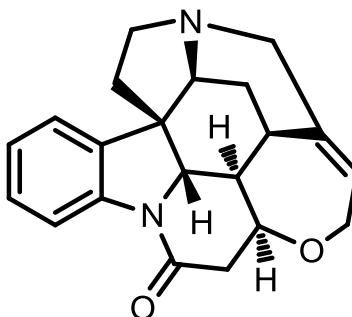


## Problem Set #4, January 2022

Strychnine is an alkaloid isolated from the seeds of the *Strychnos nux-vomica* trees. Due to the ease of its isolation and extremely high potency, strychnine was a widely used rodenticide in the 18th century (a dose as small as 50 mg can be fatal to an adult human!). Questions 61-67 refer to the structure of strychnine:

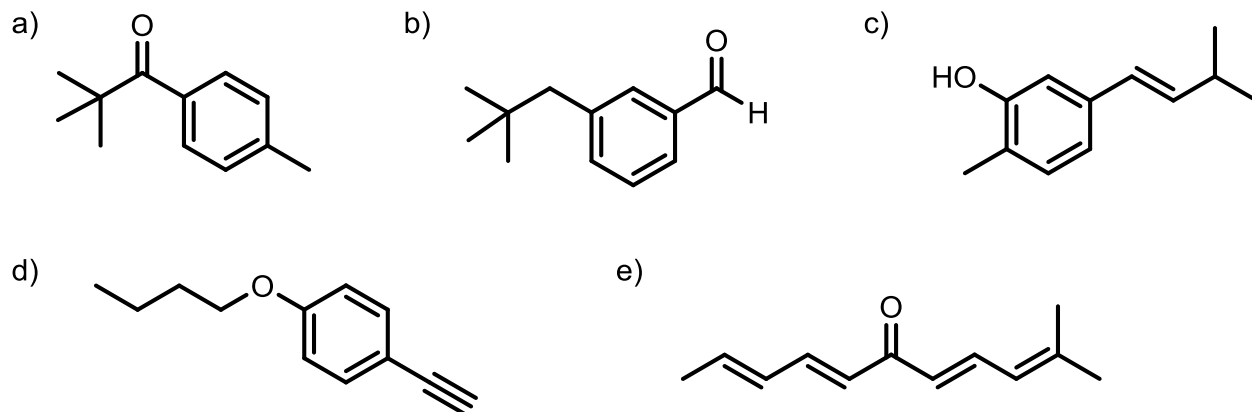


61. How many degrees of unsaturation are in the molecule?
- a) 5                      b) 7                      c) 11                      d) 12                      e) 13
62. How many  $sp^2$ -hybridized carbon atoms are in the molecule?
- a) 6                      b) 7                      c) 8                      d) 9                      e) 10
63. Which of the following functional groups are NOT in the molecule?
- a) ether                      b) substituted benzene ring                      c) alkene                      d) lactam                      e) 2° amine
64. How many chiral centres (stereocentres) are in the compound?
- a) 5                      b) 6                      c) 7                      d) 8                      e) 9
65. The enantiomer of naturally occurring strychnine can be described as being:
- a) racemic                      b) a meso compound                      c) a saturated compound                      d) optically inactive                      e) chiral
66. An isomer of strychnine that has the opposite configuration at all stereocentres is called a(n):
- a) identical compound                      b) enantiomer                      c) diastereomer                      d) meso compound  
e) constitutional isomer
67. If strychnine undergoes ozonolysis with 1.  $O_3$ ; 2. Zn/acetic acid, two new functional groups are formed. They are:
- a) an aldehyde and a ketone                      b) a ketone and an alcohol                      c) an aldehyde and an alcohol  
d) an aldehyde and a carboxylic acid                      e) a ketone and a carboxylic acid

68. Hydrogenation of (*E*)-3-methylhexa-1,3-diene on a catalytic surface of Pd/C results in the formation of which product?

- a) 3-methylhexane      b) (*Z*)-3-methylhex-3-ene      c) (*Z*)-3-methylhexa-1,3-diene  
 d) 3-methylhex-1-ene      e) (*E*)-3-methylhex-3-ene

69. Which compound below is NOT a constitutional isomer of 4-methyl-1-phenylpentan-1-one?



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

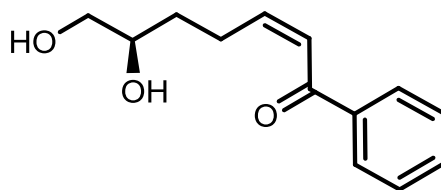


- a) A > B > C > D      b) C > D > B > A      c) D > C > B > A      d) A > C > B > D      e) D > B > C > A

71. In an infrared, a strong and broad band around 3300  $\text{cm}^{-1}$  suggests the presence of which functional group?

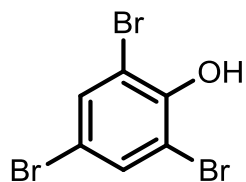
- a) alcohol      b) alkyne      c) carbonyl      d) aromatic ring      e) alkene

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

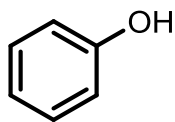


- a) (*S,Z*)-1,2-dihydroxy-7-phenylhept-5-en-7-one  
 b) (*R,Z*)-1,2-dihydroxy-7-phenylhept-5-en-7-one  
 c) (*R,E*)-6,7-dihydroxy-1-phenylhept-2-en-1-one  
 d) (*S,Z*)-6,7-dihydroxy-1-phenylhept-2-en-1-one  
 e) (*R,Z*)-6,7-dihydroxy-1-phenylhept-2-en-1-one

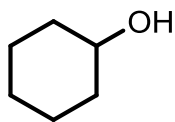
73. Rank the following compounds in order of decreasing acidity (most acidic to least acidic).



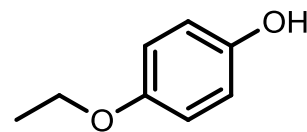
A



B



C



D

- a)  $A > B > D > C$     b)  $C > D > A > B$     c)  $C > D > B > A$     d)  $D > C > B > A$     e)  $A > B > C > D$

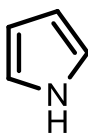
74. How many separate signals would you expect in the  $^1\text{H}$  NMR spectrum for 4-ethyl-3-methoxybenzaldehyde?

- a) 3    b) 4    c) 6    d) 7    e) 12

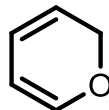
75. Which of the following compounds are aromatic?



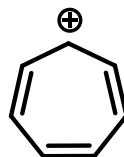
(i)



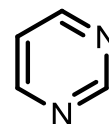
(ii)



(iii)



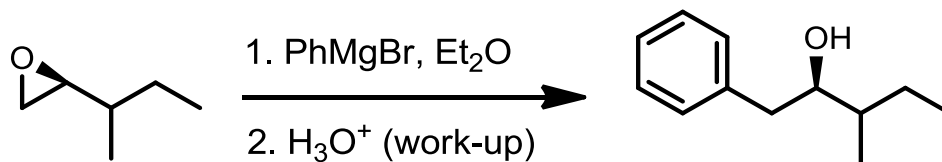
(iv)



(v)

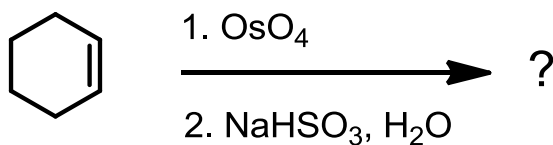
- a) Only ii, iv, v    b) Only ii, v    c) Only i, ii, v    d) Only i, iii, iv    e) All are aromatic

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



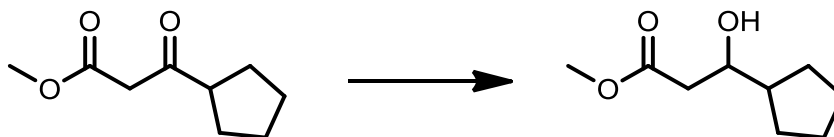
- a)  $\text{S}_{\text{N}}1$     b)  $\text{S}_{\text{N}}2$     c)  $\text{E}1$     d)  $\text{E}2$     e) radical

77. Name the product of the following reaction:



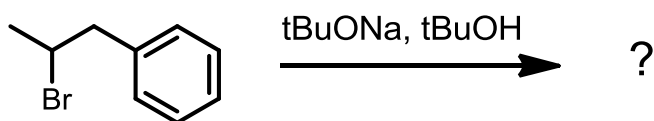
- a) (1S,2S)-cyclohexane-1,2-diol    b) (1R,2R)-cyclohexane-1,2-diol  
c) (1R,2S)-cyclohexane-1,2-diol    d) cyclohexanol    e) cyclohexanone

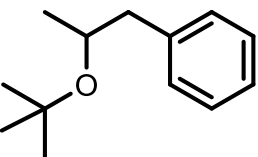
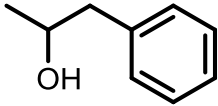
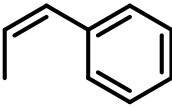
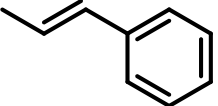
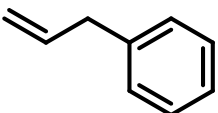
78. Which reagents could be used to complete the following reaction in good yield?



- a) 1.  $\text{LiAlH}_4$ ,  $\text{Et}_2\text{O}$ ; 2.  $\text{H}_3\text{O}^+$       b) 1.  $\text{NaBH}_4$ ,  $\text{EtOH}$ ; 2.  $\text{H}_3\text{O}^+$       c)  $\text{Na}_2\text{Cr}_2\text{O}_7/\text{H}_2\text{SO}_4$   
d)  $\text{CrO}_3$ , pyridine,  $\text{H}_2\text{O}$       e)  $\text{H}_2$ ,  $\text{Pd/C}$

79. Which of the following compounds represents the major product of the reaction below?



- a)       b)       c)   
d)       e) 

80. What reagent(s) could be used to convert 2-methyloct-2-ene into 2-bromo-2-methyloctane in good yield?

- a)  $\text{Br}_2$ ,  $\text{CH}_2\text{Cl}_2$   
b)  $\text{Br}_2$ ,  $\text{H}_2\text{O}$   
c) 1.  $\text{Hg}(\text{OAc})_2$ ,  $\text{H}_2\text{O}$ ; 2.  $\text{NaBH}_4$   
d)  $\text{HBr}$ ,  $\text{Et}_2\text{O}$   
e) 1.  $\text{BH}_3$ ,  $\text{THF}$ ; 2.  $\text{H}_2\text{O}_2/\text{NaOH}$