

1. (12 pts.) Draw resonance structures for the following molecules. Do not include any resonance structure that would be considered insignificant contributors to the resonance hybrid.

1. _____

2. _____

3. _____

4. _____

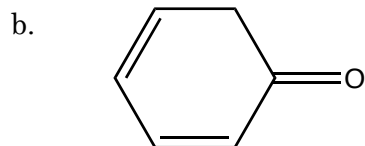
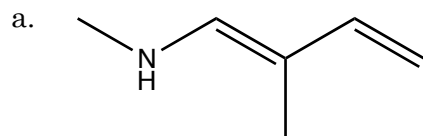
5. _____

6. _____

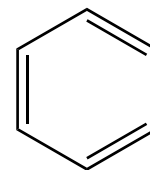
7. _____

8. _____

9. _____



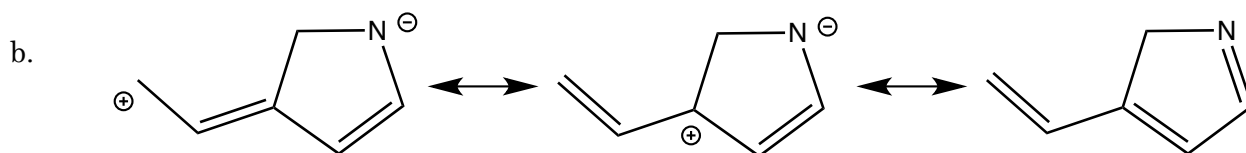
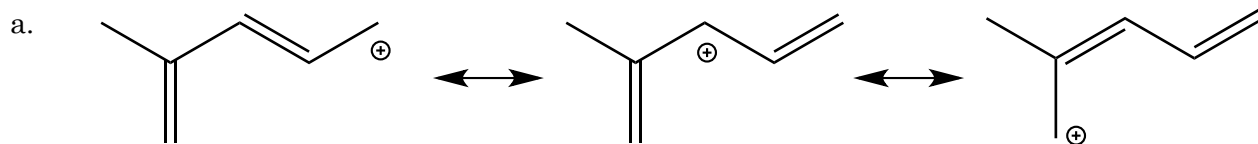
2. (10 pts.) The skeletal structure of benzene is drawn to the right. The skeletal structure drawn makes a prediction about bond lengths in a benzene molecule, but the prediction is not true.



a. What is the prediction the the structure makes regrading the C to C bond lengths in benzene.

b. What is the reality about the C to C bond lengths in benzene.

3. (12 pts.) For each set of resonance structures rank the structures in order of increasing stability. In the event of a tie, assign the same rank.



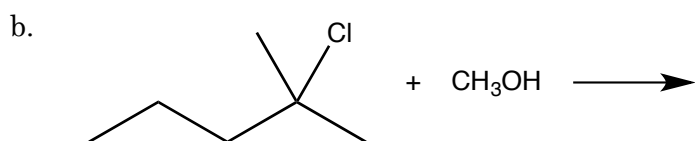
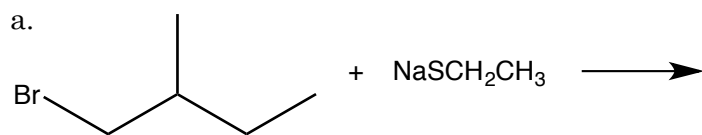
4. (12 pts.) Draw the resonance hybrids for the resonance structures in question 3. a. and 3. b.

a.

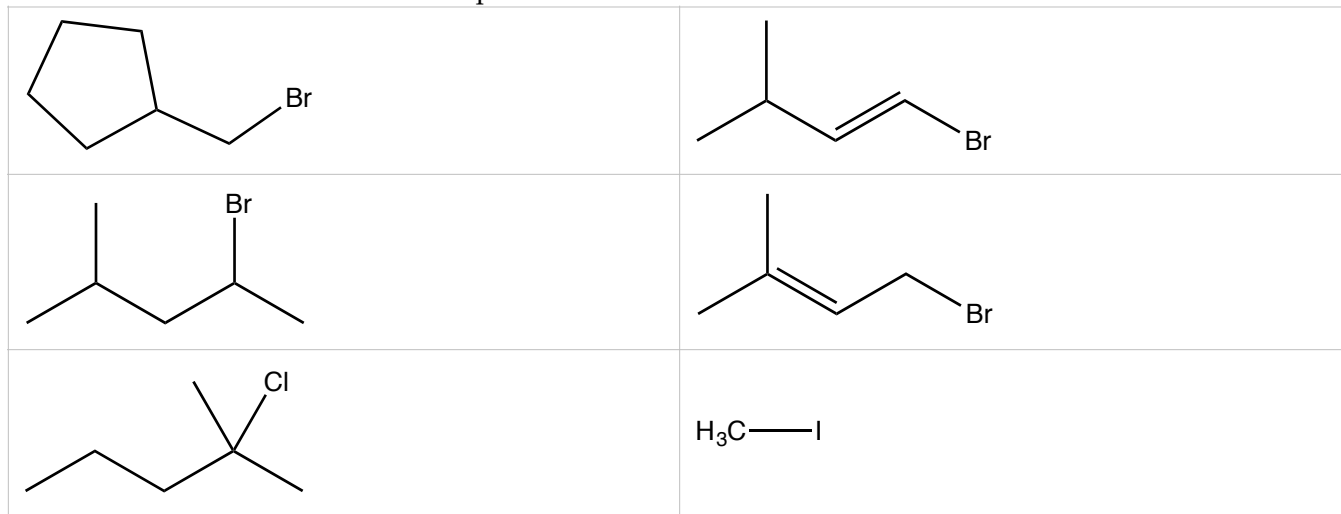
b.

5. (4 pts.) Do the resonance hybrids in 4.a. and 4.b. more strongly resemble the lowest energy resonance structures in 3.a and 3.b. or the highest?

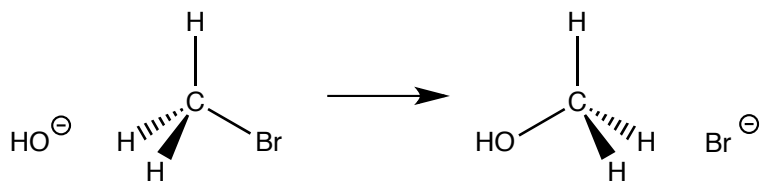
6. (12 pts.) Predict the products (include all products and byproducts; i.e., write a balanced chemical equation) for the following nucleophilic substitution reactions. Ignore the stereochemistry of the products.



7. (12 pts.) Determine whether the following molecules could participate in a nucleophilic substitution via an S_N2 and/or an S_N1 mechanism. If both mechanisms are possible, write “both”. If neither mechanism is possible write “neither”.



8. A mechanism for a nucleophilic substitution reaction is drawn below.



a. (8 pts.) What kind of mechanism is pictured, an S_N1 or S_N2 mechanism.

b. (6 pts.) Draw the transition state for this reaction. Include δ^+ and δ^- to indicate where significant charges may be developing (Ignore tiny dipoles between C and H).

9. Protic solvents reduce the nucleophilicity of nucleophiles.

a. (6 pts.) Draw a skeletal structure for a protic solvent (Yes, there's a space between “a” and “protic”).

b. (6 pts.) How do protic solvents reduce the nucleophilicity of a nucleophile. Provide the best answer you can.

1	H	1.0079	4																	2	He	4.0026
3	Li	6.941	7	Be	9.012															8	B	10.811
11	Na	22.989	12	Mg	24.305															9	C	12.011
19	K		20	Ca																10	N	14.007
37	Sc		38	Ti																14	O	15.999
39	Y		40	V																15	F	18.998
55	Zr		56	Cr																16	Ne	20.1797
72	Sr		73	Mn																17	Ar	39.948
88	Yb		89	Fe																18	Kr	79.904
			90	Co																31	Br	79.904
			91	Ni																32	I	126.905
			92	Cu																33	Xe	131.29
			93	Zn																34		
			94	Ga																49		
			95	Ge																50		
			96	As																51		
			97	Se																52		
			98	Br																53		
			99	Kr																54		
			100	Rb																81		
			101	Sr																82		
			102	Zr																83		
			103	Nb																84		
			104	Mo																85		
			105	Tc																86		
			106	Ru																112		
			107	Rh																111		
			108	Pd																110		
			109	Ag																109		
			110	Cd																111		
			111	In																112		
			112	Sn																113		
			113	Sb																114		
			114	Te																115		
			115	I																116		
			116	Xe																117		
			117																	118		
			118																	119		

58	Ce	59	Pr	60	Nd	61	Pm	62	Sm	63	Eu	64	Gd	65	Tb	66	Dy	67	Ho	68	Er	69	Tm	70	Yb	71	Lu
90	Th	91	Pa	92	U	93	Np	94	Pu	95	Am	96	Cm	97	Bk	98	Cf	99	Es	100	Fm	101	Md	102	No	103	Lr