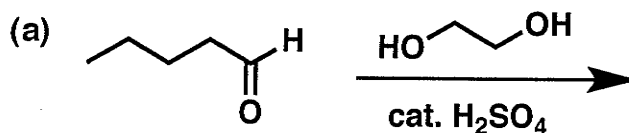


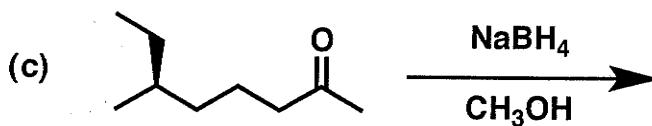
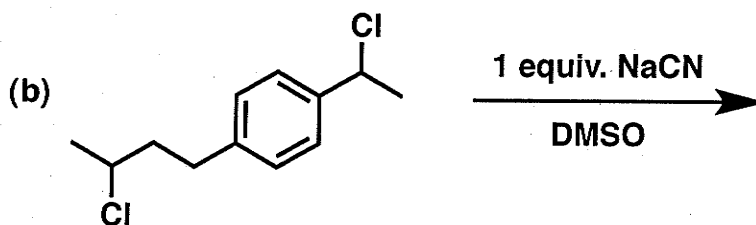
General Instructions:

- (i) Use scratch paper at back of exam to work out answers; final answers must be recorded at the proper place on the exam itself for credit.
- (ii) Print your name on each page.

1. (20 points) Show the major product or products expected from each reaction:



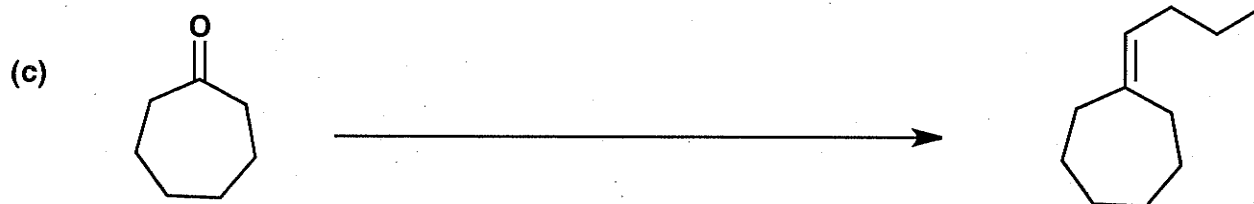
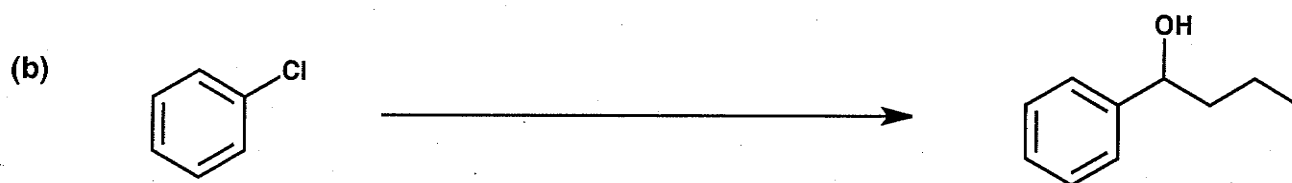
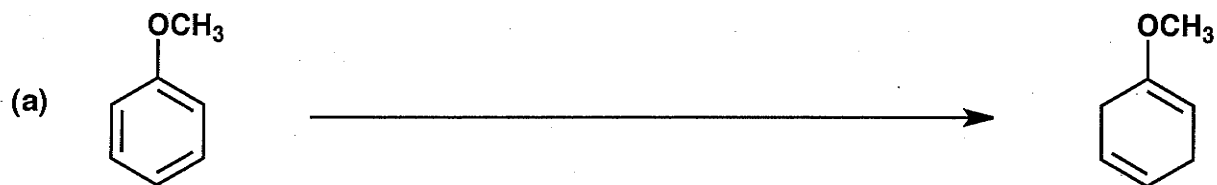
Hint: The starting material has a strong IR signal at 1720 cm^{-1} , but there is no such signal in the product.



Note: The starting material is a single enantiomer.

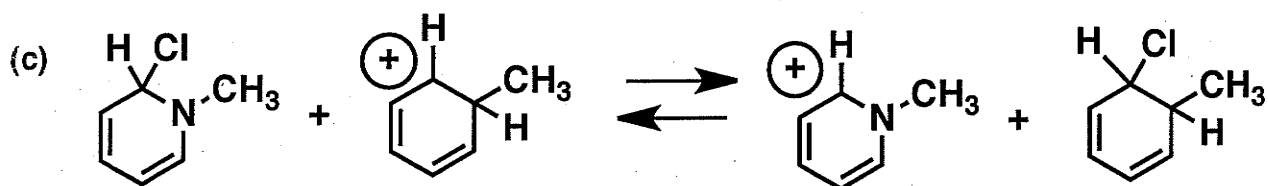
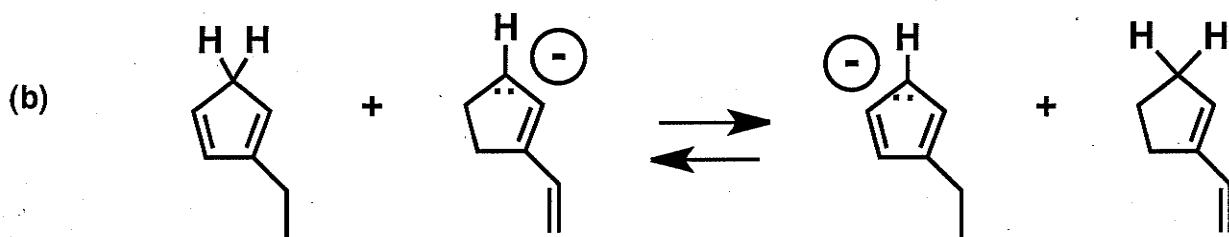
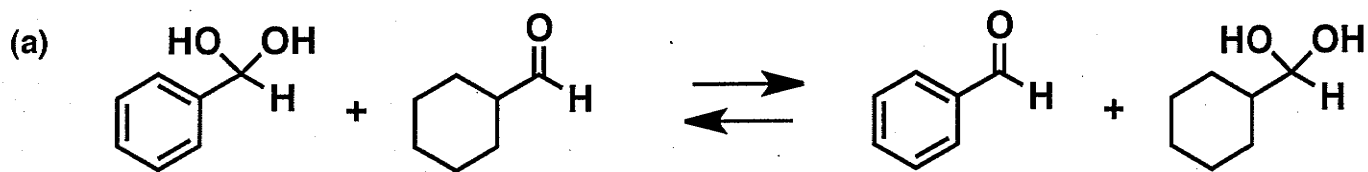
Name _____

2) (20 points) Show the reagents and other organic molecules required to convert the



Name _____

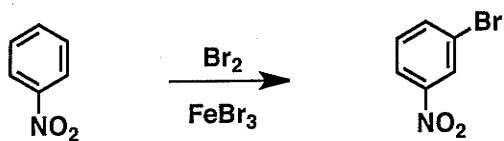
3. (21 points) For each equilibrium below, CIRCLE the side that you expect to be favored. (Do not worry about the mechanism of interconversion.) Briefly explain your reasoning.



Name _____

4. (19 points)

(a) Draw out a mechanism ("curved arrows") for the reaction shown below. Be sure to show all important resonance structures in intermediates.

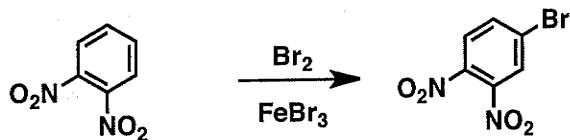


-- cont. on next page --

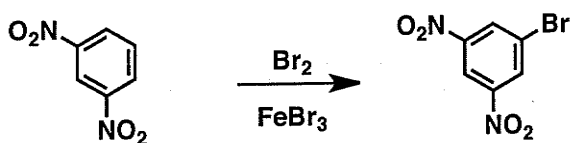
Name _____

4. (cont.)

(b) Of the two reactions shown below, CIRCLE the one that you expect to occur MORE RAPIDLY. Briefly explain your reasoning (you can use structural drawings in your explanation).



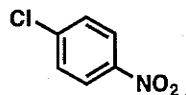
VS.



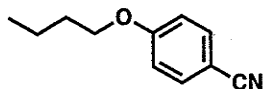
Name _____

5. (20 points) Propose a synthesis of the target molecule from the indicated starting material and any other materials. Try to identify a route that has as few steps as possible.

Starting material:



Target:



Name _____

<u>Problem #</u>	<u>Score</u>
1	/ 20
2	/ 20
3	/ 21
4	/ 19
5	/ 20

Total: / 100

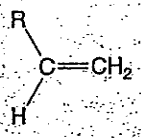
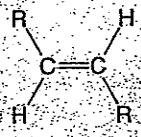
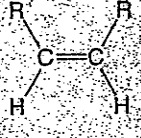
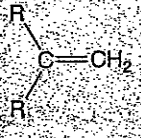
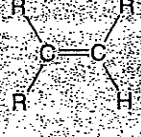

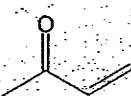
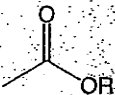
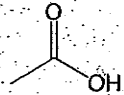
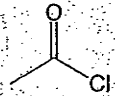
Functional Group	Position (cm^{-1})	Intensity ^b
Alkanes		
C-H	2980-2850	m-s (stretch)
C-C	1480-1420	m (bend)
Alkenes		
=C-H	3150-3000	m (stretch)
C=C	1680-1620	m-w (stretch)
(conj) C=C	1630-1600	m-w (stretch)
	995-985 915-905	s (out-of-plane bend)
	980-960	s (out-of-plane bend)
	730-665	s (out-of-plane bend) (br, variable)
	895-885	s (out-of-plane bend)
	840-790	m (out-of-plane bend)
Alkynes		
$\equiv\text{C-H}$	3350-3300	s (stretch)
$\text{C}\equiv\text{C}$	2260-2100	m-w (stretch)
Alcohols		
O-H		
free	3650-3580	m (stretch)
hydrogen bonded	3550-3300	br, s (stretch)
C-O	1350-1250 1150-1050	s (stretch)
Amines		
N-H	3500-3100	br, m (stretch)
	(two bands for primary amines one band for secondary amines)	

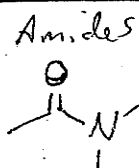
TABLE 14.3 Typical Infrared Absorptions of Functional Groups^aed
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Absorbance

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TABLE 14.3 (CONTINUED)

Functional Group	Position (cm ⁻¹)	Intensity ^b
C-N	~1200	m (stretch)
Aromatic compounds		
=C-H	3080-3020	m-w (stretch)
C=C	1650-1580	m-w (stretch)
C-H		
mono	770-730	s (out of plane bend)
ortho	710-690	s (out-of-plane bend)
meta	770-735	s (out-of-plane bend)
meta	900-860	m (out of plane bend)
meta	810-750	s (out-of-plane bend)
meta	725-680	m (out-of-plane bend)
para	860-800	s (out-of-plane bend)
Carbonyl compounds		
aldehydes, ketones		
		
C=O	1730-1700 (higher in strained cyclic molecules)	s (stretch)
		
	1680-1660	s (stretch)
C-H (aldehydes)	2900-2700 (two bands)	w (stretch)
Esters		
		
	1750-1735	s (C=O) (stretch)
	1300-1000	s (C-O) (stretch)
Acids		
		
	1730-1700	s (C=O) (stretch)
	3200-2800	s, br (O-H) (stretch)
Acid chlorides		
		
	1820-1770	s (C=O) (stretch)



1620-1680 s (C=O) (stretch)

PERIODIC TABLE OF THE ELEMENTS

1 IA	1 H Hydrogen 1.0079	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIII	9 VIII	10 VIII	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
	3 Li Lithium 6.941	4 Be Beryllium 9.0122											5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180
	11 Na Sodium 22.990	12 Mg Magnesium 24.305											13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.065	17 Cl Chlorine 35.453	18 Ar Argon 39.948
	19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.409	31 Ga Gallium 69.723	32 Ge Germanium 72.64	33 As Arsenic 74.922	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.798
	37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.94	43 Tc Technetium (99)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.91	46 Pd Palladium 106.42	47 Ag Silver 107.87	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.71	51 Sb Antimony 121.76	52 Te Tellurium 127.60	53 I Iodine 126.90	54 Xe Xenon 131.29
	55 Cs Caesium 132.91	56 Ba Barium 137.33	57 *La Lanthanum 138.91	72 Hf Hafnium 178.49	73 Ta Tantalum 180.95	74 W Tungsten 183.84	75 Re Rhenium 186.21	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.97	80 Hg Mercury 200.59	81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.98	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
	87 Fr Francium (223)	88 Ra Radium (226)	89 #Ac Actinium (227)	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (266)	107 Bh Bohrium (264)	108 Hs Hassium (277)	109 Mt Meitnerium (288)	110 Uun (281)	111 Uuu (272)	112 Uub (285)	113 Uuq (289)					

Atomic number →
 Symbol →
 Name (IUPAC) →
 Atomic mass →

6
C
Carbon
12.011

IUPAC recommendations →
 Chemical Abstracts Service group notation →

* Lanthanide Series

Actinide Series

58	Ce	59	Pr	60	Nd	61	Pm	62	Sm	63	Eu	64	Gd	65	Tb	66	Dy	67	Ho	68	Er	69	Tm	70	Yb	71	Lu	
Cerium 140.12		Praseodymium 140.91		Neodymium 144.24		Promethium (145)		Samarium 150.36		Europium 151.96		Gadolinium 157.25		Terbium 158.93		Dysprosium 162.50		Holmium 164.93		Erbium 167.26		Thulium 168.93		Ytterbium 173.04		Lutetium 174.97		Thorium 232.04
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr	Protactinium 231.04	Uranium 238.03	Neptunium (237)	Plutonium (244)	Americium (243)	Curium (247)	Berkelium (247)	Californium (251)	Einsteinium (252)	Fermium (257)	Mendelevium (258)	Nobelium (259)	Lawrencium (262)		

