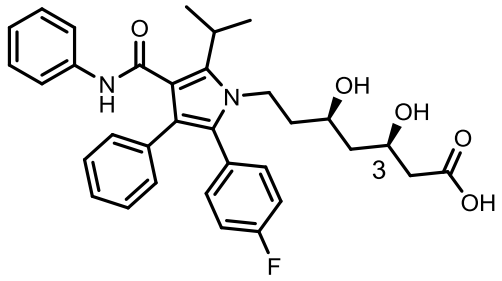
Problem Set #4, January 2018

Questions 61-66 refer to the structure of atorvastatin, marketed under the trade name Lipitor, shown below. This statin is used to treat heart disease as a lipid-lowering drug and has been a blockbuster drug since its launch in 1996.



61. How many degrees of unsaturation are in the molecule?

    a. 11
    b. 12
    c. 13
    d. 15
    e. 17

62. How many sp^2-hybridized carbon atoms are in the molecule?

    a. 18
    b. 20
    c. 22
    d. 24
    e. 26

63. Which of the following functional groups are NOT in the molecule?

    a. isopropyl
    b. diol
    c. ether
    d. carboxylic acid
    e. amide

64. What is the best way to describe the chirality of carbon 3?

    a. S
    b. R
    c. E
    d. Z
    e. The carbon is racemic

65. Would you expect to find a medium intensity infrared absorbance band at around 1550 cm^{-1} for atorvastatin? What functional group would this band correspond to?

a. No – secondary alcohol
b. No – carboxylic acid
c. No – carbonyl
d. Yes – carbonyl
e. Yes – aromatic ring

66. If atorvastatin was treated with methanol and catalytic acid, what new functional group would be formed?

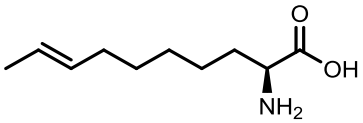
a. methyl ether
b. ketal
c. methyl amide
d. methyl ester
e. *tert*-butyl alkane

67. Rank the following carbocations in order of decreasing stability (most stable to least stable).

A B C D

a. A > B > D > C
b. C > D > A > B
c. B > A > C > D
d. A > D > B > C
e. B > A > D > C

68. Which of the following names represents the following molecule?



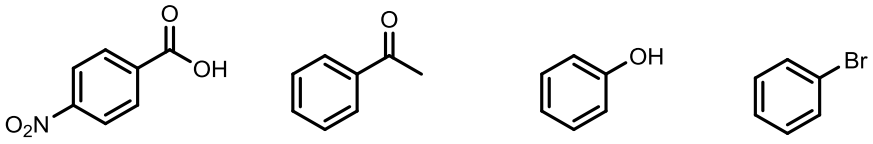
a. (R,E)-2-aminodec-8-enoic acid
b. (S,E)-2-aminodec-8-enoic acid
c. (S,Z)-2-aminodec-8-enoic acid
d. (R,Z)-2-aminodec-8-enoic acid
e. None of the above

69. Rank the following compounds in order of decreasing acidity (most acidic to least acidic).

A B C D

a. A > B > D > C
b. C > D > A > B
c. C > D > B > A
d. D > C > B > A
e. A > B > C > D

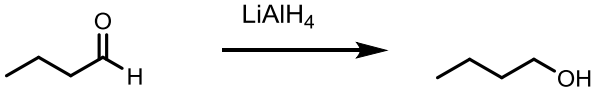
70. Rank the following compounds in order of decreasing rate of electrophilic aromatic substitution (fastest to slowest).



A B C D

a. A > B > D > C
b. C > D > A > B
c. C > D > B > A
d. D > C > B > A
e. A > B > C > D

71. Which of the following statements is false about the reaction of butanal with lithium aluminium hydride?



a. The reaction requires aqueous workup.
b. The reaction is a reduction.
c. Lithium aluminium hydride reacts selectively with aldehydes in the presence of other carbonyls.
d. The reaction should be done in an aprotic environment.
e. Lithium aluminium hydride acts as a nucleophile.

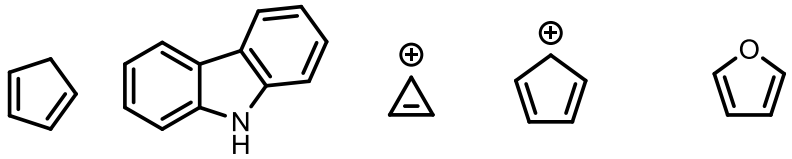
72. Examining the proton(s) attached to carbon 1 in question 71, what would you expect from the starting material to the product in the ^{1}H NMR?

a. There would be no change in the multiplicity, as both signals would be singlets.
b. The chemical shift would be shifted downfield.
c. The chemical shift would be shifted upfield.
d. The peak integration would remain the same.
e. The peak integration would decrease.

73. How many singlet signals would you expect in the ^{1}H NMR spectrum for 4-isobutyl-2-methylphenol?

a. 1
b. 2
c. 3
d. 4
e. 5

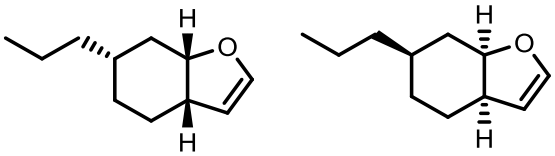
74. Which of the following compounds are aromatic?



(i) (ii) (iii) (iv) (v)

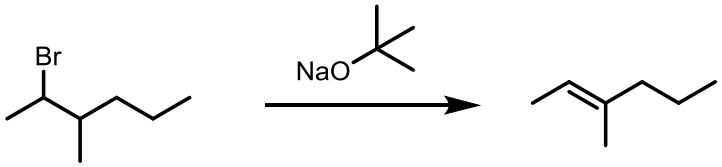
a. i, iv, v
b. ii, iv, v
c. i, ii, iii
d. ii, iii, iv
e. ii, iii, v

75. The following structures represent which of the following?



a. An achiral pair
b. Enantiomers
c. Diastereomers
d. A racemic mixture
e. Meso compounds

76. The mechanism of the following reaction is best described as...

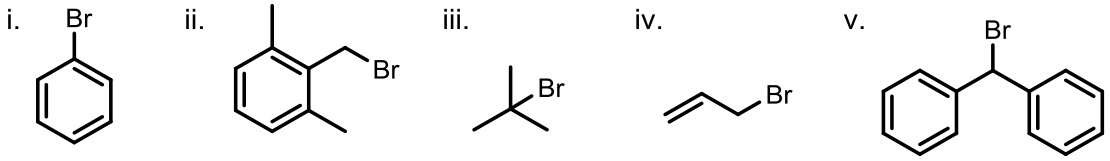


a. S_N1 b. S_N2 c. E1 d. E2 e. radical

77. Which of the following is true for the reaction in 76?

a. The reaction involves a carbocation intermediate.
b. The reaction requires an anti-periplanar configuration.
c. The reaction does not follow Zaitsev's rule.
d. The reaction involves a radical intermediate.
e. Two of the above statements are true.

78. Which of the following substrates will give the fastest S_N2 reaction?

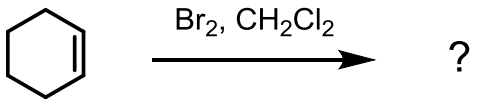


a. i b. ii c. iii d. iv e. v

79. What reagent(s) could be used to convert (Z)-4-methyloct-4-ene to 4-methyloctan-4-ol in good yield?

a. H_2O, H_2SO_4
b. H_2, Pd/C
c. 1) $Hg(OAc)_2$, H_2O 2) $NaBH_4$
d. 1) OsO_4 2) $NaHSO_3$
e. 1) BH_3, THF 2) H_2O_2/NaOH

80. The product of the following reaction can be best described as…



a. 1,2-dibromocyclohexane
b. 1,2-dichlorocyclohexane
c. 1,2-dibromocyclohex-1-ene
d. 1-bromocyclohex-1-ene
e. 3-bromocyclohex-1-ene