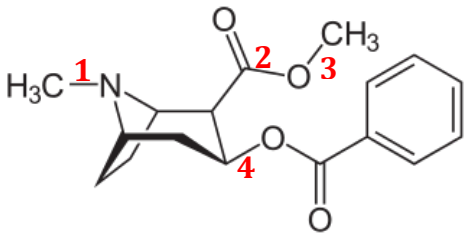
# Problem Set #4 January 2021

Questions 61 – 66 refer to the structure of cocaine shown below




61. How many chiral centres (stereocentres) are there in the compound?
    a. 2
    b. 3
    c. 4
    d. 5
    e. 6

62. How many $sp^2$-hybridized carbon atoms are in the molecule?
    a. 4
    b. 6
    c. 8
    d. 9
    e. 10

63. Which of the following functional groups are in the molecule?
    a. Carboxylic acid
    b. Amine
    c. Amide
    d. Only 2 of the above
    e. All of the above

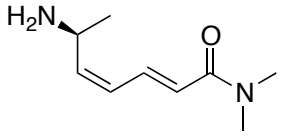
64. How many degrees of unsaturation does the molecule have?
    a. 2
    b. 4
    c. 6
    d. 7
    e. 8

65. Would you expect to find an infrared absorbance band at around 1730 $cm^{-1}$ for cocaine? What functional group does a band at 1730 $cm^{-1}$ correspond to?
    a. No; primary amine.
    b. No; alkyl halide.
    c. Yes; alcohol.
    d. Yes; ester.
    e. Yes; aromatic ring.

66. When cocaine is treated with aqueous acid, which of the bonds numbered above is most likely to break?

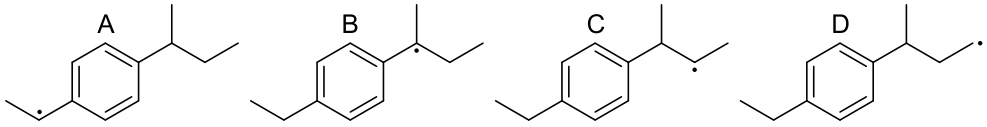
a. 1
b. 2
c. 3
d. 4
e. None of them will break.

67. Which of the following is the correct IUPAC name for this compound?



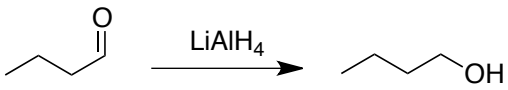

a. (*S*,6*E*,4*Z*)-2-amino-*N*,*N*-dimethylhepta-4,6-dienamide
b. (*R*,2*Z*,4*E*)-6-amino-*N*,*N*-dimethylhepta-2,4-dienamide
c. (*R*,2*E*,4*Z*)-6-amino-*N*,*N*-dimethylhepta-2,4-dienamide
d. (*S*,6*Z*,4*E*)-2-amino-*N*,*N*-dimethylhepta-4,6-dienamide
e. (*S*,2*E*,4*Z*)-6-amino-*N*,*N*-dimethylhepta-2,4-dienamide

68. Rank the following radicals in order of INCREASING stability.




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

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

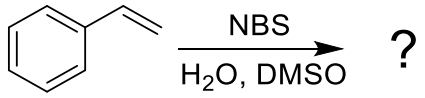


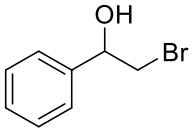

a. The reaction requires aqueous workup.
b. The reaction is a reduction.
c. Lithium aluminium hydride reacts selectively with aldehydes.
d. The reaction should be done in an aprotic environment.
e. Lithium aluminium hydride acts as a nucleophile.

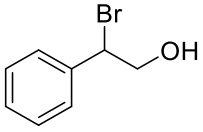
70. Examining the proton(s) attached to carbon 1 in question 69, what change would you expect from the starting material to the product in the $^1$H NMR?

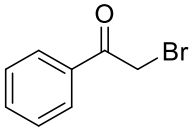
a. The peak integration would decrease.
b. The chemical shift would be shifted downfield.
c. The chemical shift would be shifted upfield.
d. The peak integration would remain the same.
e. Two of the above statements are true.

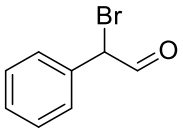
71. Which of the following compounds represents the major product of this reaction?

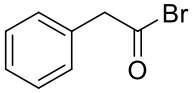



a. 

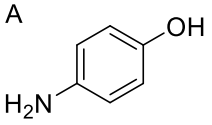

b. 

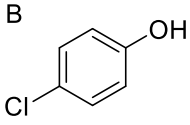

c. 

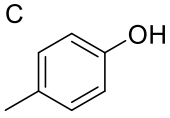

d. 

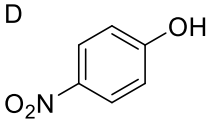

e. 


72. Rank the following substituted phenols from most to least acidic.

A 

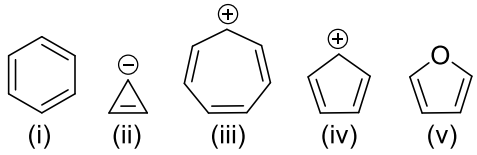

B 


C 


D 

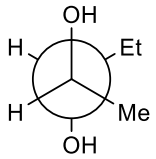

a. A > B > C > D
b. B > D > C > A
c. B > C > D > A
d. D > B > C > A
e. D > A > C > B

73. Which of the following compounds are aromatic?



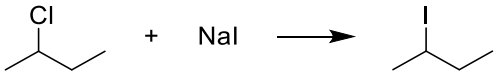

a. (i), (ii), and (iii) only
b. (i), (iii), and (v) only
c. (i) and (v) only
d. (i), (ii), and (iv) only
e. (i) and (iii) only

74. Which description best fits the following structure?




a. An achiral molecule.
b. A single enantiomer.
c. A single diastereomer.
d. A racemic mixture.
e. A meso compound.

75. Which mechanism best describes the following reaction?

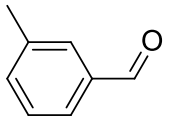



a. $S_N1$
b. $S_N2$
c. E1cB
d. E1
e. None of the above.

76. Which of the following is true for the reaction in 75?

a. The reaction involves a carbocation intermediate.
b. The reaction involves retention of stereochemistry.
c. The reaction involves an inversion of stereochemistry.
d. The reaction involves a radical intermediate.
e. Two of the above statements are true.

77. How many resonance structures can be drawn for 3-methylbenzaldehyde, shown below?




a. 0
b. 1
c. 2
d. 3
e. 4

78. What reagent(s) could be used to convert (*Z*)-4,6-dimethyl-4-nonene into 4,6-dimethyl-4,5-nonandiol 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

79. What product would you expect if (*Z*)-4,6-dimethyl-4-nonene was treated with hydrogen gas and platinum oxide catalyst ($PtO_2$)?

a. 4,6-dimethylnonane
b. 4,6-dimethylnonan-5-ol
c. 4,6-dimethylnonan-4-ol
d. 4,6-dimethylnonan-5-one
e. 4-hydroxy-4,6-dimethylnonan-5-one

80. How many separate signals would you expect in the $^1H$ NMR for 4-hydroxy-2,2,4-trimethylheptan-3-one?

a. 4
b. 5
c. 6
d. 7
e. 8