



CHEMISTRY 208  
Final

Spring 96-97  
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

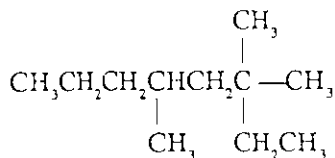
There is no penalty for a wrong answer

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



1. Give the number of primary, secondary, and tertiary hydrogens in 2,3,4-trimethylpentane.
- (a) 1°, 15; 2°, 0; 3°, 3  
 (b) 1°, 12; 2°, 3; 3°, 3  
 (c) 1°, 12; 2°, 0; 3°, 4  
 (d) 1°, 12; 2°, 6; 3°, 0  
 (e) none of the above is correct

2. What is the correct IUPAC name of the compound shown below?

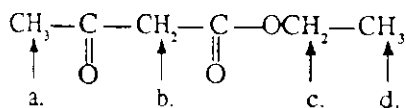


- a. 4,6-dimethyl-6-ethylpentane  
 b. 2,4-dimethyl-2-ethylheptane  
 c. 3,3,5-trimethyloctane  
 d. 4,6-dimethyl-6-isobutylpentane
3. The eclipsed and staggered forms of ethane are said to differ in  
 a. configuration  
 b. conformation  
 c. resonance  
 d. constitution
4. Compound  $\text{C}_5\text{H}_{12}$  forms four structurally different monochloroderivatives.  $\text{C}_5\text{H}_{12}$  is, therefore,  
 a. *n*-pentane  
 b. 2-methylbutane  
 c. 2,2-dimethylpropane  
 d. 2,3-dimethylpropane
5. Which of the following statement(s) for dimethylcyclohexane is/are correct?  
 A. *cis*-1,2-is more stable than *trans*-1,2.  
 B. *cis*-1,3-is more stable than *trans*-1,3.  
 C. *cis*-1,4-is more stable than *trans*-1,4.  
 a. B  
 b. A and C  
 c. C only  
 d. all are correct

6. Which is the only name that is correct?  
 a. 2-ethyl-1-butene  
 b. 1-methyl-2-cyclohexene  
 c. 2-ethyl-2-butene  
 d. 3-ethyl-1-butene

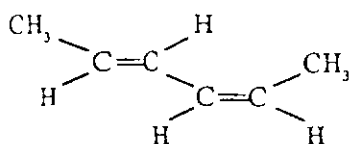
7. Which of the following compounds will have the highest boiling point?  
 a.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$   
 b.  $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$   
 c.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$   
 d.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}=\text{CF}_2$

8. Which are the most acidic hydrogens in the compound below?



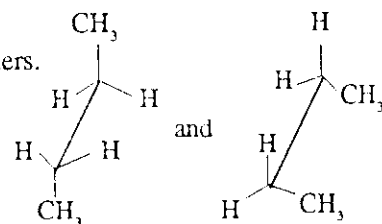
9. The most stable carbocation is  
 a.  $\text{CH}_2=\text{CH}\overset{+}{\text{C}}\text{H}_2$   
 b.  $\text{CH}_3\text{CH}=\overset{+}{\text{C}}\text{H}_2$   
 c.  $\text{CH}_3\overset{+}{\text{C}}=\text{CH}_2$   
 d.  $\text{CH}_3\text{CH}_2\overset{+}{\text{C}}\text{H}_2$

10. The name of the compound below is

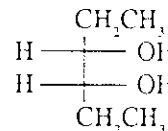


- a. (Z), (Z)-2,4-hexadiene  
 b. (E), (E)-2,4-hexadiene  
 c. (E), (Z)-2,4-hexadiene

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



12. The correct stereochemical designation for this compound is \_\_\_\_-3,4-hexanediol  
 a. (3*R*, 4*R*)      d. (3*R*)  
 b. (3*S*, 4*S*)      e. (4*S*)  
 c. (3*R*, 4*S*)



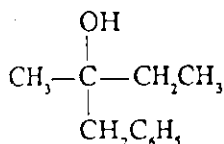
13. Acid-catalyzed hydration of 2-methyl-2-butene yields  
 a. 2-methyl-1-butanol      c. 3-methyl-2-butanol  
 b. 2-methyl-2-butanol      d. 3-methyl-1-butanol
14. Which compound yields two aldehydes upon treatment with  $O_3/Zn$ ?  
 a. 2,3-dimethyl-1-pentene      c. 2,3-dimethyl-2-pentene  
 b. 3,3-dimethyl-1-pentene      d. 2,4-dimethyl-2-pentene
15. Which alkene is not formed when 3-methyl-1-pentanol is dehydrated?  
 a. 3-methyl-1-pentene      c. 2-ethyl-1-butene  
 b. 3-methyl-2-pentene      d. 2-methyl-1-pentene

16. 
  
 a. *o-p-*      *m-*      *o-p-*      *m-*      *m-*  
 b. *m-*      *o-p-*      *o-p-*      *m-*      *m-*  
 c. *o-p-*      *o-p-*      *m-*      *m-*      *m-*  
 d. *m-*      *m-*      *o-p-*      *o-p-*      *o-p-*

17. The presence of chlorine on the benzene ring \_\_\_\_\_ the ring and directs the electrophile \_\_\_\_\_.  
 a. activates; *o-p-*      c. activates; *m-*  
 b. deactivates; *o-p-*      d. deactivates; *m-*
18. Which of the following is not a *meta*-directing substituent in electrophilic aromatic substitutions?  
 a.  $-N(CH_3)_3^+$       c.  $-C\equiv N$   
 b.  $-NO_2$       d.  $-NHCOCH_3$
19. Which of the following combinations is correct? Aldehydes  
 A are more reactive than ketones toward nucleophiles.      C are less reactive than ketones toward nucleophiles.  
 B are more easily oxidized than ketones.      D are less easily oxidized than ketones.  
 a. A, B      b. C, D      c. A, D      d. B, C
20. What is the product of the reaction of  $HOCH_2CHO$  with  $C_2H_5MgBr$ ?  
 a.  $C_2H_5CH(OH)CH_2OH$       b.  $C_2H_5OCH_2CHO$       c.  $C_2H_5CH(OH)CHO$       d.  $C_2H_6$
21. During the first step of the base-catalyzed ( $OH^-$ ) aldol condensation,  
 a. the carbonyl is protonated.      c. the  $HO^-$  ion abstracts an  $\alpha$ -hydrogen to form an enolate.  
 b. the  $HO^-$  ion attacks the carbonyl group.      d. the carbonyl gets ionized.
22. How many optical isomers of 1,2-dichlorocyclohexane are there?  
 a. one      c. three  
 b. two      d. four



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



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

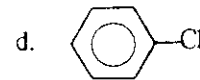
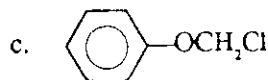
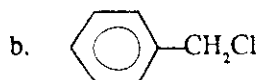
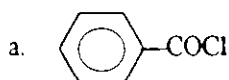
24. Which of the following Grignard reactions does *not* yield the indicated product?

- a.  $2 \text{CH}_3\text{CH}_2\text{MgI} + \text{CH}_3\text{COOC}_2\text{H}_5 \longrightarrow (\text{C}_2\text{H}_5)_2\text{C}(\text{OH})\text{CH}_3$   
 b.  $\text{CH}_3\text{CH}_2\text{MgI} + \text{C}_6\text{H}_5\text{COOH} \longrightarrow \text{C}_6\text{H}_5\text{COC}_2\text{H}_5$   
 c.  $\text{CH}_3\text{CH}_2\text{MgI} + \text{C}_6\text{H}_5\text{CHO} \longrightarrow \text{C}_6\text{H}_5\text{CH}(\text{OH})\text{C}_2\text{H}_5$   
 d.  $\text{CH}_3\text{CH}_2\text{MgI} + (\text{C}_6\text{H}_5)_2\text{C}=\text{O} \longrightarrow (\text{C}_6\text{H}_5)_2\text{C}(\text{OH})\text{C}_2\text{H}_5$

25. The reaction of propylene oxide with *excess* concentrated HCl yields

- a. 1-chloro-2-propanol  
 b. 2-chloro-1-propanol  
 c. 1,2-dichloropropane  
 d. 1-chloro-1-propanol

26. Which of the following compound is benzoyl chloride?



27. 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

28. Rank the following compounds in decreasing acidity

- A hydrocyanic acid ( $\text{p}K_a = 9.31$ )      C phenol ( $\text{p}K_a = 9.89$ )  
 B chloroacetic acid ( $\text{p}K_a = 2.85$ )      D lactic acid ( $\text{p}K_a = 3.86$ )

- a.  $A > B > C > D$       c.  $C > A > D > B$   
 b.  $B > D > A > C$       d.  $D > B > A > C$

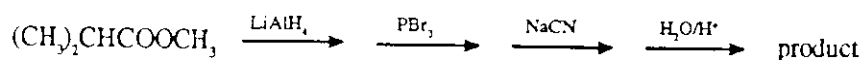
29. Which compound would not form an imine with *p*-nitrobenzaldehyde?

- a.  $\text{NH}_3$       b.  $\text{CH}_3\text{CH}_2\text{NH}_2$       c.  $(\text{CH}_3)_2\text{CHNH}_2$       d.  $(\text{CH}_3\text{CH}_2)_2\text{NH}$

30. In the substitution reaction of  $\text{CH}_3\text{Br}$  with  $\text{OH}^-$ , doubling the concentrations of both the substrate and the nucleophile leads to

- a. no change      c. tripling of the rate  
 b. doubling of the rate      d. quadrupling of the rate

31. What is the product in this sequence?



- a.  $(\text{CH}_3)_2\text{CHCONH}_2$       c.  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{OH}$   
 b.  $(\text{CH}_3)_2\text{CHCH}_2\text{COOH}$       d.  $(\text{CH}_3)_2\text{CHCH}_2\text{COO}^-\text{NH}_4^+$

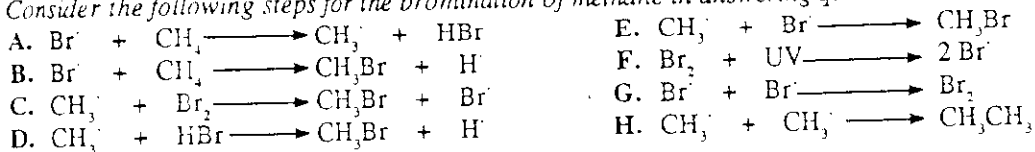
32. Which of the following is hydrolyzed the slowest by base?

- 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.  $\text{CH}_3\text{CH}_2\text{COOCH}_3$

33. In each case select the conditions which favor substitution over elimination.

- (i) 1-bromopentane with A aq. NaOH or B EtOH  
 (ii) C 1-bromopentane or D 3-bromopentane with aq. KOH  
 (iii) 2-bromopentane with aq. KOH; E warm or F hot
- (a) A, C, F  
 (b) B, D, E  
 (c) A, C, E  
 (d) B, C, E  
 (e) none of the above is correct

34. Consider the following steps for the bromination of methane in answering questions 2.7-2.9.



35. Which of the above reactions is/are the initiation step(s)?

- a. A      b. G      c. F and E      d. F

36. Which of the above can be considered as termination step(s)?

- a. E      b. G      c. H      d. E, G, H

37. Consider the following bonds:

- A. The C-C bond in ethylene  
 B. The C-C bond in ethane  
 C. The C<sub>1</sub>-C<sub>2</sub> bond in 1,3-butadiene  
 D. The C<sub>2</sub>-C<sub>3</sub> bond in 1,3-butadiene

The correct order in terms of increasing bond length (longest last) is

- (a) ACDB  
 (b) ADCB  
 (c) ABCD  
 (d) ACBD  
 (e) CADB

38. Which of the following compounds would undergo S<sub>N</sub>2 most rapidly?

- a. 1-chloropentane      c. 2-chloro-2-methylbutane  
 b. 2-chloropentane      d. neopentylchloride

39. Which compound would undergo E<sup>1</sup> reaction the fastest?

- a. 1-chlorobutane      c. 2-chloro-2-methylbutane  
 b. 2-chlorobutane      d. neopentylchloride

40. The function of FeBr<sub>3</sub> in Friedel-Crafts alkylations is

- a. to form a complex with benzene, thus increasing its reactivity.  
 b. to complex with the carbocation, thus stabilizing it.  
 c. to abstract the halide from the alkyl halide, thus forming a carbocation.  
 d. to abstract the proton from the σ complex and regenerate the aromatic ring.

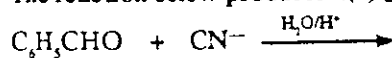
41. Ammoniacal silver nitrate converts an aldehyde to \_\_\_\_\_:

- (a) a carboxylic acid  
 (b) a primary alcohol  
 (c) an acetal in the presence of an acid  
 (d) an alkyl nitrate  
 (e) a silver complex which precipitates from solution

42. What reactants would be used to prepare *t*-butyl alcohol?

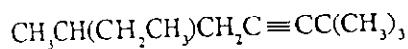
- a.  $(\text{CH}_3)_3\text{CCl} + (1:1) \text{H}_2\text{O}:\text{THF}/\text{K}_2\text{CO}_3$       c.  $(\text{CH}_3)_3\text{CMgBr} + \text{CO}_2$   
 b.  $\text{CH}_3\text{CH}(\text{O})\text{CH}_2 + \text{CH}_3\text{MgI}$       d.  $(\text{CH}_3)_2\text{C}=\text{CH}_2 + \text{B}_2\text{H}_6 + \text{H}_2\text{O}_2$

43. The reaction below produces a(n) \_\_\_\_\_.



- a. optically active compound      c. *meso* compound  
 b. racemic pair      d. a pair of diastereomers

44. The name of the compound below is



- a. 6-ethyl-2,2-dimethyl-3-heptyne  
b. 2,2,6-trimethyl-3-octyne

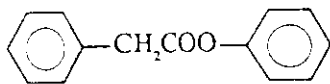
- c. *t*-butylisopropylacetylene  
d. 2,6-dimethyl-3-heptyne

45. Addition of HCl (1 mole, high temperature) to 1,3-butadiene yields \_\_\_\_\_ as the major product.

- a. 4-chloro-1-butene  
b. 3-chloro-1-butene

- c. 1-chloro-2-butene  
d. 3-chloro-2-butene

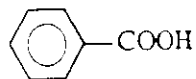
46. What is the name of this compound?



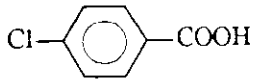
- a. benzyl benzoate  
b. phenyl benzoate

- c. phenyl phenylacetate  
d. benzyl phenolate

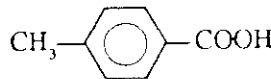
47. What is the correct descending order in acid strength of the following compounds?



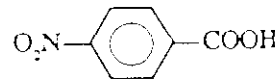
A



B



C

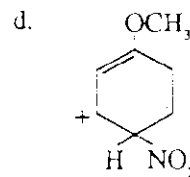
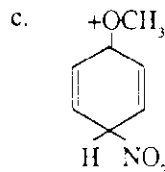
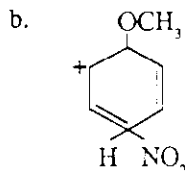
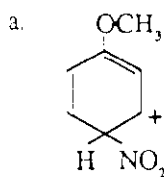


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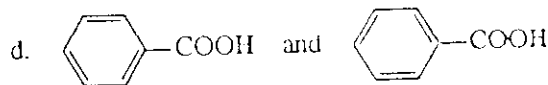
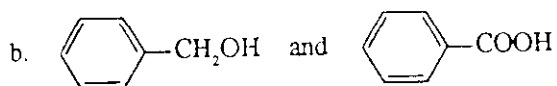
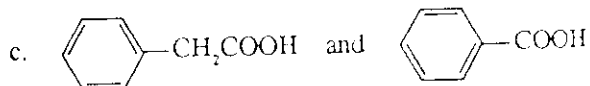
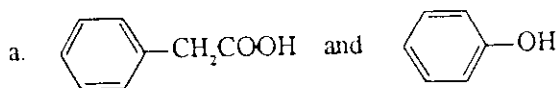
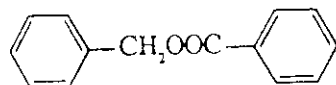
- a. A > D > C > B  
b. B > A > D > C

- c. C > D > A > B  
d. D > B > A > C

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



49. Which are the hydrolysis products of the following compound



50. A 50:50 mixture of a pair of enantiomers

- a. is optically inactive.  
b. may or may not be optically active.  
c. has the same boiling point as that of the individual enantiomers.  
d. is called a racemic mixture.  
e. all but b.

ANSWER SHEET

Family Name \_\_\_\_\_

First Name \_\_\_\_\_

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