1. Consider the structure at right:
   (a) (1 pt) What is its formula? \( \text{C}_3\text{H}_6\text{Cl}_2 \)
   (b) (1 pt) …its IUPAC name? \( 1,1\text{-dichloropropane} \)
   (c) (3 pts) Draw its three other isomers in the boxes below:

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Cl Cl
1,2-dichloropropane

Cl Cl
1,3-dichloropropane

Cl Cl
2,2-dichloropropane
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2. (4 pts) Pure water is known to have a pH of 7. Show how, from that information alone, you can calculate that the \( \text{pK}_a \) of water is 15.74. Remember that for any acid \( \text{H-A} \) (including HOH), the value of \( \text{K}_a = [\text{H}^+][\text{A}^-]/[\text{HA}] \), that \( \text{pH} = -\log_{10}[\text{H}^+] \), and that \( \text{pK}_a = -\log_{10}(\text{K}_a) \). Hint: consider the concentrations of species in this equilibrium:

\[
\text{H}_2\text{O} \rightleftharpoons \text{H}^+ + \text{OH}^-
\]

\( \text{K}_a(\text{H}_2\text{O}) = \frac{[\text{H}^+][\text{OH}^-]}{[\text{H}_2\text{O}]} \)

Note: \( \text{OH}^- = \text{A}^- \) if \( \text{HOH} = \text{HA} \) so each \( \text{H}_2\text{O} \) dissociation gives one \( \text{H}^+ \) and one \( \text{OH}^- \) and \( [\text{H}^+] = [\text{OH}^-] = 10^{-7} \text{ M} \), while \( [\text{H}_2\text{O}] = 1000/18.0 = 55.5 \text{ M} \).

Then \( \text{K}_a = 10^{-7} \times 10^{-7}/55.5 = 1.80 \times 10^{-16} \text{ M} \)

and \( -\log_{10}(\text{K}_a) = -\log_{10}(1.80 \times 10^{-16}) = 15.74 \)

3. (6 pts) Among the structures at right, find and write in numbers for…
   (a) A compound with no dipole: \( 4 \) or \( 6 \)
   (b) An alcohol of formula \( \text{C}_5\text{H}_12\text{O} \): \( 2 \)
   (c) A compound with at least one \( \text{sp}^2 \) hybridized \( \text{C} \) atom: \( 5 \) or \( 6 \)
   (d) A strained cycloalkane: \( 4 \)
   (e) A structure that should be shown with a (+) charge: \( 1 \)
   (f) Two compounds with the same empirical formulas: \( 3 & 5 \) or \( 4 & 6 \)

4. Consider the four structures at right.
   (a) (1 pts) All but one depict the same compound. Which is the unique one?
      Circle your answer: \( A \) \( B \) \( C \) \( D \)
   (b) (2 pts) The conformation in \( D \) is the same as which one of the others? \( A \) \( B \) \( C \)
   (c) (1 pt) For the two remaining Newman projections that do represent the same compound, are they conformations of the same energy? \( \text{Yes} \) \( \text{No} \)
   (d) (1 pts) If you answered “No” in (c), which is higher in energy? \( A \) \( B \) \( C \) \( \text{none} \)