

CHEM 2311

E3 Practice-iii (answers *not* provided)

1. (32 points) Circle the letter *on the right* which corresponds to the answer to each question. There is only one correct answer for each question.

(i) Which of the following terms describes the reactivity of boron tribromide, BBr_3 ?

- A. Brønsted-Lowry acid and Lewis acid
 B. Brønsted-Lowry base and Lewis base
 C. Lewis acid and *not* a Brønsted-Lowry acid
 D. Lewis base and *not* a Brønsted-Lowry base

A
B
C
D

(ii) What is the equilibrium constant (K_{eq}) at 25 °C for a reaction with a ΔG° value of 0 kcal/mole.

- E. -1 F. 0 G. 1 H. 1×10^8

E
F
G
H

(iii) Which of the following is the correct order of increasing acidity (less acidic < more acidic)?

- I. $\text{CH}_4 < \text{NH}_3 < \text{H}_2\text{O} < \text{CH}_3\text{NH}_2$ J. $\text{NH}_3 < \text{CH}_4 < \text{MeOH} < \text{HF}$
 K. $\text{NH}_3 < \text{CH}_4 < \text{H}_2\text{O} < \text{MeOH}$ L. $\text{H}_2\text{O} < \text{CH}_3\text{CO}_2\text{H} < \text{H}_3\text{O}^+ < \text{HCl}$

I
J
K
L

(vi) During which of the following reactions did a rearrangement occur?

- M. *t*-butanol \rightarrow 2-methylpropene
 N. 3,3-dimethyl-2-butanol \rightarrow 2,3-dimethyl-2-butene
 O. cyclohexene \rightarrow 1,2-dichlorocyclohexane
 P. *t*-butanol \rightarrow *t*-butyl chloride

M
N
O
P

(v) Which of the following is would react most quickly in an $\text{S}_{\text{N}}1$ reaction with acetic acid?

- Q. methyl fluoride R. ethyl chloride
 S. isopropyl chloride T. *tert*-butyl bromide

Q
R
S
T

(vi) Which of the following statements is *not* true regarding the reaction of 1° alkyl halides with good nucleophiles?

- U. the rate depends on concentration of nucleophile
 V. alkyl fluorides are unreactive
 W. large groups near the halide will not effect the rate
 X. the rate will be faster at higher temperatures

U
V
W
X

(vii) Which of the following is the most reactive nucleophile?

- Y. *tert*-butyl cation Z. dimethyl ether AA. dimethylamine BB. water

Y
Z
AA
BB

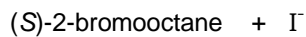
(viii) Which of the following anions is the strongest base?

- CC. CH_3COO^- DD. HO^- EE. NH_2^- FF. Cl^-

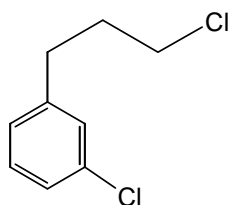
CC
DD
EE
FF

2. (36 points). Provide the structure of products or reagents for each of the following reactions

(a)



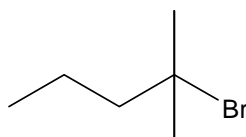
Product



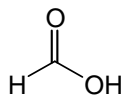
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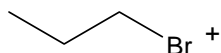
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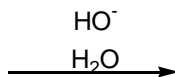
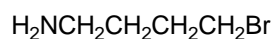
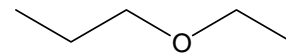


Product



+

Reagent



Product, $\text{C}_4\text{H}_9\text{N}$

(b) Complete the following statements:

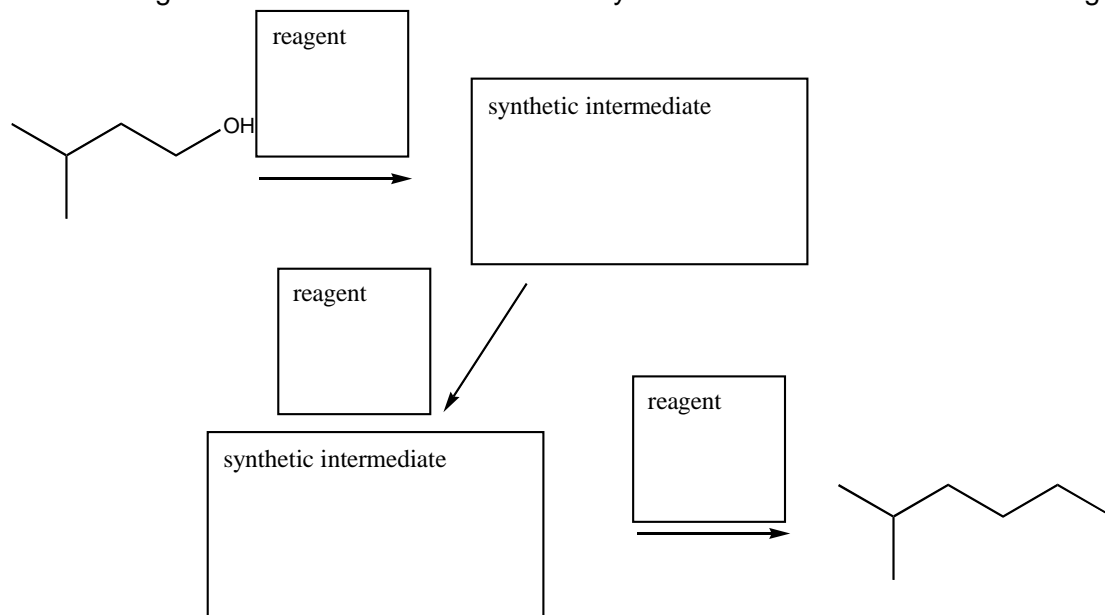
(i) Reaction of (R)-1-bromo-3-methylhexane with sodium methoxide produces (R) / (S) / racemic
methyl 3-methylhexyl ether **(circle one)**

(ii) The rate of the above reaction depends on the concentration of alkyl halide / methoxide.
(circle all that apply)

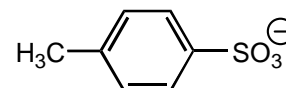
(iii) Heating the above reaction will result in a faster / slower reaction
(circle one)

(iv) The best solvent for this reaction would be water / DMF / hexane / acetic acid
(circle one)

3. (32 points). Conversion of 3-methyl-1-butane to 2-methylhexane requires three synthetic steps. Provide reagents and the structure of the two synthetic intermediates in the following scheme



(b) *With reference to structure*, explain why the tosylate anion (shown at right) is a much better leaving group in S_N2 reactions than the hydroxide anion (HO^-).



(c) *With reference to structure*, explain why acetonitrile, CH_3CN , is a weaker base than ethylamine, $\text{CH}_3\text{CH}_2\text{NH}_2$.

(d) A student realizes that protonation of an alcohol makes the $-\text{OH}$ into a better leaving group. Therefore, he suggested that reaction of 1-propanol, H_2SO_4 and trimethylamine would provide *N,N,N*-trimethyl-*N*-propylammonium hydrogen sulfate according to the following key mechanistic step. However, this process does not yield the product predicted here. Why not?

