

CHEM 3311 (Richardson) Second Hour Exam – March 14, 2017

Your Name Key

Student ID _____

- Recitation Time
- 8:00 Wednesday w/ Josh Kamps
 - 2:00 Wednesday w/ Josh Kamps
 - 10:00 Thursday w/ Brendan Griffiths
 - 11:00 Thursday w/ Brendan Griffiths
 - 12:00 Friday w/ Brendan Griffiths

Question	Score	Out of
1		20
2		10
3		15
4		10
5		25
6		20
7		10 e.c.
Total		100

This is a closed-book exam. The use of notes, calculators, or cell phones will not be allowed during the exam. You may use models sets brought in a clear ziplock bag. Use the backs of the pages for scratch work. If your final answer is not clearly specified, you will lose points. For mechanisms, show all intermediates including correct formal charges, but do not show transition states.

Hydrogen 1 H 1.0079																	Helium 2 He 4.0026														
Lithium 3 Li 6.941	Boron 5 B 10.811	Carbon 6 C 12.011	Nitrogen 7 N 14.007	Oxygen 8 O 15.999	Fluorine 9 F 18.998	Neon 10 Ne 20.180																									
Sodium 11 Na 22.990	Magnesium 12 Mg 24.305																	Aluminum 13 Al 26.982	Silicon 14 Si 28.086	Phosphorus 15 P 30.974	Sulfur 16 S 32.065	Chlorine 17 Cl 35.453	Argon 18 Ar 39.948								
Potassium 19 K 39.098	Calcium 20 Ca 40.078	Scandium 21 Sc 44.956	Titanium 22 Ti 47.867	Vanadium 23 V 50.942	Chromium 24 Cr 51.996	Manganese 25 Mn 54.938	Iron 26 Fe 55.847	Cobalt 27 Co 58.933	Nickel 28 Ni 58.693	Copper 29 Cu 63.546	Zinc 30 Zn 65.38	Gallium 31 Ga 69.723	Germanium 32 Ge 72.61	Arsenic 33 As 74.922	Selenium 34 Se 78.96	Bromine 35 Br 79.904	Krypton 36 Kr 83.80														
Rubidium 37 Rb 85.468	Strontium 38 Sr 87.62	Yttrium 39 Y 88.906	Zirconium 40 Zr 91.224	Niobium 41 Nb 92.906	Molybdenum 42 Mo 95.94	Technetium 43 Tc [98]	Ruthenium 44 Ru 101.07	Rhodium 45 Rh 101.07	Palladium 46 Pd 106.32	Silver 47 Ag 107.87	Cadmium 48 Cd 112.41	Indium 49 In 114.82	Tin 50 Sn 118.71	Antimony 51 Sb 121.76	Tellurium 52 Te 127.60	Iodine 53 I 126.905	Xenon 54 Xe 131.29														
Cesium 55 Cs 132.91	Barium 56 Ba 137.33	Lanthanum 57 La 138.905	Cerium 58 Ce 140.12	Praseodymium 59 Pr 140.908	Neodymium 60 Nd 144.24	Promethium 61 Pm [145]	Samarium 62 Sm 150.36	Europium 63 Eu 151.96	Gadolinium 64 Gd 157.25	Terbium 65 Tb 158.93	Dysprosium 66 Dy 162.50	Holmium 67 Ho 164.93	Erbium 68 Er 167.26	Thulium 69 Tm 168.93	Ytterbium 70 Yb 173.05	Lutetium 71 Lu 174.967	Hafnium 72 Hf 178.49	Tantalum 73 Ta 180.95	Tungsten 74 W 183.84	Rhenium 75 Re 186.21	Osmium 76 Os 190.23	Iridium 77 Ir 192.22	Platinum 78 Pt 195.08	Gold 79 Au 196.97	Mercury 80 Hg 200.59	Thallium 81 Tl 204.38	Lead 82 Pb 207.2	Bismuth 83 Bi 208.98	Polonium 84 Po [209]	Astatine 85 At [210]	Radon 86 Rn [222]
Francium 87 Fr [223]	Radium 88 Ra [226]	Actinium 89 Ac [227]	Thorium 90 Th 232.04	Protactinium 91 Pa 231.04	Uranium 92 U 238.03	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]																

* Lanthanide series

57	58	59	60	61	62	63	64	65	66	67	68	69	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	173.05

** Actinide series

89	90	91	92	93	94	95	96	97	98	99	100	101	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]

pKa Values

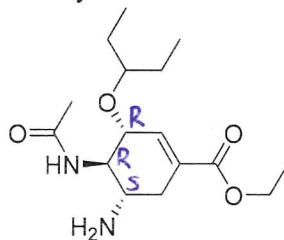
HI	-10	CH ₃ COOH	4.7	ArOH	10	H ₂	35
HBr	-8	HN ₃	4.7	RSH	10-12	NH ₃	36
HCl	-6	H ₂ S	7.0	H ₂ O	15.7	H ₂ C=CH ₂	45
H ₃ O ⁺	-1.7	NH ₄ ⁺	9.3	ROH (R=alkyl)	16-18	CH ₄	60
HF	3.2	HCN	9.4	HC≡CH	26		

Average = 67.5
(8-pt curve)
St Dev = 15.6
Max = 102 (before curve)
Min = 26

- 1) Fill in the table below. For each compound name, draw the structure, rank its stability (1=most stable), and draw the major product(s) for this molecule reacting with HBr. (20 pts)

Name	Structure (1 pt)	Stability Ranking	Major product(s) formed by HBr addition (2 pts)
(E)-4,5-dimethyl-2-hexene		(1 pt) 3	 (can also show - not enough for full pts by itself)
(E)-2,3-dimethyl-3-hexene		2	
2,3-dimethyl-2-hexene		1	
4,5-dimethyl-1-hexene		5	
(Z)-4,5-dimethyl-2-hexene		4	 (can also show)

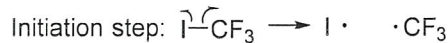
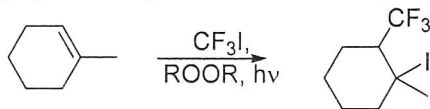
- 2) Tamiflu, shown below, is used for the prevention and treatment of flu. What is the absolute configuration at each of its asymmetric carbons? How many stereoisomers are possible for this molecule, ignoring E/Z stereochemistry at the double bond? (10 pts)



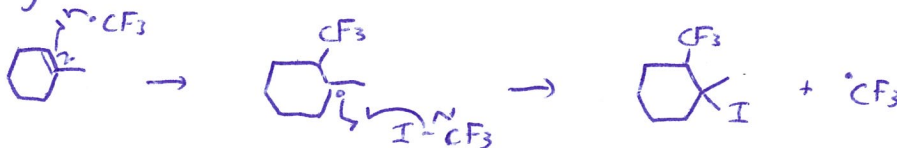
8 total stereoisomers.

(2.5 pts per answer, rounding down.)

- 3) The reaction shown below is very similar to a reaction that we covered in lecture. Suggest a reasonable mechanism for this reaction. The initiation step is already shown, but give the propagation steps and at least two possible termination steps. (15 pts)

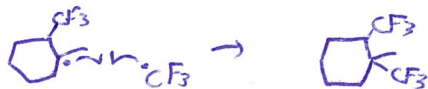


Propagation:



(Propagation starts & ends w/ same radical)

Termination:



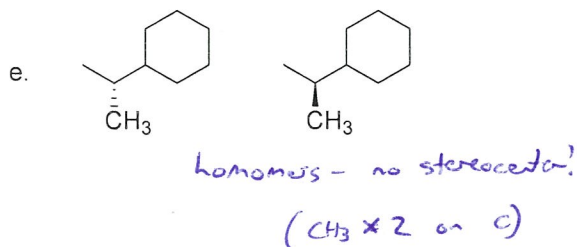
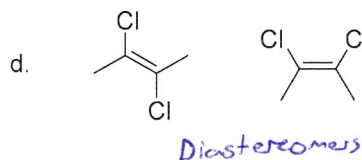
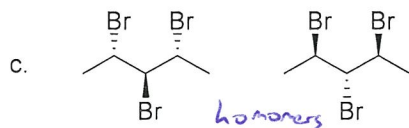
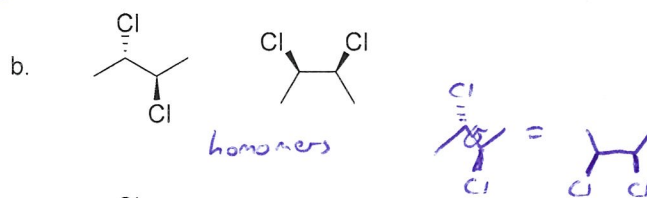
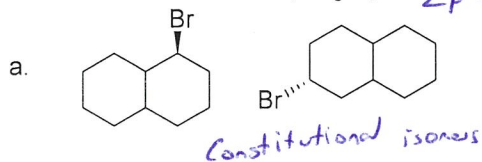
+ others (some based on ROOR radicals)

9 pts for propagation (-3 for forming radical in wrong place, -3 for showing termination to get major prod, -1 for each arrow out of place)

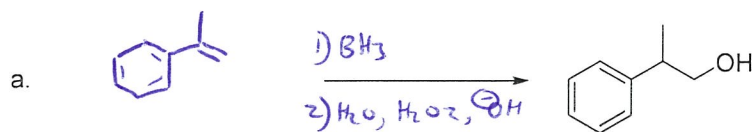
3 pts for each termination



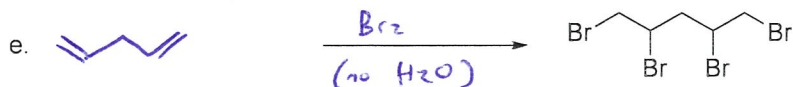
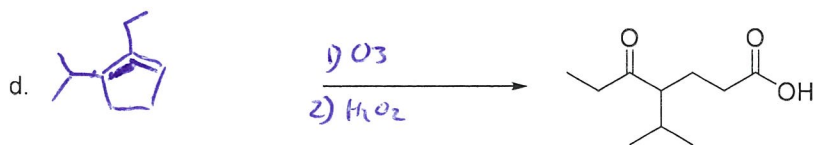
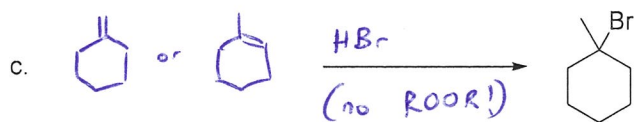
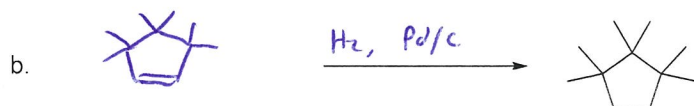
- 4) Describe the following pairs of molecules as homomers, enantiomers, diastereomers, or constitutional isomers. (10 pts) *2pts each.*



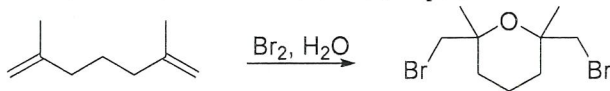
5) Starting from any hydrocarbon with the same number of carbon atoms as the product, and using any reactions that have been covered so far in class, show how you would create the products shown as the only major product of the reaction. Write your hydrocarbon starting material before the arrow, and the other reagents above or below the arrow. (25 pts)



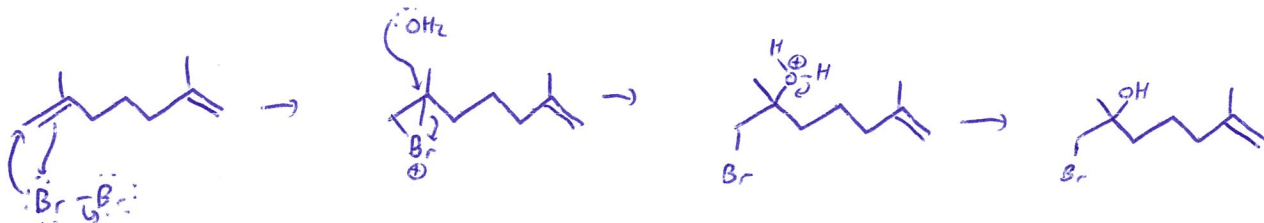
3 pts for starting material
 2 pts for reagents



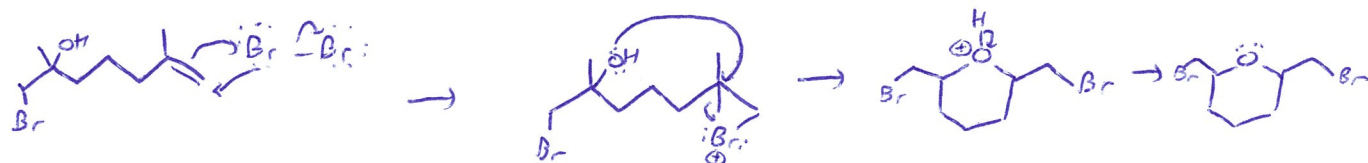
6) Suggest a reasonable mechanism for this reaction. (20 pts)



Haloalcohol formation first:



Haloether formation second:



-1 for minor errors (missing arrow or \oplus charge on a mech that is otherwise okay)

+5/10/15/20 for mechs that are about 1/4, 1/2, 3/4, or fully correct. Must at least follow the "flavor" of haloalcohol formation for partial credit.

7) Extra credit! Using only C, H and O, draw the structures for the lowest-molecular-weight acyclic chiral molecule with the functional group listed. You do not need to show absolute configuration. (10 pts extra credit)

a. Alkane



b. Ester

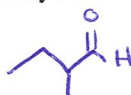


2 pts each.
Must be chiral
& have correct
fg or ~~not~~ no pts

c. Alcohol



d. Aldehyde



e. Ketone

