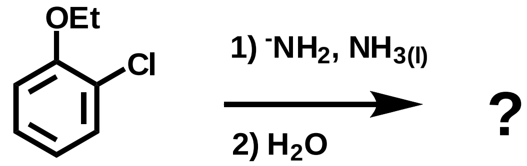
University of Windsor
Chemistry and Biochemistry

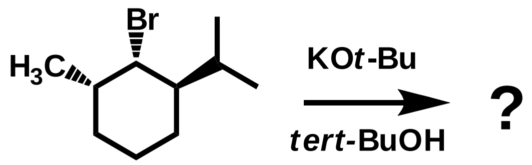
Chemistry 59-235 **Mar. 19, 2013**
Midterm #2 **Time: 50 minutes**

Answer all questions in the test booklets. Exams in pen are greatly preferred; ones written in pencil will be marked, but cannot be returned for remarking. As in previous midterms, if there is a functional with 'complex' bonding (i.e., nitro, sulfonic acid, or azide), a proper valence bond structure once (anywhere) is required for full marks.

1a. Give the complete mechanism of the following reaction. The complete answer will include all steps of the reaction (and intermediates), the product formed, and any small molecules given off. The reasoning behind the regiochemistry that you show in the product should be apparent. (**10 marks**).

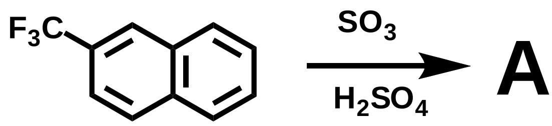


1b. Show the product for the following transformation, and rationalize the product that is formed in terms of the minimum energy conformation of the starting material, the reactive conformation of the starting material, and what groups are oriented properly for reaction. Also, what is the *name* for the type of mechanism of the reaction. Aside: In terms of size, *i*-Pr > CH_3 > Br > H (**10 marks**)

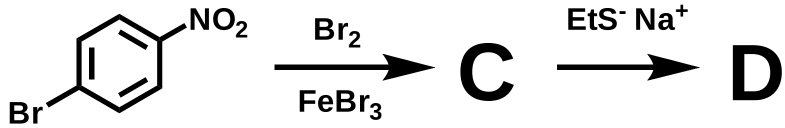


2. Predict the major product(s) of the following reactions. Mechanisms are not necessary, but showing your work is likely to be a help (**5 each, 40 marks total**).

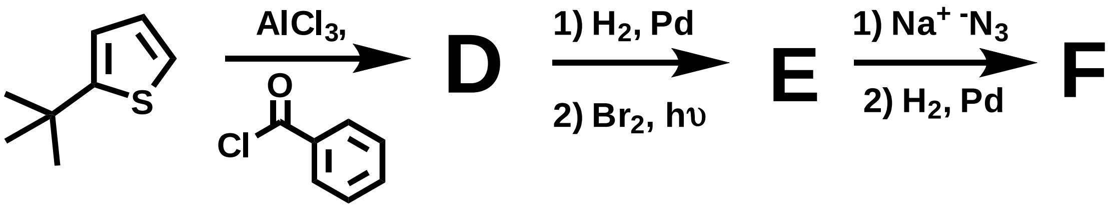
a.



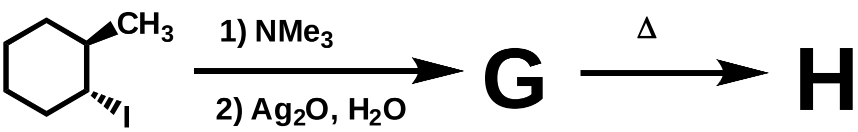
b.



c.



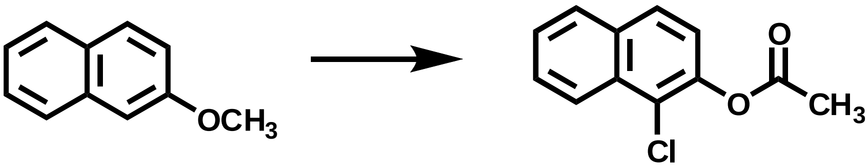
d.



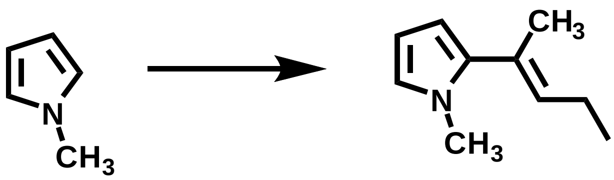
Note: In terms of size, the new functional group in **G** > CH_3 > I

3. Show by equations how you would prepare each of the shown products from the indicated starting materials. You may use any other reagents you deem fit, as long as they are stable and make chemical sense. Show all intermediates that could be isolated. Mechanisms are not necessary (**10 each, 20 marks total**).

a.



b.



Note: In terms of size, a pyrrole ring > CH_3

WebElements: the periodic table on the world-wide web

http://www.webelements.com/

Key: element name / **atomic number** / **symbol** / 2001 atomic weight (mean relative mass)

1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
hydrogen **1** **H** 1.00794(7)																		helium **2** **He** 4.002602(2)
lithium **3** **Li** 6.941(2)	beryllium **4** **Be** 9.012182(3)												boron **5** **B** 10.811(7)	carbon **6** **C** 12.0107(8)	nitrogen **7** **N** 14.00674(7)	oxygen **8** **O** 15.9994(3)	fluorine **9** **F** 18.9984032(5)	neon **10** **Ne** 20.1797(6)
sodium **11** **Na** 22.989770(2)	magnesium **12** **Mg** 24.3050(6)												aluminium **13** **Al** 26.981538(2)	silicon **14** **Si** 28.0855(3)	phosphorus **15** **P** 30.973761(2)	sulfur **16** **S** 32.065(5)	chlorine **17** **Cl** 35.453(2)	argon **18** **Ar** 39.948(1)
potassium **19** **K** 39.0983(1)	calcium **20** **Ca** 40.078(4)		scandium **21** **Sc** 44.955910(8)	titanium **22** **Ti** 47.867(1)	vanadium **23** **V** 50.9415(1)	chromium **24** **Cr** 51.9961(6)	manganese **25** **Mn** 54.938049(9)	iron **26** **Fe** 55.845(2)	cobalt **27** **Co** 58.933200(9)	nickel **28** **Ni** 58.6934(2)	copper **29** **Cu** 63.546(3)	zinc **30** **Zn** 65.409(4)	gallium **31** **Ga** 69.723(1)	germanium **32** **Ge** 72.64(1)	arsenic **33** **As** 74.92160(2)	selenium **34** **Se** 78.96(3)	bromine **35** **Br** 79.904(1)	krypton **36** **Kr** 83.798(2)
rubidium **37** **Rb** 85.4678(3)	strontium **38** **Sr** 87.62(1)		yttrium **39** **Y** 88.90585(2)	zirconium **40** **Zr** 91.224(2)	niobium **41** **Nb** 92.90638(2)	molybdenum **42** **Mo** 95.94(1)	technetium **43** **Tc** [98]	ruthenium **44** **Ru** 101.07(2)	rhodium **45** **Rh** 102.90550(2)	palladium **46** **Pd** 106.42(1)	silver **47** **Ag** 107.8682(2)	cadmium **48** **Cd** 112.411(8)	indium **49** **In** 114.818(3)	tin **50** **Sn** 118.710(7)	antimony **51** **Sb** 121.760(1)	tellurium **52** **Te** 127.60(3)	iodine **53** **I** 126.90447(3)	xenon **54** **Xe** 131.293(6)
caesium **55** **Cs** 132.90545(2)	barium **56** **Ba** 137.327(7)	**57-70** *****	lutetium **71** **Lu** 174.967(1)	hafnium **72** **Hf** 178.49(2)	tantalum **73** **Ta** 180.9479(1)	tungsten **74** **W** 183.84(1)	rhenium **75** **Re** 186.207(1)	osmium **76** **Os** 190.23(3)	iridium **77** **Ir** 192.217(3)	platinum **78** **Pt** 195.078(2)	gold **79** **Au** 196.96655(2)	mercury **80** **Hg** 200.59(2)	thallium **81** **Tl** 204.3833(2)	lead **82** **Pb** 207.2(1)	bismuth **83** **Bi** 208.98038(2)	polonium **84** **Po** [209]	astatine **85** **At** [210]	radon **86** **Rn** [222]
francium **87** **Fr** [223]	radium **88** **Ra** [226]	**89-102** ******	lawrencium **103** **Lr** [262]	rutherfordium **104** **Rf** [261]	dubnium **105** **Db** [262]	seaborgium **106** **Sg** [266]	bohrium **107** **Bh** [264]	hassium **108** **Hs** [269]	meitnerium **109** **Mt** [268]	ununnilium **110** **Uun** [271]	unununium **111** **Uuu** [272]	ununbium **112** **Uub** [285]		ununquadium **114** **Uuq** [289]				

*lanthanoids	lanthanum **57** **La** 138.9055(2)	cerium **58** **Ce** 140.116(1)	praseodymium **59** **Pr** 140.90765(2)	neodymium **60** **Nd** 144.24(3)	promethium **61** **Pm** [145]	samarium **62** **Sm** 150.36(3)	europium **63** **Eu** 151.964(1)	gadolinium **64** **Gd** 157.25(3)	terbium **65** **Tb** 158.92534(2)	dysprosium **66** **Dy** 162.500(1)	holmium **67** **Ho** 164.93032(2)	erbium **68** **Er** 167.259(3)	thulium **69** **Tm** 168.93421(2)	ytterbium **70** **Yb** 173.04(3)
**actinoids	actinium **89** **Ac** [227]	thorium **90** **Th** 232.0381(1)	protactinium **91** **Pa** 231.03588(2)	uranium **92** **U** 238.02891(3)	neptunium **93** **Np** [237]	plutonium **94** **Pu** [244]	americium **95** **Am** [243]	curium **96** **Cm** [247]	berkelium **97** **Bk** [247]	californium **98** **Cf** [251]	einsteinium **99** **Es** [252]	fermium **100** **Fm** [257]	mendelevium **101** **Md** [258]	nobelium **102** **No** [259]

Element symbols and names: symbols, names, and spellings are those recommended by IUPAC (http://www.iupac.org/). After controversy, the names of elements 101-109 are now confirmed (Pure & Appl. Chem., 1997, **69**, 2471–2473). Names have yet to be proposed for the elements 110–112, and 114 - those used here are IUPAC's temporary systematic names (Pure & Appl. Chem., 1979, **51**, 381–384). In the USA and some other countries, the spellings **aluminum** and **cesium** are normal while in the UK and elsewhere the usual spelling is **sulphur**.

Atomic weights (mean relative masses): Apart from the heaviest elements, these are IUPAC 2001 values (Pure & Appl. Chem., 2001, **73**, 667–683). Elements with values given in brackets have no stable nuclides and are represented by 5-figure values for the longest-lived isotope. The elements thorium, protactinium, and uranium have characteristic terrestrial abundances and these are the values quoted. The last significant figure of each value is considered reliable to ±1 except where a larger uncertainty is given in parentheses.

Periodic table organisation: for a justification of the positions of the elements La, Ac, Lu, and Lr in the WebElements periodic table see W.B. Jensen, "The positions of lanthanum (actinium) and lutetium (lawrencium) in the periodic table", J. Chem. Ed., 1982, **59**, 634–636.

Group labels: the numeric system (1–18) used here is the current IUPAC convention. For a discussion of this and other common systems see: W.C. Fernelius and W.H. Powell, "Confusion in the periodic table of the elements", J. Chem. Ed., 1982, **59**, 504–508.