CH 335

Second Midterm Exam

Monday, February 21, 2022

Form B

Name_____

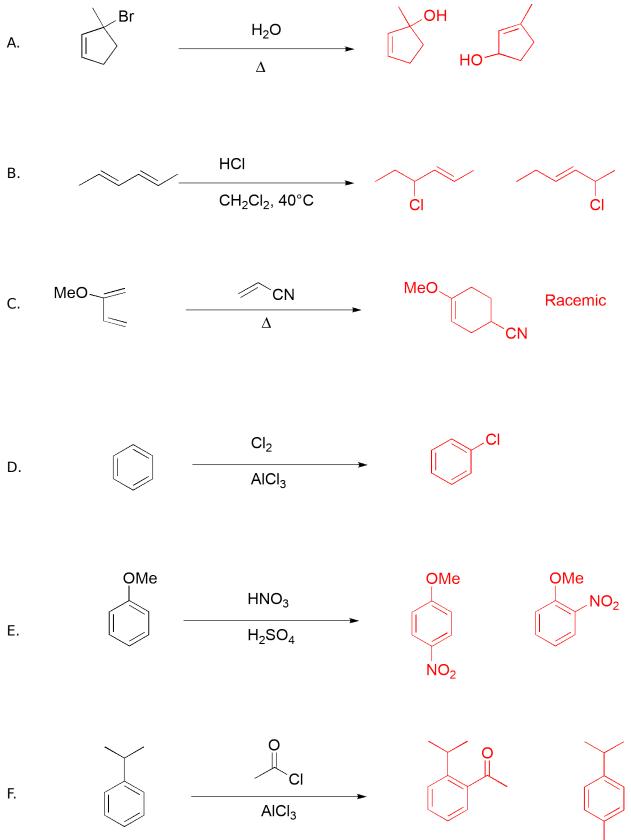
You may use model kits but no other material with chemical information without instructor approval.

hydroger 1 heliur 2 Н He 1.0079 lithium 3 4.0026 neon 10 beryllium 4 fluorine 9 boron 5 carbon 6 nitrogen 7 oxygen 8 B C Be Ν 0 F Li Ne 10.811 aluminiur **13** 12.011 silicon 14 6.941 sodium **11** 15.999 sulfur 16 18.998 chlorine 17 20.180 argon **18** 9.0122 magnesiur **12** 14.007 losphor 15 AI Si Ρ S CI Na Mg Ar 39.948 krypton 36 22.990 potassium 19 24.305 calciun 20 gallium 31 32.065 eleniun 34 35.453 bromine 35 rmaniu 32 scandium 21 vanadium 23 chromium 24 titanium 22 mangane 25 iron 26 cobalt 27 nickel 28 copper 29 zinc 30 arseni 33 V Κ Cr Mn Co Ni Cu Ca Sc Ti Fe Zn Ga Ge As Se Br Kr 78.96 tellurium 52 44.956 yttrium **39** 50.942 niobium 47.867 rconiur 54.938 technetiu 43 55.845 ruthenium 44 63.546 silver 47 72.61 tin 50 83.80 xenon 54 39.098 rubidium 37 58,933 rhodium 65.39 admiun 48 69.723 Indium 49 74.922 intimon 79.904 iodine 53 40.078 strontiun 38 58,693 balladiur 51 40 41 42 45 46 Pd Ag Rb Sr Y Zr Nb Мо Tc Ru Rh Cd In Sn Sb Те T Xe 91.224 hafniun 72 114.82 thallium 81 118.71 lead 82 126.90 astatine 85 85.468 caesium 55 87.62 barium 56 [98] rhenium 75 106.42 platinum **78** 112.41 mercury 80 121.76 bismuth 83 127.60 polonium 84 131.29 radon 86 88.906 Iutetium 71 92.906 tantalum 73 95.94 tungsten 74 101.07 osmium 76 102.91 iridium 77 gold 79 57-70 Cs Та W Au Hg TL Pb Bi Po Ba Hf Re Pt At × Lu 0s lr Rn 132.91 francium **87** 183.84 137.33 radium 88 178.49 perford 186.21 bohrium 190.23 hassium 192.22 eitneriu 195.08 nunnilium 196.97 unununiur 207.2 Incuadu [210] [222] 180.95 dubnium 200.59 ununbium 89-102 103 105 108 110 111 112 114 104 106 107 109 Fr Rf Db Ra * * Lr Sg Bh Hs Mt Uun Uuu Uub Uuq [261] [271] [289]

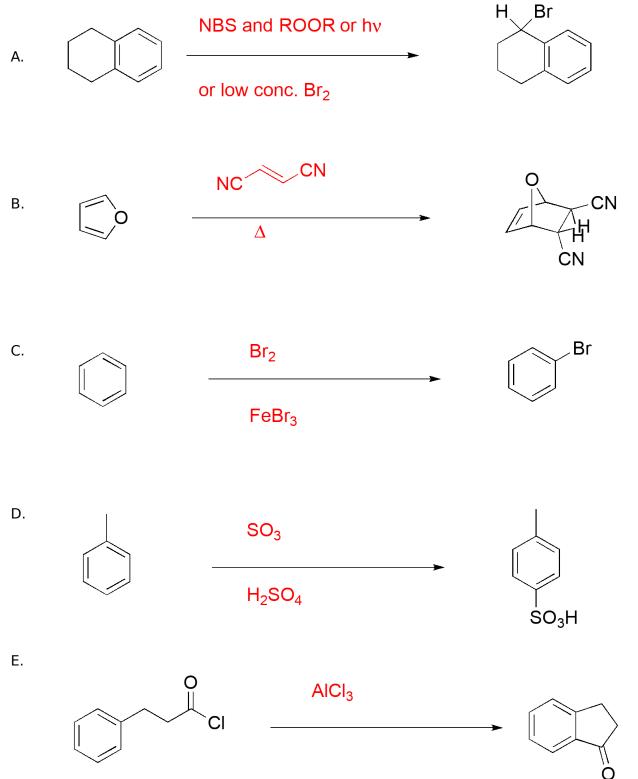
Please do not use ipods or other music players.

*Lanthanide series	lanthanum 57	cerium 58	praseodymium 59	neodymium 60	promethium 61	samarium 62	europium 63	gadolinium 64	terbium 65	dysprosium 66	holmium 67	erbium 68	thulium 69	ytterbium 70
	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb
	138.91	140.12	140.91	144.24	[145]	150.36	151.96	157.25	158.93	162.50	164.93	167.26	168.93	173.04
**Actinide series	actinium 89	thorium 90	protactinium 91	uranium 92	neptunium 93	plutonium 94	americium 95	curium 96	berkelium 97	californium 98	einsteinium 99	fermium 100	mendelevium 101	nobelium 102
	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No
	[227]	232.04	231.04	238.03	[237]	[244]	[243]	[247]	[247]	[251]	[252]	[257]	[258]	[259]

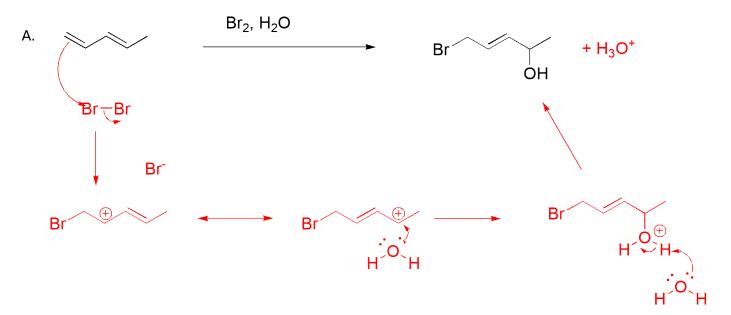
1. (30 points) Write the expected product(s) for each of the following reactions. Specify stereochemistry where appropriate, and include all expected organic products.



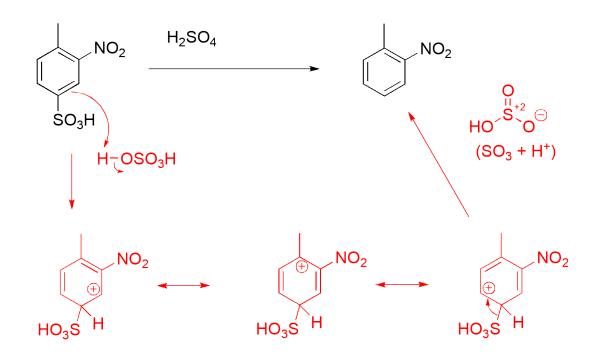
2. (25 points) Write (over the arrow) the reagents and/or conditions needed to accomplish the following transformations.



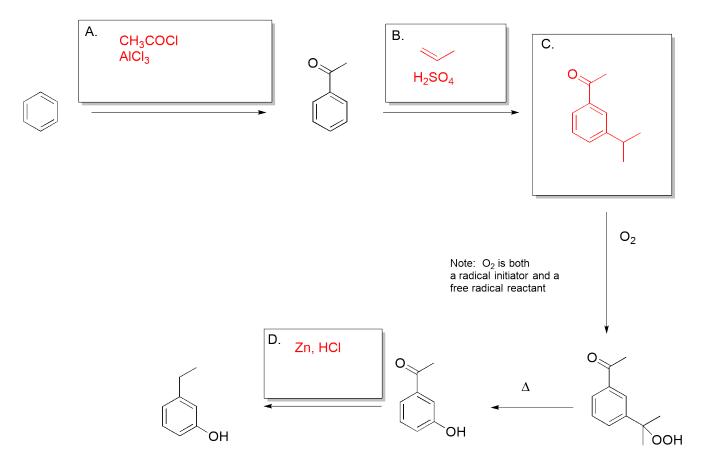
3. (20 points) Write multistep mechanisms (using the correct electron-pushing formalism, and as many steps as needed) for each of the following transformations. Be sure to draw resonance structures for any intermediate so stabilized.



Β.



4. (16 points) Using multistep synthesis, show how to make 3-ethylphenol, a compound with two o/p-directors arranges meta to each other.



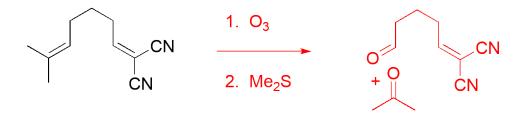
5. (9 points) The reaction of ozone with an alkene is thought to be a concerted pericyclic reaction like the Diels-Alder reaction.

A. Sketch the two HOMO-LUMO interactions between ozone and an alkene. Fill in the correct wavefunction phases by shading the appropriate parts of the p orbitals. (If the particular p orbital is on a node, leave it completely blank.)



Note that the ozone HOMO actually has a node that lies on the central O atom.

B. Given that thermodynamically, ozone is an oxidant and thus electron poor, explain which alkene in the following molecule would react faster (or if they are expected to react at the same rate) in an ozonolysis and why.



The methyl groups raise the alkene HOMO, making it more reactive, while the nitriles lower the alkene HOMO, making it less reactive. The left side will thus be expected to react faster.

Bond strengths (kcal/mol):

Cl-Cl 58 Br-Br 46 I-I 36 H-F 136 H-Cl 103 H-Br 87 H-I 71	
I-I 36 H-F 136 H-Cl 103 H-Br 87	
H-F 136 H-Cl 103 H-Br 87	
H-Cl 103 H-Br 87	
H-Br 87	
H-T 71	
11 ± , ±	
CH ₃ -H 105	
CH ₃ CH ₂ -H 101	
(CH ₃) ₂ CH-H 98.5	
(CH ₃) ₃ C-H 96.5	
CH ₃ -F 110	
CH₃-Cl 85	
CH ₃ -Br 70	
CH ₃ -I 57	
CH ₃ CH ₂ -F 111	
CH_3CH_2-Cl 84	
CH_3CH_2 -Br 70	
CH ₃ CH ₂ -I 56	
(CH ₃) ₂ CH-F 111	
(CH ₃) ₂ CH-Cl 84	
$(CH_3)_2CH-Br$ 71	
(CH ₃) ₂ CH-I 56	
(CH ₃) ₃ C-F 110	
(CH ₃) ₃ C-Cl 85	
(CH ₃) ₃ C-Br 71	
(CH ₃) ₃ C-I 55	

