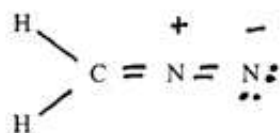**Problem 1. (10 points)** Give the most stable Lewis electron dot structure for diazomethane. CH_2N_2 which has the following points of connection. Place the electron dots on the figure provided. What is the formal charge on the C and each of the two N's?
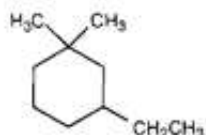

Problem 2. (15 points) For the following reactions, does the equilibrium for the reaction lie toward the reactant side or the product side?

Circle one

A) $NaCl + HF \Leftrightarrow HCl + NaF$ — (reactant) product

B) $NH_4^+Cl^- + NaOH \Leftrightarrow NH_3 + H_2O + NaCl$ — reactant (product)

C) $NH_3 + CH_3OH \Leftrightarrow NH_2^- + CH_3OH_2^+$ — (reactant) product

D) $CH_4 + H_2C=CH^-Na^+ \Leftrightarrow CH_3^-Na^+ + H_2C=CH_2$ — (reactant) product

E) $H_3O^+ + Br^- \Leftrightarrow H_2O + HBr$ — (reactant) product

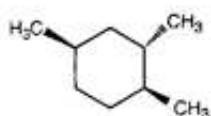**Problem 3. (5 points)** Give the IUPAC name for the following compound.

3-ethyl-1,1-dimethylcyclohexane

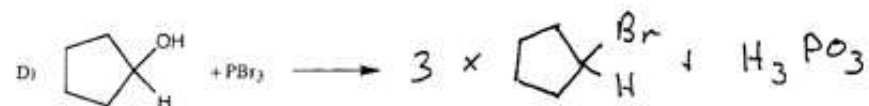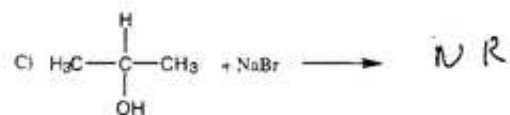**Problem 4. (10 points)** Identify (circle) which stereoisomer is more stable and explain why.
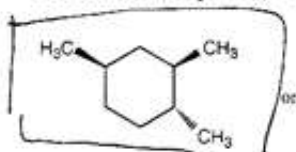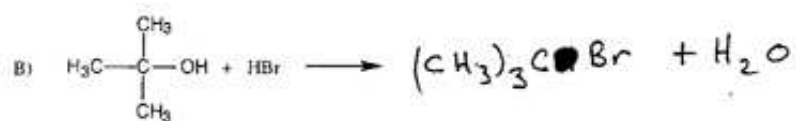

more stable

all CH_3 are equatorial

one apical 2-equatorial

2

Problem 5. (20 points) Give the products for the following reactions. If no reaction occurs, state so. **Circle your answers**

A) $CH_3CH_2OH + HCl \longrightarrow$ N R

B) $H_3C-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-OH + HBr \longrightarrow (CH_3)_3C\bullet Br + H_2O$

C) $H_3C-\underset{\underset{OH}{|}}{\overset{\overset{H}{|}}{C}}-CH_3 + NaBr \longrightarrow$ N R

D) $+ PBr_3 \longrightarrow 3 \times$ $+ H_3PO_3$

E) $+ SOCl_2 \longrightarrow$ $+ SO_2 + HCl$

Problem 6. (10 points) For the conversion of an alcohol (ROH) to an alkyl bromide (RBr) in the presence of HBr,

A) If the reactions proceeds through an S_N1 mechanism, what is the rate determining step? Use curved arrows to show the flow of electrons.
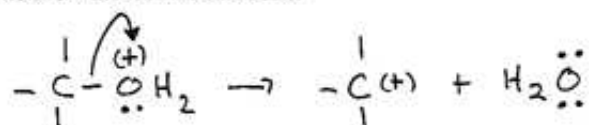
B) If the reaction proceeds through an S_N2 mechanism, what is the rate determining step? Use curved arrows to show the flow of electrons.

3

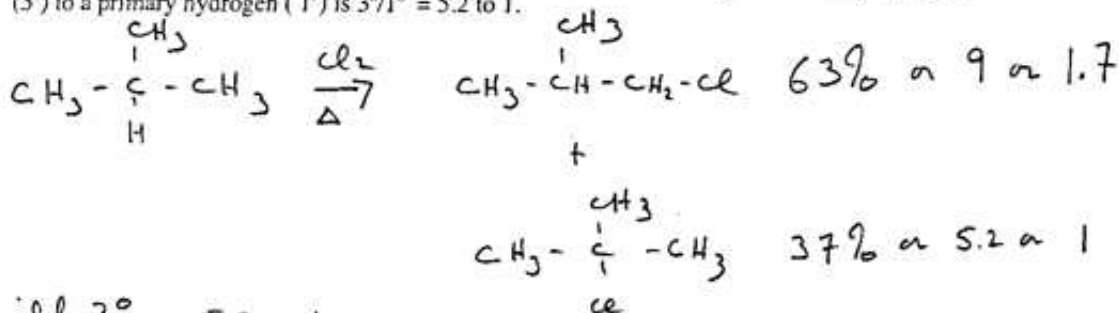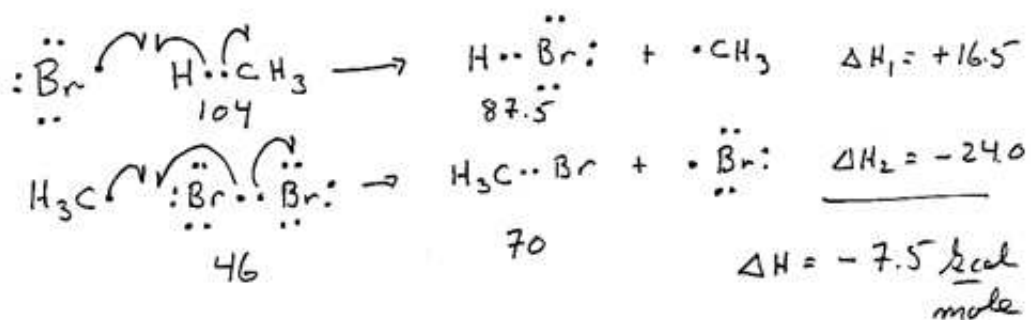**Problem 7. (15 points)** Give the relative product distributions for the free radical reaction of 2-methylpropane (isobutane) with Cl_2. Assume the relative rate of reactivity for a tertiary hydrogen ($3°$) to a primary hydrogen ($1°$) is $3°/1° = 5.2$ to 1.

$$CH_3-\underset{\underset{H}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_3 \xrightarrow[\Delta]{Cl_2} CH_3-\underset{}{\overset{\overset{CH_3}{|}}{CH}}-CH_2-Cl \quad 63\% \text{ or } 9 \text{ or } 1.7$$

$$+$$

$$CH_3-\underset{\underset{Cl}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_3 \quad 37\% \text{ or } 5.2 \text{ or } 1$$

$$\frac{\text{yield } 3°}{\text{yield } 1°} = \frac{5.2 \times 1}{1 \times 9} = \frac{5.2}{9}$$

Problem 8. (15 points) Give the overall enthalpy change for the two chain propagation steps in the free radical bromination of methane, CH_4. The bond energies are H_3C-H (104 kcal/mole), Br_2 (46 kcal/mole), H-Br (87.5 kcal/mole), H_3C-Br (70 kcal/mole). **Write you answer in the box.** Show the two chain propagation reactions.

$$:\ddot{B}r \cdot\cdot\cdot H\cdot\cdot C H_3 \longrightarrow H\cdot\cdot\ddot{B}r: + \cdot CH_3 \qquad \Delta H_1 = +16.5$$

$$\overset{}{\underset{104}{}} \qquad \qquad \overset{}{\underset{87.5}{}}$$

$$H_3C\cdot\cdot\cdot:\ddot{B}r\cdot\cdot\ddot{B}r: \longrightarrow H_3C\cdot\cdot\ddot{B}r + \cdot\ddot{B}r: \qquad \Delta H_2 = -24.0$$

$$\underset{46}{} \qquad\qquad \underset{70}{}$$

$$\Delta H = -7.5 \frac{kcal}{mole}$$

$$\boxed{\Delta H = -7.5 \; kcal/mole}$$

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