GW1: Due at 1pm EST on 2/2/24

RULES: Each team consists of 3 or 4 people (if less than 3, points will be deducted). You can pick your own teammates, and they can vary for all 4 GWs. **You are allowed** to use class notes, textbooks, and discuss answers with the members of ***your team only***. **You are NOT allowed** to use web browsing (Internet, AI, etc.) to aid you in any shape or form (including GWs from other years), *or* to communicate results, answers, or anything related to the GWs with *other teams, tutors, etc*. (see Syllabus for additional details).

The only ways to use the Internet are to: video chat, e-message, or email your teammates. Again, no web browsing/postings to look for answers! *You are expected to abide by the honor system.* **One submission per team, signed & dated by all members.**

To submit, drop off the completed document in Luke's mailbox, *located outside* of the Chemistry Office in Havemeyer (room 340).

OR by email to ochemcampos@gmail.com

Subject heading: **GW Submission,** followed by the message containing the **names of your team members.** Make sure that the file is attached to your email.

If it can't be printed, it won't be graded! It is recommended that you print your answers or digitally annotate this PDF to make sure it's legible.

Be concise in your explanations. Adding wrong statements mixed with the correct explanations will lead to a deduction of points.

Points: ___/25

Team Name (feel free to be creative, but not offensive, we may call this name when returning the GW)**:**

_____

Print the name of team member A (recorder): _____

Print the name of team member B: _____

Print the name of team member C: _____

Print the name of team member D: _____

(Write *N/A*, if there are only 3 members of your team)

On our honor, we have not given or received help on this GW.

_____ _____

Signature, Team member A Date **Signature**, Team member B Date

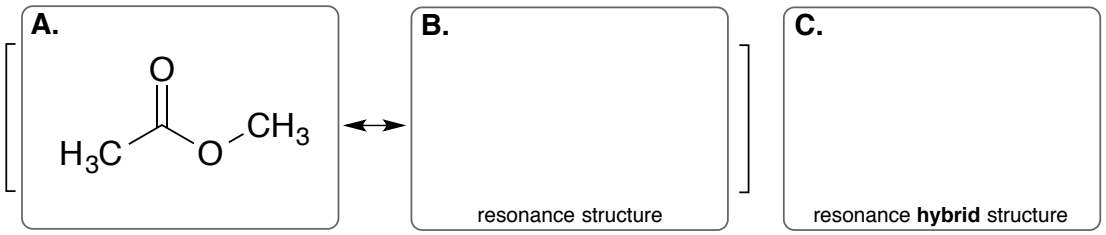
_____ _____

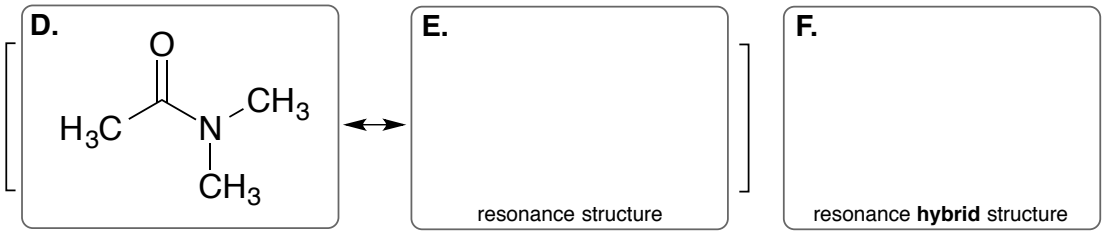
Signature, Team member C Date **Signature**, Team member D Date

A-F. 7 pts. Consider the molecules drawn in boxes **A** and **D** below. Add the lone pairs where necessary. In boxes **B** and **E**, draw the best resonance structure (make sure that all octets are filled, don't forget to add the lone pairs and charges).

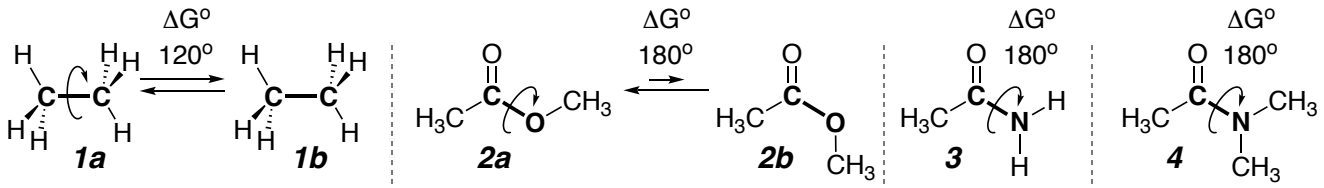
Draw the curly arrows that show the movement of electrons between *both* structures in **A** – **B** and **D** – **E**.

In boxes **C** and **F**, draw the single resonance structure that represents both **A** – **B** and **D** – **E**. Include symbols for "slightly positive" (δ^+) and "slightly negative" (δ^-) on the appropriate atoms, if any.





The C-X single-bond in **bold** (where X = C, O, or N) shows the 120° rotation for ethane (from **1a** to **1b**), and the 180° rotation for compounds **2**, **3** and **4**, and the corresponding activation energies (E_a) and ΔG^o. In compounds **1, 3,** and **4**, the process of bond rotation is thermoneutral (ΔG^o = 0 kcal/mol), but it is endothermic from **2a** to **2b**.



E_a to rotation =	3 kcal/mol	11 kcal/mol	16 kcal/mol	20 kcal/mol
ΔG^o =	0 kcal/mol	8.5 kcal/mol	0 kcal/mol	0 kcal/mol

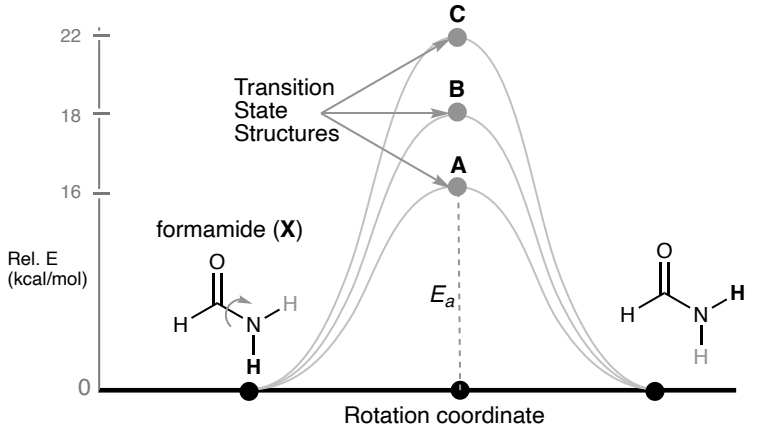
G. 5 pts. Comparing molecules **1** and **3**, briefly explain why the activation energy (E_a) to rotate the **C-N bond** is higher in energy than the process to rotate the **C-C bond** in compound **1**. Use chemical structures in your answer.

H. 3 pts. Comparing molecules **3** and **4**, briefly explain why the activation energy (E_a) to rotate the **C-N bond** is higher in energy in **4** than in **3**. Draw structures to aid your answer.

I. 3 pts. Comparing molecules **2** and **3**, briefly explain why the activation energy (E_a) to rotate the **C-N bond** is higher in energy in **3** than rotating the **C-O bond** in **2**. Draw structures to aid your answer.

J. 4 pts. Now look at the ΔG^o values to go from **2a** to **2b**. Briefly explain why equilibrium favors **2a** than the **2b** conformer. (Hint: both molecules are flat). Draw structures to aid your answer.

K. 3 pts. As the C-N bond in formamide (compound **X**) rotates, the nitrogen *rehybridizes <u>at</u> the transition state* to access the lowest energy path for rotation. There are three possible modes for the rotation of the C-N bond, with relative activation energies (E_a) in the order of: **A** = 16 kcal/mol, **B** = 18.5 kcal/mol, and **C** = 22 kcal/mol. The three possible drawings that can represent the structure of the transition state for each possible path in the C-N bond rotation are shown on the right of the free-energy diagram. Match the label (**A, B, C**) from the free energy diagram to the representative transition state structure on the right.



Representative Transition State Structures:

Label