1. Give the degrees of unsaturation in the following:

a. \( \text{C}_7\text{H}_8\text{ClNO}_2 \)  
\[
D.o.U = \frac{2C + 2H - X + N}{2} = \frac{2(7) + 2 - 6 - 1 + 1}{2} = \boxed{5}
\]

b. 
\[
\boxed{5} \quad (4\pi + 1 \text{ ring})
\]

2. Name the following:

a. 
3-ethyl-4-methyl-1-hexene

b. 5-ethyl-1-methylcyclohexene

c. 3-chloro-5-methylcyclopentene

d. (Z)-3-ethyl-2-hexene

3. Draw the following:

a. (3Z,5E)-4-methyl-3,5-nonadiene

b. (3E,5E)-2,5-dibromo-3,5-octadiene
4. Identify the following as a nucleophile or an electrophile:

a. H₂O  
   nucleophile
b. Br⁻  
   nucleophile
c. H⁺  
   electrophile
d. CH₃CH=CH₂  
   (π bond)
   nucleophile
e. CH₃CH⁺CH₃  
   electrophile
f. BH₃
   electrophile

5. Use curved arrows to show the flow of electrons in the following reaction:

CH₃CH=CH₂ + HBr → CH₃CHBrCH₃

6. Given the reaction coordinate diagram:

   a. How many intermediates are formed in the reaction? 2 (C & E)
b. How many transition states? 3 (B, D, F)
c. Which is the rate-determining step? C → E
d. Is the overall reaction exergonic or endergonic? Exergonic
e. Which is the most stable intermediate? C
f. Which forward step has the smallest rate constant? C → E
g. Which forward step has the largest rate constant? C → G

7. Put in order of increasing heat of hydrogenation:

\[
\begin{align*}
\text{Smallest} & \rightarrow \Delta H_{H₂} \\
\text{most stable} \quad \text{(trans)} & \rightarrow \text{least stable} \\
\end{align*}
\]