CHEM 3331 (Richardson) Final Exam – December 15, 2016

Your Name _____

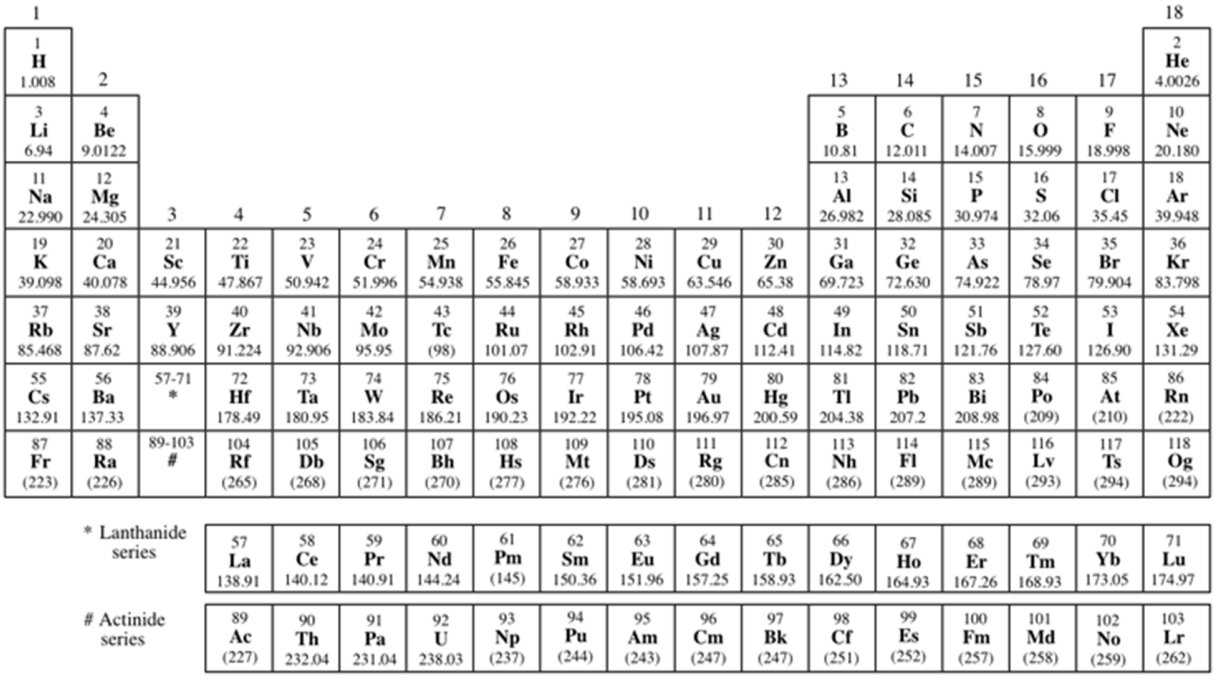
Student ID _____

Recitation (check one)

- O 1:00 Monday w/ Thomas Carey
- O 2:00 Monday w/ Thomas Carey
- O 3:00 Monday w/ Matthew Farmer
- O 9:00 Tuesday w/ Ryan McCaffrey
- O 11:00 Tuesday w/ Ryan McCaffrey
- O 1:00 Tuesday w/ Ryan McCaffrey
- O 2:00 Tuesday w/ Patrick Nordeen
- O 3:00 Tuesday w/ Matthew Farmer

Question	Score	Out of
1		25
2		25
3		60
4		20
5		40
6		30
7		10 e.c.
Total		200

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.



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H 1.008																	2 He 4.0026
3 Li 6.94	4 Be 9.0122											5 B 10.81	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180
11 Na 22.990	12 Mg 24.305											13 Al 26.982	14 Si 28.085	15 P 30.974	16 S 32.06	17 Cl 35.45	18 Ar 39.948
19 K 39.098	20 Ca 40.078	21 Sc 44.956	22 Ti 47.867	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.845	27 Co 58.933	28 Ni 58.693	29 Cu 63.546	30 Zn 65.38	31 Ga 69.723	32 Ge 72.630	33 As 74.922	34 Se 78.97	35 Br 79.904	36 Kr 83.798
37 Rb 85.468	38 Sr 87.62	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.95	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57-71 *	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89-103 #	104 Rf (265)	105 Db (268)	106 Sg (271)	107 Bh (270)	108 Hs (277)	109 Mt (276)	110 Ds (281)	111 Rg (280)	112 Cn (285)	113 Nh (286)	114 Fl (289)	115 Mc (289)	116 Lv (293)	117 Ts (294)	118 Og (294)

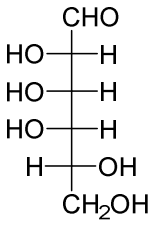
* Lanthanide series	57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.05	71 Lu 174.97
# Actinide series	89 Ac (227)	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)

pKa Values

HI	-10	CH_3COOH	4.7	Phenol	10	H_2	35
HBr	-8	HN_3	4.7	RSH	10-12	NH_3	36
HCl	-6	H_2S	7.0	H_2O	15.7	$H_2C{=}CH_2$	45
H_3O^+	-1.7	NH_4^+	9.3	Alcohol (ROH)	16-18	CH_4	60
HF	3.2	HCN	9.4	HC≡CH	26		

 Name_____

1) The structure of **D**-talose is shown below. (25 pts)



Draw the following structures:

a. Haworth projection for β-**D**-talofuranose

b. Haworth projection for α-**L**-talofuranose

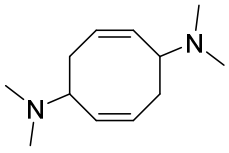
c. Haworth projection for α-**D**-talopyranose

d. both chair forms for α-**D**-talopyranose

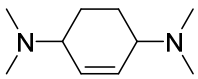
e. Circle all of the terms that describe **D**-talose. (aldose, ketose, pentose, hexose, heptose)

2) A chemist treated diamine A with methyl iodide and then with Ag_2O and heat to form hydrocarbon B, C_8H_8. Compound B reacted rapidly with Br_2 under mild conditions. Treatment of compound C in the same way gave a hydrocarbon D, C_6H_6, which did not react with Br_2. Draw the two hydrocarbons B and D, and explain their very different behavior toward Br_2. (25 pts)

A

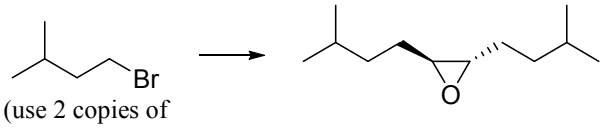


C

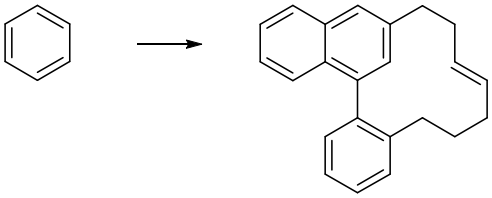


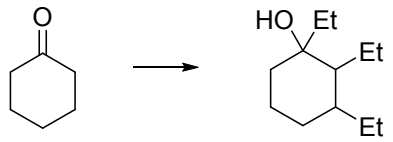
 Name_____

3) Find a way to synthesize the desired product from the given starting material plus any other reagents. If more than one step is necessary, show the product of each step. You do not need to show mechanisms. (60 pts; 15 pts each)

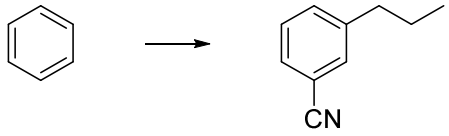
a. 

(use 2 copies of this molecule)

b.  (other reagents may contains at most 14 carbon atoms)

c. 

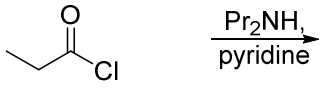
 Name_____

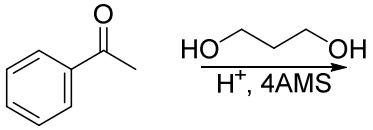
d. 

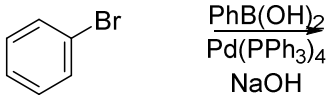
4) You have just realized that instead of adding a spoonful of sucrose (table sugar) to your daily cup of coffee, you have accidentally been adding something from a jar labeled “Mystery D-aldopentose” that was lying around your lab. Whoops! In an attempt to figure out what you’ve been ingesting, you oxidize it with nitric acid (converting both end groups to carboxylic acids) and find it to be optically active. You also perform a Kiliani-Fischer synthesis on Mystery D-aldopentose and get two different hexoses, one of which is optically active after treatment with nitric acid, and one of which is not. Draw the structure of Mystery D-aldopentose. (20 pts)

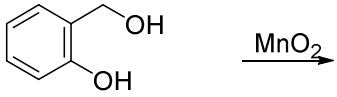
 Name_____

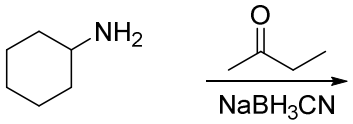
5) Predict the major product of the following reactions. If no reaction occurs, then write NR. Do not show stereochemistry. (40 pts; 4 pts each)

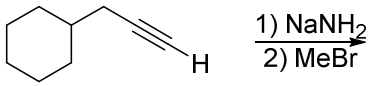
a. 

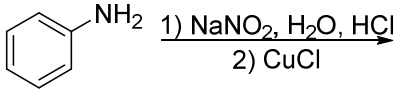
b. 

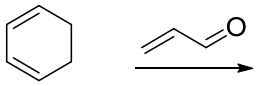
c. 

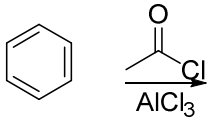
d. 

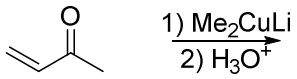
e. 

f. 

g. 

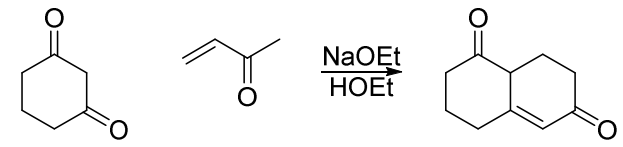
h. 

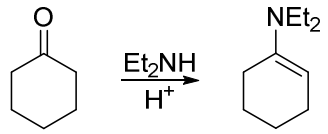
i. 

j. 

 Name_____

6) Write out the mechanisms for these reactions. (30 pts; 15 pts each)

a. 

b. 

7) Extra credit! Draw the product of benzene reacting with each of the following. (10 pts e.c.)

a. HNO_3, H_2SO_4

b. Br_2, $FeBr_3$

c. SO_3, H_2SO_4

d. MeCl, $AlCl_3$

e. AcCl, $AlCl_3$