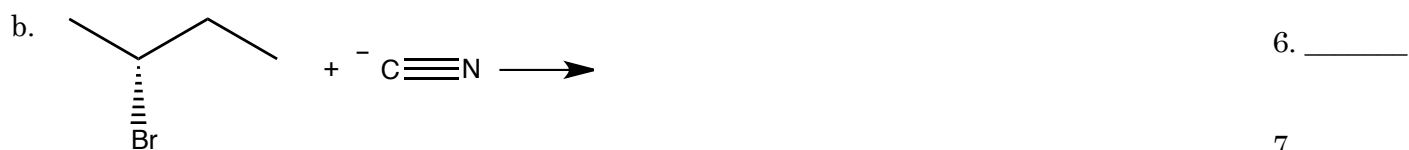
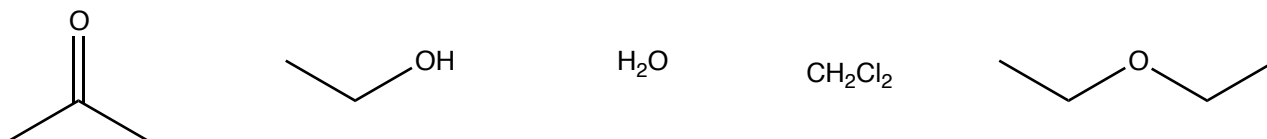


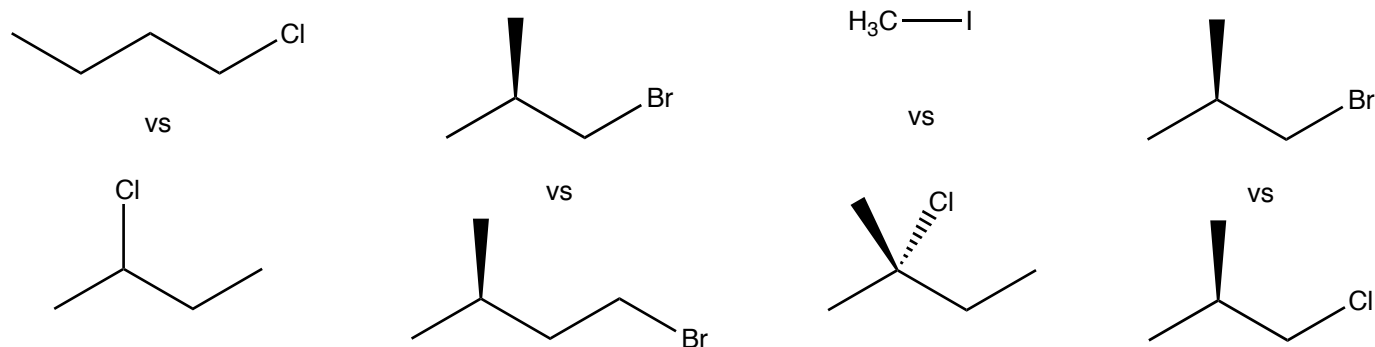
1. (12 pts.) Assuming the following reactions proceed via an  $S_N2$  mechanism determine what the likely organic products would be. Remember to indicate the stereochemistry of the products and use wedge and dashed bonds where appropriate. 1. \_\_\_\_\_



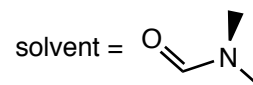
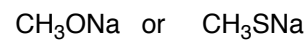
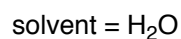
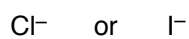
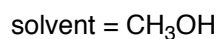
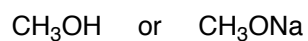
2. (10 pts) Determine whether the following solvents are protic or aprotic



3. (12 pts.) For each pair of molecules determine which would be the better  $S_N2$  substrate, and **very** briefly explain your choice.

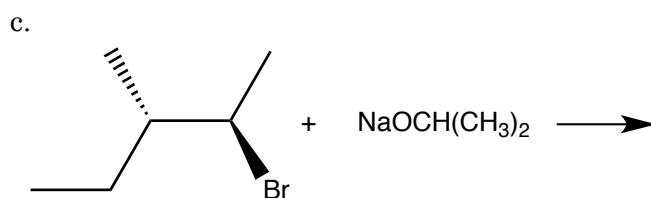
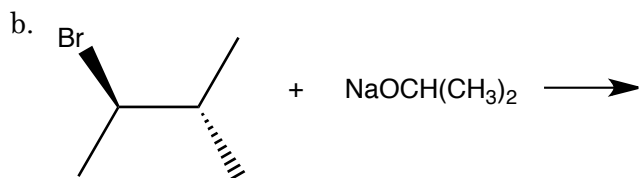
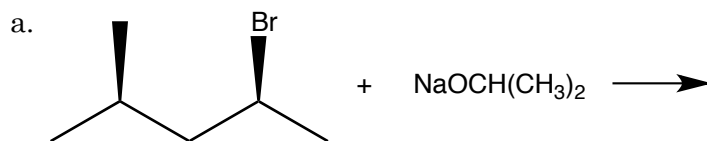


4. (3 pts. each) For the following pairs of molecules/ions which is the better nucleophile under the stated conditions.

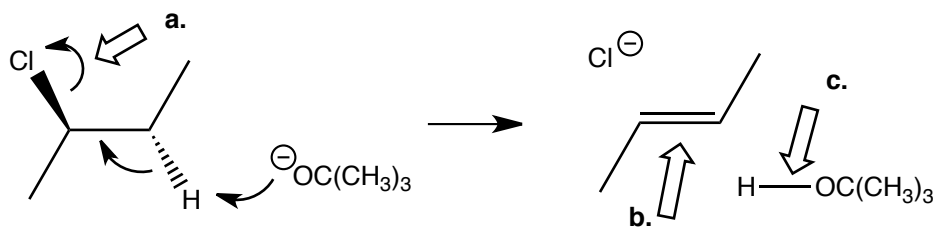


5. (10 pts.) How do protic solvent effect the nucleophilicity of a nucleophile; that is, do protic solvents make nucleophiles more or less nucleophilic. Explain your response.

6. (18 pts.) Assuming the following reactions proceed via an E2 mechanism determine what the likely organic products would be. Remember to indicate the stereochemistry of the products and use wedge and dashed bonds where appropriate.



7. (9 pts) An E2 reaction is a concerted reaction where multiple bonds are broken and formed at the same time in one step. A mechanism for an E2 reaction is drawn below and electron movement arrows have been added.



- a. Arrow **a** reminds us of what the role of the leaving group is. What is arrow **a** suggesting to the reader?
- b. According to the arrows, where do the electrons that are used to form the  $\pi$  bond come from?
- c. According to the arrows, where do the electrons that are used to form the H to O bond come from?
8. The stereoselectivity of many E2 reactions supports the conclusion that a specific alignment of the leaving group and the  $\beta$ -hydrogen involved in the reaction is required.
- a. (6 pts.) Describe the alignment of the  $\beta$ -H and the leaving group. There is a specific word that chemists use to describe the alignment, but you should explain what this word means to receive full credit.
- b. (6 pts.) Provide an explanation for why the specific alignment in part a is required.

1	H	1.0079	4	He	4.0026
3	Li	6.941	9	Be	9.012
11	Na	22.989	12	Mg	24.305
19	K	39	20	Ca	40
37	Cs	132.905	55	Rb	85.468
55	Rb	85.468	87	Fr	223
87	Fr	223	88	Ra	226
21	Sc	44.956	21	Ti	47.88
22	Ti	47.88	22	V	50.942
23	V	50.942	23	Cr	52.004
24	Cr	52.004	24	Mn	54.938
25	Mn	54.938	25	Fe	55.845
26	Fe	55.845	26	Co	58.933
27	Co	58.933	27	Ni	58.693
28	Ni	58.693	28	Cu	63.546
29	Cu	63.546	29	Zn	65.38
30	Zn	65.38	30	Ga	69.723
31	Ga	69.723	31	Ge	72.64
32	Ge	72.64	32	As	74.922
33	As	74.922	33	Se	78.96
34	Se	78.96	34	Br	79.904
35	Br	79.904	35	Kr	83.80
36	Kr	83.80	36	Xe	131.29
37	Cs	132.905	55	Rb	85.468
55	Rb	85.468	87	Fr	223
87	Fr	223	88	Ra	226

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