CHEMISTRY 302
EXAM 1
11:15 AM / SECTION 4
24 Feb 2012

Name: _____

Note: Your exam should consist of 6 pages including the cover page and grade tabulation sheet. Skim the entire exam, and solve the easiest problems first. Exams not returned when time is called will not be graded.

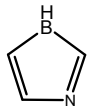
	1 1A												13 3A	14 4A	15 5A	16 6A	17 7A	18 8A
1	1 H Hydrogen 1.01	2 2A																2 He Helium 4.00
2	3 Li Lithium 6.94	4 Be Beryllium 9.01											5 B Boron 10.81	6 C Carbon 12.01	7 N Nitrogen 14.01	8 O Oxygen 16.00	9 F Fluorine 19.00	10 Ne Neon 20.18
3	11 Na Sodium 22.99	12 Mg Magnesium 24.31	3 3B	4 4B	5 5B	6 6B	7 7B	8	9 8B	10	11 1B	12 2B	13 Al Aluminum 26.98	14 Si Silicon 28.09	15 P Phosphorus 30.97	16 S Sulfur 32.07	17 Cl Chlorine 35.45	18 Ar Argon 39.95
4	19 K Potassium 39.10	20 Ca Calcium 40.08	21 Sc Scandium 44.96	22 Ti Titanium 47.87	23 V Vanadium 50.94	24 Cr Chromium 52.00	25 Mn Manganese 54.94	26 Fe Iron 55.85	27 Co Cobalt 58.93	28 Ni Nickel 58.69	29 Cu Copper 63.55	30 Zn Zinc 65.39	31 Ga Gallium 69.72	32 Ge Germanium 72.61	33 As Arsenic 74.92	34 Se Selenium 78.96	35 Br Bromine 79.90	36 Kr Krypton 83.80
5	37 Rb Rubidium 85.47	38 Sr Strontium 87.62	39 Y Yttrium 88.91	40 Zr Zirconium 91.22	41 Nb Niobium 92.91	42 Mo Molybdenum 95.94	43 Tc Technetium (98)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.91	46 Pd Palladium 106.42	47 Ag Silver 107.87	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.71	51 Sb Antimony 121.76	52 Te Tellurium 127.60	53 I Iodine 126.90	54 Xe Xenon 131.29
6	55 Cs Cesium 132.91	56 Ba Barium 137.33	57 La Lanthanum 138.91	72 Hf Hafnium 178.49	73 Ta Tantalum 180.95	74 W Tungsten 183.84	75 Re Rhenium 186.21	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.97	80 Hg Mercury 200.59	81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.98	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
7	87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (266)	107 Bh Bohrium (264)	108 Hs Hassium (269)	109 Mt Meitnerium (268)									

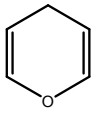
58 Ce Cerium 140.12	59 Pr Praseodymium 140.91	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.93	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93	68 Er Erbium 167.26	69 Tm Thulium 168.93	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.97
90 Th Thorium 232.04	91 Pa Protactinium 231.04	92 U Uranium 238.03	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)

* If this number is in parentheses, then it refers to the atomic mass of the most stable isotope.

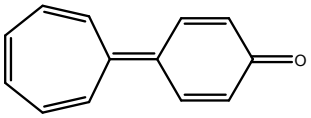
PLEASE DO NOT OPEN THIS EXAM UNTIL YOU ARE INSTRUCTED TO DO SO.

1. (16 pts) For each molecule below, report the total number of π electrons in the molecule below, and classify the molecule as aromatic, antiaromatic, or nonaromatic. You can assume the molecules are planar. Briefly explain your choice.

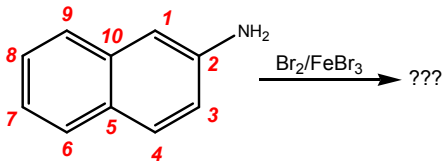
(a) 

(b) 

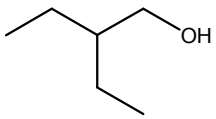
(c) draw and analyze an important resonance contributor of (c)



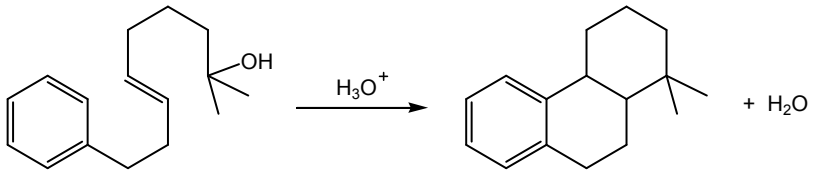
2. (12 pts) Is 2-aminonaphthalene more likely to react with $Br_2/FeBr_3$ at C6 or C7? Explain your answer using a combination of words and important resonance structures. It is not necessary to draw all possible resonance structures.



3. (8 pts) Predict what the ^1H NMR spectrum will look like for the molecule shown below:
(i) Label the magnetically different H's as a, b, …
(ii) Indicate the splitting pattern (singlet, doublet, etc) expected for each signal

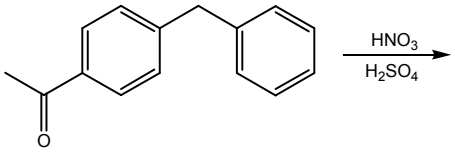


4. (12 pts) Provide a complete mechanism for the following reaction.

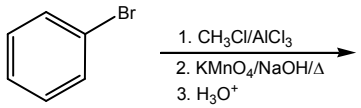


5. (12 pts) Predict the major product for each of the following aromatic reactions.

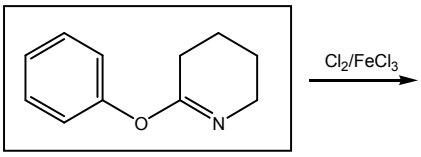
a.



b.

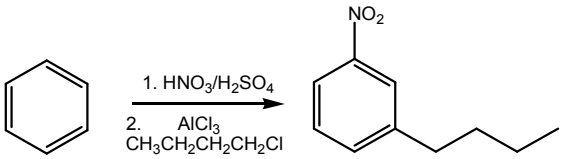


c.



6. (10 pts) Compare the boxed molecule in question 5c to phenol (C_6H_5OH). Under identical experimental conditions ($Cl_2/FeCl_3$), would the boxed molecule be expected to react faster, slower, or at an identical rate compared to phenol? Clearly explain <u>using structures</u> where appropriate.

7. (12 pts) (a.) Provide two specific reasons for why the synthesis shown below will fail to produce the desired target. (b.) Design a successful synthesis of the target molecule starting from benzene.



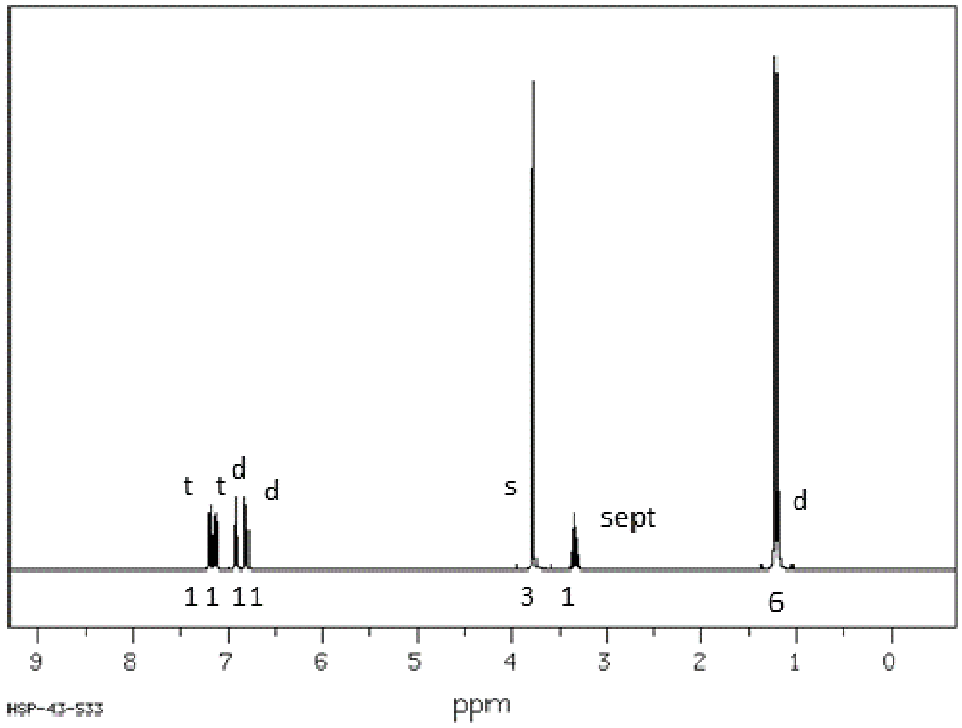
8. (18 pts) Shown below are ^{1}H NMR, ^{13}C NMR, for an unknown compound **SHINA** that has the molecular formula $C_{10}H_{14}O$. Propose a structure for **SHINA** using the data provided. Draw your proposed structure in the box below.

For full credit, you must do the following:

a. Calculate the IHD.
b. Assign all signals in the ^{1}H NMR spectrum (a, b, etc) to labeled protons in the structure.
c. Show that the splitting pattern of two of the signals is consistent with your structure.
d. Assign all signals in the ^{13}C NMR spectrum (a, b, etc) to labeled carbons in the structure.

SHINA

SHINA


t
t
d
d
s
sept
d
1 1 1 1
3
1
6
9
8
7
6
5
4
3
2
1
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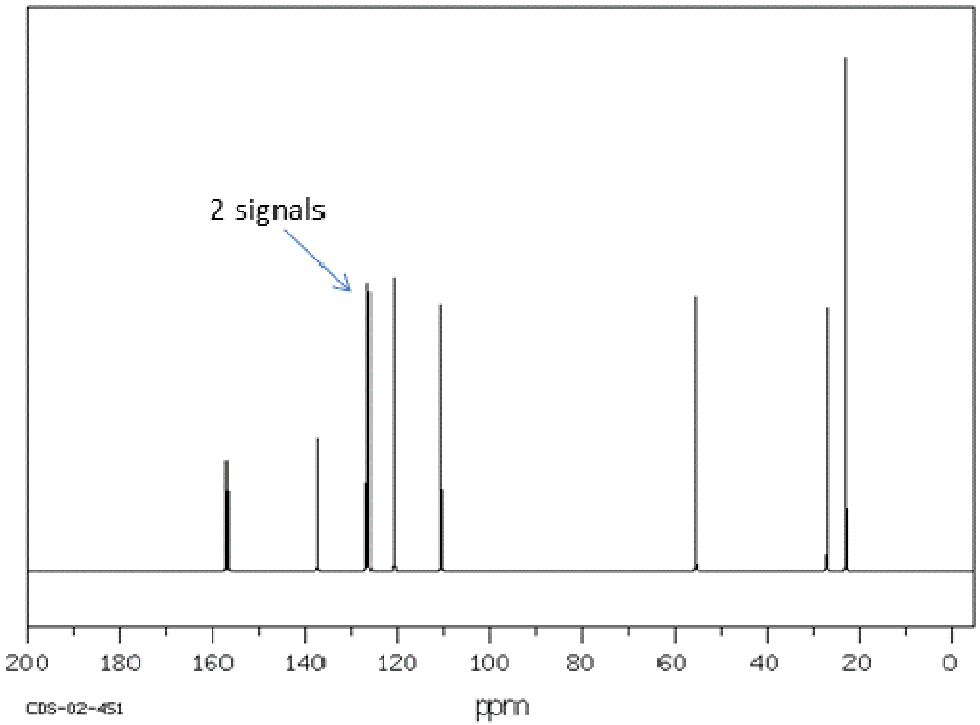
ppm


2 signals
200
180
160
140
120
100
80
60
40
20
0
ppm

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Page	Points	Score
2	36	
3	34	
4	30	
Total	100