

CHEMISTRY 208
Final

SPRING 97-98
2 hours

Family Name _____
First Name _____
ID No _____

Instructions

Answer all questions

All answers must be clearly indicated by a vertical line in the box of your choice on the answer sheet as indicated below:



If you make a mistake cross it out, as indicated below:



There is only one correct answer per question

There is no penalty for a wrong answer

If more than one box is filled per question (except to cross out mistakes), then that question will not be graded.

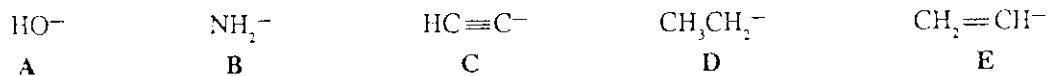
1. How many carbons lie in a straight line in 2-methyl-3-hexyne?

- a. 2 c. 4
b. 3 d. 6

2. Acid-catalyzed hydration of propyne yields

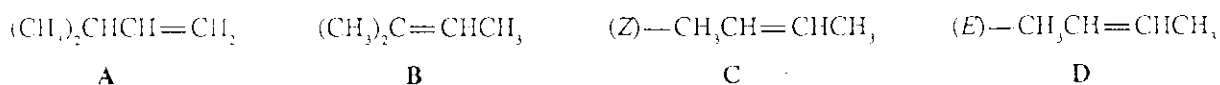
- a. $(\text{CH}_3)_2\text{C}=\text{O}$ c. $(\text{CH}_3)_2\text{C}(\text{OH})_2$
b. $\text{CH}_2=\text{C}(\text{OH})\text{CH}_3$ d. $\text{CH}_3\text{CH}_2\text{CHO}$

3. Which is the correct order of decreasing basicity in the anions



- a. $\text{A} > \text{B} > \text{C} > \text{D} > \text{E}$ c. $\text{C} > \text{B} > \text{D} > \text{A} > \text{E}$
b. $\text{D} > \text{E} > \text{B} > \text{C} > \text{A}$ d. $\text{D} > \text{E} > \text{C} > \text{B} > \text{A}$

4. What is the order of stability of the following alkenes?



- a. $\text{A} > \text{B} > \text{D} > \text{C}$ c. $\text{B} > \text{A} > \text{D} > \text{C}$
b. $\text{B} > \text{D} > \text{C} > \text{A}$ d. $\text{A} > \text{B} > \text{C} > \text{D}$

5. The first step in the acid catalyzed dehydration of an alcohol to yield an alkene is:

- a. loss of OH^- to form a carbocation
b. loss of water to form a carbocation
c. protonation of the $-\text{OH}$ group to form a protonated alcohol
d. loss of a proton from the alcohol to form a carbocation.

6. Which compound yields two aldehydes upon treatment with O_3/Zn ?

- a. 2,3-dimethyl-1-pentene c. 2,3-dimethyl-2-pentene
b. 3,3-dimethyl-1-pentene d. 2,4-dimethyl-2-pentene

7. Acid-catalyzed hydration of 2-methyl-2-butene yields

- a. 2-methyl-1-butanol c. 3-methyl-2-butanol
b. 2-methyl-2-butanol d. 3-methyl-1-butanol

8. Addition of one mole of HCl to 1,3-butadiene, followed by one mole of bromine yields

- a. 1,2-dibromo-3-chlorobutane c. 1,2-dibromo-4-chlorobutane
b. 2,3-dibromo-1-chlorobutane d. both (a) and (b)

9. Which of the following is *not* true for enantiomers?

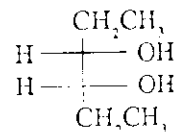
- A. They have the same boiling point.
B. They have the same melting point.
C. They have the same chemical reactivity with achiral reagents.
D. They have the same reactivity with chiral reagents.
E. They have the same density.
F. They have the same specific rotation.

- a. C and F c. F
b. D and F d. all but F

10. Which of the following compounds have chiral carbons?

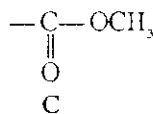
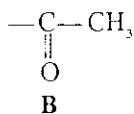
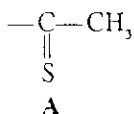
- A. 1-bromobutane
B. 3-bromohexane
C. *n*-butyl chloride
D. *sec*-butyl chloride
E. isobutane
- a. B c. B and D
b. C d. all but C

11. The correct stereochemical designation for this compound is ____-3,4-hexanediol
- a. (3*R*, 4*R*)
 b. (3*S*, 4*S*)
 c. (3*R*, 4*S*)

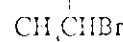


12. The Pt-catalyzed addition of H_2 to 1,2-dimethylcyclopropene will result in the formation of
- a. one *R* isomer.
 b. one *S* isomer.
 c. a *dl* pair.
 d. a *meso* compound.
 e. both (c) and (d).

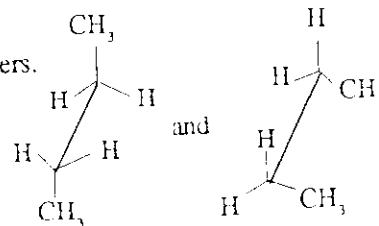
13. Arrange the following three groups in the order of highest to lowest priority.



- a. $\text{A} > \text{B} > \text{C}$
 b. $\text{C} > \text{B} > \text{A}$
- c. $\text{A} > \text{C} > \text{B}$
 d. $\text{B} > \text{C} > \text{A}$
14. How many configurational isomers are possible for a compound with the structure $\text{CH}_3\text{CH}=\text{C}(\text{CH}_3)\text{CH}(\text{CH}_3)\text{CH}(\text{CH}_3)?$
- a. 2^3
 b. 2^4
 c. 2^5
 d. 2^6
 e. 2^7



15. The relationship between these compounds is that they are
- a. superimposable without bond rotation.
 b. diastereomers.
 c. enantiomers.
 d. conformational isomers.

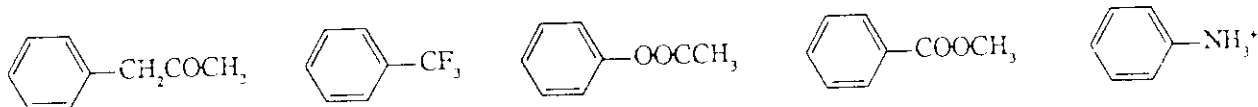


16. The leaving group in the synthesis of 1-bromopropane from 1-propanol and HBr is
- a. H_2O
 b. OH^-
 c. H_3O^+
 d. HBr
17. The rate law in the solvolysis of *t*-butyl chloride, $\text{R}-\text{Cl}$, is
- a. $\text{Rate} = k[\text{R}-\text{Cl}][\text{H}_2\text{O}]$
 b. $\text{Rate} = k[\text{R}-\text{Cl}]$
 c. $\text{Rate} = k[\text{R}-\text{Cl}]^2$
 d. $\text{Rate} = k[\text{R}-\text{Cl}][\text{H}_2\text{O}]^{-1}$ (where $\text{R} = (\text{CH}_3)_3\text{C}-$)
18. Which compound will not yield 1-chlorobutane from 1-butanol?
- a. SOCl_2
 b. AlCl_3
 c. PCl_3
 d. (a) and (b)
19. Which of the following reactions would not lead to the formation of the indicated product?
- a. $\text{CH}_3\text{CH}_2\text{O}^- + \text{CH}_3\text{OH} \longrightarrow \text{CH}_3\text{CH}_2\text{OCH}_3 + \text{OH}^-$
 b. $\text{CH}_3\text{S}^- \text{Na}^+ + \text{CH}_3\text{CH}_2\text{I} \longrightarrow \text{CH}_3\text{CH}_2\text{SCH}_3 + \text{NaI}$
 c. $\text{NaN}_3 + \text{CH}_3\text{CH}_2\text{CH}_2\text{Br} \longrightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{N}_3 + \text{NaBr}$
 d. $(\text{CH}_3)_2\text{NH} + \text{CH}_3\text{Br} \longrightarrow (\text{CH}_3)_3\text{NH}^+\text{Br}^-$
20. Which of the following compounds would undergo $\text{S}_\text{N}2$ most rapidly?
- a. 1-chloropentane
 b. 2-chloropentane
 c. 2-chloro-2-methylbutane
 d. neopentylchloride
21. Which compound would undergo $\text{E}1$ reaction the fastest?
- a. 1-chlorobutane
 b. 2-chlorobutane
 c. 2-chloro-2-methylbutane
 d. neopentylchloride

22. The function of FeBr_3 in Friedel-Crafts alkylations is
- to form a complex with benzene, thus increasing its reactivity.
 - to complex with the carbocation, thus stabilizing it.
 - to abstract the halide from the alkyl halide, thus forming a carbocation.
 - to abstract the proton from the σ complex and regenerate the aromatic ring.

23. The electrophile in the nitration reaction of benzene is _____.
- HNO_3
 - $\text{HNO}_3/\text{H}_2\text{SO}_4$
 - NO_2
 - NO_2^+

24. The major mononitration product of the following compounds is

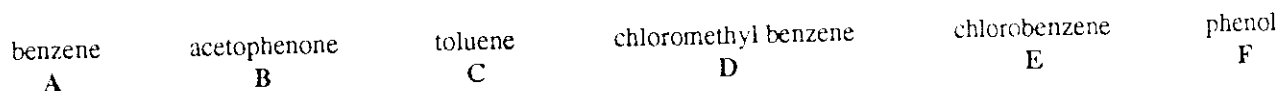


- | | | | | | |
|----|------------|------------|------------|------------|------------|
| a. | <i>o-p</i> | <i>m</i> | <i>o-p</i> | <i>m</i> | <i>m</i> |
| b. | <i>m</i> | <i>o-p</i> | <i>o-p</i> | <i>m</i> | <i>m</i> |
| c. | <i>o-p</i> | <i>o-p</i> | <i>m</i> | <i>m</i> | <i>m</i> |
| d. | <i>m</i> | <i>m</i> | <i>o-p</i> | <i>o-p</i> | <i>o-p</i> |

25. Which of the following is not a *meta*-directing substituent in electrophilic aromatic substitutions?

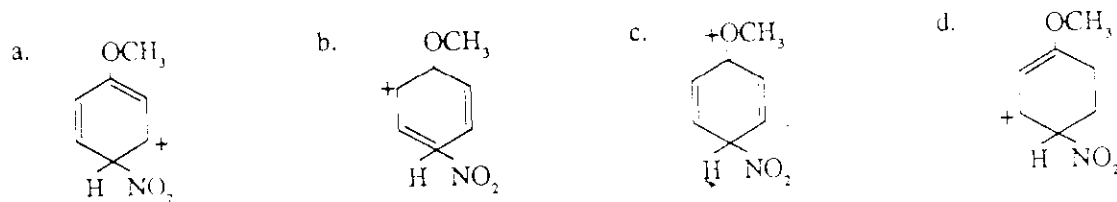
- $-\text{N}(\text{CH}_3)_3^+$
- $-\text{NO}_2$
- $-\text{C}\equiv\text{N}$
- $-\text{NHCOCH}_3$

26. The most reactive and the least reactive compound towards nitration are



- F/B
- A/B
- C/E
- F/D

27. Which is the incorrect resonance formula in the nitration of anisole?



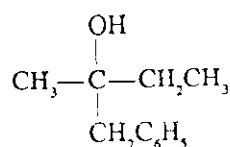
28. Which compound will produce only one alkene from E^2 elimination?

- 1-bromo-3-methylbutane
- 2-bromopentane
- 3-bromopentane
- 2-bromo-2-methylbutane

29. What is the first step in the reaction of cyclohexanol with HBr to produce 1-bromocyclohexane?

- nucleophilic attack of Br^- to displace OH^-
- loss of OH^- to form the carbocation
- protonation of the $-\text{OH}$ group to form $-\text{OH}_2^+$
- concerted mechanism: as the $\text{C}-\text{OH}$ bond breaks, the $\text{C}-\text{Br}$ bond is formed

30. Give the best route for the synthesis of this alcohol:



- $\text{C}_2\text{H}_5\text{COOCH}_3 + \text{C}_6\text{H}_5\text{MgBr} \longrightarrow$
- $\text{C}_2\text{H}_5\text{COCH}_3 + \text{C}_6\text{H}_5\text{CH}_2\text{MgBr} \longrightarrow$
- $\text{CH}_3\text{COCH}_2\text{C}_6\text{H}_5 + \text{CH}_3\text{CH}_2\text{CH}_2\text{MgBr} \longrightarrow$
- $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{MgBr} + \text{C}_6\text{H}_5\text{CHO} \longrightarrow$

31. The reaction of *t*-butyl bromide and sodium methoxide yields
- a. $(\text{CH}_3)_2\text{C}=\text{CH}_2 + \text{CH}_3\text{OH} + \text{NaCl}$ c. $(\text{CH}_3)_3\text{CO}^-\text{Na}^+ + \text{CH}_3\text{Cl}$
 b. $(\text{CH}_3)_3\text{COCH}_3 + \text{NaCl}$ d. $\text{ClCH}_2\text{C}(\text{CH}_3)_2\text{O}^-\text{Na}^+$
32. Which combination of reagents would afford the highest yield of methyl phenyl ether
- $\text{CH}_3\text{O}^-\text{Na}^+$ $\text{C}_6\text{H}_5\text{Br}$ CH_3I $\text{C}_6\text{H}_5\text{O}^-\text{Na}^+$
 A B C D
- a. A and C c. A and B
 b. B and D d. C and D
33. Which reagent is used in the cleaving of ethers?
- a. LiAlH_4 c. hot KMnO_4/H^+
 b. hot HI d. conc. NaOH
34. Rank the following in order of decreasing boiling point:
- $\text{CH}_3\text{COOCH}_3$ $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_3$ $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$ $\text{CH}_3\text{CH}_2\text{COOH}$
 A B C D
- a. $A > B > C > D$ c. $B > D > A > C$
 b. $A > D > C > B$ d. $D > C > A > B$
35. Which of the following alcohols yields a carboxylic acid when treated with hot KMnO_4 ?
- $(\text{CH}_3)_2\text{CHOH}$ $(\text{CH}_3)_2\text{CHCH}_2\text{OH}$ $(\text{CH}_3)_3\text{CCH}_2\text{OH}$ $(\text{CH}_3)_3\text{COH}$
 A B C D
- a. all but D c. only B
 b. B and C d. A and B
36. Carboxylic acids are _____ acids than alcohols because _____.
- a. stronger; the carboxylate anion is destabilized by resonance
 b. stronger; the carboxylate anion is stabilized by resonance
 c. weaker; the alkoxide anion is more basic because of the alkyl group's inductive effect
 d. weaker; the carboxyl group is more stabilized by resonance than the carboxylate anion
37. The acid-catalyzed esterification of a carboxylic acid with an alcohol involves the attack of the
- a. carboxylic acid $-\text{OH}$ group, which displaces the protonated hydroxyl group of the alcohol.
 b. alcohol $-\text{OH}$ on the carboxylate anion.
 c. alcohol $-\text{OH}$ on the protonated carbonyl of the acid.
 d. alcohol $-\text{OH}$ on the neutral carbonyl of the acid.
38. Which of the following is hydrolyzed the slowest by base?
- a. $(\text{CH}_3\text{CH}_2\text{CO})_2\text{O}$ c. $\text{CH}_3\text{CH}_2\text{CONH}_2$
 b. $\text{CH}_3\text{CH}_2\text{COCl}$ d. $\text{CH}_3\text{CH}_2\text{COOCH}_3$
39. Which is the weakest base?
- a. *N*-methylaniline b. benzylamine c. aniline d. cyclohexylamine
40. An aqueous solution of glucose behaves as an aldehyde because
- a. glucose is actually a cyclic aldehyde.
 b. it is hydrolyzed by water to the free aldehyde.
 c. it is a ketone, but is in equilibrium with the aldehyde form.
 d. its predominant form (the cyclic hemiacetal) is in equilibrium with the free aldehyde form.
41. Which compound would not form an imine with *p*-nitrobenzaldehyde?
- a. NH_3 b. $\text{CH}_3\text{CH}_2\text{NH}_2$ c. $(\text{CH}_3)_2\text{CHNH}_2$ d. $(\text{CH}_3\text{CH}_2)_2\text{NH}$

ANSWER SHEET

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First Name _____

ID No _____

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