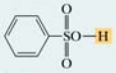
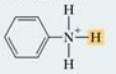
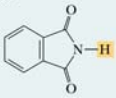
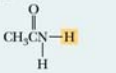
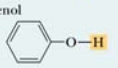
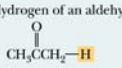
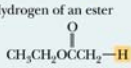
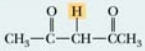
Source

CHE321 **Exam 3** **11/21/2006**

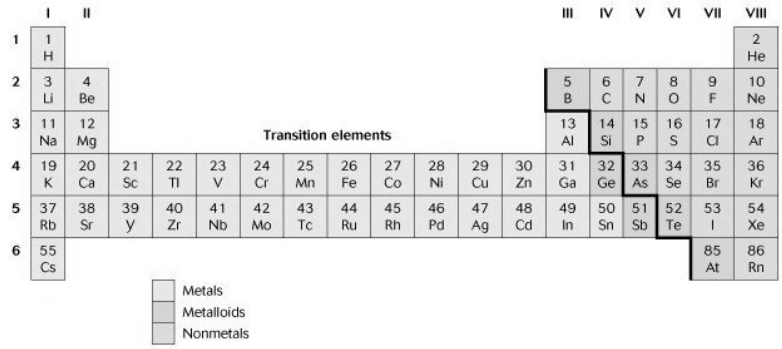
The first 12 questions are 5 point multiple choice questions and should be answered by filling in the appropriate bubble for each question.

Questions 13-16 are 10 point short answer questions and should be answered in the space provided on the front and back of the answer form.

Bond	ΔH^0	Bond	ΔH^0	Bond	ΔH^0
H—H bonds		**C—C multiple bonds**		**C—Br bonds**	
H—H	435 (104)	$CH_2{=}CH_2$	727 (174)	CH_3—Br	301 (72)
D—D	444 (106)	HC≡CH	966 (231)	C_2H_5—Br	301 (72)
				$(CH_3)_2CH$—Br	309 (74)
X—X bonds		**C—H bonds**		$(CH_3)_3C$—Br	305 (73)
F—F	159 (38)	CH_3—H	439 (105)	$CH_2{=}CHCH_2$—Br	247 (59)
Cl—Cl	247 (59)	C_2H_5—H	422 (101)	C_6H_5—Br	351 (84)
Br—Br	192 (46)	$(CH_3)_2CH$—H	414 (99)	$C_6H_5CH_2$—Br	263 (63)
I—I	151 (36)	$(CH_3)_3C$—H	405 (97)		
		$CH_2{=}CH$—H	464 (111)	**C—I bonds**	
H—X bonds		$CH_2{=}CHCH_2$—H	372 (89)	CH_3—I	242 (58)
H—F	568 (136)	C_6H_5—H	472 (113)	C_2H_5—I	238 (57)
H—Cl	431 (103)	$C_6H_5CH_2$—H	376 (90)	$(CH_3)_2CH$—I	238 (57)
H—Br	368 (88)	HC≡C—H	556 (133)	$(CH_3)_3C$—I	234 (56)
H—I	297 (71)			$CH_2{=}CHCH_2$—I	192 (46)
		C—F bonds		C_6H_5—I	280 (67)
O—H bonds		CH_3—F	481 (115)	$C_6H_5CH_2$—I	213 (51)
HO—H	497 (119)	C_2H_5—F	472 (113)		
CH_3O—H	439 (105)	$(CH_3)_2CH$—F	464 (111)	**C—N single bonds**	
C_6H_5O—H	376 (90)	C_6H_5—F	531(127)	CH_3—NH_2	355 (85)
				C_6H_5—NH_2	435 (104)
O—O bonds		**C—Cl bonds**			
HO—OH	213 (51)	CH_3—Cl	351 (84)	**C—O single bonds**	
CH_3O—OCH_3	159 (38)	C_2H_5—Cl	355 (85)	CH_3—OH	385 (92)
$(CH_3)_3CO$—$OC(CH_3)_3$	159 (38)	$(CH_3)_2CH$—Cl	355 (85)	C_6H_5—OH	468 (112)
		$(CH_3)_3C$—Cl	355 (85)		
C—C single bonds		$CH_2{=}CHCH_2$—Cl	288 (69)		
CH_3—CH_3	376 (90)	C_6H_5—Cl	405 (97)		
C_2H_5—CH_3	372 (89)	$C_6H_5CH_2$—Cl	309 (74)		
$CH_2{=}CH$—CH_3	422 (101)				
$CH_2{=}CHCH_2$—CH_3	322 (77)				
C_6H_5—CH_3	435 (104)				
$C_6H_5CH_2$—CH_3	326 (78)				

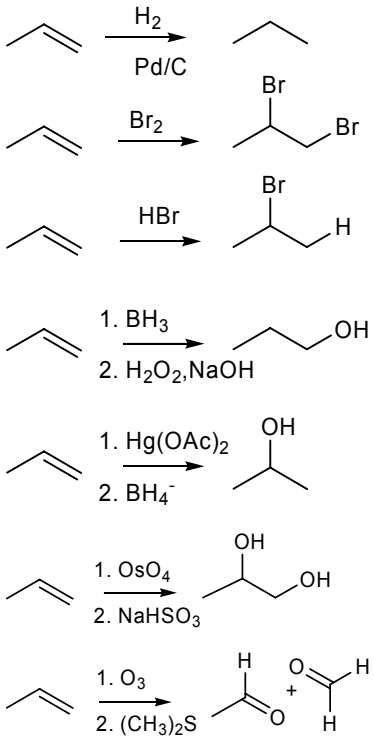
Class and Example	Typical pK_a	Class and Example	Typical pK_a
Sulfonic acid 	0–1	β-Ketoester 	11
Carboxylic acid 	3–5	Water HO—H	15.7
Arylammonium ion 	4–5	Alcohol CH_3CH_2O—H	15–19
Imide 	8–9	Amide 	15–19
Thiol CH_3CH_2S—H	8–12	Cyclopentadiene 	16
Phenol 	9–10	α-Hydrogen of an aldehyde or ketone 	18–20
Ammonium ion NH_3—H^+	9.24	α-Hydrogen of an ester 	23–25
β-Diketone 	10	Alkyne HC≡C—H	25
Nitroalkane H—CH_2NO_2	10	Ammonia NH_2—H	38
Alkylammonium ion $(CH_3CH_2)_3\overset{+}{N}$—H	10–12	Amine $[(CH_3)_2CH]_2N$—H	40
		Alkene $CH_2{=}CH$—H	44
		Alkane CH_3CH_2—H	51

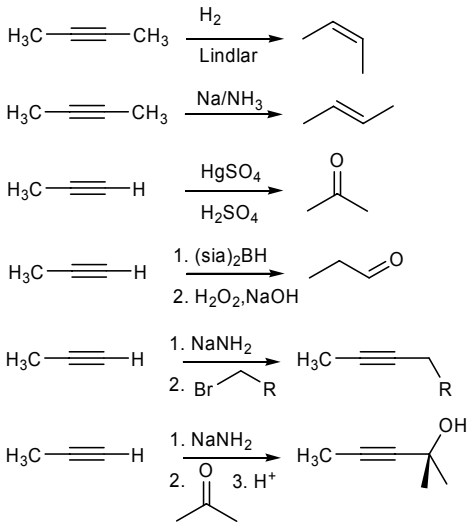
Source

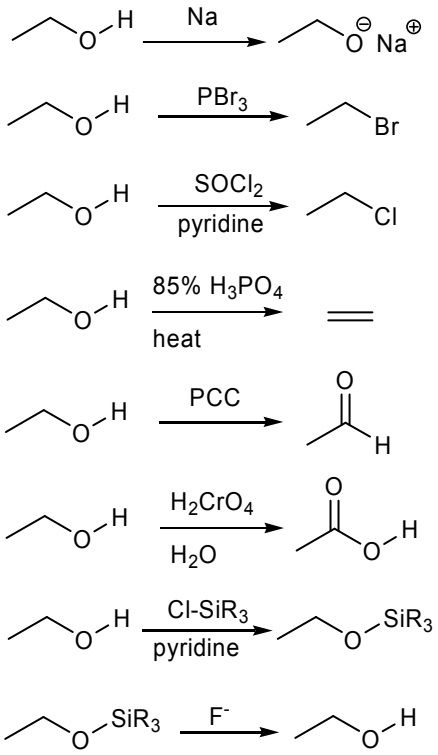


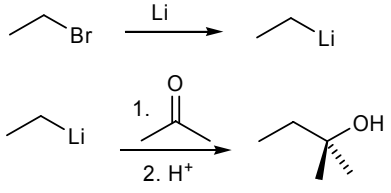
Selected Reactions of CHE 321

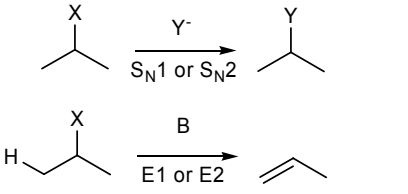
Note: This list is not complete. You are responsible for the limitations, regiochemstry and stereochemistry of

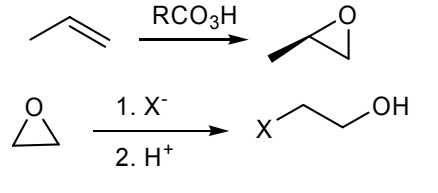








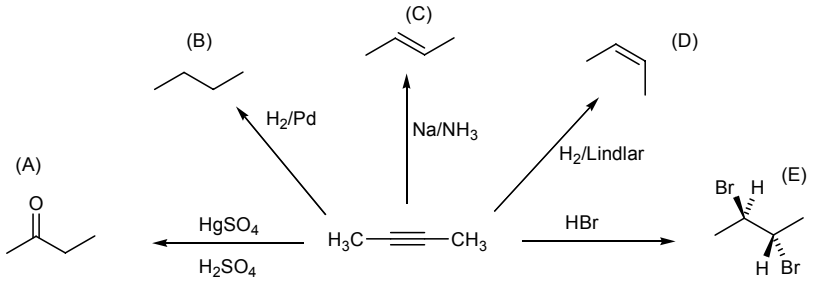




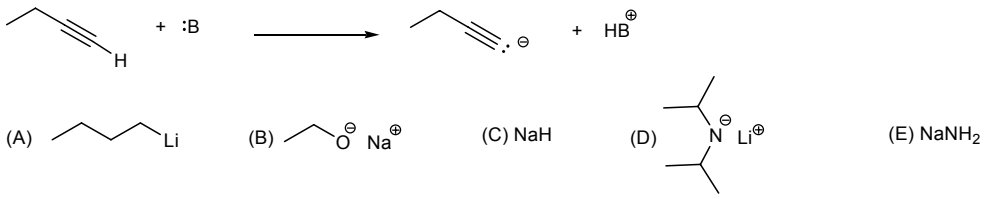
Source

Multiple Choice Questions. 60 points Select the best answer to each of the questions.

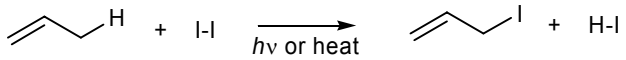
1. Choose the *incorrect* reaction.



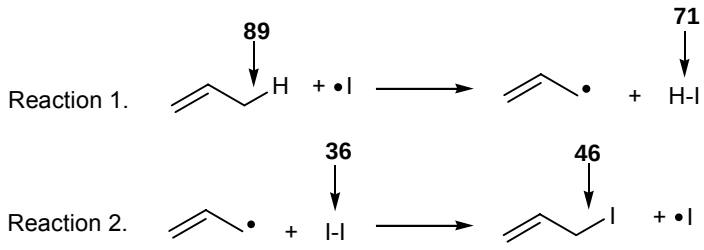
2. Choose the species that could not be used as the base in the following reaction.



3. Professor Lee proposed the following reaction for the preparation of 3-iodo-1-propene from propene.



The following two propagation steps were hypothesized. The relevant bond energies in kcal/mole are shown.



Choose the *incorrect* statement.

(A) The first reaction is endothermic.

(B) The second reaction is exothermic.

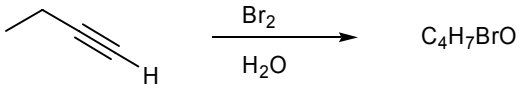
(C) The overall reaction is exothermic.

(D) The I–I bond is weaker than the H–I bond.

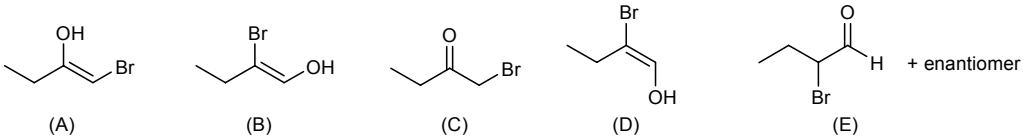
(E) The proposed reaction is not a good method for the preparation of 3-iodo-1-propene from propene.

Source

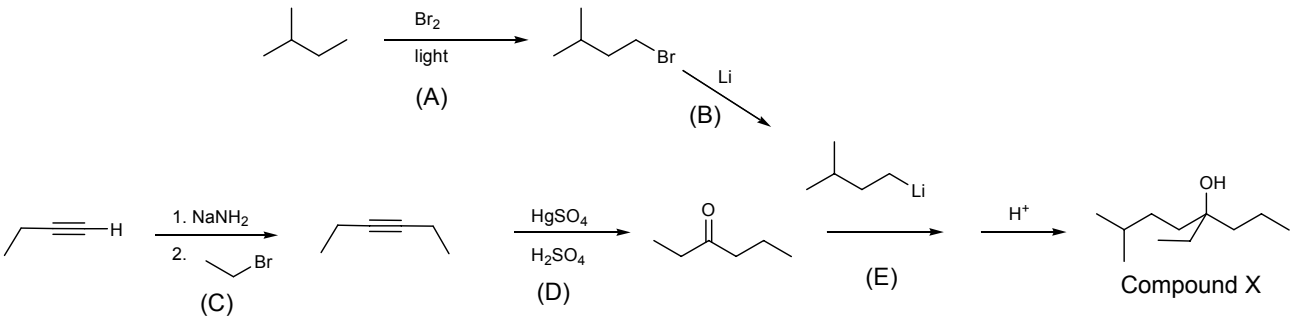
4. Here is a reaction that we did not cover in the lectures.



Use your knowledge of mechanisms to choose the most likely product from among the following compounds.

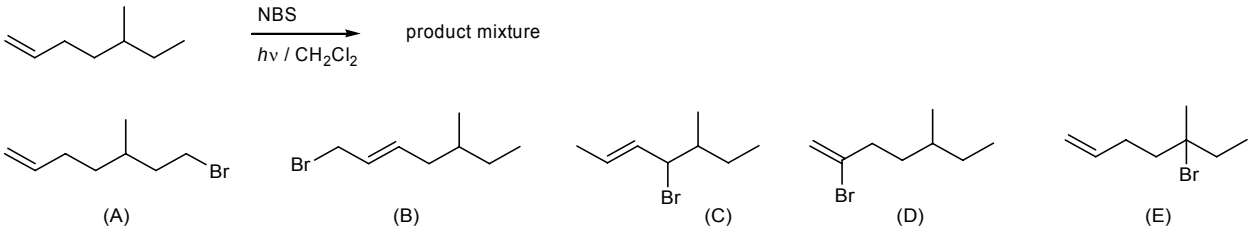


5. On the final exam in CHE 321 a student was asked to propose a synthesis of compound X and came up with the scheme shown below.



The TA grading the problem thought most of the steps were just fine, but she took off a couple of points because she knew that one step would not work. Choose the reaction of the proposed synthesis that is least likely to be successful.

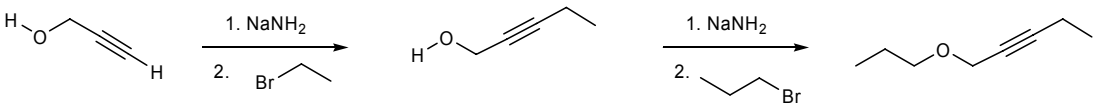
6. The NBS bromination of the compound shown below gives a mixture of products.

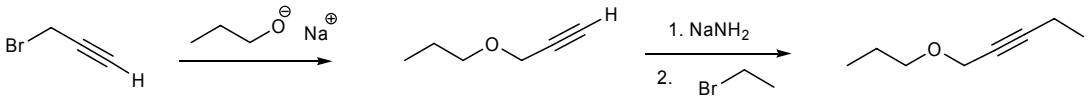


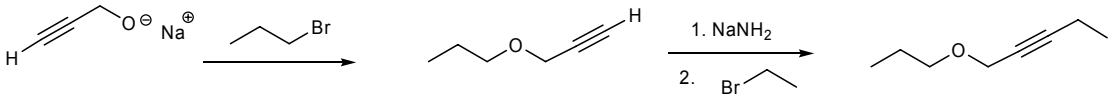
Choose the compound that should be the main product of this reaction.

Source

7. Which of the following schemes will proceed to give the compound indicated as the major product.

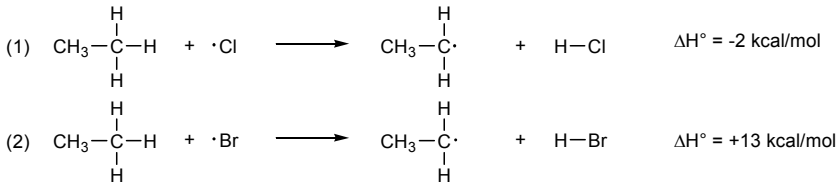
(1) 

(2) 

(3) 

(A) (1) only (B) (1) and (2) (C) (1) and (3) (D) (2) and (3) (E) all of them

8. Choose the *incorrect* statement about the following two reactions.



(A) Reaction (1) would be expected to be faster than reaction (2).

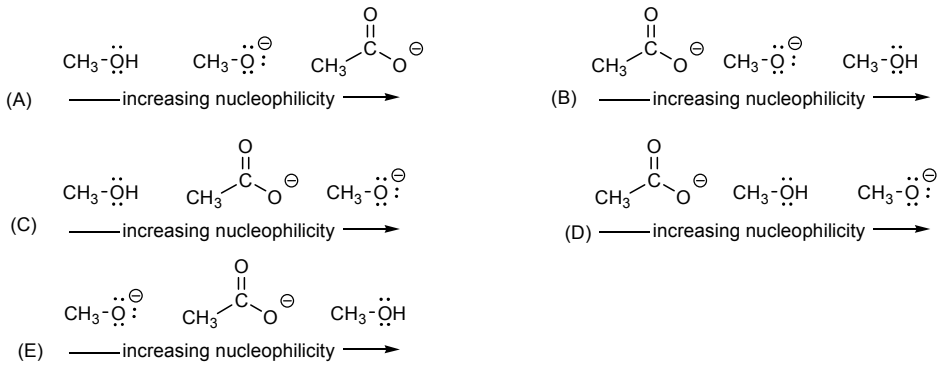
(B) According to Hammond's postulate the transition state of reaction (2) resembles the product.

(C) According to Hammond's postulate the transition state of reaction (1) resembles the reactant.

(D) The C−H bond of reaction (2) is completely broken in the transition state.

(E) The reaction of ethane with the fluorine radical (•F) would be expected to be faster than either (1) or (2).

9. Choose the answer that has the following nucleophiles correctly arranged with respect to increasing reactivity.



Source

10. Choose the *incorrect* statement about organohalogen compounds.

    A) Organohalogen compounds, such as the polychlorinated biphenyls (PCBs), are persistent in our environment and are often found in the hydrophobic lipid bilayers of our cell membranes.

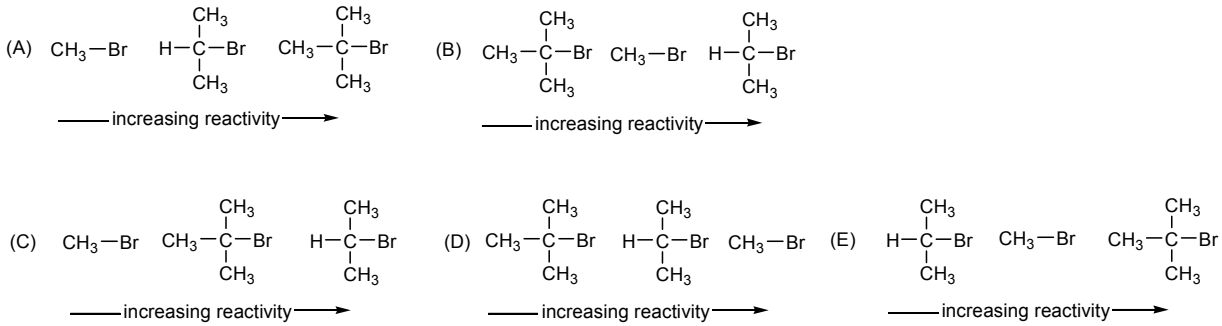
    (B) Organohalogen compounds are also produced by living organisms, particularly in the marine environment.

    (C) Technology has produced commonly used materials containing organohalogen compounds.

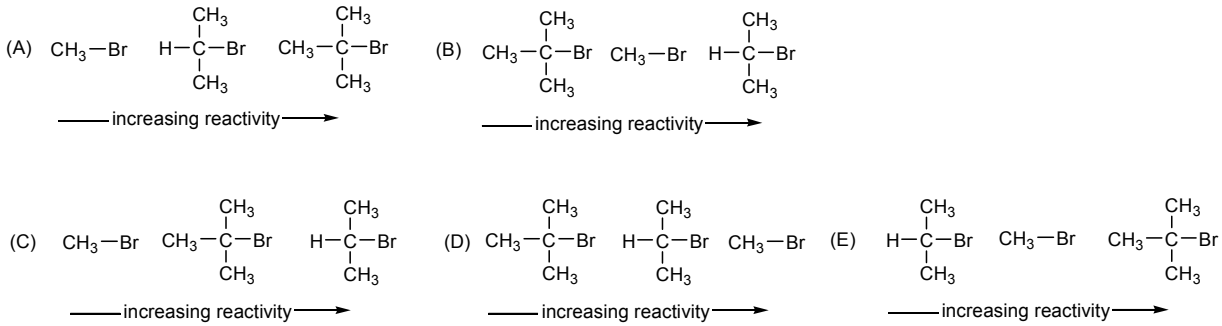
    (D) Based upon periodic table considerations, the C−Cl bond is predicted to be stronger than the C−I bond.

    (E) Based upon periodic table considerations, the C−Cl bond is predicted to be longer than the C−I bond.

11. Choose the order that has the following alkyl bromides correctly arranged with respect to increasing reactivity in a S_N2 reaction.

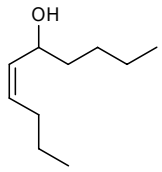


12. Choose the order that has the following alkyl bromides correctly arranged with respect to increasing reactivity in a S_N1 reaction.



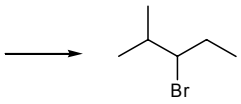
Short Answer Questions. 40 points.

13. Propose a synthesis of the following compound from compounds containing four carbons or less. (10 points)



Source

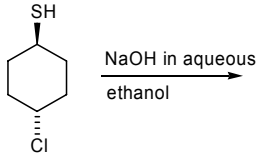
14. Consider the following reaction.



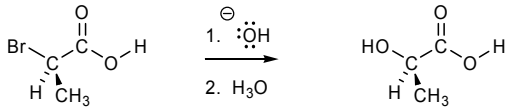
(a) Give an acceptable name for the product of the above reaction.

(b) Give the best reactant(s) and reagent(s) that could be used to perform the above transformation in one step using the reactions we have covered in CHE 321.

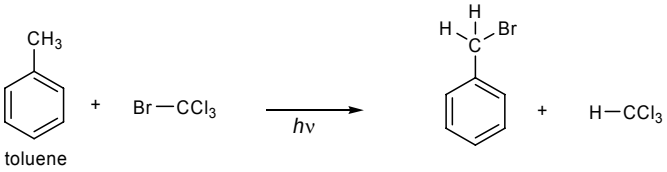
15. (a) Predict the product of the following reaction.



(b) Using the curved arrow formalism, give a reaction mechanism that explains why the following substitution reaction proceeds with retention of configuration.



16. The following reaction of toluene with bromotrichloromethane proceeds via a radical chain mechanism.



(a) Give the initiating reaction.

(b) Give the two propagating reactions of this reaction mechanism.

(c) Give one of the several possible termination reactions.