Chemistry 11 Spring 2012
Examination #4 ANSWER KEY

On the first portion of this exam, select the best answer choice for the questions/synthetic sequences below and mark the answers on your scantron. Then answer the free response questions that follow (100 pts. total; multiple choice 3 pts. each).

For Questions #1 - #6, complete the synthetic sequence below by selecting from the answer choices listed below.

[Diagram of synthetic sequence]

7. Which of the following represents the correct (unbalanced) equation for the reaction of dimethylamine, (CH₃)₂NH, with hydrochloric acid?

A. (CH₃)₂NH + HCl(aq) → CH₄(g) + NH₂Cl(l)
B. (CH₃)₂NH + HCl(aq) → (CH₃)₂NH₂(aq) + Cl₂(g)
C. (CH₃)₂NH + HCl(aq) → (CH₃)₂NH₂⁺(aq) + Cl⁻(aq)
D. (CH₃)₂NH + HCl(aq) → (CH₃NHCl(l) + H₂(g)
E. (CH₃)₂NH + HCl(aq) → (CH₃)₂NH₂⁺(aq) + Cl₂(g)
For Questions #8 - #11, complete the synthetic sequence and then answer the corresponding question below by selecting from the answer choices listed.

11. Which of the answer choices above is an expected product in the proposed sequence and is a saturated carboxylic acid? **CD**

12. Which of the following statements regarding the qualitative analysis of hydrocarbons is TRUE? Note that the structure for toluene (mentioned below) is:

A. During bromination, a solution with a compound containing an alkyne is expected to remain colored red.
B. During bromination, a solution with a compound containing an alkene is expected to remain colored red.
C. During a reaction with potassium permanganate, a solution with a compound containing an alkene is expected to remain colored purple.
D. **During a reaction with potassium permanganate, a solution containing toluene is expected to remain colored purple.**
E. During the reaction with sulfuric acid, an alkene is converted into a glycol, resulting in a brown precipitate.
For Questions #13 - #20, consider the descriptions below and select from the three molecules shown. Note that answers may be used more than once, and multiple answers per question, which may be possible, should be filled in on the scantron when applicable.

A.

B.

C.

13. trans fat  B
14. most likely to be a fat at room temperature  A
15. most likely to be an oil at room temperature  C
16. unsaturated  B and C
17. saturated  A
18. expected lowest melting point  C
19. expected highest melting point  A
20. more (likely) predominant unsaturated isomer  C

For Questions #21 - #25, determine whether the listed compound is a primary amine, secondary amine, tertiary amine, or "something else" by selecting the appropriate answer below. Note that answer choices may be used more than once.

A. primary (1°) amine
B. secondary (2°) amine
C. tertiary (3°) amine
D. something else

21.  B
22.  C
23.  D
24.  A
25.  C

END OF MULTIPLE CHOICE
26. (4 pts.) Name and describe the two qualitative oxidation techniques used in the laboratory setting to distinguish the presence of aldehydes. How do these techniques compare and contrast, and what is/are their expected outcome(s)? Give a chemical example (i.e., reaction) that illustrates each technique.

1. Tollens' reagent distinguishes aldehydes from ketones. A positive test for an aldehyde is the formation of a shiny gray precipitate of silver metal, formed by reduction of silver ion as the aldehyde is oxidized into a carboxylic acid under acidic conditions.

2. Benedict's reagent is another useful oxidizing agent. Similar to Tollens' reagent, it oxidizes aldehydes. However, it differs in that Benedict's reagent is generally used to test for the presence of aldehydes present in sugar molecules, thereby NOT oxidizing any alcohols also present. The reagent is a blue solution of copper(II) ion that, in the presence of an aldehyde, is reduced and forms a red precipitate of Cu₂O, while the aldehyde is oxidized into a carboxylic acid. For example, consider the oxidation of D-glucose below:

![](image)

D-Glucose

27. (7 pts.) Answer the following questions:

A. Identify if the structure shown below is a hemiacetal, acetal, or neither and say whether the compound is formed from an aldehyde, a ketone, or neither. Also indicate the formula of the alcohol if used in the reaction, in the blank provided. If you think no alcohol is used, then choose none. Lastly, also indicate the number of alcohol molecules if used to make the product.
OCH₂CH₃
OCH₂CH₃
CH₃CH₂OH
Hemiacetal Acetal neither
Aldehyde Ketone neither
Alcohol: CH₃CH₂OH none
# of alcohol molecules: 2 none

B. Fill in the blanks:

OH
aldehyde or ketone
O
O
O

CH₃OH alcohol
H₂SO₄

aldehyde or ketone + alcohol → hemiacetal

C. Circle ONE answer that best indicates what the compound to the left is.

CH₃OCH₂CH₂OCH₃ Hemiacetal Acetal neither

28. (14 pts. total; 7 pts. each)

A. SYNTHESIS! Design a synthetic sequence using your knowledge of organic chemistry to date, the appropriate reagents on the cover page of this examination, as well as learned laboratory reactions to account for the following chemical transformations:

(Hint: think about the "hydrocarbon" laboratory experiment)
A. (Hint: think about the “hydrocarbon” laboratory experiment)

B. Predict the MAJOR and MINOR products for the reaction listed below AND give the appropriate curved arrow notation (mechanism) for formation of each final product.

Mechanism: Include lone pairs, arrows, and all steps for full credit.