

1. Circle the correct answer: (48 pts)

(1) When a carbonyl group is part of a conjugated  $\pi$ -network, the C=O bond is:

- a. longer than that in a nonconjugated system.
- b. shorter than that in a nonconjugated system.
- c. the same as that in a nonconjugated system.
- e. none of the above.

(2) Compared to ketones, aldehydes react in \_\_\_\_\_ rates in nucleophilic addition reactions

- a. the same
- b. slower
- c. faster
- d. different

(3) When the carbonyl group of a ketone is protonated:

- a. the resulting species can react with both weak and strong electrophile(s).
- b. the resulting species can react with both weak and strong nucleophile(s).
- c. the resulting species only reacts with strong acid.
- d. the resulting species does not react at all.

(4) The reagent which converts a carbonyl group of an amide into a methylene group is:

- a. Na, NH<sub>3</sub>, CH<sub>3</sub>CH<sub>2</sub>OH.
- b. NaBH<sub>4</sub>, CH<sub>3</sub>CH<sub>2</sub>OH.
- d. BH<sub>3</sub>-THF.
- e. LiAlH<sub>4</sub>.

(5) Compared to an alkene C=C bond, a carbonyl double bond has:

- a. higher polarity.
- b. lower polarity.
- c. the same polarity.
- d. no polarity.

(6) What reagent can be used to convert a carboxylic acid to a ketone?

- a. water.
- b. NaOH.
- c. LiAlH<sub>4</sub>.
- d. an organolithium (RLi).

(7) Carboxylic acids boil at considerably higher temperatures than do alcohols, ketones, or aldehydes of similar molecular weights. This is because they:

- a. have a greater oxygen content.
- b. are more acidic.
- c. form stable hydrogen-bonded dimers.**
- d. are hydrophobic.

(8) Nucleophilic acyl substitution is a reaction involving:

- a. aldehydes.
- b. ketones.
- b. carboxylic acids and their derivatives.**
- d. any compounds containing the carbonyl group.

(9) Typically, esters will hydrolyze under \_\_\_\_\_ conditions than amides.

- a. stronger
- b. more dilute
- c. less rigorous
- e. milder**

(10) Amides are much less basic than amines because:

- a. the carbonyl group donates electrons by resonance.
- b. the carbonyl group withdraws electrons by resonance.**
- c. the nitrogen does not have a lone pair of electrons.
- d. the nitrogen has a full positive charge.
- e. amides do not contain nitrogen.

(11) Nitriles (R-CN) are considered to be carboxylic acid derivatives because:

- a. they share the same general structure with the other derivatives.
- b. they also contain the carbonyl group.
- c. they are always prepared from esters.
- d. they can be converted into both amide and carboxylic acids.**

(12) The reactivity of carboxylic acid derivatives decreases as leaving group becomes

- a. smaller
- b. larger
- c. less basic
- d. more basic**

2. Provide the structure of the major product in reactions shown below. (16 pts)

