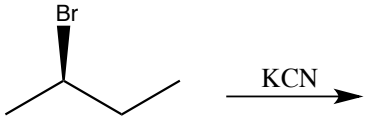
Practice Questions

1. What is true about the reaction between (*R*)-2-bromobutane and potassium cyanide as shown below?



a) The product is a racemic mixture.
b) The product is (*S*)-2-cyanobutane.
c) The mechanism proceeds through a stable intermediate.
d) The mechanism proceeds through a single transition state step.
e) Answers a and c.
f) Answers b and d.

2. The following reaction goes through an S_N2 mechanism.

$CH_3CH_2CH_2Br + {}^{-}OH \rightarrow CH_3CH_2CH_2OH + Br^{-}$

At constant temperature, what is the effect on the rate of the reaction by simultaneously doubling the concentration of propyl bromide and OH^- ion?

a) It would increase the rate by six.
b) It would double the rate.
c) It would triple the rate.
d) It would increase the rate by four.
e) It would have no effect on the rate.

3. Which is the minor substitution product in the following reaction?

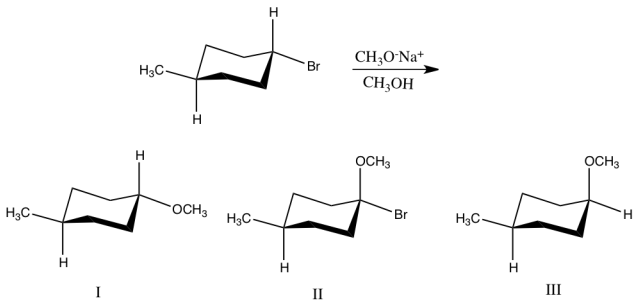
a) I

b) II

c) III

d) Equal amounts of I and II

e) None of these products



4. What is the major product of the following reaction?

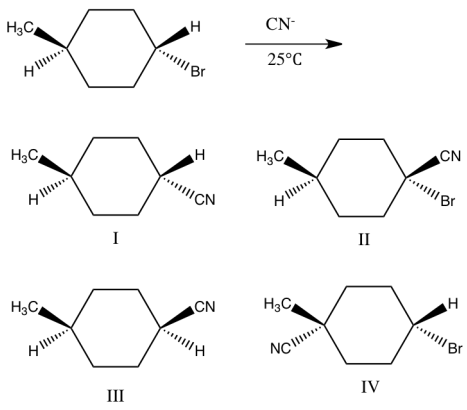
a) I

b) II

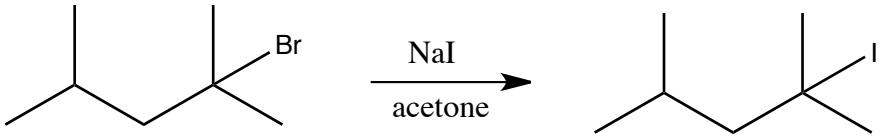
c) III

d) IV

e) Equal amount of I and III



5. Consider the reaction between 2-bromo-2,4-dimethylpentane and sodium iodide, NaI, in acetone.



At constant temperature, what is the effect on the reaction rate if one simultaneously double the concentration of 2-bromo-2,4-dimethylpentane and sodium iodide?

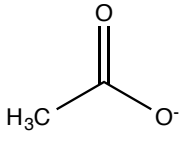
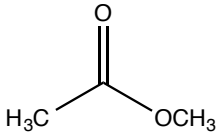
a) It would double the reaction rate.
b) It would triple the reaction rate.
c) It would quadruple the reaction rate.
d) It would increase the reaction rate by 5.
e) There would be no effect on the rate of reaction.

6. In nucleophilic substitution reactions and elimination reactions the Hammond-Leffler postulate states that

a) nucleophilic substitution reactions that are bimolecular are 2nd order kinetically.
b) a negatively-charged nucleophile is stronger than its conjugate acid.
c) polar aprotic solvents accelerate the rate of S_N2 processes.
d) the transition state of an endothermic step resembles the product of that step.
e) elimination reactions will always compete with nucleophilic substitution reactions.

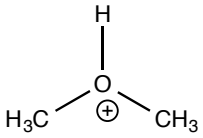
7. Which of the following reactions would take place at a faster rate?

a) $CH_3Cl + {}^{-}OH \xrightarrow[25°C]{H_2O} CH_3OH + Cl^-$

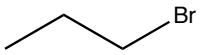
b) $CH_3Cl +$  $\xrightarrow[25°C]{H_2O}$  $+ Cl^-$

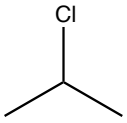
c) $CH_3Cl + H_2O \xrightarrow[25°C]{H_2O} CH_3OH_2^+ + Cl^-$

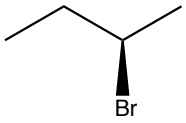
d) $CH_3Cl + {}^{-}SH \xrightarrow[25°C]{H_2O} CH_3SH + Cl^-$

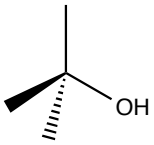
e) $CH_3Cl + CH_3OH \xrightarrow[25°C]{H_2O}$  $+ Cl^-$

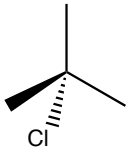
8. Which of the following reactions can produce substitution and elimination products in about equal amounts?

a)  $\xrightarrow[acetone]{NaI}$ S_N2

b)  $\xrightarrow[DMSO]{NaSCH_3}$ S_N2 very small amounts of E2

c)  $\xrightarrow[CH_3OH]{NaOCH_3}$ S_N2 and E2

d)  $\xrightarrow[Room\ Temp.]{HBr}$ S_N1

e)  $\xrightarrow[CH_3OH]{NaOCH_3}$ E2

9. Which of the following S_N2 reactions will take place at a faster rate?

a) $CH_3CH_2\text{–}F + Br^- \xrightarrow[25°C]{H_2O\ /\ ethanol} CH_3CH_2\text{–}Br + F^-$

b) $CH_3CH_2\text{–}F + I^- \xrightarrow[25°C]{H_2O\ /\ ethanol} CH_3CH_2\text{–}I + F^-$

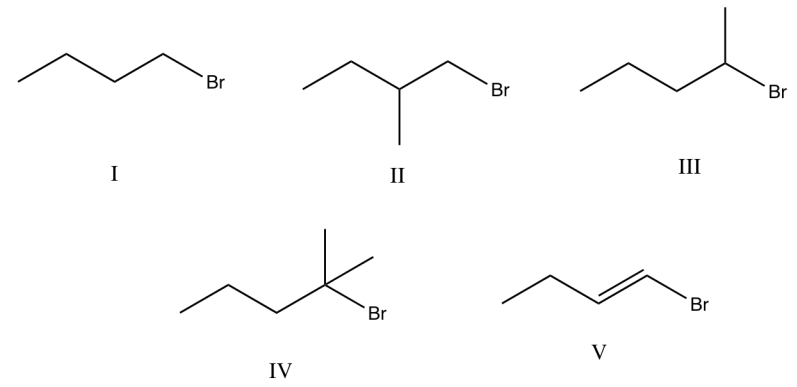
c) $CH_3CH_2\text{–}Cl + Br^- \xrightarrow[25°C]{H_2O\ /\ ethanol} CH_3CH_2\text{–}Br + Cl^-$

d) $CH_3CH_2\text{–}Cl + I^- \xrightarrow[25°C]{H_2O\ /\ ethanol} CH_3CH_2\text{–}I + Cl^-$

(e) $CH_3CH_2\text{–}Br + I^- \xrightarrow[25°C]{H_2O\ /\ ethanol} CH_3CH_2\text{–}I + Br^-$

10. Which alkyl halide would be the most reactive in an S_N1 reaction?

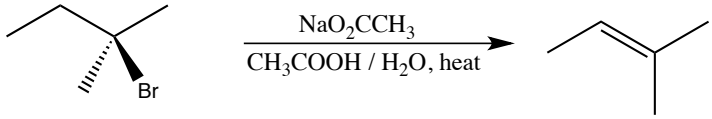
a) I
b) II
c) III
d) IV
e) V



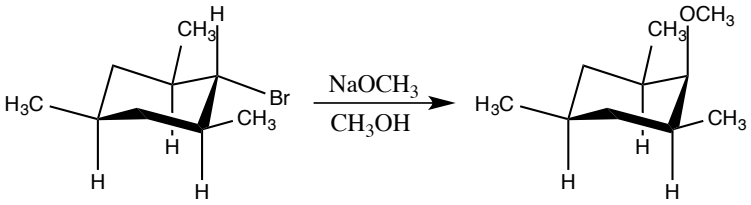
11. Which alkyl halide would be expected to have the slowest rate in a substitution reaction?

a) $(CH_3)_3C\text{-}F$
b) $(CH_3)_3C\text{-}Cl$
c) $(CH_3)_3C\text{-}Br$
d) $(CH_3)_3C\text{-}I$
e) All of them will react at the same rate.

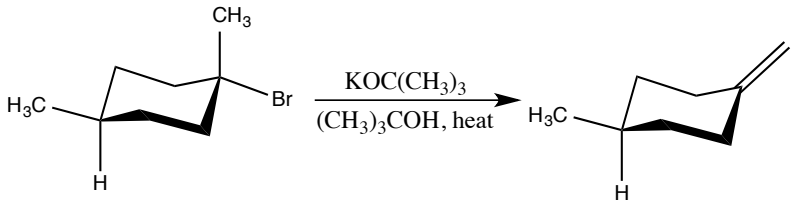
12. Draw the structure of the major product(s). If the major product is a mixture of enantiomers draw one and write **+ enantiomer**. If the product is a mixture of diastereomers in approximately equal amount draw all of them. Circle the mechanism by which the product(s) is(are) formed.



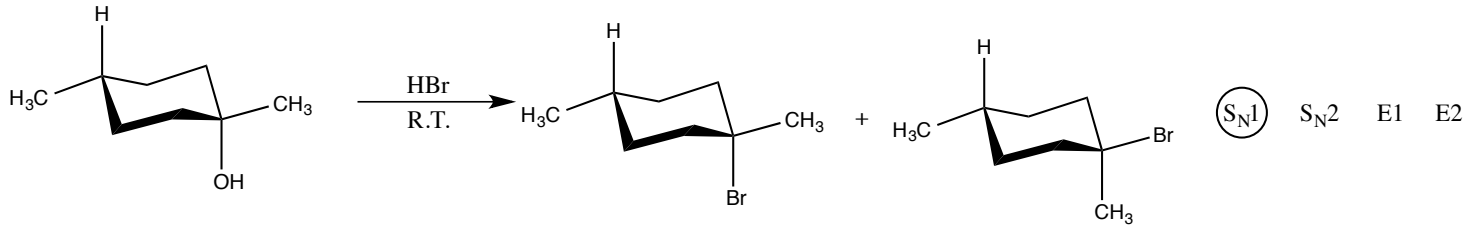
S_N1 S_N2 E1 (E2)



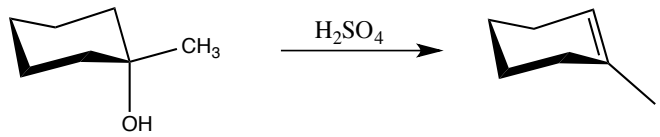
S_N1 (S_N2) E1 E2



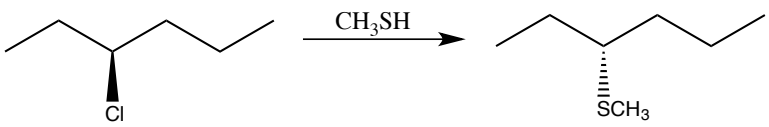
S_N1 S_N2 E1 (E2)



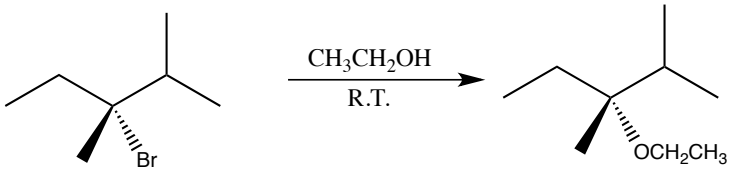
(S_N1) S_N2 E1 E2



S_N1 S_N2 (E1) E2



S_N1 (S_N2) E1 E2



+ enantiomer

(S_N1) S_N2 E1 E2

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