Sign Name _____*Key*_____ Print Name _____
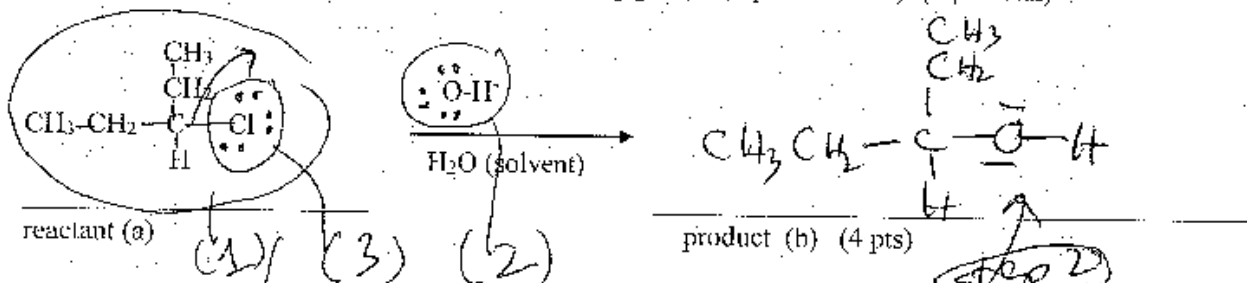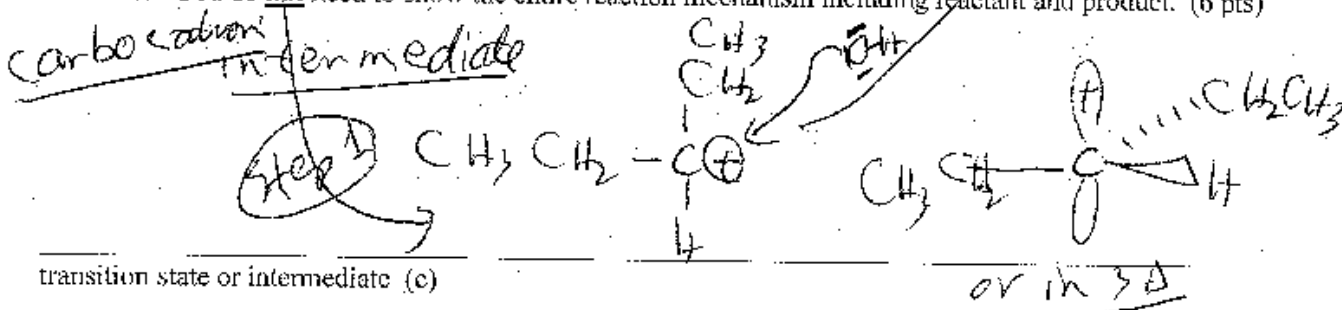
Show work on all questions for partial credit even on questions which do not specify show work. (25 total pts)

1. Given the following reactant: Assume that the reaction undergoes an (**SN1**) reaction mechanism.
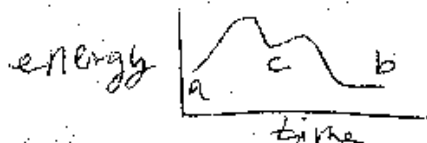
A. Complete the overall reaction by showing the structural formula of the **Organic Major Product**. Label the circled parts of the molecule with one of the numbers for substrate, nucleophile and leaving group.

(1) substrate   (2) nucleophile   (3) leaving group   (1 pt each label) (7 pts total)

reactant (a)   (1) (3) (2)   product (b)   (4 pts)

B. Please show the **transition state or intermediate**. You do **not** need to show the reaction using a 3 D structure. You do **not** need to show the entire reaction mechanism including reactant and product. (6 pts)

Carbocation intermediate

Step 1

$CH_3 CH_2 - C\oplus$
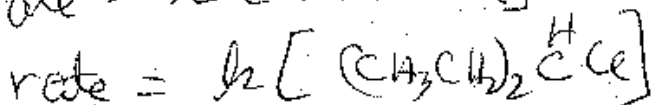
or in 3D

transition state or intermediate (c)

C. Draw an energy diagram which matches the above mechanism. Above in part A & B, I labeled the reactant (a), product (b) and transition state or intermediate (c). Label your energy diagram with (a), (b) and (c). (energy diagram – 3 pts, label 3 pts, 6 pts total)

because of carbocation intermediate – you get 50:50 attack from top + bottom

D. Write the rate law for the reaction mechanism using the actual molecule in your reaction above. If you write the rate law using the words substrate or nucleophile, I will count off. (6 pts)

rate = k [substrate]

rate = k [$(CH_3CH_2)_2 \overset{H}{C} Cl$]

if chiral center, racemic mixture

Extra Credit: (2 pts) Given the molecule below, **show your calculation** of the number for the **molecular ion peak** (mass/charge number) in a **mass spectrum**.
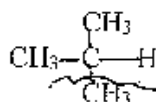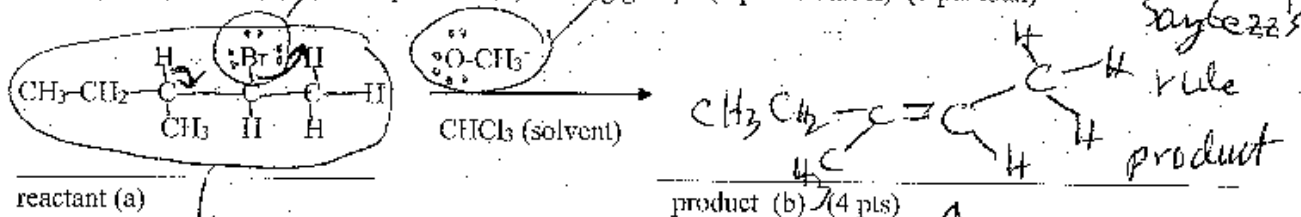
$4(12) + 10(1) = 58 = $ molecular ion peak $= m/z$

likely cleavage

Sign Name _____*Key*_____ Print Name _____

Show work on all questions for partial credit even on questions which do not specify show work. (25 total pts)
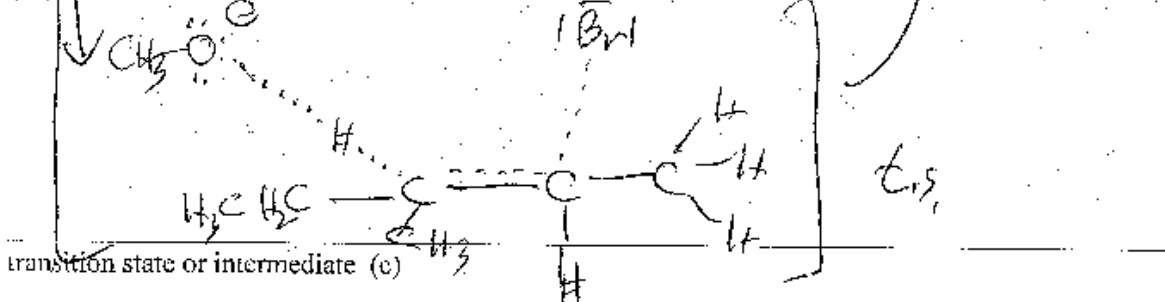
1. Given the following reactant: Assume that the reaction undergoes an (**E2**) reaction mechanism.

A. Complete the overall reaction by showing the structural formula of the **Organic Major Product**: Label the circled parts of the molecule with one of the numbers for substrate, nucleophile and leaving group.
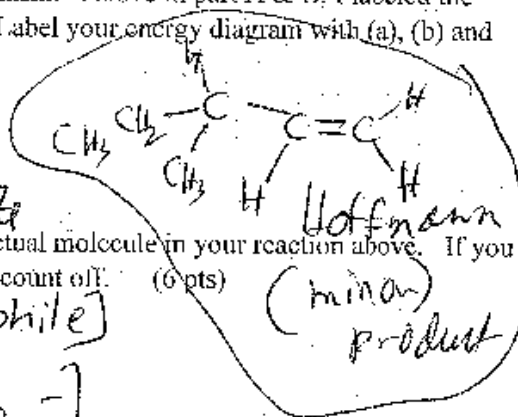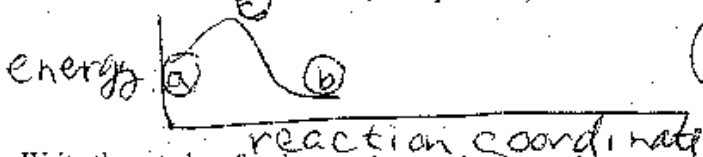 (1) substrate (2) nucleophile (3) leaving group (1 pt each label) (7 pts total)

reactant (a)

B. Please show the **transition state or intermediate**. You do **not** need to show the reaction using a 3 D structure. You do **not** need to show the entire reaction mechanism including reactant and product. (6 pts)


transition state or intermediate (c)

C. Draw an energy diagram which matches the above mechanism. Above in part A & B, I labeled the reactant (a), product (b) and transition state or intermediate (c). Label your energy diagram with (a), (b) and (c). (energy diagram – 3 pts, label 3 pts, 6 pts total)

D. Write the rate law for the reaction mechanism using the actual molecule in your reaction above. If you write the rate law using the words substrate or nucleophile, I will count off. (6 pts)

$$rate = k[substrate][nucleophile]$$
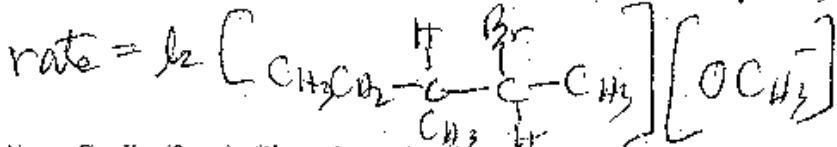
Extra Credit: (2 pts) Given the molecule below, **show your calculation** of the number for the **molecular ion peak** (mass/charge number) in a **mass spectrum**.

$$4(12) + 8(1) + 16 = 72 \Leftarrow molecular\ ion$$
$$C H O m/z$$
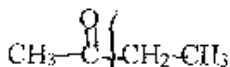
Sign Name _____ *Key* _____   Print Name _____
Show work on all questions for partial credit even on questions which do not specify show work. (25 total pts)

1.   Given the following reactant: Assume that the reaction undergoes an (SN2) reaction mechanism.

A.   Complete the overall reaction by showing the structural formula of the **Organic Major Product**:   Label the circled parts of the molecule with one of the numbers for substrate, nucleophile and leaving group.
     (1) substrate   (2) nucleophile   (3) leaving group   (1 pt each label) (7 pts total)

$CH_3-CH_2-\overset{H}{\underset{CH_3}{C}}-Br$ $:\overset{..}{O}- CH_2 CH_3$ (2)

acetone (solvent) $\longrightarrow$

reactant (a)   (1)

$CH_3\ CH_2 - \overset{H}{\underset{CH_3}{C}} - O CH_2 CH_3$

product (b) (4 pts)   *(would be inverted)*

B.   Please show the **transition state or intermediate.**   You do **not** need to show the reaction using a 3 D structure.   You do **not** need to show the entire reaction mechanism including reactant and product. (6 pts)

reactant

$CH_3 CH_2 - C - Br$
OCH_2CH_3
CH_3

$[CH_3 CH_2 O ---- C ---- Br \quad t.s.]$
CH_3

$\rightarrow CH_3 CH_2 O - C$
Product CH_3

transition state or intermediate (c)

C.   Draw an energy diagram which matches the above mechanism.   Above in part A & B, I labeled the reactant (a), product (b) and transition state or intermediate (c).   Label your energy diagram with (a), (b) and (c). (energy diagram – 3 pts, label 3 pts, 6 pts total)
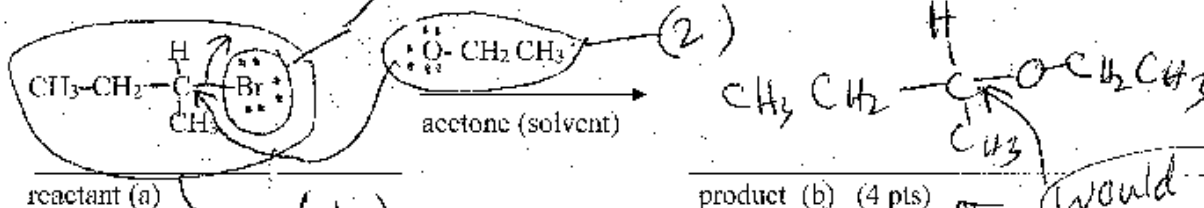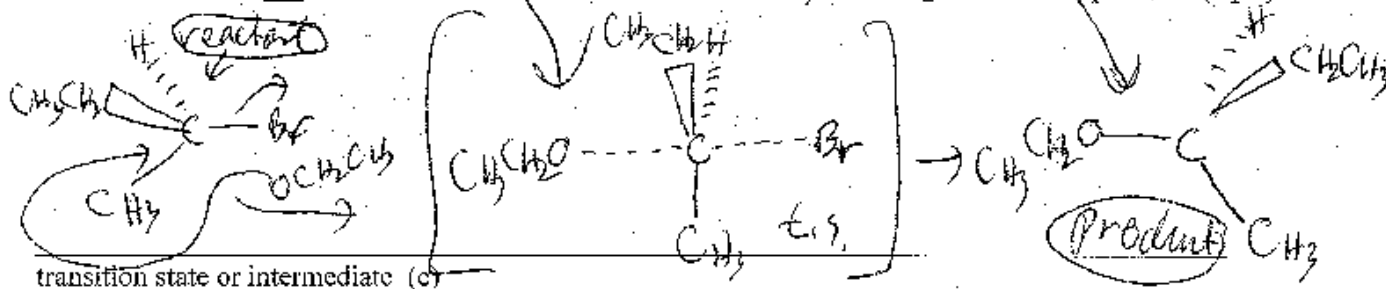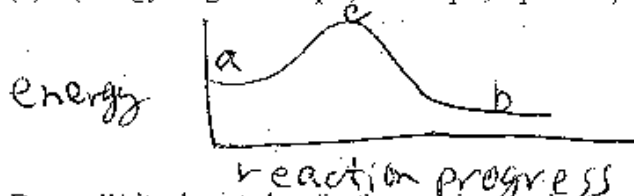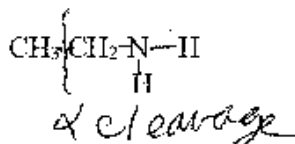
energy

reaction progress

D.   Write the rate law for the reaction mechanism using the actual molecule in your reaction above. If you write the rate law using the words substrate or nucleophile, I will count off.   (6 pts)

$rate = k [Nu][substrate]$

$rate = k [OCH_2CH_3][CH_3 CH_2 - \overset{H}{\underset{CH_3}{C}} - Br]$

Extra Credit: (2 pts) Given the molecule below, **show your calculation** of the number for the **molecular ion peak** (mass/charge number) in a **mass spectrum.**

$CH_3 CH_2 - \overset{H}{\underset{H}{N}} - H$

α cleavage

$2(12) + 7(1) + \underset{N}{14} = 45$
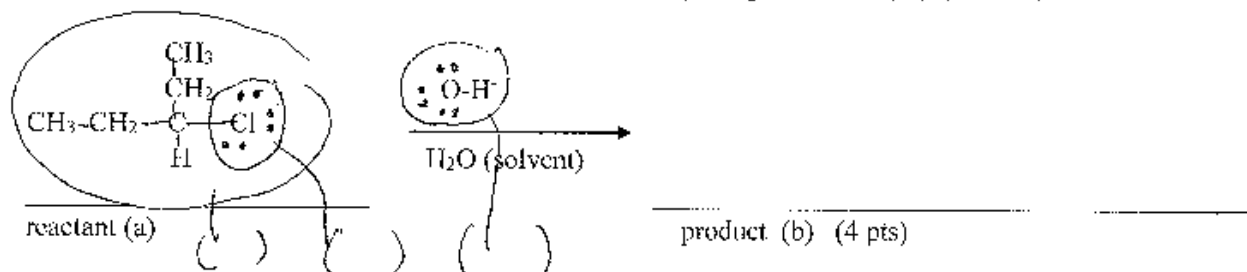$\underset{C}{\quad} \quad \underset{H}{\quad}$

Sign Name _____ _____ Print Name _____ _____
Show work on all questions for partial credit even on questions which do not specify show work. (25 total pts)

I.   Given the following reactant: Assume that the reaction undergoes an S_N1 reaction mechanism.

A.   Complete the overall reaction by showing the structural formula of the **Organic Major Product**; Label the circled parts of the molecule with one of the numbers for substrate, nucleophile and leaving group.
    (1) substrate   (2) nucleophile   (3) leaving group   (1 pt each label) (7 pts total)

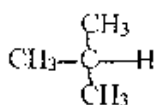reactant (a)   product (b)   (4 pts)

B.   Please show the **transition state or intermediate**. You do **not** need to show the reaction using a 3 D structure. You do **not** need to show the entire reaction mechanism including reactant and product. (6 pts)

transition state or intermediate (c)

C.   · Draw an energy diagram which matches the above mechanism. Above in part A & B, I labeled the reactant (a), product (b) and transition state or intermediate (c). Label your energy diagram with (a), (b) and (c). (energy diagram – 3 pts, label 3 pts, 6 pts total)

D.   Write the rate law for the reaction mechanism using the actual molecule in your reaction above. If you write the rate law using the words substrate or nucleophile, I will count off.   (6 pts)

Extra Credit: (2 pts) Given the molecule below, **show your calculation** of the number for the **molecular ion peak** (mass/charge number) in a **mass spectrum**.
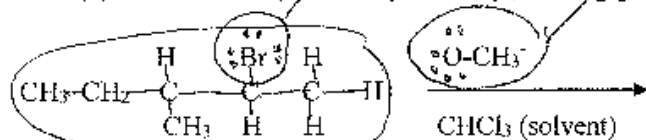
Sign Name _____ Print Name _____

Show work on all questions for partial credit even on questions which do not specify show work. (25 total pts)

Color

1. Given the following reactant: Assume that the reaction undergoes an   E2   reaction mechanism.

A.   Complete the overall reaction by showing the structural formula of the **Organic Major Product**: Label the circled parts of the molecule with one of the numbers for substrate, nucleophile and leaving group.

   (1) substrate   (2) nucleophile   (3) leaving group   (1 pt each label) (7 pts total)

CH₃-CH₂—C—C—C—H

   CH₃ H H   :Br: :O-CH₃⁻

   CHCl₃ (solvent)

_____   _____
reactant (a)   product (b)   (4 pts)
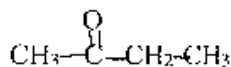
   (1)

B.   Please show the **transition state or intermediate**. You do **not** need to show the reaction using a 3 D structure. You do **not** need to show the entire reaction mechanism including reactant and product. (6 pts)

_____
transition state or intermediate (c)

C.   Draw an energy diagram which matches the above mechanism. Above in part A & B, I labeled the reactant (a), product (b) and transition state or intermediate (c). Label your energy diagram with (a), (b) and (c). (energy diagram – 3 pts, label 3 pts, 6 pts total)

D.   Write the rate law for the reaction mechanism using the actual molecule in your reaction above. If you write the rate law using the words substrate or nucleophile, I will count off.   (6 pts)

Extra Credit: (2 pts) Given the molecule below, **show your calculation** of the number for the **molecular ion peak** (mass/charge number) in a **mass spectrum**.
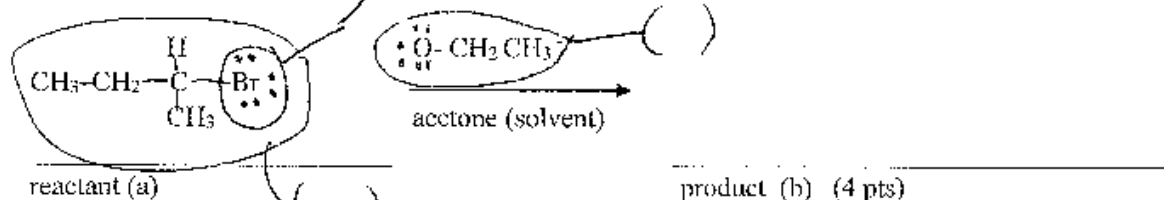
   O
   ‖
CH₃—C—CH₂-CH₃

Sign Name _____ Print Name _____.
Show work on all questions for partial credit even on questions which do not specify show work. (25 total pts)

1.   Given the following reactant: Assume that the reaction undergoes an   S$_N$2 reaction mechanism.

A.   Complete the overall reaction by showing the structural formula of the **Organic Major Product**: Label the circled parts of the molecule with one of the numbers for substrate, nucleophile and leaving group.
      (1) substrate   (2) nucleophile   (3) leaving group   (1 pt each label) (7 pts total)

CH$_3$–CH$_2$—C—Br   :O- CH$_2$ CH$_3$
            | ————————→
            H   acetone (solvent)
            CH$_3$

reactant (a)   product (b)   (4 pts)

B.   Please show the **transition state or intermediate**. You do **not** need to show the reaction using a 3 D structure.   You do **not** need to show the entire reaction mechanism including reactant and product. (6 pts)

_____
transition state or intermediate (c)

C.   Draw an energy diagram which matches the above mechanism.   Above in part A & B, I labeled the reactant (a), product (b) and transition state or intermediate (c).   Label your energy diagram with (a), (b) and (c). (energy diagram – 3 pts, label 3 pts, 6 pts total)

D.   Write the rate law for the reaction mechanism using the actual molecule in your reaction above.   If you write the rate law using the words substrate or nucleophile, I will count off.   (6 pts)

Extra Credit: (2 pts) Given the molecule below, **show your calculation** of the number for the **molecular ion peak** (mass/charge number) in a **mass spectrum**.

CH$_3$-CH$_2$-N—H
               |
               H