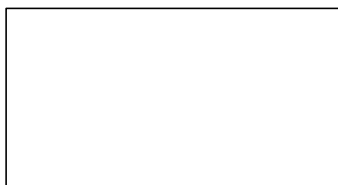
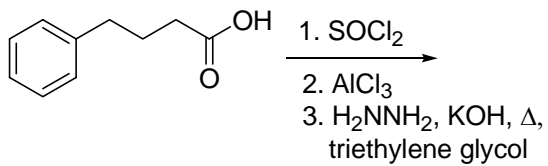
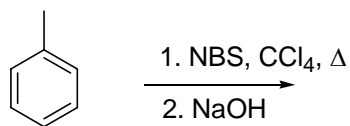
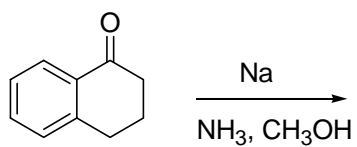
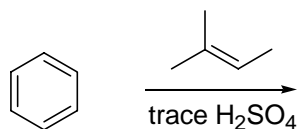
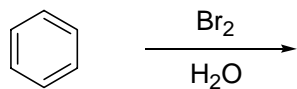
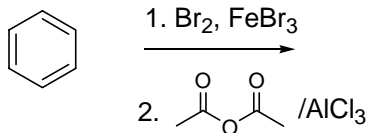
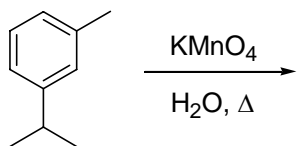


General Instructions. There are 4 pages of questions and 7 pages total, including this cover sheet and 2 scratch pages. Be sure you have them all. Read each problem carefully so that you know what is being asked and what you need to write or draw. Good luck!

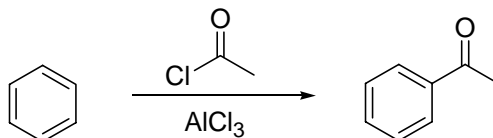
PERIODIC CHART OF THE ELEMENTS

| IA | IIA | IIIB | IVB | VB | VIB | VIIIB | VIII | IB | IIB | IIIA | IVA | VA | VIA | VIIA | VIIIA | 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) | | | | | | |

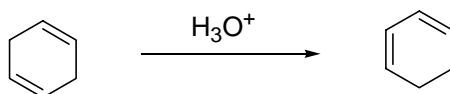
1) Predict the major organic product of each of the following reactions or reaction sequences. If no reaction occurs, write "N.R." (35 pts)



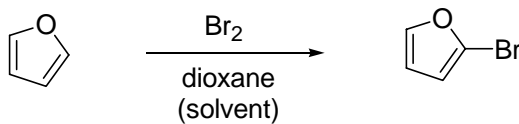
2a) Draw an arrow-pushing mechanism for *the formation of the electrophile only* in the following transformation. Show all bonds, arrows, formal charges and necessary lone pairs clearly to receive full credit (10 pts).



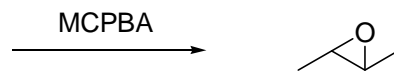
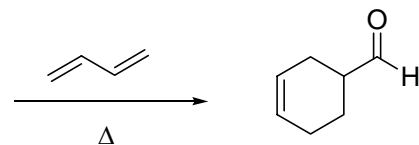
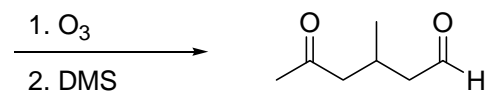
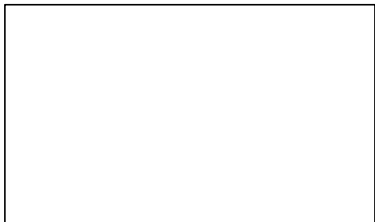
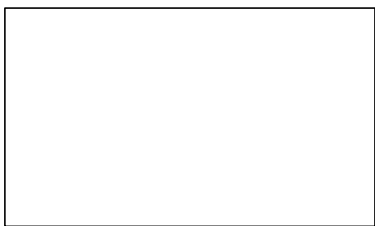
2b) Draw an arrow-pushing mechanism for the following transformation. Show all bonds, arrows, formal charges and necessary lone pairs clearly to receive full credit (10 pts).



2c) Using the principles of electrophilic aromatic substitution mechanisms, propose an arrow-pushing mechanism for the bromination of furan. Furan is much more reactive than benzene and does not require a Lewis acid catalyst. Show all bonds, arrows, formal charges and necessary lone pairs clearly to receive full credit (10 pts).



3) Provide the starting material necessary to produce each of the molecules shown using the given reagents. Some may have more than one possible precursor, but you just have to draw one (15 pts).



4) Propose multi-step syntheses of each of the following target molecules using the starting materials shown. You may use any inorganic reagents and organic reagents containing four or fewer carbons. You don't have to draw any mechanisms, just write the reagents needed for each step and the product of each step (20 pts).

