Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# Part I. Functional group review.

**Each question is worth two (2) points each. There is no partial credit. (12 pts)**

1. Match the given structures to appropriate functional group represented by writing the matching letter in the space provided under each structure.



|  |  |
| --- | --- |
| **A.** Acid chloride | **H.** Enamine |
| **B.** Acetal | **I.** Ester |
| **C.** Aldehyde | **J.** Imine |
| **D.** Alcohol | **K.** Ketone |
| **E.** Amide | **L.** Lactam |
| **F.** Amine | **M.** Lactone |
| **G.** Anhydride | **N.** Nitrile |

# Part II. Multi-step synthesis reactions.

**Each reaction transformation is worth two (2) points each. There is no partial credit. (18 pts)**

1. Use the space provided below to write the chemical formula or draw the structure of the reagent(s) used to complete each reaction transformation.



|  |  |  |
| --- | --- | --- |
| **A** | **B** | **C** |

1. Use the space provided below to write the chemical formula or draw the structure of the reagent(s) used to complete each reaction transformation.



|  |  |  |
| --- | --- | --- |
| **A** | **B** | **C** |

1. Use the space provided below to write the chemical formula or draw the structure of the reagent(s) used to complete each reaction transformation.



|  |  |  |
| --- | --- | --- |
| **A** | **B** | **C** |

# Part III. Reaction Review.

**Each question is worth two (2) points each. There is no partial credit. (18 pts)**

1. Draw the major product(s) formed in the following reaction transformations.



















# Part IV. Mechanism.

1. Draw a stepwise mechanism for the following reaction. (14 points)



# Part V. Spectroscopy and Synthesis.

1. Draw product, **E**, of the following reaction sequence. Use the corresponding 1H NMR spectrum to confirm if the product is ortho or para substituted. Draw and label products A thru **E** to receive partial credit (10 points)



**Product F**



# Part VI. Spectroscopy.

**No partial credit.**

1. Match the correct constitutional isomer with the appropriate 1H NMR spectra below. Write the name of the spectra A, B, C, or D in the box located below each compound. (12 points)





**Spectra A**



**Spectra B**

**Spectra C**



**Spectra D**



1. Use the following 1H and 13C NMR spectra to determine the correct constitutional amide. Please circle your answer. (6 points)







# Part VI. Reagent Review.

**Please circle one reagent from the options given to answer the questions provided below.**

**Each question is worth 2 points. No partial credit. (10 points)**

1. Which reagent should you use to convert an aldehyde or ketone into an alkene?

|  |  |  |
| --- | --- | --- |
| **Gilman reagent** | **Tollens reagent** | **Wittig reagent** |

1. Which reagent should you use to reduce an ester to an aldehyde?

|  |  |  |
| --- | --- | --- |
| **DIBALH** | **LiAlH4** | **NaBH4** |

1. Which reagent should you use to convert an amide into a nitrile?

|  |  |  |
| --- | --- | --- |
| **H3O+** | **LiAlH4** | **SOCl2** |

1. Which reagent should you use to reduce the alkene only in an α, β – unsaturated compound?

|  |  |  |
| --- | --- | --- |
|  **(1 equiv.) H2, Pt** | **NaBH4** | **Excess H2, Pt** |

1. Which reagent is used to oxidize an aldehyde to a carboxylic acid?

|  |  |  |
| --- | --- | --- |
| **KMnO4** | **Ag2O, NH4OH** | **PCC** |



