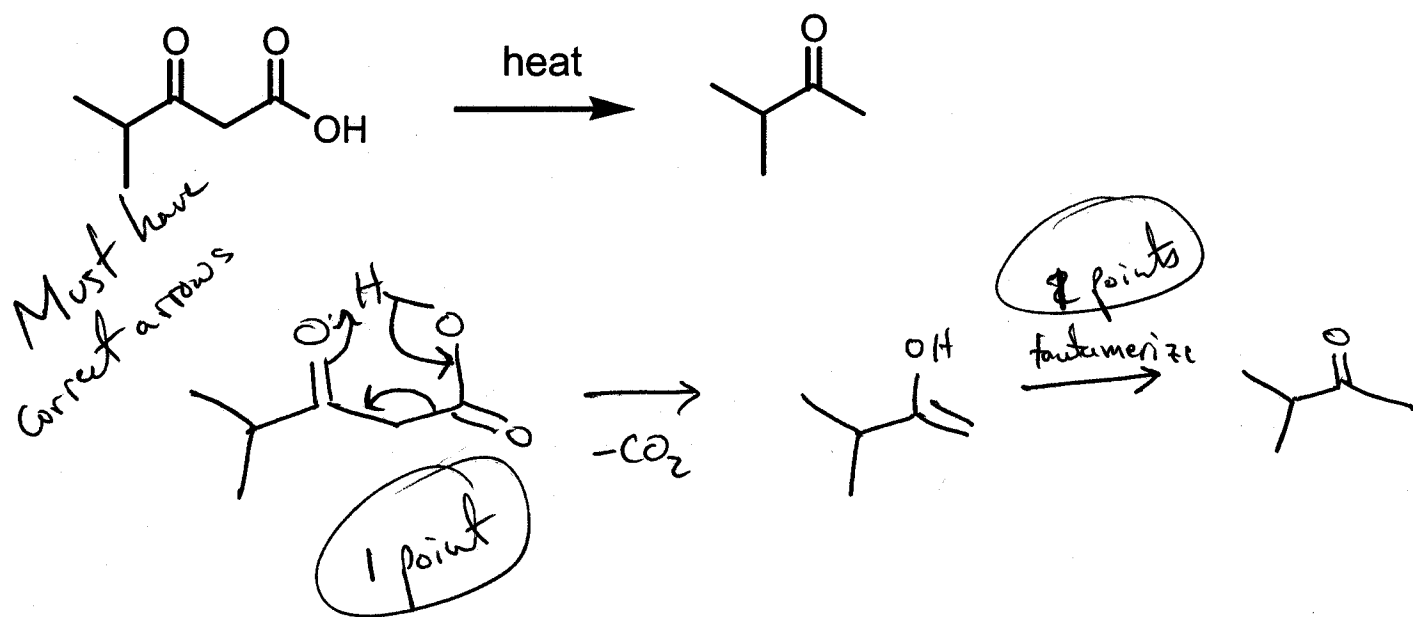
NAME: _____

Question 4. (4 points) Acetals and hemi-acetals. Compound A is optically active and is a single enantiomer. Draw the structures for the hemi-acetal and the acetal including all possible stereoisomers.

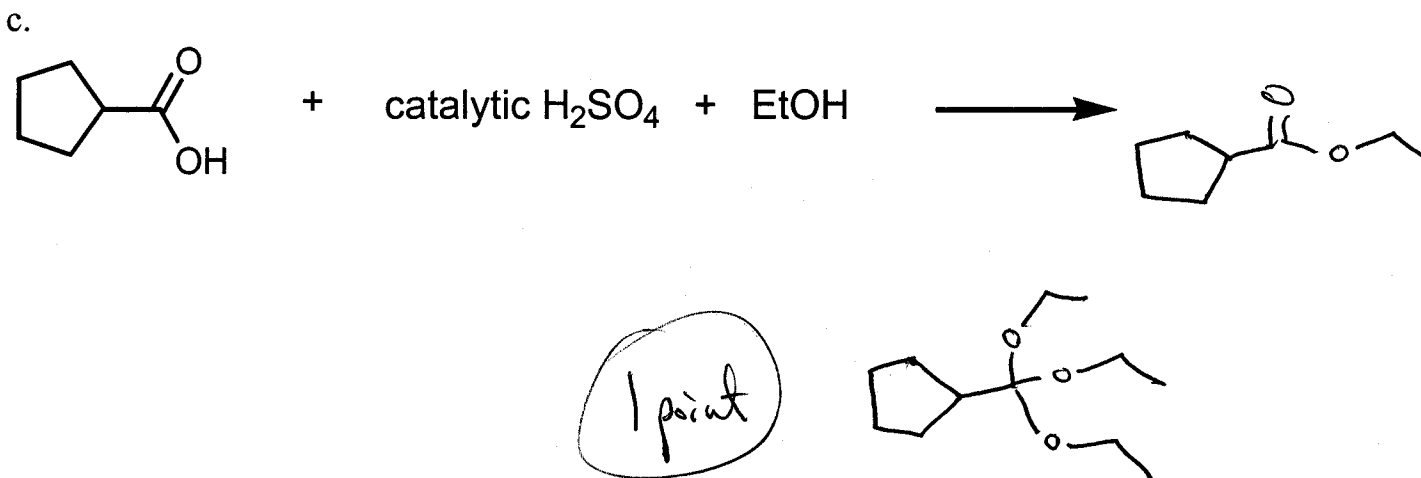
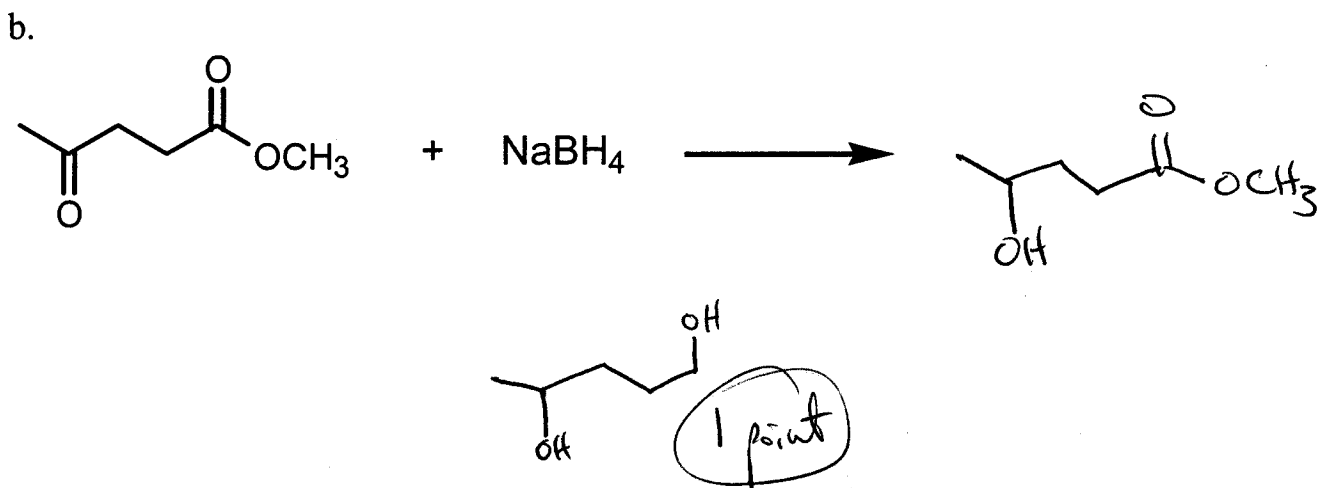
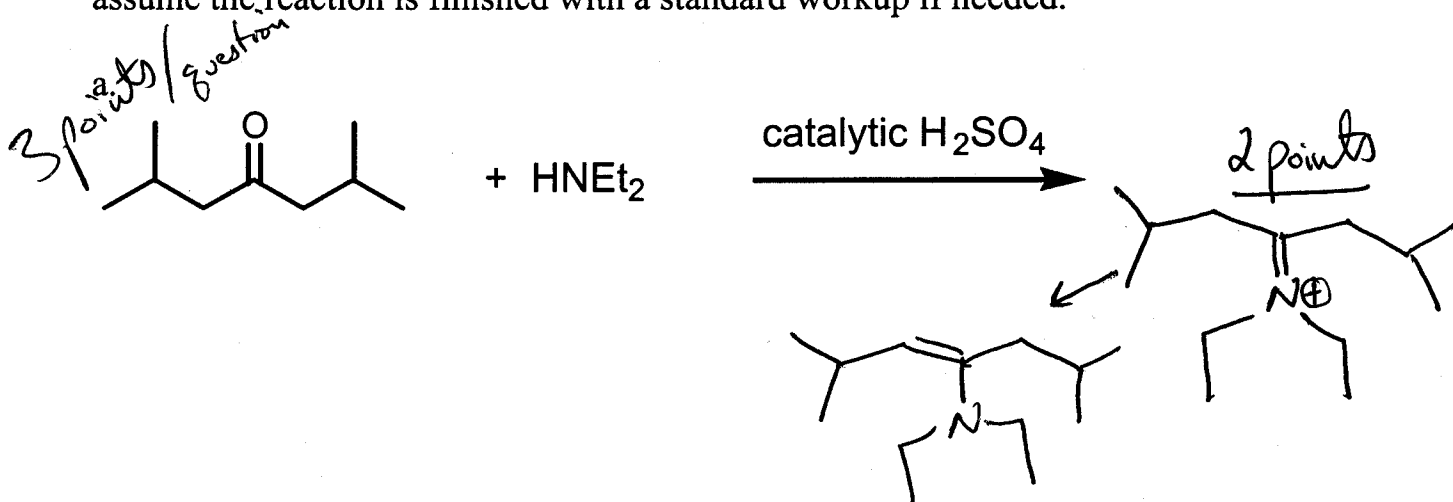


NAME: _____

Question 6. (2 points) Provide a detailed mechanism for the following reaction.



Question 7. (45 points) Show the expected products from the following reactions. You may assume the reaction is finished with a standard workup if needed.

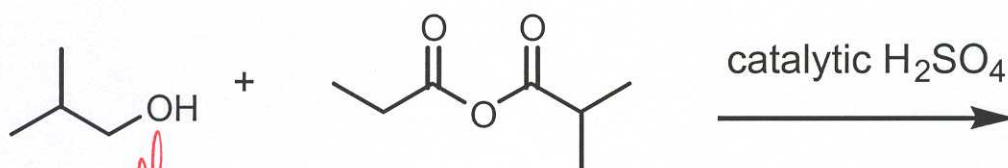


d.

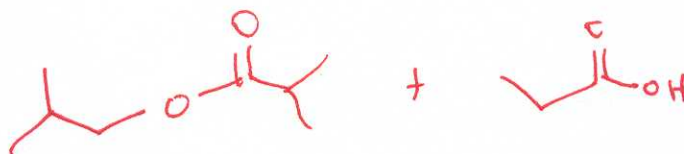


2 points for only one product

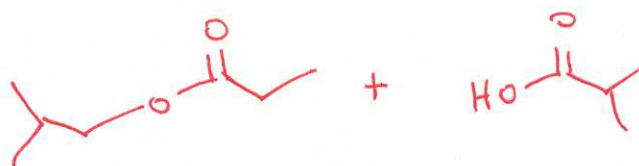
e.



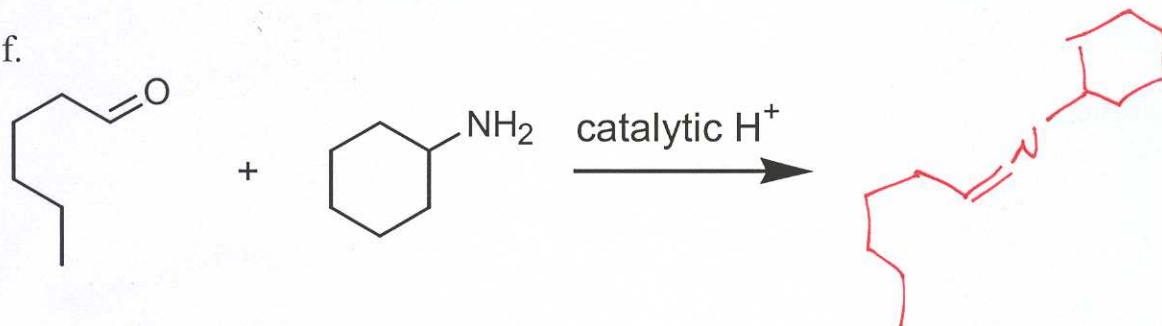
*6 points for all
4 answers
+ 4 points for 2 answers*



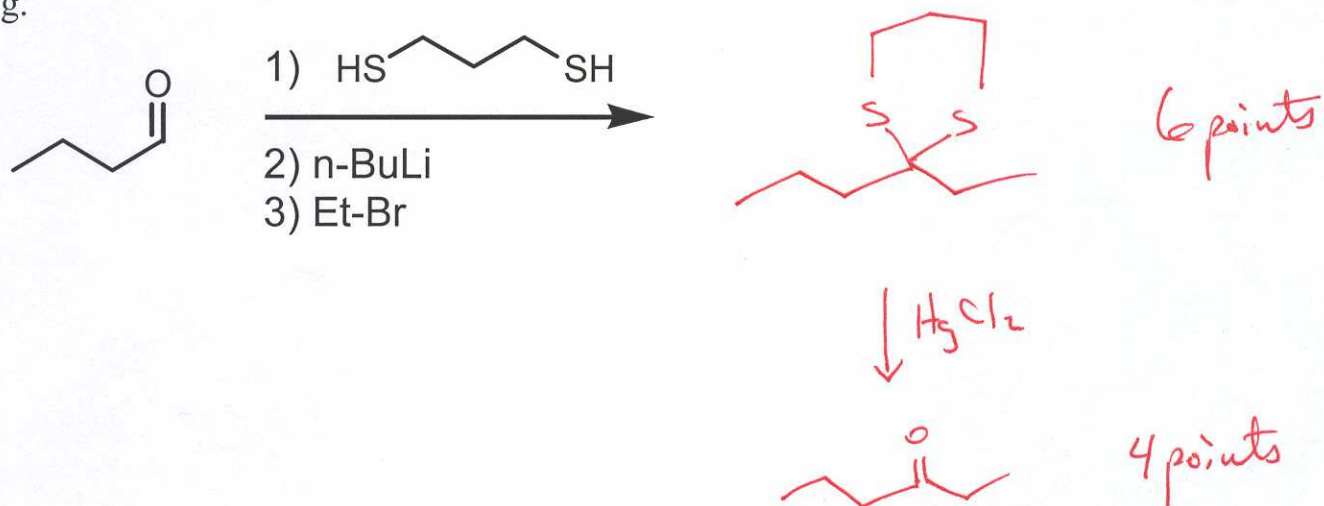
or



f.

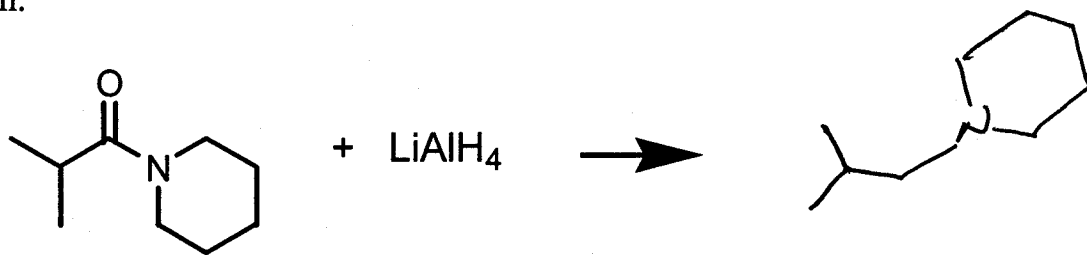


g.

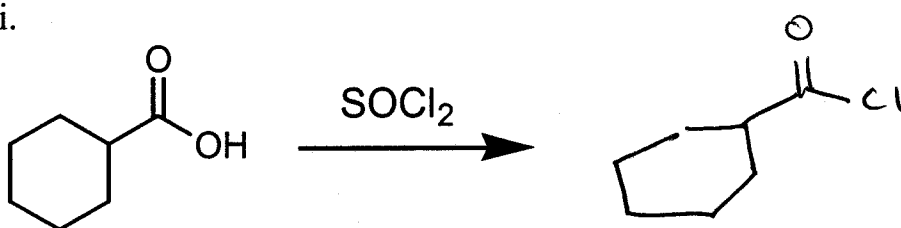


NAME: _____

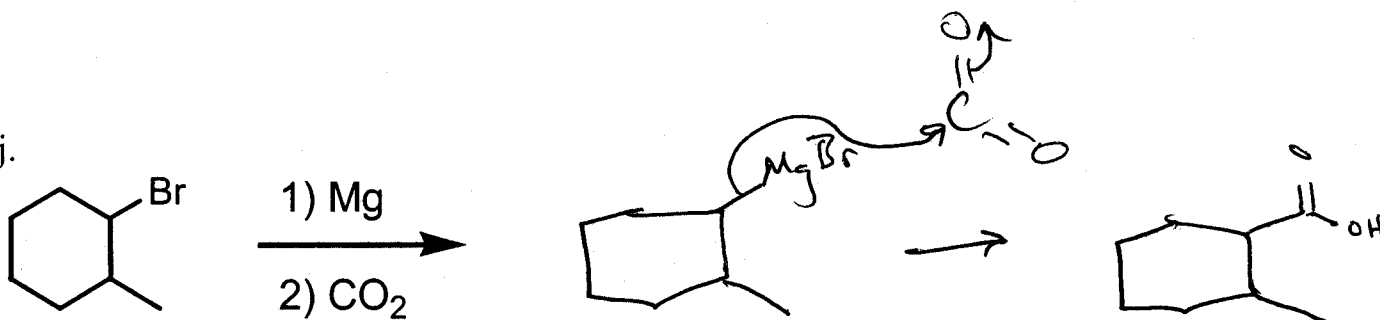
h.



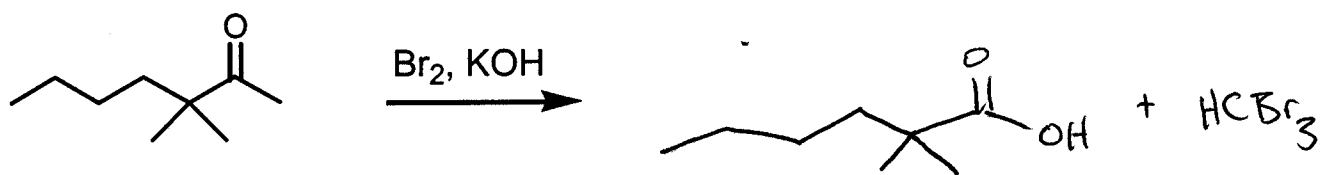
i.



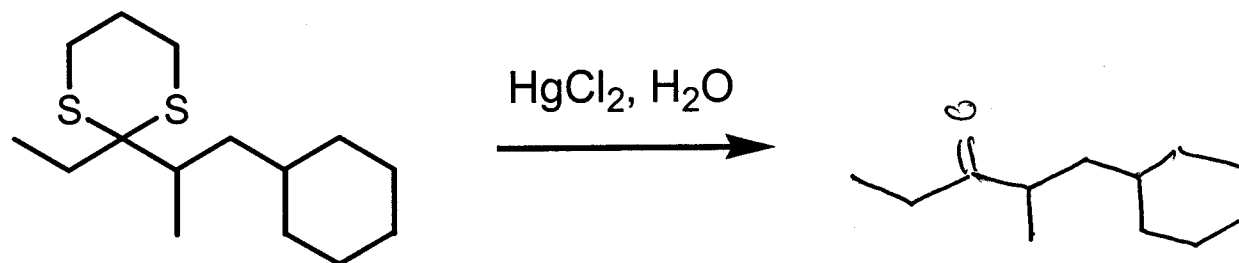
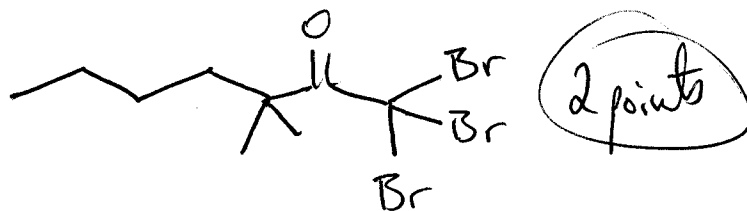
j.



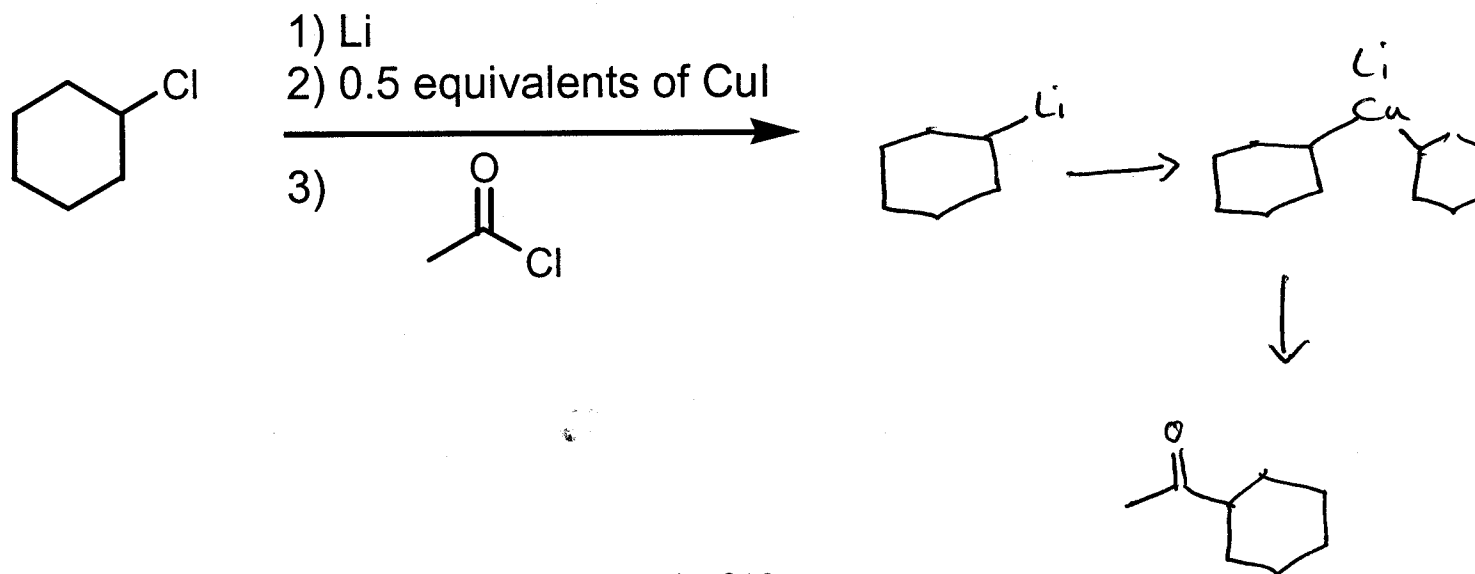
k.



1 point



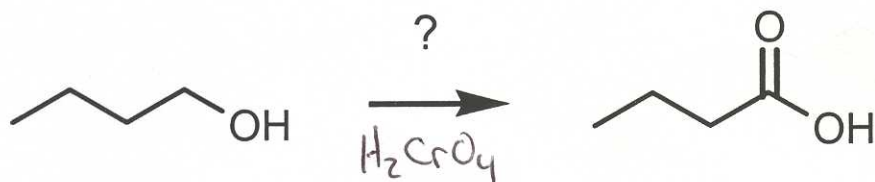
m.



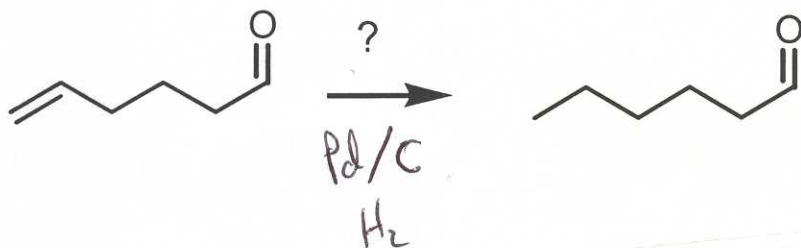
NAME: _____

Question 8. (9 points) Provide the necessary reagents to effect the following reactions.

a.

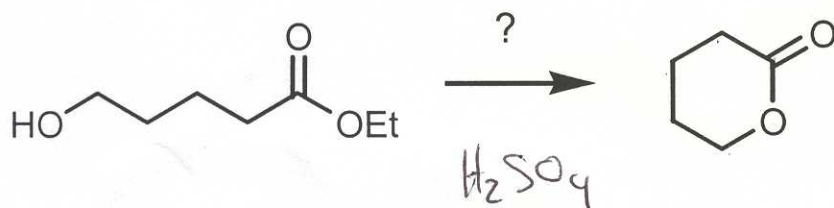


b.



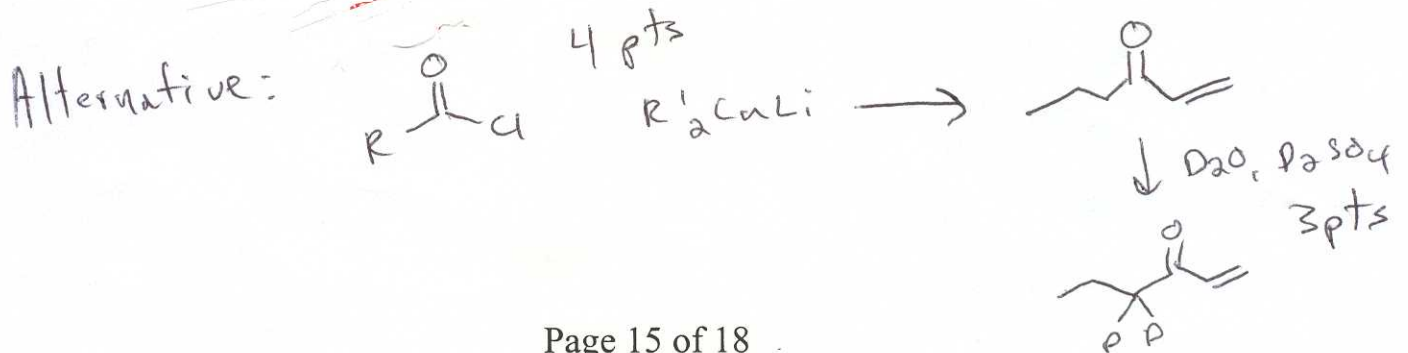
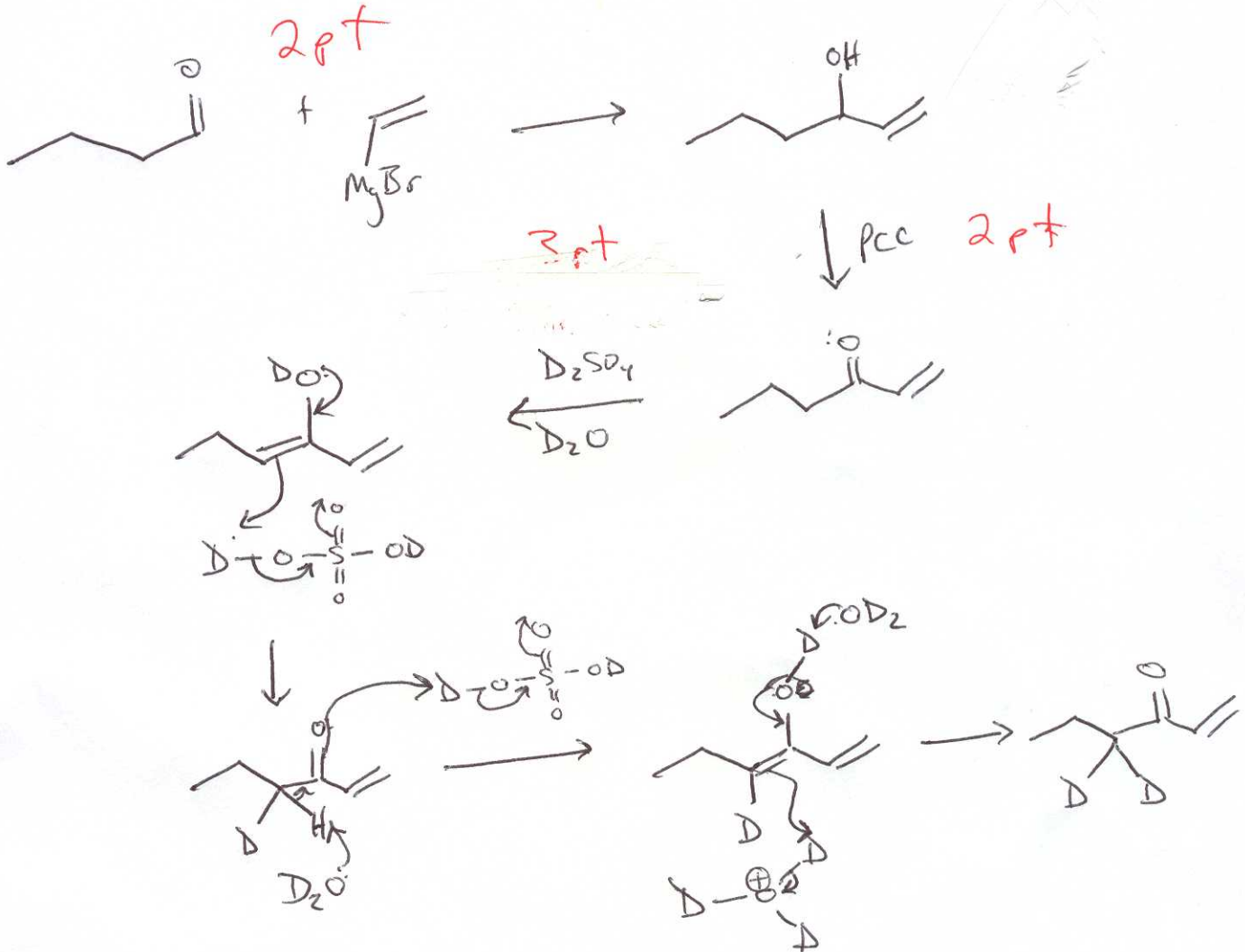
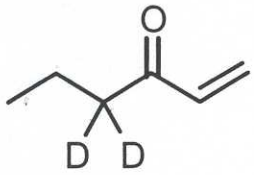
lpt if forget H₂

c.



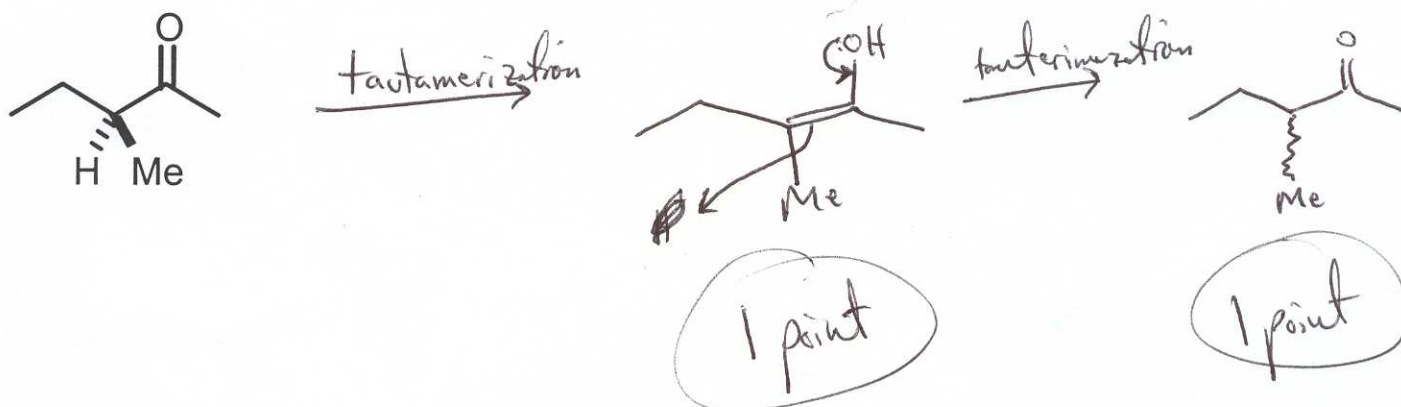
NAME: _____

Question 9. (7 points) Propose a synthesis of the following molecule starting from anything with 4 carbons or less. The only sources of deuterium you can use are D₂O and D₂SO₄.



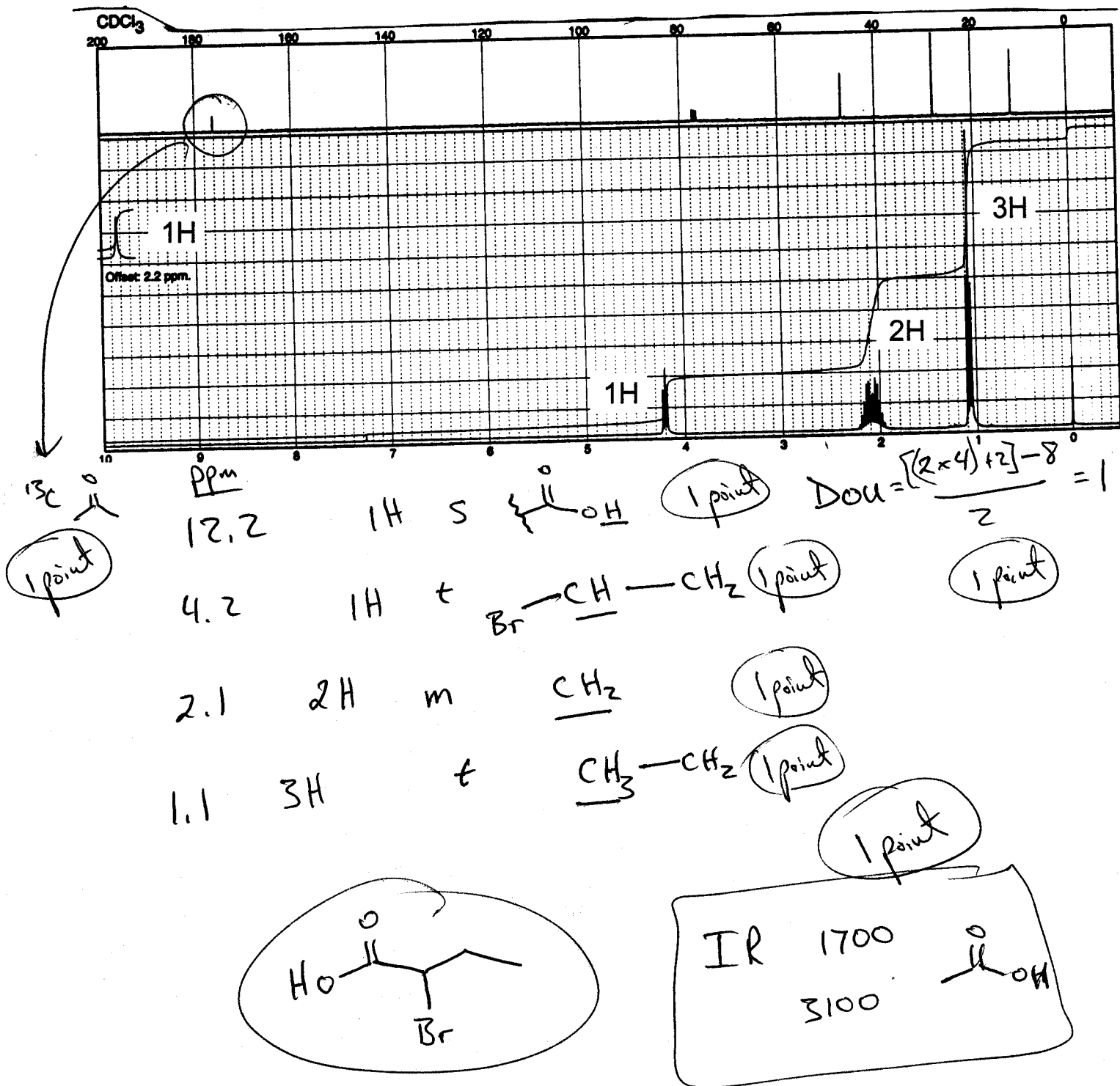
NAME: _____

Question 10. (2 points) The ketone shown below is an optically active single enantiomer, but when stored it gradually becomes racemic. Provide a mechanism to show how racemization occurs.



have to show
enol tautomer
(flat, sp²)

Question 11. (10 points) NMR. Formula $C_4H_7O_2Br$. Enlargement on next page. This compound is readily soluble in basic water, and the IR spectrum shows a very broad peak around 3100 and a strong peak at about 1700 cm^{-1} .



3-5 points TA's discretion based on clarity, accuracy, and thought process of answer.