MINISTRY OF PUBLIC HEALTH
ZAPOROZHYE STATE MEDICAL UNIVERSITY

DEPARTMENT OF ORGANIC AND BIOORGANIC CHEMISTRY

EDUCATIONAL PROBLEMS
OF BIOORGANIC CHEMISTRY

for medical students
specialty 7.110101 "medicine"

1st-year student of ___.group

_____

name

Zaporozhye
2013

GUIDELINES AND LABORATORY PROTOCOLS OF BIOORGANIC CHEMISTRY FOR MEDICAL STUDENTS OF SPECIALTY 7.110101 "MEDICINE"

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EVALUATION CRITERIA OF STUDENT ACADEMIC PROGRESS

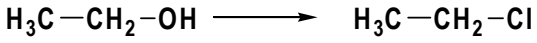
Every lesson student gets mark: "excellent" - 5 points, "good" - 4 points, "satisfactory" - 3 points, "unsatisfactory" - 0 points.

The student is allowed to take the final module control if he scores no less than 42 mark points (14 × 5 = 42) for 14 lessons, which corresponds to 60 rate points.

The final module is counted finished if the student scores no less than 50 rate points.

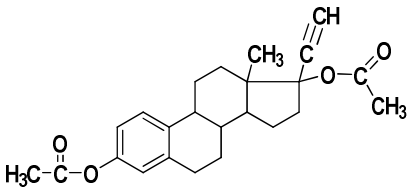
Characteristics	The minimum score	The maximum score
Total score for submodules.	**60**	**110**
Individual student self-work: Preparation the scientific literature review on the selected topic.	**–**	**10**
The score for final module test.	**50**	**80**
TOTAL	**110**	**200**

1. Mark optimal reagent to conduct the next reaction:



A. Cl_2
B. $SOCl_2$
C. HCl
D. KCl
E. CH_3–Cl

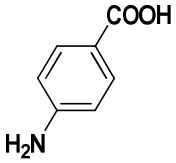
2. ***Ethynyl estradiol diacetate*** — is a synthetic steroid.



Choose reagent, which we can use to find out triple bond in molecule.

A. $FeCl_3$
B. I_2 (KOH)
C. $K_2Cr_2O_7$
D. **[**$Ag(NH_3)_2$]OH
E. Br_2

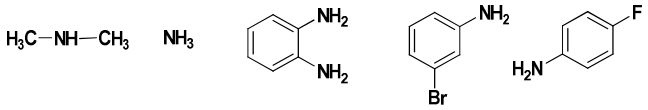
3. ***p-Aminobenzoic acid*** – Carbolic acid, synthon for analgesics:



Mark directing influence of the COOH-group in S_E reactions:

A. activator o-, p-directing
B. deactivator o-, p-directing
C. activator m-directing
D. deactivator m-directing
E. activator o-, m-directing

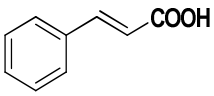
4. Choose the strongest base in the following line of amines:



1 **2** **3** **4** **5**

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

5. ***Cinnamic acid*** – is found in cinnamon oil and balsams such as storax.



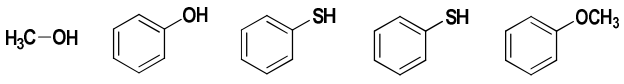
Choose reagents for quality analysis of double bond in molecule.

A. H_2O_2
B. $ZnCl_2$; Cl_2
C. HBr
D. $FeCl_3$; O_3
E. $KMnO_4$

6. Choose more strong acid in following line:

A. ethanoic acid
B. methanoic acid
C. benzoic acid
D. propanoic acid
E. succinic acid

7. Choose a compound with strongest basic properties:



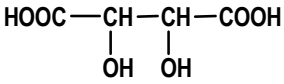
1 **2** **3** **4** **5**

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

8. What types of atoms are present in alkanes with unbranched chain of carbon atoms?

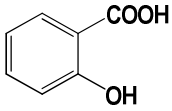
A. Primary
B. Secondary
C. Tertiary
D. Fourtary
E. Primary and secondary

9. How many asymmetric carbon atoms are present in the molecule of tartaric acid:



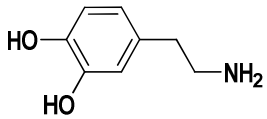
A. 0
B. 1
C. 2
D. 3
E. 4

10. Define the type of electronic effects of hydroxyl in the molecule of ***salicylic acid***:



A. +I
B. +M
C. -I
D. -I; +M
E. -I; -M

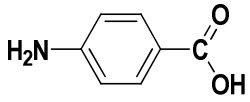
11. ***Dopamine*** **–** is a neurotransmitter and a hormone in the bodies of animals :



Choose reagent, which we can use to find amino group in a molecule

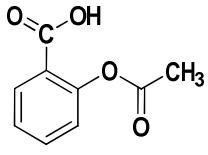
A. HCl; $NaNO_3$
B. Br_2
C. **[**$Ag(NH_3)_2$]OH
D. HCl; $NaNO_2$
E. $H_2N–NH_2$

12. Choose the reagent used to obtain hydrazide of para-aminobenzoic acid



A. $H_2N–NH–C_6H_5$
B. $H_2N–NH_2$
C. $H_2N–CH_3$
D. $H_2N–OH$
E. $H_2N–NH–C(O)–NH_2$

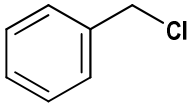
13. Choose an optimal reagent to obtain ***Acetylsalicylic acid***:



A. **(**$COOH)_2$; $CaCO_3$
B. $CH_3COCOOH$
C. **(**$CH_3CO)_2O$
D. CH_3COCH_3
E. CO; CH_3COOH

14. Define the type of electronic effects of halogen

atom in the molecule of ***benzyl chloride***:

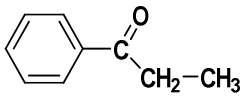


A. -I
B. -I; -M
C. -I; +M
D. +I
E. +I; +M

15. Choose the compound, from which we can synthesize benzene in one step:

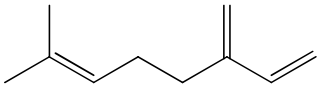
A. acetone
B. methanol
C. acetylene
D. acetaldehyde
E. ethanol

16. Choose the product of the reaction of propiophenon with $H_2N–NH–C(O)–NH_2$



A. Hydrazone
B. Hemiacetal
C. Shiff's base
D. Oxime
E. Semicarbazone

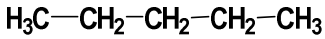
17. Myrcene – is a monoterpene contained in bay leaves.



How many bromine molecules can be added to the following compound?

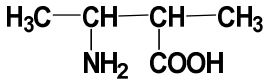
A. 0
B. 1
C. 2
D. 3
E. 4

18. Choose, how many structural isomers can be present for pentane:



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

19. How many chiral centres are present in the following compound?

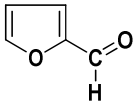


A. 0
B. 1
C. 2
D. 3
E. 4

20. Mark, which of the following amino acids contains imidazole ring:

A. Tryptophane.
B. Histidine.
C. Proline.
D. Oxyproline.
E. Asparagine.

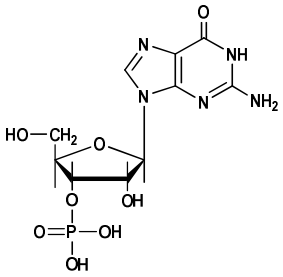
21. ***Furfural*** – is a synthon for furanoic-antiseptics.



Choose the reagent used to obtain semicarbazone of furfural.

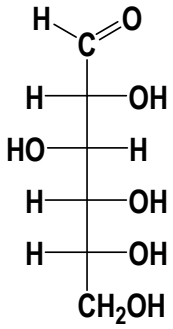
A. $H_2N–NH–C(S)–NH$
B. $H_2N–OH$
C. $H_2N\text{-}C_6H_5$
D. $H_2N–NH–C(O)–NH_2$
E. $H_2N–NH_2$

21. Give correct nomenclature name for the following compound:



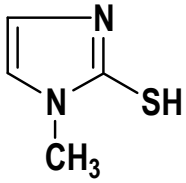
A. Guanosine phosphate.
B. Guanosine-3'-phosphate.
C. Adenosine-2'-phosphate.
D. Cytidine-3'-phosphate.
E. Guanosine –5'-phosphate.

22. How many asymmetric carbon atoms are present in oxo-form of glucose?



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

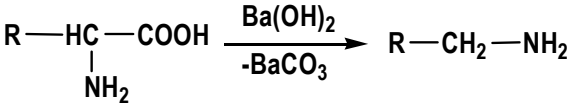
23. ***Mercazolyl*** – is an antihyperthyroid remedy, has present structure:



Choose the most correct systematic name for mercazolyl.

A. 1-Methyl-2-mercaptopyrazole.
B. 1-Methyl-2-mercaptoimidazole.
C. 1-Methyl-2-thiopyrrole.
D. 2-Mercapto-3-methylimidazole.
E. 1-Methyl-2-thiopyrazol.

24. It is known, that boiling α-amino acids with $Ba(OH)_2$ result their decarboxylation and form corresponding amines:



Which of the following amino acids is needed to be added to a reaction to obtain ethylamine ($C_2H_5NH_2$) by this method?

A. Alanine (R = CH_3–).
B. Glycine (R = H–).
C. Phenylalanine (R = C_6H_5–CH_2–).
D. Valine (R = $(CH_3)_2CH$–).
E. Serine (R = HO–CH_2–).

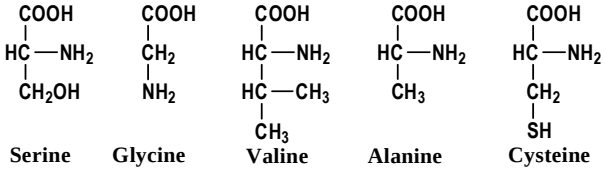
25. Which of the following α-amino acids is essential?

A. Glycine.
B. Alanine.
C. Lysine.
D. Serine.
E. Histidine.

26. Name the compound which is a monomer of a cellulose.

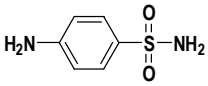
A. Fructose
B. Arabinose
C. Glucose
D. Ribose
E. Galactose

27. In the following line, mark amino acid which has no optical activity:



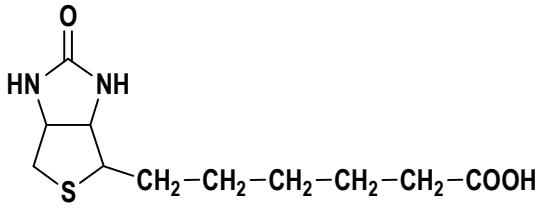
A. Valine.
B. Serine.
C. Cysteine.
D. Glycine.
E. Alanine.

28. Classify antibacterial remedy streptocid:



A. Aromatic amine
B. Carbocyclic amine
C. Aromatic acid
D. Aromatic sulfonic acid
E. Amide of aromatic sulfonic acid

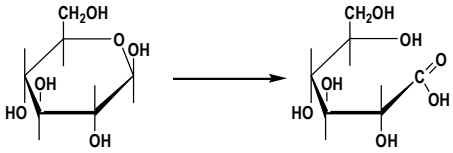
29. ***Biotin (vit H)*** has following structure:



What heterocycles form biotin?

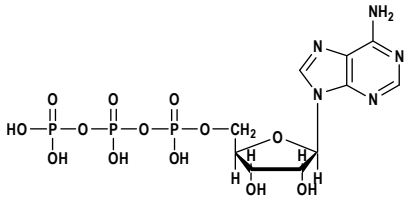
A. Pyrazole and thiophene
B. Hydrated pyrazole and thiophene
C. Hydrated pyrrole and thiazole
D. Imidazole and hydrated thiophene
E. Hydrated imidazole and hydrated thiophene

30. Classify the following reaction:



A. Reduction
B. Recyclization
C. Oxidation
D. Esterification
E. Hydrolysis

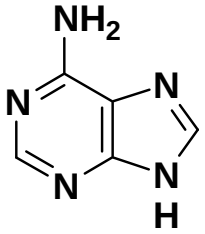
31. ***ATP — is adenosine5'- triphosphoric acid***:



Classify chemical bond between parts of the phosphoric acids in a molecule of ATP.

A. Ester.
B. Ether.
C. Anhydrous.
D. O-Glycoside.
E. Amide.

32. ***Adenine*** (6-aminopurine) — is a nucleonic base, contained in RNA and DNA:



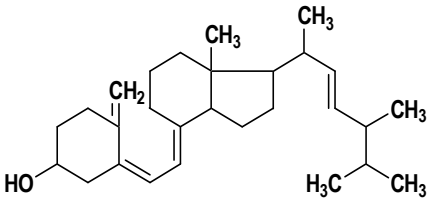
What isomerism is more typical for adenine?

A. Azole tautomerism.
B. Keto-enol tautomerism.
C. Thio-thiol tautomerism.
D. Lactim-lactam tautomerism.
E. Enatiomerism.

33. ***Linoleic acid*** ($C_{17}H_{31}COOH$) is contained in plants oils. How many moles of bromine can be added to one mole of linoleic acid?

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

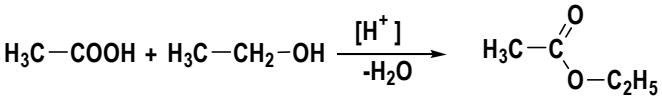
34. ***Vitamin D_2*** (ergocalciferol) manages metabolism of calcium and phosphorous in human organism:



How many atoms of bromine can be added to one molecule of vitamin D_2?

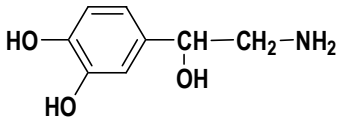
A. 8
B. 6
C. 10
D. 12
E. 14

35. Name the mechanism for esterification reaction.



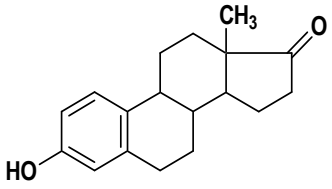
A. S_N1
B. S_R
C. A_E
D. S_N2
E. S_E

36. How many asymmetrical carbon atoms are present in a molecule of epinephrine?



A. 0
B. 1
C. 2
D. 3
E. 4

37. ***Estrone*** — is a woman sex hormone.



Choose a reagent for analytical definition of phenolic hydroxy group in this molecule.

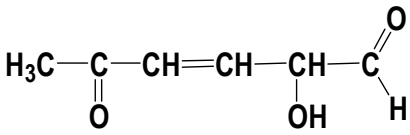
A. $ZnCl_2$
B. $K_2Cr_2O_7$
C. $NaHCO_3$

D. $AgNO_3$
E. $FeCl_3$

38. Give the most principal reason why amylopectin has chained structure:

A. Presence of β-1,4-glycosides bonds
B. Presence of α-1,4-glycosides bonds
C. Presence of α-1,6- glycosides bonds
D. Presence of 1,2- glycosides bonds
E. Presence of ether bonds.

39. Give the most correct nomenclature name (IUPAC) for the following compound:

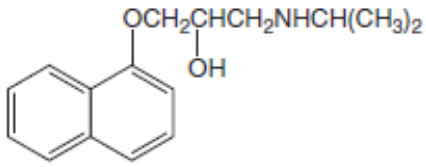


A. 1,5-dioxohexene-3-ol-2
B. 1-oxo–2–hydroxyhexene-3-one-4
C. 2,6-dioxo-5-hydroxyhexene-3
D. 2-oxo-5-hydroxyhexenal
E. 2-hydroxy-5-oxohexene-3-al

40. From the name alone, decide which of the following might be enzymes:

A. sucrose;
B. sucrase;
C. lactose;
D. lactase;
E. phosphofructokinase.

42. Propranolol (trade name: Inderal) is used in the treatment of high blood pressure and heart disease.



propranolol

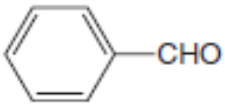
How many enantiomers could propranolol have?

A. 0
B. 1
C. 2
D. 3
E. 4

43. What product is formed when carbonyl compound is treated with $K_2Cr_2O_7$?

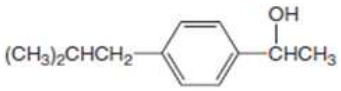
A. alcohol
B. carboxylic acid
C. ketone
D. amine
E. amide

44. What alcohol is formed when the next compound is treated with H_2 and a Pd catalyst?

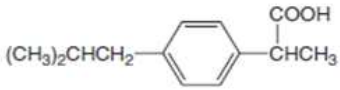


A. benzyl alcohol
B. phenyl alcohol
C. hexyl alcohol
D. heptyl alcohol
E. cyclohexyl alcohol

45. Alcohol A can be converted to the anti-inflammatory agent ibuprofen by:



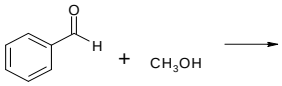
A

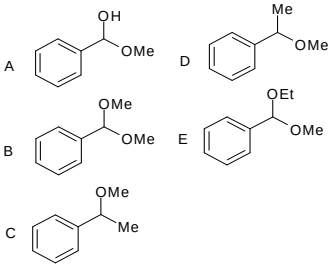


ibuprofen

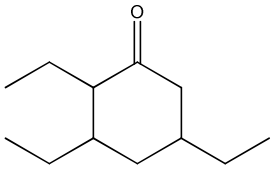
A. reduction
B. oxydation
C. methylation
D. acylation
E. amination

46. Mark the substance formed when carbonyl compound is treated with two equivalents of the given alcohol in the presence of H_2SO_4.



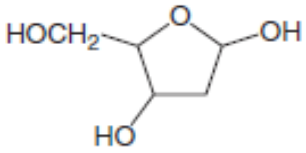


47. Name the substance in accordance with its structure:



A. 3,3-dimethyl-2-hexanone
B. 2,3,5-triethylcyclohexanone
C. methyl propyl ketone
D. m-ethylacetophenone
E. 2,4,5-triethylcyclohexanone

48. 2-Deoxyribose is a building block of DNA, very large organic molecules that store all genetic information.

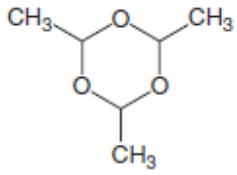


2-deoxyribose

Choose the position of the OH group in 2-deoxyribose that is being part of a hemiacetal.

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

49. Paraldehyde, a hypnotic and sedative once commonly used to treat seizures and induce sleep in some hospitalized patients.

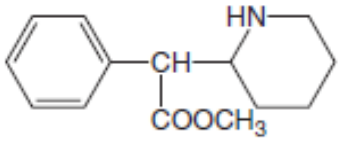


paraldehyde

It is formed from three molecules of :

A. acetaldehyde
B. acetic acid
C. formaldehyde
D. formic acid
E. acetone

50. Ritalin is the trade name for methylphenidate, a drug used to treat attention deficit hyperactivity disorder (ADHD).

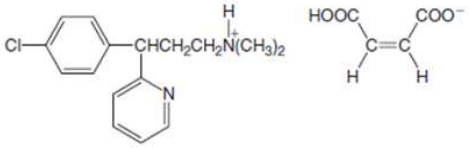


methylphenidate
(Trade name: Ritalin)

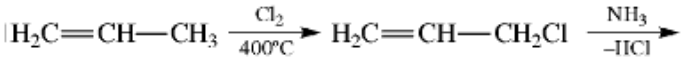
Label the amine as 1°, 2°, or 3°.

A. 2°
B. 1°
C. 3°
D. 4°
E. no amine group

51. The antihistamine in the over-the-counter product Chlortrimeton is chlorpheniramine maleate.



Name the carboxylic acid that is used to form its ammonium salt.



A. maleic
B. phtalic
C. oxalic
D. malic
E. fumaric

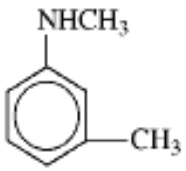
52. Decide just by the name which of the following compounds surely rotate plane polarized light clockwisely

A. Ethanol
B. D-glucose
C. (+)-phenylalanine
D. racemic glutamic acid
E. L-phenylalanine

53. Which of the following compound doesn't give a positive Benedict's test?

A. maltose
B. glucose
C. sucrose
D. lactose
E. galactose

54. Name this amin:



A. dimethylamine
B. methylisopropylamine
C. N-methyl-m-toluidine
D. trimethylanilinium
E. t-butylamine

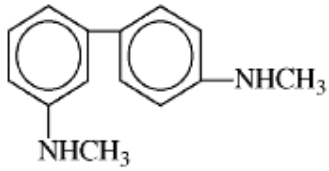
55. Which of the following amins is dymethylamine?

A. CH_3NHCH_3

B. $CH_3NHCH(CH_3)_2$

C.

D.

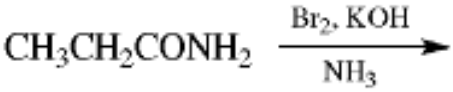


E. $(CH_3)_3CNH_2$

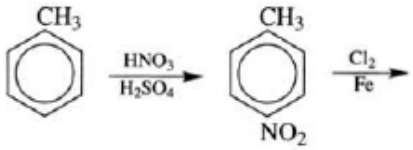
56. Identify the preparation of allylamine?

A. $H_2C{=}CHCH_2NH_2$

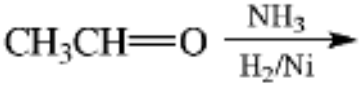
B.



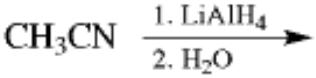
C.



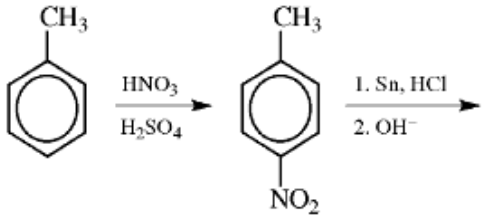
D.



E.

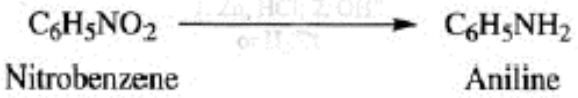


57. What can be prepared this way?



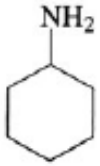
A. m-Nitroaniline
B. m-Dinitrobenzene
A. **C**.o-methylaniline
C. *p*-toluidine
B. **E**.Cyclohexylamine

58.With the help of what substance goes this reaction?



A. 1.Zn, HCl; 2. OH or H_2/Pt
B. NH_4SH
C. $LiAlH_4$
D. H_2NNH_2
E. Na

59. Name this amin utilizing IUPAC nomenclature rules:

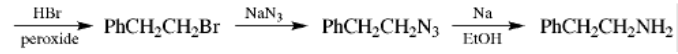


A. cyclohexanamine
B. oxime
C. nitrianiline
D. aniline
E. benzenamine

60. What reaction is Hofmann degradation of amides:

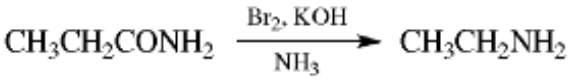
A. $RCONH_2 + Br_2 + 4KOH \rightarrow RNH_2 + K_2CO_3 + 2KBr + 2H_2O$
B. $RCONH_2 + HNO_2 \rightarrow RCOOH + H_2O + N_2$
C. $C_6H_5NH_2 + 3\ H_2 \rightarrow C_6H_{11}NH_2$
D. $2\ C_6H_5NH_2 + CH_2O \rightarrow CH_2(C_6H_4NH_2)_2 + H_2O$
E. R'CONHCOR" + R'"CHO
R'CON(CHR'"OH)COR'

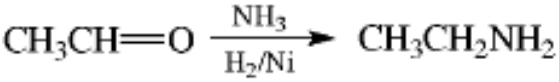
61. From what can be synthesized 2-phenylethanamine?

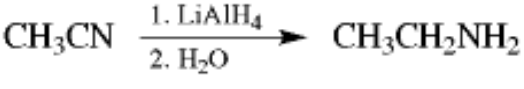


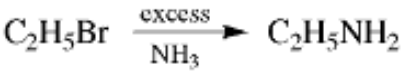
A. **A**.styrene
B. **B**.alkyl isocyanate
C. **C**.N-bromoamide
D. **D**.aniline
E. **E**.propilamine

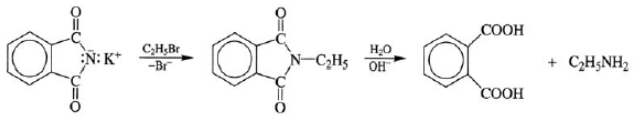
62. Prepare ethylamine by Gabriel synthesis:

A. 

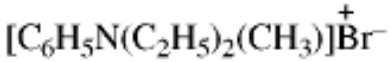
B. 

C. 

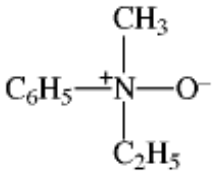
D. 

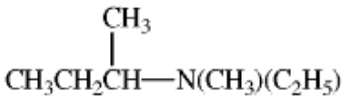
E. 

63. Which of the following compounds are not chiral and not resolvable?

A. 

B. 

C. 

D. 

64. Choose the right statements:

A. In the gas phase, the order of increasing basicity is $NH_3 < CH_3NH_2 < (CH_3)_2NH < (CH_3)_3N$.

A. In water, the order is $NH_3 < CH_3NH_2 = (CH_3)_3N < (CH_3)_2NH$

B. In the gas phase, the order of increasing basicity is $NH_3 < (CH_3)_2NH < (CH_3)_2NH < (CH_3)_3N$.

C. In water, the order is $NH_3 > CH_3NH_2 = (CH_3)_3N > (CH_3)_2NH$

D. In the gas phase, the order of increasing basicity is NH3 $> CH_3NH_2 > (CH_3)_2NH > (CH_3)_3N$.

E. In water, the order is $NH_3 < CH_3NH_2 = (CH_3)_3N < (CH_3)_2NH$

C. In the gas phase, the order of increasing basicity is $NH_3 > CH_3NH_2 > (CH_3)_2NH > (CH_3)_3N$.

F. In water, the order is $NH_3 > CH_3NH_2 = (CH_3)_3N > (CH_3)_2NH$

D. nothing is right

65. Choose the strongest base of the following

A. $CH_3\ddot{N}H^-Na^+$

B. $C_2H_2NH_2$

C. $(i\text{-}C_3H_7)_3N$

D. CH_3CONH_2

66. Choose at least strong base of the following

A. $C_6H_5NH_2$

B. $p\text{-}NO_2C_6H_4NH_2$

C. $m\text{-}NO_2C_6H_4NH_2$

D. $p\text{-}H_3COC_6H_4NH_2$

67. Choose the right order of decreasing basicity:

A. $R\ddot{N}H_2 > R\ddot{N}{=}CHR' > RC{\equiv}N:$

B. $R\ddot{N}H_2 < R\ddot{N}{=}CHR' < RC{\equiv}N:$

C. there is no right answer

68. What is the product of reaction aniline with nitrous acid

$C_6H_5NH_2 \xrightarrow[HCl,\ 5°C]{HONO}$

A. $\ddot{N}{\equiv}\overset{+}{O}:$

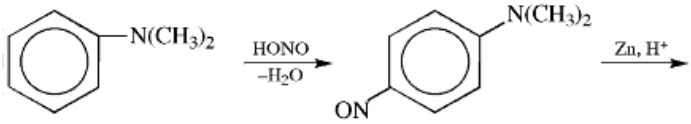
B. CH_3CHCH_3 (Cl)

C. $CH_3CH_2CH_2Cl$

D. $CH_3CH_2CH_2OH$

E. $[C_6H_5{-}\overset{+}{N}{\equiv}N:]Cl^-$

69. What is the product of this reaction?



A. $p\text{-}H_2NC_6H_4N(CH_3)_2$

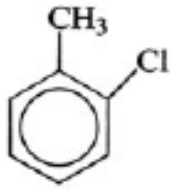
B. $C_6H_5NH_2$

C. $C_6H_5CH{=}O$

D. $(C_3H_7)N(CH_3)_2$

E. $p\text{-}H_2NC_6H_4COOH$

70. Choose the right name of substance



A. *o*-chlorotoluene

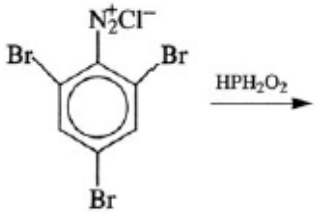
B. *m*-chlorotoluene

C. *p*-chlorotoluene

D. *p*-cyanobenzoic acid

E. *p*-dinitrobenzene

71. What is the product of this reaction?

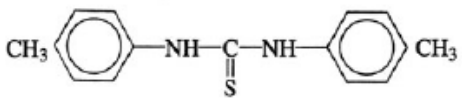


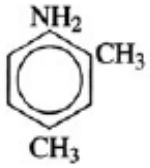
A. 2,4,6-Tribromobenzene
B. 1,3-Dinitrobenzene
C. 1,3,5-Tribromobenzene
D. Aniline
E. Propylaniline

72. Choose the methylethylamine

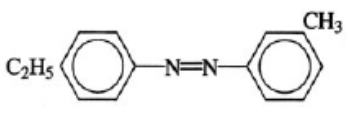
A. $C_6H_5CH_2CH_2NH_2$
B. $CH_3NHCH_2CH_3$
C. $NH_2CH_2CH_2CH(NH_2)CH_3$
D. $NH_2CH_2CH_2OH$
E. $NH_2CH_2CH_2NH_2$

73. Which of the following amines is 4-ethyl-3′-methylazobenzene

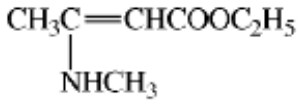
A.


B.


C.

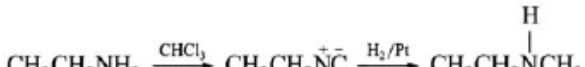

D.


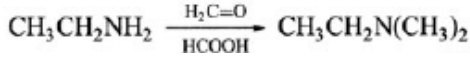
74. Name the next structure

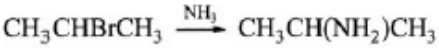


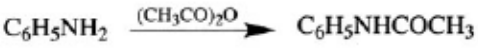
A. 3-(*N*-methylamino)-1-propanol
B. ethyl 3-(*N*-methylamino)-2-butenoate
C. 2-*N*,*N*-dimethylaminobutane
A. D.allylamine

75. Show the steps in the following synthesis: ethylamine ->methylethylamine

A.


B.


C.


D.


76. What sugar is the unit of DNA:

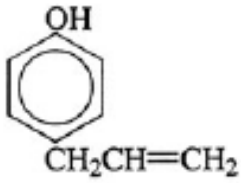
A. *α*,D-ribose
B. *β*,D-ribose
C. *β*,D-2′-deoxyribose
D. *α*,D-2′-deoxyribose
E. *β*,D-3′-deoxyribose

77. Name the following phenol by the IUPAC system:

B. A.hydroxybenzene
C. B.1,4-dihydroxybenzene
D. C.Resorcinol
E. Hydroquinone

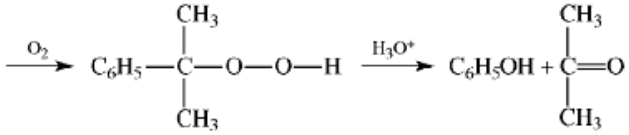
F. Catechol

78. Name the following compound:



A. *p*-methoxyethylbenzene
B. *p*-hydroxyacetanilide
C. *p*-allylphenol
D. sodium acetylsalicylate
A. E.ethoxybenzene

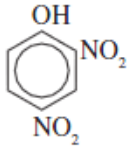
79. What substance is used in this method of preparation?



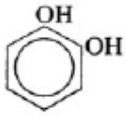
B. A.Chlorobenzene
C. B.Cumene
D. C.Acetone
E. Sodium phenoxide
F. E.Mesitol

80. Choose from the following list catechol:

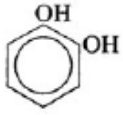
A.



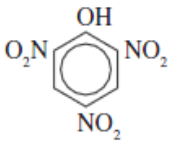
B.



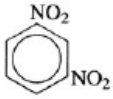
C.



D.



E.



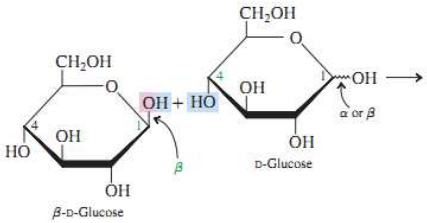
81. Assign numbers from (1) for LEAST to (4) for MOST to indicate the relative acid strengths in the following group: phenol, *m*-cholorophenol, *m*-nitrophenol, *m*-cresol.

A. 2, 3, 4, 1
B. 1, 3, 2, 4
C. 2, 4, 1, 3
D. 1, 2, 4, 3
E. 4, 2, 1, 3

82. What is the oxidizing agent in Tollens solution?

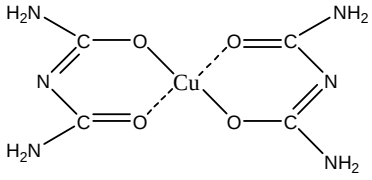
A. Copper sulfate
B. Silver nitrate
C. Copper nitrate
D. Ferric sulfate
E. Silver sulfate

83. What disaccharide is formed by the next reaction?



A. maltose
B. glucose
C. cellobiose
D. fructose
E. sucrose

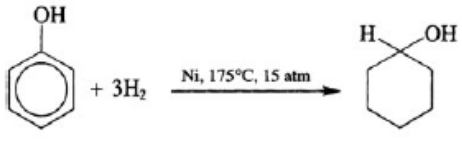
84. What test requires formation of the next complex compound:

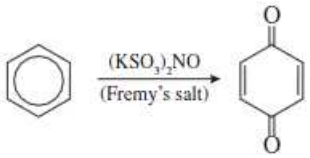


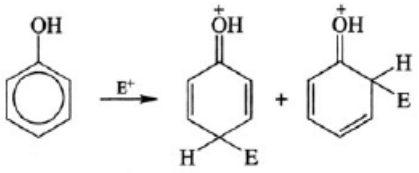
A. Tollens

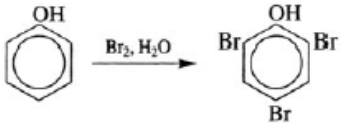
B. Biuret
C. Selivanov
D. Fehling
E. Iodoform

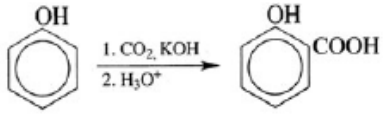
85. Which of the following reactions of the benzene ring is reaction of hydrogenation?

A. 

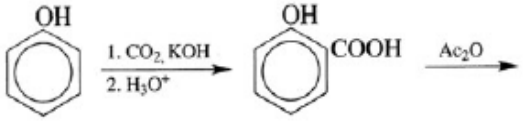
B. 

C. 

D. 

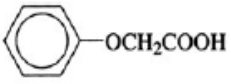
E. 

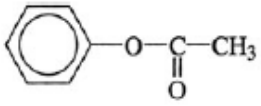
86. What is the product of this reactions?

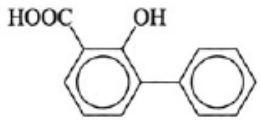


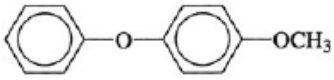
A. aspirin
B. methyl salicylate
C. benzal chloride
D. phenoxyacetic acid
E. phenoxyanisole

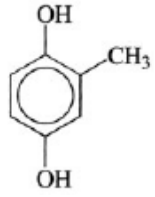
87. Write the structure for phenoxyacetic acid:

A. 

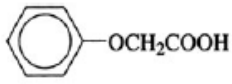
B. 

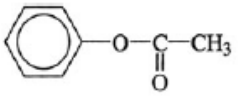
C. 

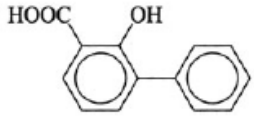
D. 

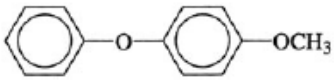
E. 

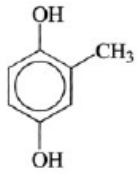
88. Write the structure for phenyl acetate:

A. 

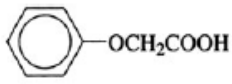
B. 

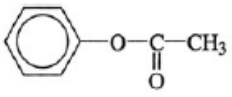
C. 

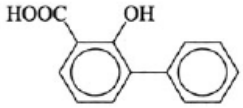
D. 

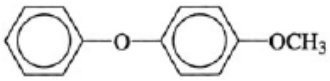
E. 

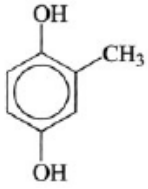
89. Write the structure for 2-hydroxy-3-phenylbenzoic acid:

A. 

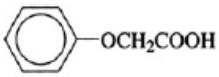
B. 

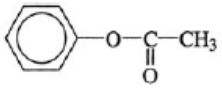
C. 

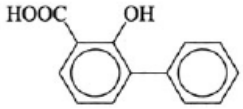
D. 

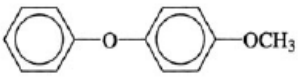
E. 

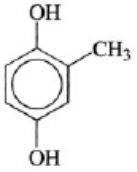
90. Write the structure for *p*-phenoxyanisole:

A. 

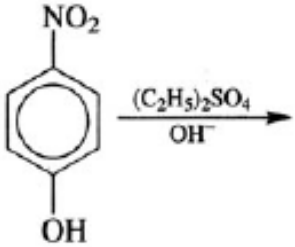
B. 

C. 

D. 

E. 

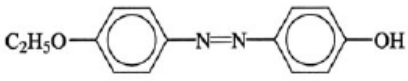
91. What is the product of this reaction?

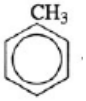


A. p-$C_2H_5OC_6H_4NO_2$

B. p-$C_2H_5OC_6H_4NH_2$

C. p-$C_2H_5OC_6H_4N_2^+Cl^-$

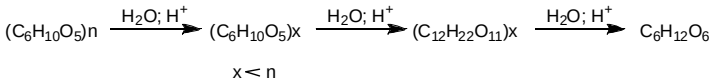
D. 

E. 

92. What polysaccharide contains alternating residues of *N*-acetyl-β-D-glucosamine and D-glucuronic acid?

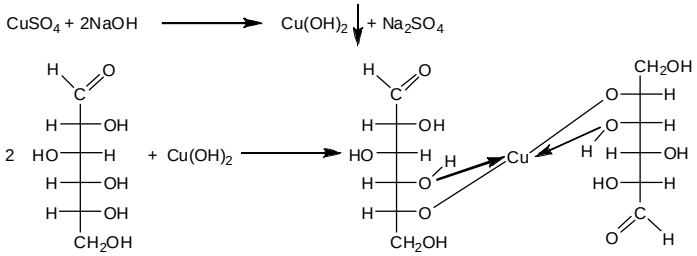
A. chitin
B. hyaluronic acid
C. heparin
D. cellulose
E. maltose

93. What is the type of this reaction:



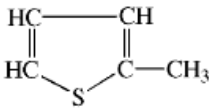
A. oxidation
B. hydrolysis
C. reduction
D. esterification
E. polymerization

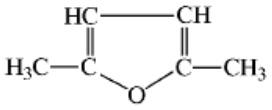
94. What is the color of the next reaction product?

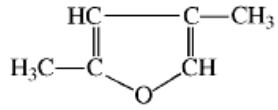


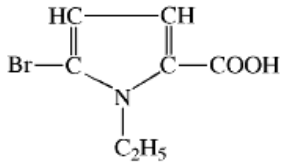
A. red
B. green
C. blue
D. brown
E. black

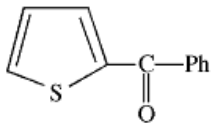
95. Write the structure for 2,4-dimethylfuran:

A. 

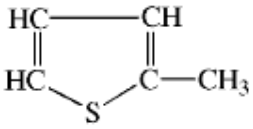
B. 

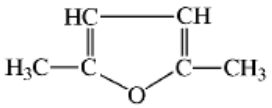
C. 

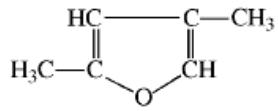
D. 

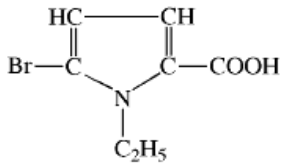
E. 

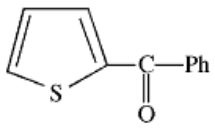
96. Write the structure for 1-ethyl-5-bromo-2-pyrrolecarboxylic acid:

A. 

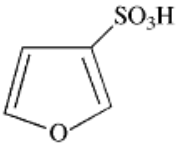
B. 

C. 

D. 

E. 

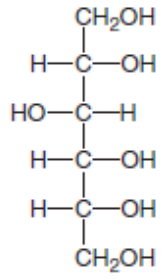
97. Name the following compound

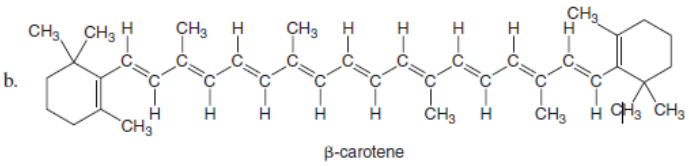


:

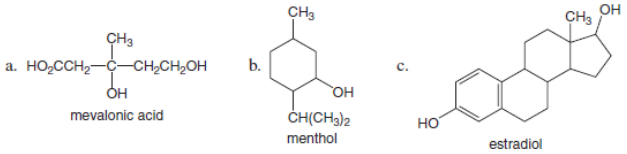
A. 2-benzoylthiophene
B. 3-furansulfonic acid
C. disulfopyrrole
D. 3-benzoylthiophene
E. 2-methylthiophene

98. Which compounds are likely to be lipids? Sorbitol is a sweetener used in sugar-free mints and gum. β-Carotene is the orange pigment in carrots, and the precursor of vitamin A.

a. 

b. 

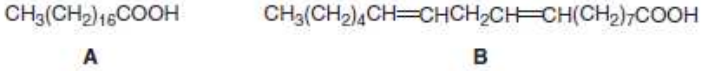
99. Which compounds are likely to be lipids?



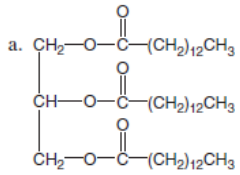
100. In which solvents or solutions will a lipid be soluble:

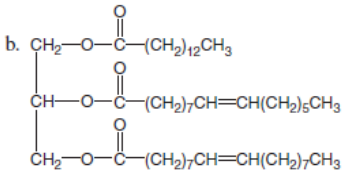
A. CH_2Cl_2;
B. 5% aqueous NaCl solution;
C. $CH_3CH_2CH_2CH_2CH_3$

101. Which fatty acid has the higher melting point, **A** or **B?** Explain your choice.



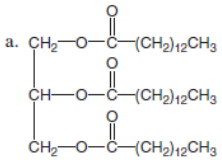
102. What the products formed from hydrolysis of each triacylglycerol?

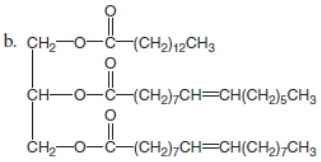




A. Water
B. Alcohol
C. Soap
D. Acid

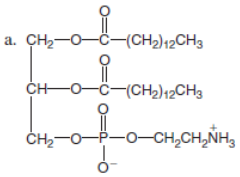
103. Which method you can used if you want to get the soap?

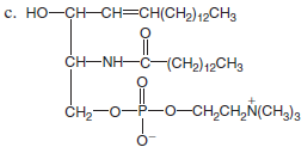


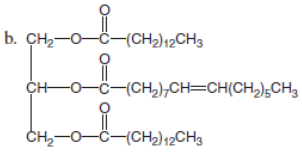


A. basic hydrolysis
B. acid hydrolysis
C. dehydration
E. + Ag

104. What substance is a triacylglycerol, a phosphoacylglycerol, or a sphingomyelin?







105. What is the product of the iodoform reaction (acetone identifying reaction), that is yellowish-white precipitate with a characteristic odor?

A. CH_3I
B. CHI_3
C. $CHCl_3$
D. $CHBr_3$
E. CH_2Cl_2

106. What is the name of the identification test of the uric acid?

A. Tollence
B. Murexide
C. Fehling
D. Benedict
E. Iodiform

107. In which solvents might a wax be soluble:

A. H_2O;
B. CH_2Cl_2;
C. $CH_3CH_2OCH_2CH_3$

108. What is the oxidizing agent in Benedict's solution?

A. Copper sulfate
B. Silver nitrate
C. Copper nitrate
D. Ferric sulfate
E. Silver sulfate

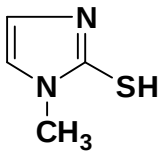
109. Which of the following reactions is classified as a reduction reaction?
A. Alcohol to ketone
B. Alcohol to aldehyde
C. Aldehyde to alcohol
D. Aldehyde to carboxylic acid
E. Alcohol to carboxylic acid

110. In a hemiacetal, the hemiacetal carbon atom is bonded to which of the following?
A. Two hydroxyl groups
B. Two alkoxy groups
C. One hydroxyl group and one alkoxy group
D. Two hydroxyl groups and one alkoxy group
E. Three hydroxyl groups

111. For which of the following molecular combinations is hydrogen bonding possible?

A. Aldehyde–aldehyde
B. Ketone–ketone
C. Aldehyde–ketone
D. Water–ketone
E. Ketone-Aldehyde

112. Merkazolil is an antithyroid drug:



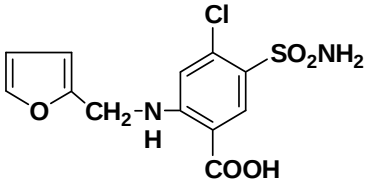
Choose its correct IUPAC name.

A. 1-methyl-2-thiopyrazol
B. 1-methyl-1*H*-imidazol-2-thiol
C. 1-methyl-2-thiopyrrol
D. 2-mercapto-3-methylimidazol
E. 1-methyl-2-thiopyrazol

113. Which of the following are phospholipids:

A. prostaglandins;
B. cephalins;
C. lecithins;
D. steroids

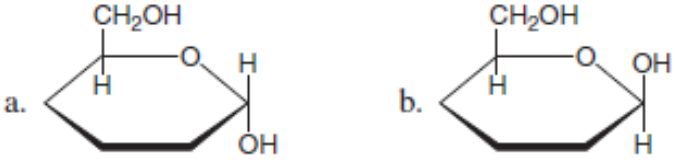
114. Furosemide is a strong diuretic:



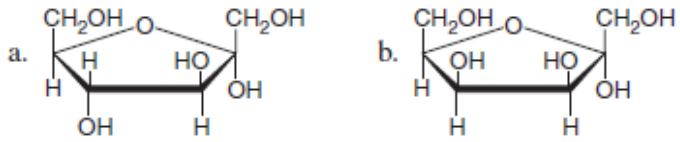
Specify its senior functional group.

A. SO_2NH_2
B. furan ring
C. secondary amino group
D. COOH
E. Cl

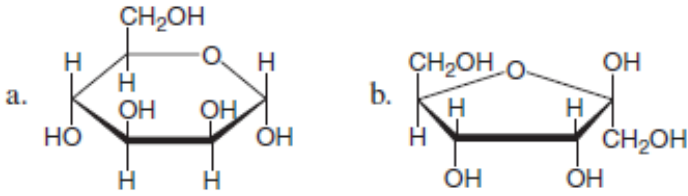
115. What monosaccharide is an α anomer?



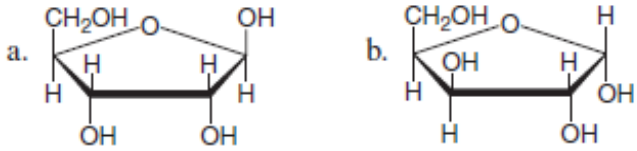
116. What monosaccharide is an β anomer?



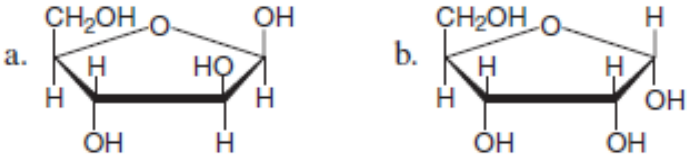
117. What monosaccharide is an α anomer?



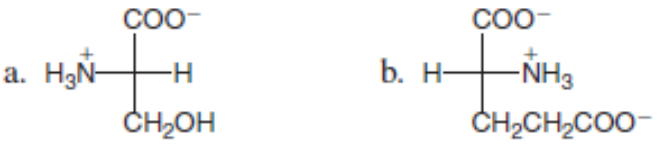
118. What monosaccharide is an α anomer?



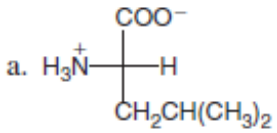
119. What monosaccharide is an β anomer?

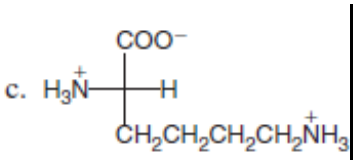


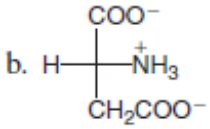
120. Which of the following amino acids is naturally occurring?



121. Which of the following Fischer projections represent naturally occurring amino acids?

a. 

c. 

b. 

122. What amino acid is coded for by GCC codon?

- **A.** glycine
- **B.** isoleucine
- **C.** lysine
- **D.** glutamic acid

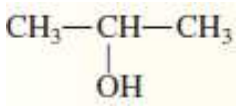
123. What codons code for glycine?

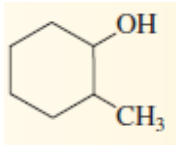
- **A.** GCC
- **B.** AAU
- **C.** CUA
- **D.** AGC
- **E.** CAA
- **F.** GGU

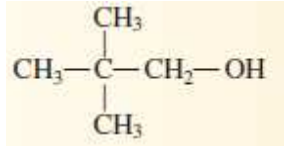
124. In which region of the mitochondrion—the matrix or the intermembrane space—would the pH be lower?

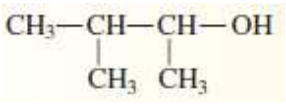
- **A.** the matrix
- **B.** intermembrane space

125. Which of the following alcohols is primary?

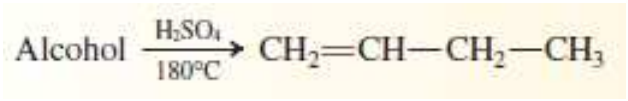
A. 

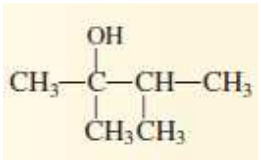
B. 

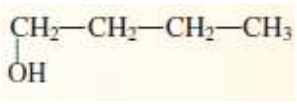
C. 

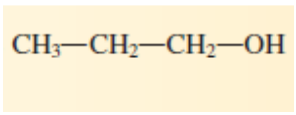
D. 

126. Identify the starting alcohol from which this product was obtained by an alcohol dehydration reaction?

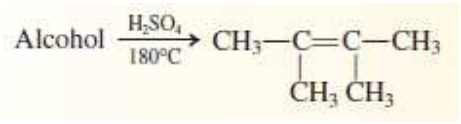


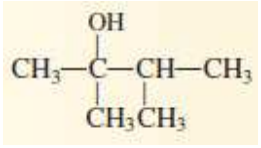
A. 

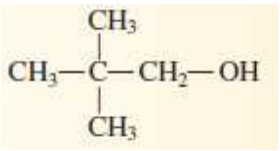
B. 

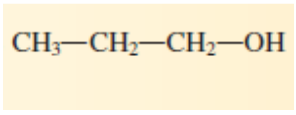
C. 

127. Identify the starting alcohol from which this product was obtained by an alcohol dehydration reaction?

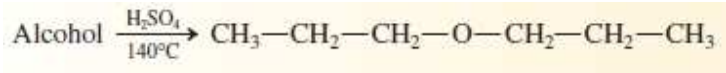


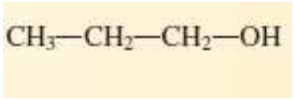
A. 

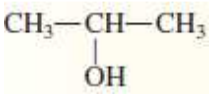
B. 

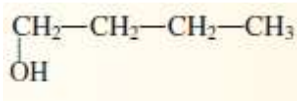
C. 

128. Identify the starting alcohol from which this product was obtained by an alcohol dehydration reaction?

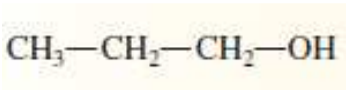


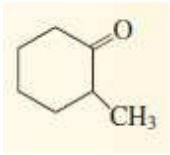
A. 

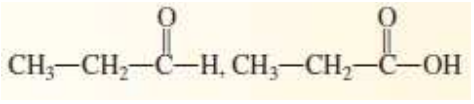
B. 

C. 

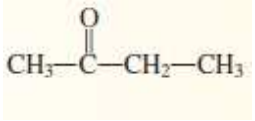
129. Draw the structural formula(s) for the product(s) formed by oxidation of this alcohol with a mild oxidizing agent.



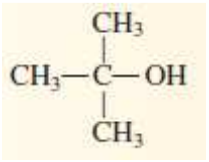
A. 

B. 

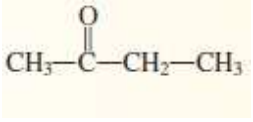
C. No reaction

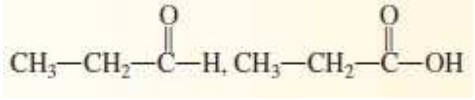
D. 

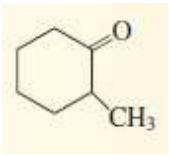
130. Draw the structural formula(s) for the product(s) formed by oxidation of this alcohol with a mild oxidizing agent.



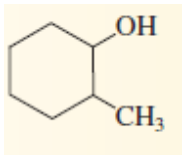
A. No reaction

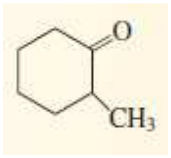
B. 

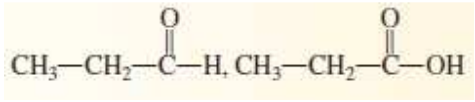
C. 

D. 

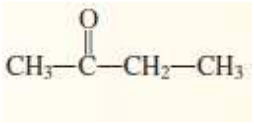
131. Draw the structural formula(s) for the product(s) formed by oxidation of this alcohol with a mild oxidizing agent.



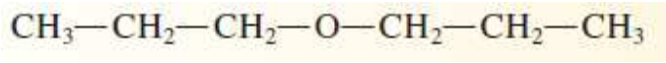
A. 

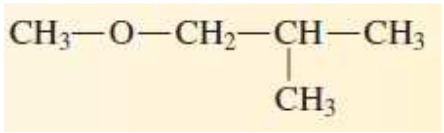
B. 

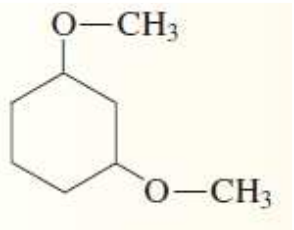
C. No reaction

D. 

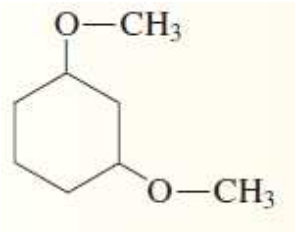
132. Which of the following ethers is 1-propoxypropane ?

A. 

B. 

C. 

133. Name this ether utilizing IUPAC nomenclature rules:



A. 1,3 – Dimethoxycyclohexane
B. 1- Methoxy-2-methylpropane
C. Methoxymethane
D. 1- Propoxypropane

134. Name Dimethyl ether utilizing IUPAC nomenclature rules:

A. Methoxymethane
B. 1- Propoxypropane
C. 1- Methoxy-2-methylpropane
D. 1,3 – Dimethoxycyclohexane

135. Convert this common name for thiol to IUPAC name - Methyl mercaptan

A. Methanethiol
B. 1-Pentanethiol
C. 1-propanethiol
D. 2-Methyl-2-propanethiol

136. What IUPAC name has this common name for thiol - *sec*-Butyl mercaptan ?

A. 2-Butanethiol
B. 1-propanethiol
C. 2-Methyl-2-propanethiol
D. 1-Butanethiol

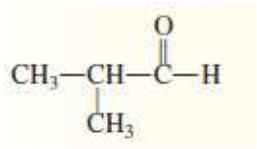
137. Convert IUPAC name to common names for thiol - 2-Methyl-2-propanethiol ?

A. Isobutyl mercaptan
B. *tert*-Butyl mercaptan
C. Pentyl mercaptan
D. *sec*-Butyl mercaptan

138 . Convert IUPAC name to common names for thiol - 1-Pentanethiol ?

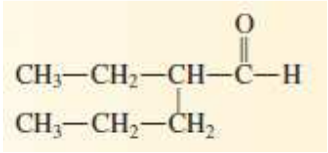
A. Pentyl mercaptan
B. *sec*-Butyl mercaptan
C. *tert*-Butyl mercaptan
D. Isobutyl mercaptan

139. Assign IUPAC names to this aldehyde



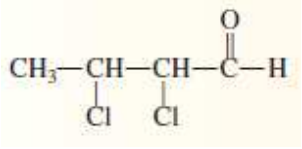
A. 2-Methylpropanal
B. 2,3-Dichlorobutanal
C. 3-hydroxypentanal
D. 3-methylbutanal

140. Assign IUPAC names to this aldehyde



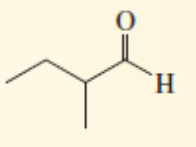
A. 2-Ethylpentanal;
B. 3-hydroxypentanal
C. 3-methylbutanal
D. 2,3-Dichlorobutanal

141. Assign IUPAC names to this aldehyde



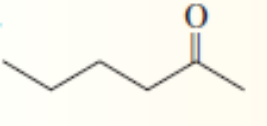
A. 2,3-Dichlorobutanal
B. 2-Methylbutanal
C. 3-hydroxypentanal
D. 3-methylbutanal

142. What IUPAC name has this aldehyde?



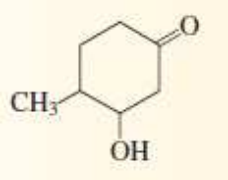
A. 2-Methylbutanal
B. 3-hydroxypentanal
C. 3-methylbutanal
D. 2,3-Dichlorobutanal

143. Assign IUPAC names to this ketone



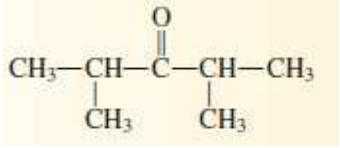
A. 2-Hexanone
B. 2,4-Dimethyl-3-pentanone
C. Cyclobutanone
D. 3-Hydroxy-4-methylcyclohexanone

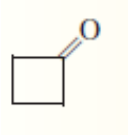
144. Assign IUPAC names to this ketone

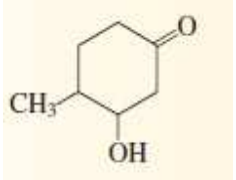


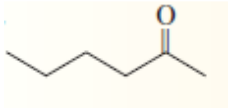
A. 3-Hydroxy-4-methylcyclohexanone
B. 2,4-Dimethyl-3-pentanone
C. 3-bromocyclopentanone
D. 2-methylcyclohexanone

145. What keton has this IUPAC name - <u>2,4-Dimethyl-3-pentanone</u>?

A.


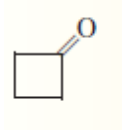
B.


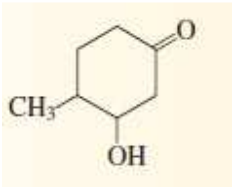
C.


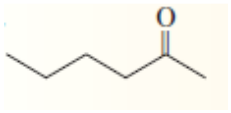


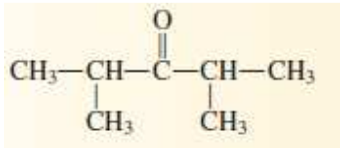
D.

146. What keton has this IUPAC name - <u>Cyclobutanone</u>?

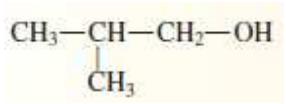
A.


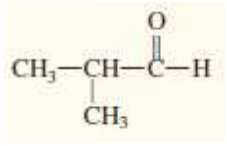
B.


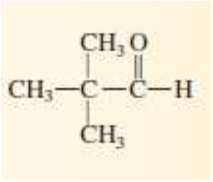
C.


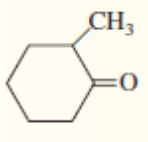
D.


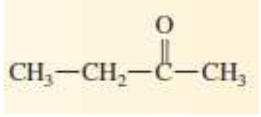
147. Draw the structure of the aldehyde or ketone formed from the oxidation of this
Alcohol



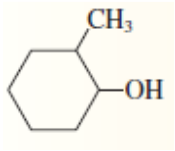
A.


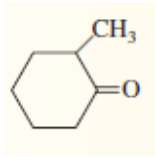
B.


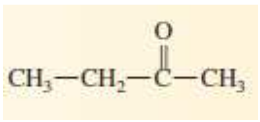
C.


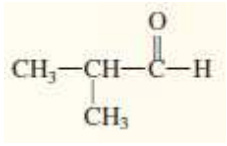
D.


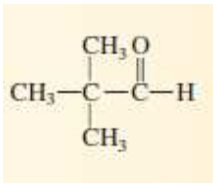
148. Draw the structure of the aldehyde or ketone formed from the oxidation of this Alcohol



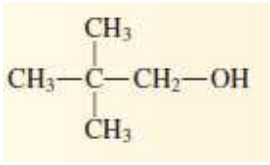
A. 

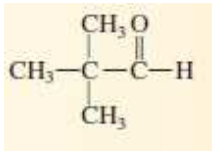
B. 

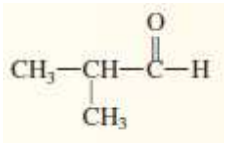
C. 

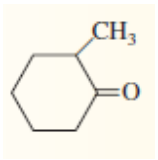
D. 

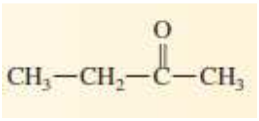
149. Draw the structure of the aldehyde or ketone formed from the oxidation of this Alcohol



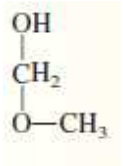
A. 

B. 

C. 

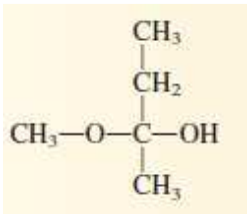
D. 

150. Indicate is this compound a hemiacetal?



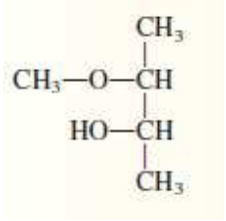
A. Yes
B. NO

151. Indicate is this compound a hemiacetal?



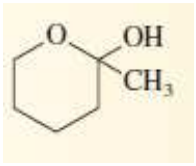
A. Yes
B. No

152. Indicate is this compound a hemiacetal?



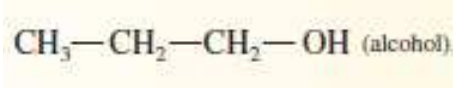
A. Yes
B. No

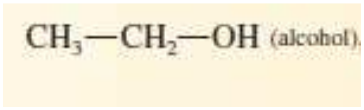
153. Indicate is this compound a hemiacetal?

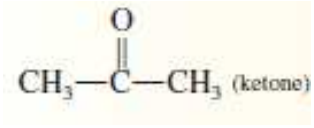


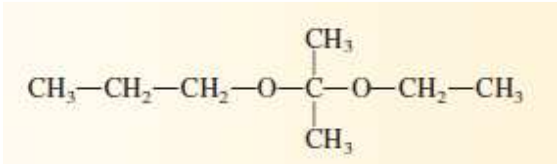
A. Yes
B. No

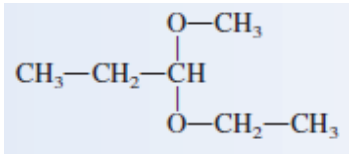
154. What acetal undergoes hydrolysis in acidic solution producing this ketone and two alcohols?

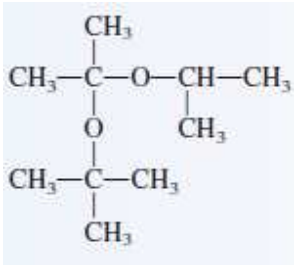




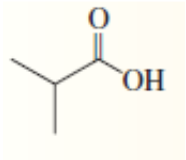


A. 

B. 

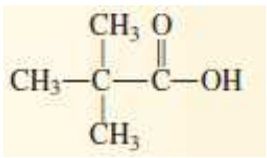
C. 

155. Assign IUPAC name to this carboxylic acid



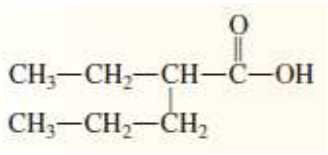
A. 2-Methylpropanoic acid
B. Butanoic acid
C. propanoic acid
D. 2,2-Dimethylpropanoic acid

156. Assign IUPAC name to this carboxylic acid



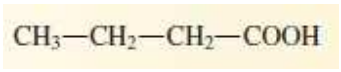
A. 2,2-Dimethylpropanoic acid
B. propanoic acid
C. 2-Methylpropanoic acid
D. Butanoic acid

157. Assign IUPAC name to this carboxylic acid



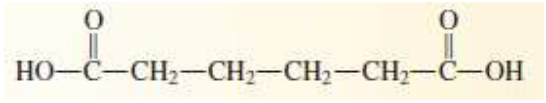
A. 2-Ethylpentanoic acid
B. 2,2-Dimethylpropanoic acid;
C. 2-Methylpropanoic acid;
D. propanoic acid

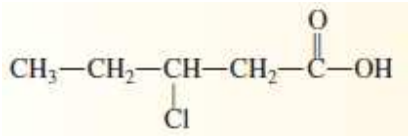
158. Assign IUPAC name to this carboxylic acid

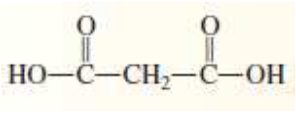


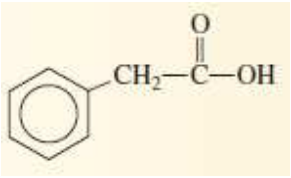
A. Butanoic acid
B. propanoic acid
C. 2,2-Dimethylpropanoic acid;
D. 2-Methylpropanoic acid;

159. What structural formula has Adipic acid?

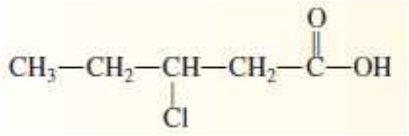
A. 

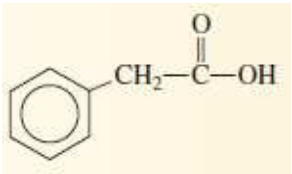
B. 

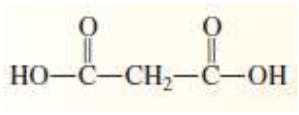
C. 

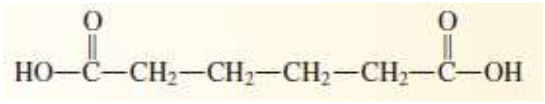
D. 

160. What structural formula has Chlorovaleric acid?

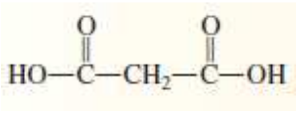
A. 

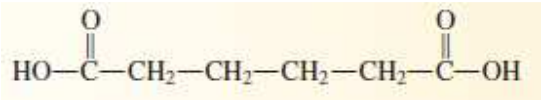
B. 

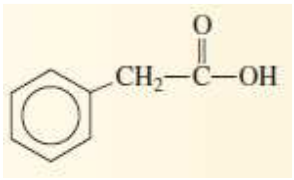
C. 

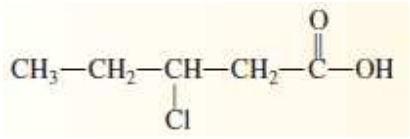
D. 

161. What structural formula has Malonic acid?

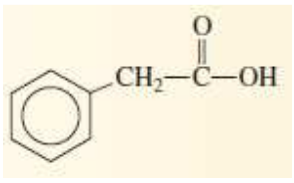
A. 

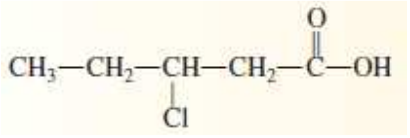
B. 

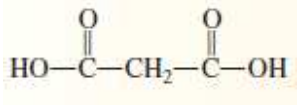
C. 

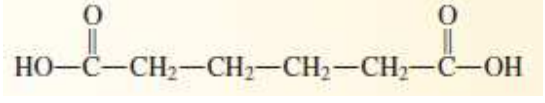
D. 

162. What structural formula has Phenylacetic acid?

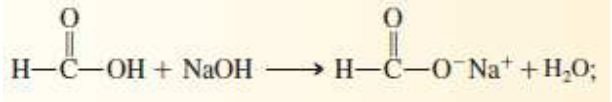
A. 

B. 

C. 

D. 

163. What carboxylic salt formed by this acid-base neutralization reaction?



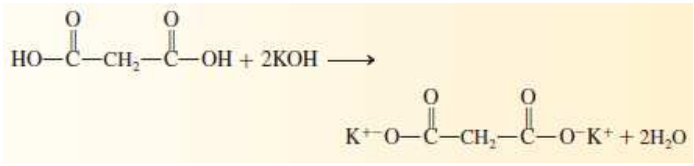
A. Sodium formate

B. Potassium malonate

C. Sodium propionate

D. Potassium oxalate

164. What carboxylic salt formed by this acid-base neutralization reaction?



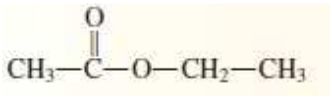
A. Potassium malonate

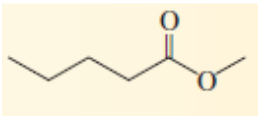
B. Sodium propionate

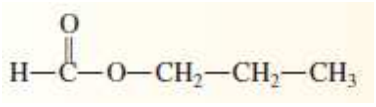
C. Potassium oxalate

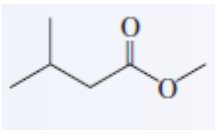
D. Sodium formate

165. What ester has this IUPAC and common names - Ethyl ethanoate, ethyl acetate ?

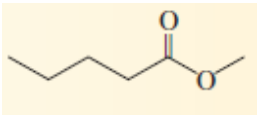
A. 

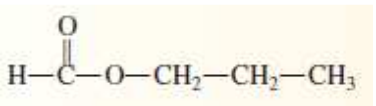
B. 

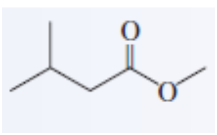
C. 

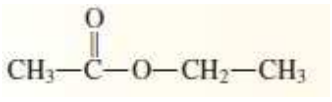
D. 

166. What ester has this IUPAC and common names - Methyl pentanoate, methyl valerate ?

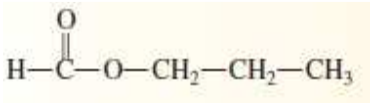
A. 

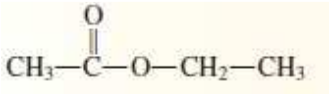
B. 

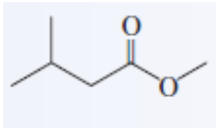
C. 

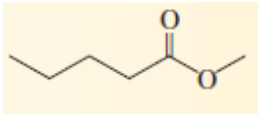
D. 

167. What ester has this IUPAC and common names - Propyl methanoate, propyl formate ?

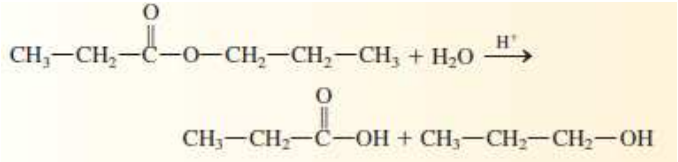
A. 

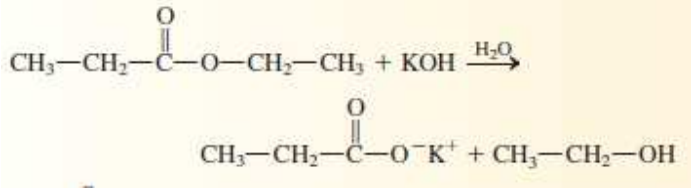
B. 

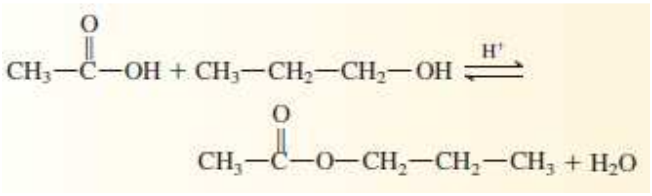
C. 

D. 

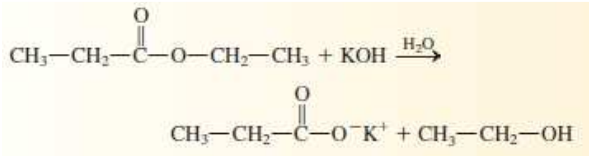
168. What structural equation describes this reaction - Hydrolysis, with an acidic catalyst, of propyl propanoate

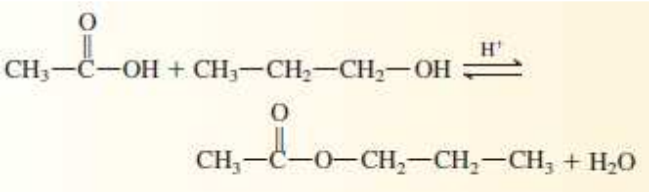
A. 

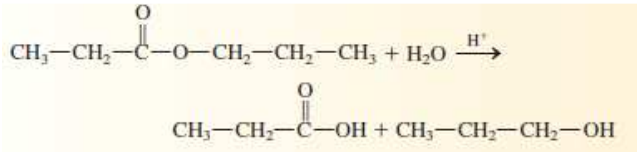
B. 

C. 

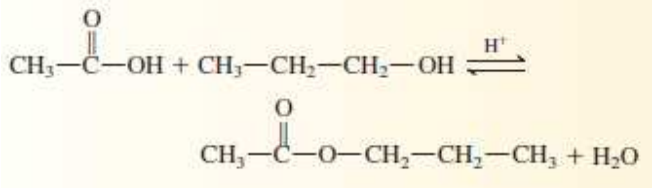
169. What structural equation describes this reaction - Saponification, with KOH, of ethyl propanoate

A. 

B. 

C. 

170. What reaction describes this structural equation



A. Esterification of acetic acid with propyl alcohol
B. Hydrolysis, with an acidic catalyst, of propyl propanoate
C. Saponification, with KOH, of ethyl propanoate
D. Esterification of propionic acid using isopropyl alcohol

171. Which of the following statements concerning the carboxylicacid functional group is *correct*?

A. It is called a carboxylate group.
B. It can be denoted using the notation —COOH.

C. An oxygen–oxygen single bond is present.
D. A carbon–hydrogen single bond is present.

172. What are the common names for the C1 and C2 monocarboxylicacids, respectively?

A. Formic acid and acetic acid
B. Acetic acid and formic acid
C. Oxalic acid and acetic acid
D. Acetic acid and oxalic acid

173. In which of the following pairs of carboxylic acids does the first member of the pair have more carbon atoms than the second member of the pair?

A. Malonic acid and succinic acid
B. Glutaric acid and succinic acid
C. Oxalic acid and malonic acid
D. Oxalic acid and glutaric acid

174. Which statement is true for the carboxyl carbon atom in the IUPAC nomenclature system for monocarboxylic acids?

A. It is always assigned the number one.
B. It is always assigned the highest number possible.
C. It is always known as the alpha carbon atom.
D. It is always known as the beta carbon atom.

175. Which of the following is a C3 monohydroxy carboxylic acid?

A. Tartaric acid
B. Lactic acid
C. Citric acid
D. Pyruvic acid

176. An ester is a carboxylic acid derivative in which the —OH portion of the carboxyl group has been replaced with which of the following?

A. —OR group
B. —OCl group
C. —Cl atom
D. —ONa group

177. Which of the following esters, upon hydrolysis, produces a two-carbon alcohol as one of the products?

A. Methyl methanoate
B. Propyl ethanoate
C. Methyl propanoate
D. Ethyl methanoate

178. Which of the following is neither a reactant nor a product in an ester saponifi cation reaction?

A. A strong base
B. An alcohol
C. A carboxylic acid
D. A carboxylic acid salt

179. A polyester is a condensation polymer in which the reacting monomers are a dicarboxylic acid and which of the following?

A. Carboxylic acid anhydride
B. Carboxylic acid salt
C. Monoalcohol
D. Dialcohol

180. What is the number of oxygen atoms present in a triester of phosphoric acid?

A. One
B. Two
C. Three
D. Four

181. Which of the following statements concerning aldehydes and ketones is correct?

A. Aldehydes contain a carbonyl group but ketones do not.

B. Ketones contain a carbonyl group but aldehydes do not.
C. Both aldehydes and ketones contain a carbonyl group.
D. Neither aldehydes nor ketones contain a carbonyl group.

182. Which is the IUPAC name for the ketone *ethyl propyl ketone*?

A. 3-Pentanone
B. 4-Pentanone
C. 3-Hexanone
D. 4-Hexanone

183. Which of the following compounds is a constitutional isomer of acetone?

A. Formaldehyde
B. Acetaldehyde
C. Propionaldehyde
D. Butyraldehyde

184. The physical state, at room temperature and pressure, for the simplest aldehyde and the simplest ketone is, respectively, which of the following?

A. Gas and gas
B. Gas and liquid
C. Liquid and gas
D. Liquid and liquid

185. For which of the following molecular combinations is hydrogen bonding possible?

A. Aldehyde–aldehyde
B. Ketone–ketone
C. Aldehyde–ketone
D. Water–ketone

186. A general method for the preparation of ketones is oxidation of which of the following?

A. 1_ alcohols
B. 2_ alcohols
C. 3_ alcohols
D. Aldehydes

187. Which of the following reactions is classifi ed as a reduction reaction?

A. Alcohol to ketone
B. Alcohol to aldehyde
C. Aldehyde to alcohol
D. Aldehyde to carboxylic acid

188. In a hemiacetal, the hemiacetal carbon atom is bonded to which of the following?

A. Two hydroxyl groups
B. Two alkoxy groups
C. One hydroxyl group and one alkoxy group
D. Two hydroxyl groups and one alkoxy group

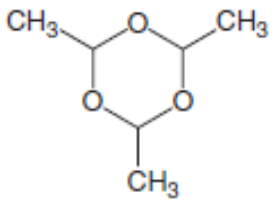
189. To produce an acetal from a ketone, the ketone must react with which of the following?

A. One alcohol molecule
B. Two identical alcohol molecules
C. Two different alcohol molecules
D. Two alcohol molecules, which may or may not be identical

190. What is the number of organic product molecules produced from the complete hydrolysis of an acetal molecule?

A. Two
B. Three
C. Four
D. Five

191. Paraldehyde, a hypnotic and sedative once commonly used to treat seizures and induce sleep in some hospitalized patients.

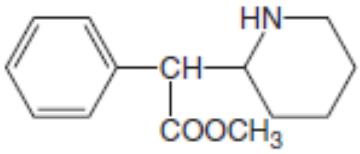


paraldehyde

It is formed from the three molecules of :

A. acetaldehyde
B. acetic acid
C. formaldehyde
D. formic acid
E. acetone

192. Ritalin is the trade name for methylphenidate, a drug used to treat attention deficit hyperactivity disorder.

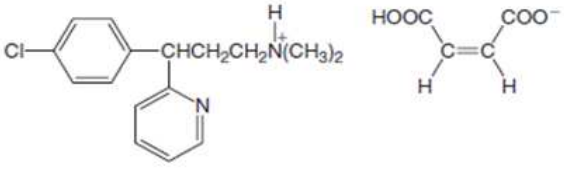


methylphenidate
(Trade name: Ritalin)

Label the amine as 1°, 2°, or 3°.

A. 2°
B. 1°
C. 3°
D. 4°
E. no amine group

193. The antihistamine in the over-the-counter product Chlortrimeton is chlorpheniramine salt.



Name the carboxylic acid that is used to form its ammonium salt.

A. maleic
B. phtalic
C. oxalic
D. malic
E. fumaric

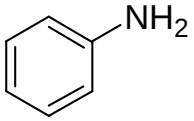
194. Decide just by the name which of the following compounds surely rotate plane polarized light clockwisely

F. Ethanol
G. D-glucose
H. (+)-phenylalanine
I. racemic glutamic acid
J. L-phenylalanine

195. Which of the following compound doesn't give a positive Benedict's test?

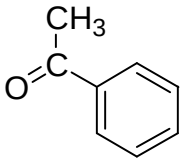
F. maltose
G. glucose
H. sucrose
I. lactose
J. galactose

196. Specify the type and charge of the electronic effects of the nitrogen atom in the molecule of the aniline



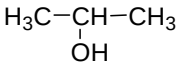
A. -I
B. -I; -M
C. -I; +M
D. +I
E. +I; +M

197. Specify the type and charge of the electronic effects of the oxygen atom of the carbonyl group in the molecule of acetophenone:



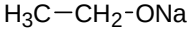
A. -I
B. -I; -M
C. -I; +M
D. +I
E. +I; +M

198. Specify the type and charge of the electronic effect of the oxygen in the molecule of 2-propanol:



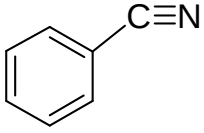
A. -I
B. +I
C. -M
D. +M
E. -I; +M

199. Specify the type and charge of the electronic effect of the oxygen atom in a molecule of sodium ethoxide:



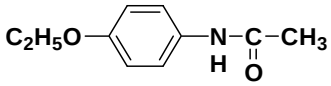
A. -I
B. +I
C. -M
D. +M
E. -I; +M

200. Specify the type and charge of the electronic effect of the nitrogen atom in the molecule of benzonitrile:



A. -I; -M
B. -I
C. -I; +M
D. –M
E. +M

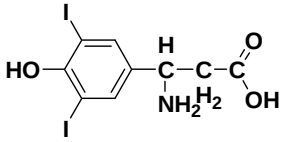
201. Phenacetine is an antipyretic drug.



Determine which class of organic compounds it is referred to?

A. amine
B. amide
C. aldehyde
D. ester
E. ketone

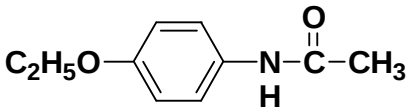
202. Betazine is a synthetic hormone drug:



Specify the senior functional group in the molecule:

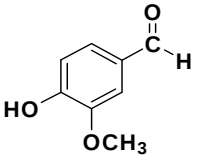
A. –I
B. –OH
C. $–NH_2$
D. –COOH
E. aromatic ring

203. Select the two starting substances for Phenacetin synthesis:



A. *p*-Phenetidin + $(CH_3CO)_2O$
B. Aniline + $(CH_3CO)_2O$
C. *p*-Phenetidin+ C_2H_5OH
D. *p*-Toluidine + $(CH_3CO)_2O$
E. Phenol + CH_3COOH

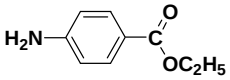
204. Vanilla has a strong smell of aldehyde vanillin:



What is the product of treatment vanillin with $H_2N–NH_2$:

A. the reaction does not go
B. vanillin hydrazine
C. vanillin hydrazone
D. vanillin hydrazide
E. vanillin oxime

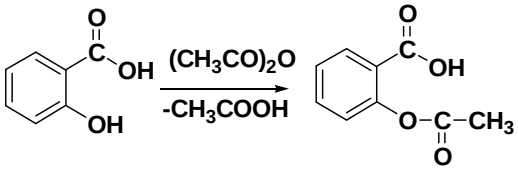
205. Benzocaine is a local anesthetic:



Specify the agent which could qualitatively prove the aromatic amino group in the molecule:

A. $AgNO_3$
B. $NaNO_2$ (HCl)
C. HNO_3 (H_2SO_4)
D. $NaHCO_3$
E. $Cu(OH)_2$

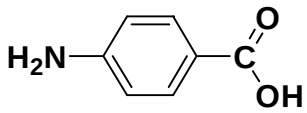
206. Aspirin is generally obtained by acetylating of the salicylic acid:



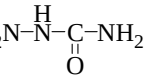
Specify the reagent which could confirm the presence of salicylic acid as an impurity:

A. Br_2
B. NaOH
C. $FeCl_3$
D. $Cu(OH)_2$
E. $Ag(NH_3)_2OH$

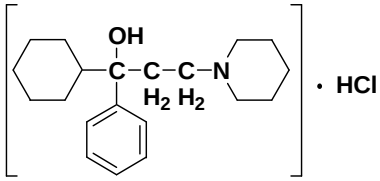
207. PABA (*p*-aminobenzoic acid), is part of the folic acid and paracetamol:



Specify the reagent to get its hydrazide:

A. $H_2N–NH_2$
B. $H_2N–NH–C_6H_5$
C. $H_2N–C_6H_5$
D. $H_2N–OH$
E. 

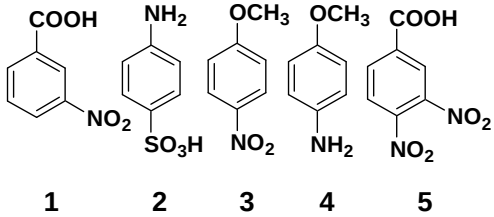
208. Cyclodol is an anticholinergic.



Specify the number of asymmetric carbon atoms in the molecule:

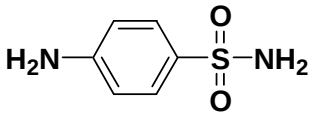
F. 0
G. 1
H. 2
I. 3
J. 4

209. Which of following benzene heterofunctional derivatives is the most active in the S_E:



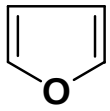
A. 1
B. 2
C. 3
D. 4
E. 5

210. Determine the class of organic compounds of Streptocide:



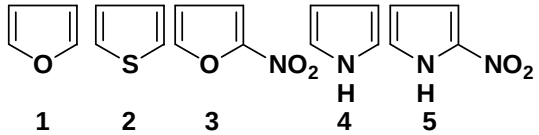
A. aromatic amine
B. carbocyclic amine
C. aromatic acid
D. aromatic sulfonic acid
E. amide of aromatic sulfonic acid

211. Indicate the type and sign of electronic effects of the oxygen atom in the molecule of furan:



A. **-I**
B. +I
C. -M
D. +M
E. -I; +M

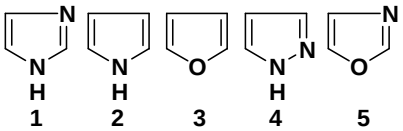
212. There are some five-membered heterocyclic compounds components of the many drugs:



Which of them has the strongest acidic properties.

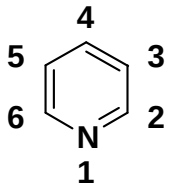
A. 3
B. 5
C. 1
D. 2
E. 4

213. Select the compound with the strongest basic properties among the next compounds:



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

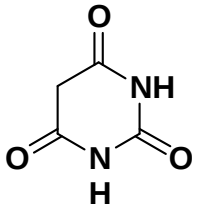
214. Pyridine is a part of many drugs:



Indicate how many monomethyl-substitued pyridines (picolines) could be formed.

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

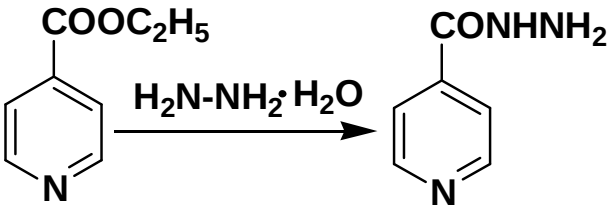
215. Barbituric acid is the basis of many sedatives and anticonvulsants:



Specify the tautomerism which is typical of barbituric acid.

A. lactim-lactam, azole
B. lactim-lactam, keto-enol
C. keto-enol, amine-imine
D. oxo-hydroxy, azole
E. lactamim-lactam, tion-thiol

216. Isoniazid is an antituberculosis drug, is obtained according to the next reaction:



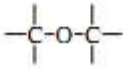
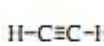
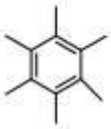
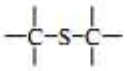
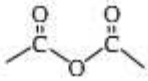
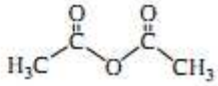
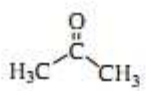
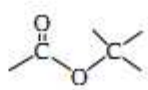
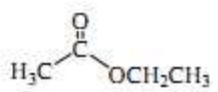
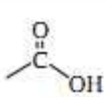
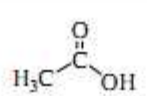
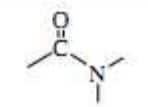
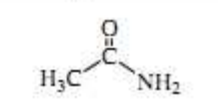
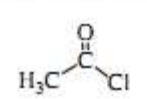
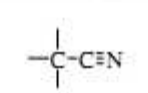
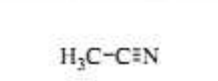
A. S_E
B. S_N1
C. S_R
D. S_N2

Literature

1. Organic Chemistry / J. McMurry. – 8th ed. Brooks/Cole. 2012; 184–200, 237–253, 264–276, 284–287, 296–297, 316–322, 372–397.
2. General, Organic, and Biological Chemistry / J.G. Smith. – 1st ed. 2010; 371-372, 392-398, 402-411, 428-430.
3. Principles of general, organic, and biological chemistry / J.G. Smith. – 1st ed. McGraw-Hill. 2012; 332-336, 340-344, 362-375.
4. Organic Chemistry / W.H. Brown, Ch.S. Foote, B.L. Iverson, E.V. Anslyn. – 5th ed. Brooks/Cole. 2011; 97-99, 204-262, 269-278, 800-873.
5. Organic Chemistry / I. Blei, G. Odian – 2nd ed. W. H. Freeman and Company. 2006; 324-328, 346–355, 357-367.
6. General, Organic, and Biological Chemistry: An Integrated Approach / K.W. Raymond. – 2nd ed. John Wiley & Sons, Inc. 2008; 183–184, 324-326, 322-323.
7. Lectures.

APPENDIX

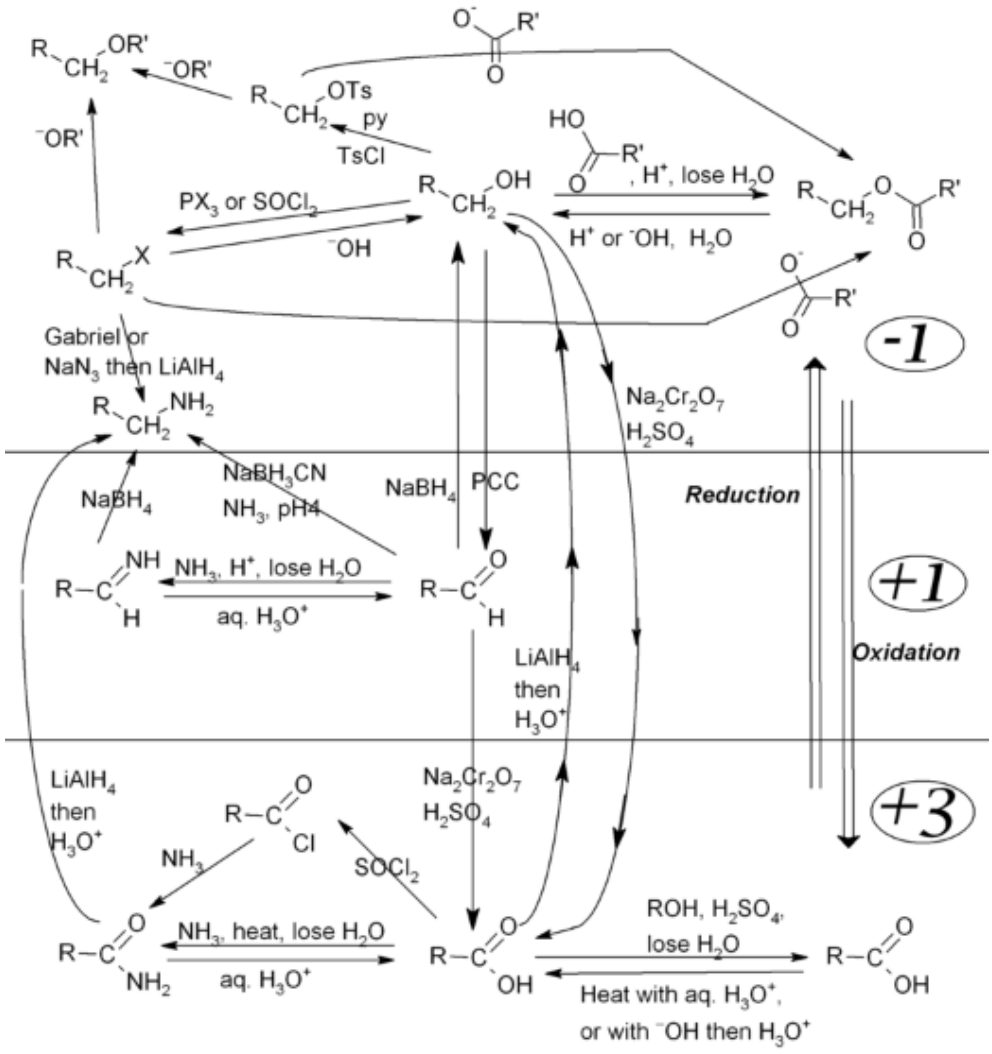
Organic compounds are generally classified based on the reactive parts of their structures, known as **FUNCTIONAL GROUPS**. The remainder of the molecule is usually based upon alkyl chains, which are relatively unreactive. Each functional group has its own characteristic reactions, and it tends to determine many of the chemical and physical properties of the overall compound.

Functional Group – General Structure	Example	Functional Group – General Structure	Example
	CH_3CH_3		CH_3CH_2OH
Alkane	**Ethane**	**Alcohol**	**Ethanol**
	$CH_2{=}CH_2$		$CH_3OCH_2CH_3$
Alkene	**Ethylene**	**Ether**	**Ethyl methyl ether**
			CH_3CH_2SH
Alkyne	**Acetylene**	**Thiol**	**Ethanethiol**
			CH_3SCH_3
Aromatic Ring (Arene)	**Benzene**	**Sulfide**	**Dimethyl sulfide**
 (X = F, Cl, Br, I)	CH_3CH_2Br		$CH_3CH_2NH_2$
Alkyl Halide	**Ethyl bromide**	**Amine**	**Ethylamine**
			
Aldehyde	**Acetaldehyde**	**Acid anhydride**	**Acetic anhydride**
			
Ketone	**Acetone**	**Ester**	**Ethyl acetate**
			
Carboxylic acid	**Acetic acid**	**Amide**	**Acetamide**
			
Acid chloride	**Acetyl chloride**	**Nitrile**	**Acetonitrile**

The IUPAC names of the first 10 alkanes

Number of Carbon Atoms	Prefix	Name	Molecular Formula
1	Meth	Methane	CH_4
2	Eth	Ethane	C_2H_6
3	Prop	Propane	C_3H_8
4	But	Butane	C_4H_{10}
5	Pent	Pentane	C_5H_{12}
6	Hex	Hexane	C_6H_{14}
7	Hept	Heptane	C_7H_{16}
8	Oct	Octane	C_8H_{18}
9	Non	Nonane	C_9H_{20}
10	Dec	Decane	$C_{10}H_{22}$

The **REACTION MAP** shown below shows most of the common functional groups, and how to convert between them. The large numbers on the right hand side indicate the oxidation state for the carbon attached to the functional group.[1]



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