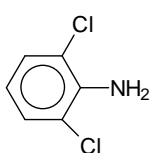
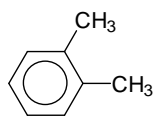


A

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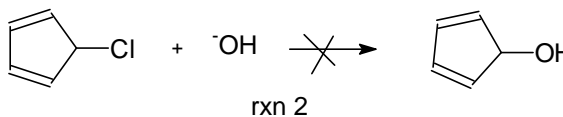
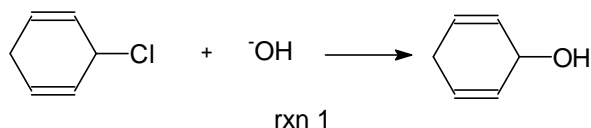
1. What are the names of the following compounds?



- A. cumene and 2,6-dichloroaniline B. ortho-cumene and 1,5-dichloroaniline
 C. ortho-xylene and 2,6-dichloroaniline D. 2-xylene and 1,5-dichloroaminobenzene
 E. 2-toluene and 2,6-dichloroamine

2. What is the molecular formula for biphenyl?

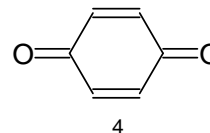
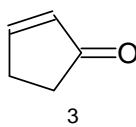
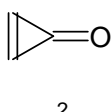
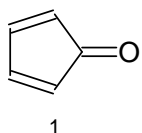
- A. $C_{12}H_{20}$ B. $C_{12}H_{12}$ C. $C_{12}H_{10}$ D. $C_{14}H_{14}$ E. $C_{10}H_8$

3. S_N1 substitution 2 below is exceedingly slow, compared with S_N1 substitution 1. What is the most plausible reason for this?

- A. The chlorocyclopentadiene is too strained to react
 B. Reaction 2 would have to proceed via an antiaromatic carbocation as intermediate
 C. Reaction 2 generates an antiaromatic product
 D. Reaction 1 generates an aromatic product
 E. The leaving group in reaction 2 is in vinylic position

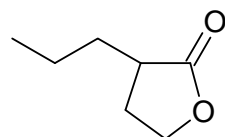
4. Three of the compounds below are stable while one is very unstable. Which one, and why? (Hint: the

C=O double bond is highly polarized, and has a dominant resonance form of

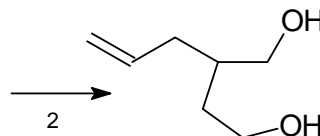
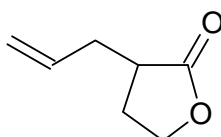


- A. Compound 2 is unstable because cyclopropenes are too strained to exist
 B. Compound 3 is unstable because it is non-aromatic while the other three are aromatic
 C. Compound 1 is unstable because it has a dominant antiaromatic resonance form
 D. Compound 4 is unstable because it cannot enolize
 E. Compound 4 is unstable because it is antiaromatic

5. Which reagents are suitable for the reductions below?



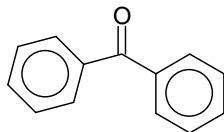
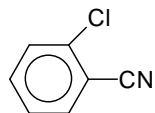
← 1



→ 2

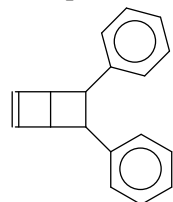
- A. $NaBH_4$ for 1, $LiAlH_4$ for 2 B. H_2/Pt for 1, $LiAlH_4$ for 2 C. H_2/Pt for 1, Sn/HCl for 2
 D. H_2/Pt for 1, $NaBH_4$ for 2 E. Sn/HCl for 1, $LiAlH_4$ for 2

6. What are the names of the following compounds?



- A. 2-chlorobenzonitrile and acetophenone B. ortho-chlorobenzonitrile and acetophenone
 C. ortho-chloronitrile and benzophenone D. 2-chlorobenzonitrile and benzophenone
 E. 2-chloro-1-benzonitrile and cumene

7. The cyclobutadiene molecule is highly reactive and will add to any suitable dienophile. Which dienophile would generate to product below?

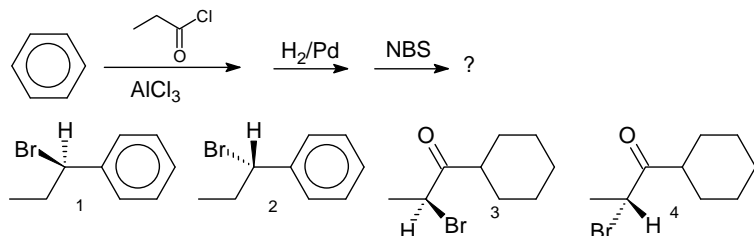


- A. naphthalene B. 1,2-diphenylethene C. 1,1-diphenylethene D. anthracene E. diphenylethyne

8. What can we say about benzyne?

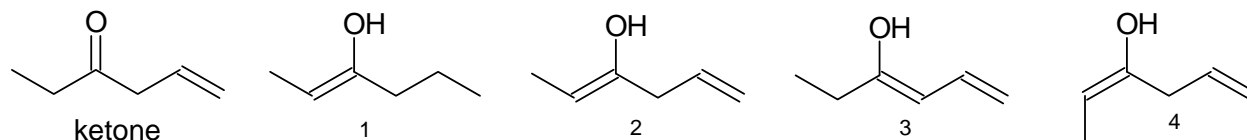
- A. It contains two sp hybridized carbons and four sp^2 hybridized carbons and is **aromatic**
 B. It contains two sp hybridized carbons and four sp^2 hybridized carbons and is **nonaromatic**
 C. It contains two sp hybridized carbons and four sp^2 hybridized carbons and is **antiaromatic**
 D. It contains six sp^2 hybridized carbons and is **nonaromatic**
 E. It contains six sp^2 hybridized carbons and is **aromatic**

9. What is the most likely outcome of the following reaction?



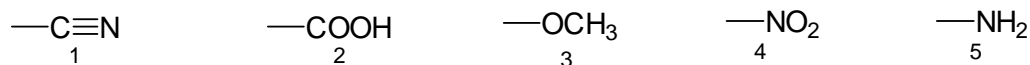
- A. a mixture of 1 and 2 B. a mixture of 2 and 3 C. a mixture of 3 and 4 D. compound 3
 E. compound 4

10. Consider the ketone below. Which of the structures 1-4 represent valid enol forms for this ketone?



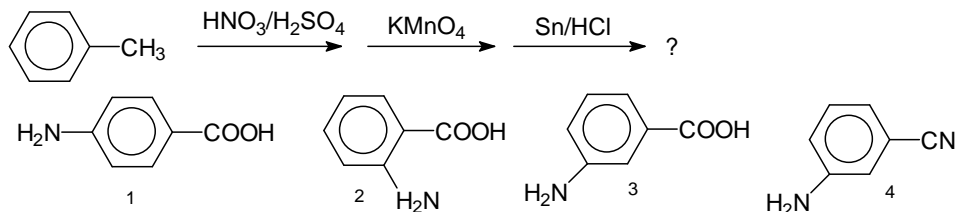
- A. only 1 B. 1 and 2 C. 2 and 3 D. 2, 3 and 4 E. all of them

11. Grignard reactions are limited in scope because many functional groups interfere. Only one of the following functional groups is tolerated (does not interfere). Which one?



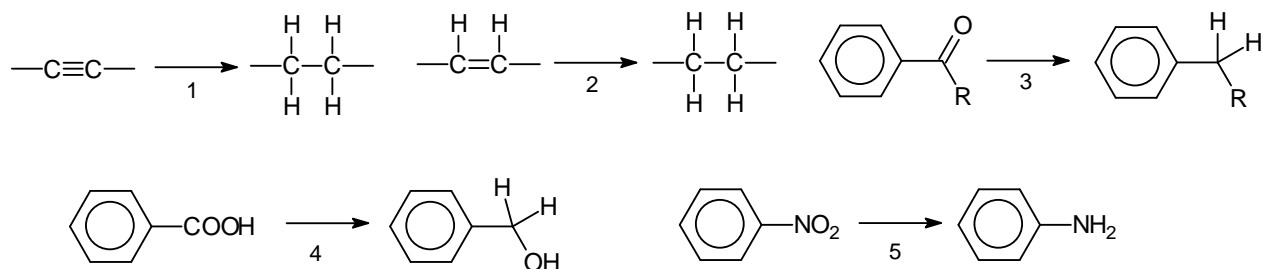
- A. 1 B. 2 C. 3 D. 4 E. 5

12. Consider the following reaction sequence. What major product(s) would you expect?



- A. only 1 B. a mixture of 1 and 2 C. only 3 D. a mixture of 2 and 3 E. only 4

13. Catalytic reduction with hydrogen over a palladium catalyst is a versatile reaction in organic chemistry. It can be used for all conversions below **except one**. Which one cannot be carried out with H_2/Pd ?

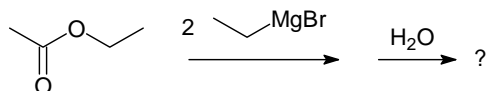


- A. 1 B. 2 C. 3 D. 4 E. 5

14. How is methanol commercially manufactured?

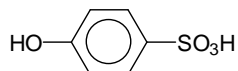
- A. from carbon dioxide and hydrogen B. by reduction of formic acid with hydrogen
 C. from carbon monoxide and hydrogen D. by catalytic oxidation of methane with oxygen
 E. by oxidation of ethanol with oxygen

15. Ethyl acetate was treated with two mole equivalents of ethylmagnesium bromide, followed by aqueous workup. What is the most plausible product?



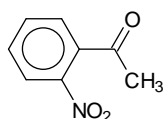
- A. 3-pentanol B. 3-methyl-3-pentanol C. 2-butanol D. 3-ethyl-3-pentanol
 E. 2-methyl-3-pentanol

16. What is the most appropriate name for the compound below?



- A. 4-hydroxysulfonic acid B. para-hydroxyphenylsulfuric acid C. 4-sulfophenol
 D. 4-hydroxybenzenesulfonic acid E. para-sulphenylphenol

17. What is the most appropriate name for the compound below?

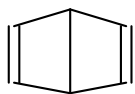


- A. 2-benzophenone nitrate B. 2-nitroacetophenone C. 2-nitrostyrene
 D. ortho-acylnitrobenzene E. 2-nitro-1-acetophenone

18. What is the molecular formula of styrene?

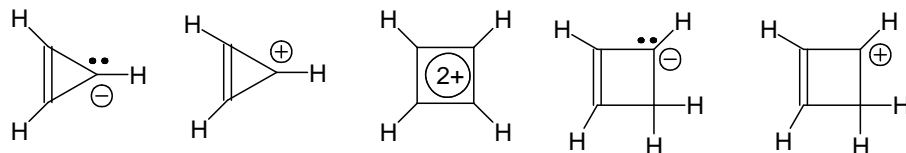
- A. C_7H_8 B. C_8H_{10} C. C_8H_8 D. C_8H_{12} E. $C_{12}H_{10}$

19. During the early days of chemistry, the structure below was suggested for benzene and named “Dewar benzene” after the chemist proposing it. What can be say about Dewar benzene? (Hint: before you consider the questions below, think about the shape of this molecule!)



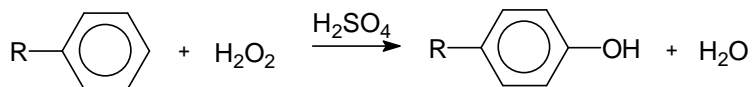
- A. It is a resonance form of benzene, but antiaromatic
- B. It is a resonance form of benzene, and also aromatic
- C. It is a resonance form of benzene, but non-aromatic
- D. It is not a resonance form of benzene, and non-aromatic
- E. It is not a resonance form of benzene, and anti-aromatic

20. How many of the following ions are likely aromatic?



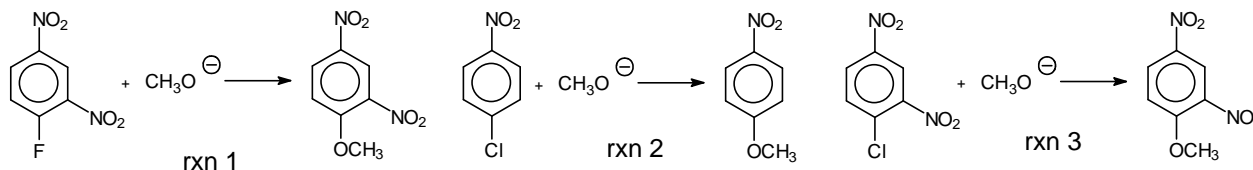
- A. one
- B. two
- C. three
- D. four
- E. all

21. Some benzene derivatives can be converted to phenols by treatment with hydrogen peroxide and sulfuric acid. What is the most plausible electrophile in these reactions?



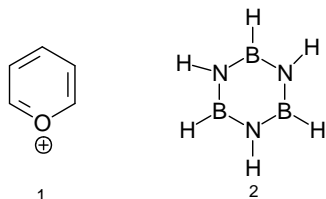
- A. $\text{H}-\overset{\oplus}{\text{O}}-\text{O}-\text{H}$
- B. SO_3
- C. $\ominus\text{OH}$
- D. $\text{H}_3\text{O}^{\oplus}$
- E. $\text{SO}_3\text{H}^{\oplus}$

22. The rates of the reactions below increase as the halonitrobenzenes become more reactive. Sort the reactions in order of increasing rates!



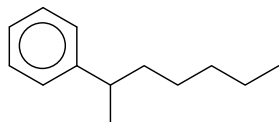
- A. $1 < 2 < 3$
- B. $3 < 2 < 1$
- C. $3 < 1 < 2$
- D. $2 < 1 < 3$
- E. $2 < 3 < 1$

23. The two compounds below were targeted for synthesis to further test the concept of aromaticity. What do you expect them to be? (hint: first decide how many lone pairs 2 has)



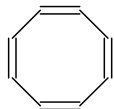
- A. both aromatic
- B. both non-aromatic
- C. both antiaromatic
- D. 1 is aromatic, 2 antiaromatic
- E. 1 is antiaromatic, 2 aromatic

24. What is the most appropriate name for the compound below?



- A. iso-heptylbenzene B. (1-methylhexyl) benzene C. 2-phenylheptane
D. 1-methyl-1-phenylhexane E. 2-benzylheptane

25. Cyclooctatetraene should be antiaromatic and quite unstable according to Huckel, yet this compound is commercially available and quite stable. What is the most plausible reason for this?



- A. Huckel's rule only holds for five and six-membered rings
B. Some antiaromatic compounds are quite stable
C. This compound was prepared before Huckel's rule was invented, so it doesn't have to abide by it
D. This compound probably is not planar, thereby staying non-aromatic
E. Octagonal molecules are exempt from Huckel's rule.

26. This is exam version A. Please mark A on your scantron!

Key ex232-01_2_101a

1. C
2. C
3. B
4. C
5. B
6. D
7. B
8. E
9. A
10. D
11. C
12. B
13. D
14. C
15. B
16. D
17. B
18. C
19. D
20. B
21. A
22. E
23. A
24. C
25. D