1. (6 pts) Name the following compounds: Use R or S where appropriate.

- HO
- CH₃
- H
- O

2. (6 pts) Draw the following compounds from the names given:

- Cyclopentyl ethyl ether
- 2-hydroxypropanal
- Butanedioic acid

3. (18 pts) Draw arrows and necessary lone pairs to demonstrate the proper mechanism for the formation of a ketone from an alkyne.

(a) What is the mechanism from A to B called? ______________________
(b) What is the role of hydronium in this reaction? ______________________
(c) In reality, the reaction drawn above is very sluggish. What reagent must be added to make the reaction get started?
(d) What reagents would you use to turn 1-butyne into butanal?

(e) Why are A and B not resonance structures?
4. (16 pts) These reactions all have a fatal mistake in them. Explain and show actual products. Answer 2 out of 3 and cross out one or graded in order.

(a) $\text{CH}_3\text{CH}_2\text{MgBr}$

(b) $\text{CH}_3\text{MgBr}$ (1 mole)

2. aqueous acid

(c) $\text{Br}$

6. (4 pts) Which combination of reagents would not form this alcohol shown here. → Assume acid workup for each case.

- $\text{CH}_3\text{MgBr} + \text{CH}_3\text{MgBr}$
- $\text{CH}_3\text{Li} + \text{CH}_3\text{MgBr}$
- $\text{H}_2\text{C} + \text{H}_3\text{C}\text{MgBr}$
- $\text{CH}_3\text{MgBr} + \text{CH}_3\text{CH}_2\text{MgBr}$
7. (33 pts) Identify products and reagents that will accomplish the following organic transformations. Answer where you see the ? marks.

1. NaNH₂
2. CH₃CH₂Br

CH₃

C≡CH

1. Lindlar's Catalyst
2. H₂

CH₃

CH₃

H₂

CH₃

1. Ph₃P
2. BuLi

CH₃

CH₂Br

1. NBS
2. Mg (ether)

CH₃

OH

1. formaldehyde
2. aqueous acid

H₂C

C

O

acid catalyst

H₂C

O

1. NBS
2. Mg (ether)

H₂C

O

1. formaldehyde
2. aqueous acid

?
8. (18 pts) Pick 3 out of the 9 reagents and put them in the correct order that would accomplish these reactions.

(a) \[ \text{OH} \]

1. \[ a. \text{H}_2\text{N-NH}_2, \text{KOH}, \text{heat} \]
2. \[ b. \text{CH}_3\text{MgBr, ether} \]
3. \[ c. (\text{CH}_3)_2\text{CuLi} \]

(b) \[ \text{Cl} \]

1. \[ a. \text{H}_2\text{N-NH}_2, \text{KOH}, \text{heat} \]
2. \[ b. \text{CH}_3\text{MgBr, ether} \]
3. \[ c. (\text{CH}_3)_2\text{CuLi} \]

(c) \[ \text{CH}_2\text{OH} \]

1. \[ a. \text{H}_2\text{N-NH}_2, \text{KOH}, \text{heat} \]
2. \[ b. \text{CH}_3\text{MgBr, ether} \]
3. \[ c. (\text{CH}_3)_2\text{CuLi} \]

9. (4 pts) Given that alcohols have pKa~16; carboxylic acids have pKa~5; ammonia, NH\textsubscript{3}, has pKa~33; and ammonium ion, NH\textsubscript{4}\textsuperscript{+}, has a pKa~9. Explain the most stable form of the amino acid serine shown below (not necessarily the most stable form):

\[ \text{serine} \]

\[ \text{HO} \]

\[ \text{O} \]

\[ \text{NH}_2 \]