

## Wood Chemistry & Lab. Exam 1

4/10/2002

1. Determination of major components(Klason lignin, holocellulose,  $\alpha$ -cellulose, and hemicellulose)을 설명하라(4).
2. Mannose의 cyclic form 형성 과정을 설명하라(5).
3. Hemiacetal과 acetal을 설명하라(4).
4. Furanose와 Pyranose의 차이는? 또 mutarotation이란?(4)
5. Chiral center(or carbon)를 그림을 그려 설명하고 Galactose는 몇 개의 chiral center or carbon을 갖는가?(3)
6. Ether, Ester, carbonyl, carboxyl functional groups를 그려라(4).
7. Arabinose를 bromine water( $\text{Br}_2$ ,  $\text{H}_2\text{O}$ )와 반응시켰다. 예상되는 반응과정 및 product를 Fischer formula로 설명하라(6)
8. Galactose를 hydroxyl amine( $\text{H}_2\text{N}-\text{OH}$ )과 반응시켰다. 예상되는 반응과정 및 product를 Fischer formula로 설명하라(6)
9. Xylose를 Sodium borohydride( $\text{NaBH}_4$ )와 반응시켰다. 예상되는 반응과정 및 product를 Fischer formula로 설명하라(6)
10. Kiliani reaction을 arabinose를 이용하여 설명하라(8)

## Wood Chemistry & Lab. Exam 2

5/22/2002

1. Lignin은 shikimic acid pathway를 통한 biosynthesis 과정 중 3개의 주요한 lignin precursor를 형성한다. 무엇인가? 또한 그 중 하나를 이용하여 enzymatic dehydrogenation에 의하여 발생될 수 있는 radical의 5종류를 설명하라(8).
2. Lignin은 위에서 형성된 precursor의 radical에 의해 endwise 또는 bulk polymerization으로 중합되는데 그 중 제일 많이 볼 수 있는  $\beta$ -O-4와  $\beta$ - $\beta$  lignol의 중합과정을 설명하라(4).
3. Cellulose와 hemicellulose biosynthesis에 기여하는 주요한 2가지의 sugar nucleotide는?(4)
4. Cellulose를 구성하는 각각의 glucose는 어떤 결합으로 이뤄져 있으며, microfibril내 분자간(intermolecular) 또는 분자내(intramolecular)는 어떤 결합으로 glucose의 어느 부분이 서로 연결되는가?(4)
5. Native cellulose와 Regenerated cellulose의 차이점은 무엇이며, 어떤 cellulose의 분자량( $M_w$ )이 8,910일 때 DP(degree of polymerization)를 계산하라.(4)

6. Cellulose Xanthate의 합성과정을 설명하고 주로 이용되는 곳은?(4)
7. Softwood 와 hardwood hemicellulose를 구성하는 당의 종류는?(4)
8. 다음 반응을 완성시키고 product를 그리거나 이름을 써라(10).

- a. Xylose  $\xrightarrow[\text{HNO}_3]{\text{Br}_2/\text{H}_2\text{O}}$
- b. Glucose  $\xrightarrow{\text{Hydroxyl amine}}$
- c. Arabinose  $\xrightarrow[12\% \text{ HCl/reflux}]{}$
- d. Mannose  $\xrightarrow[0.01\text{N HCl}]{}$
- e. Galactose  $\xrightarrow{\hspace{2cm}}$

9. Cellulose를 weak alkaline solution에서 반응시켰을 때 나타날 수 있는 반응의 종류를 간단하게 설명하라.(4)
10. Alkaline pulping에서처럼 strong alkaline solution을 cellulose에 첨가했을 때 나타날 수 있는 반응의 종류 및 최종산물은?(4)

Wood Chemistry & Lab. Final Exam.

6/12/2002

1. Synapyl alcohol의 가능한 dehydrogenative radical들을 그리고, 생성된 radical이 순차적으로  $\beta$ -O-4,  $\beta$ -1,  $\alpha$ -O-4,  $\beta$ - $\beta$  coupling을 하여 tetralignol을 형성한다. tetralignol을 그려라.(12)
2. Cellulose derivatives(유도체) 중 cellulose ether에 대하여 설명하라.(8)
3. Lignin 화합물을 methylation-permanganate( $\text{KMnO}_4$ ) oxidation과 Nitrobenzene ( $\text{C}_6\text{H}_5\text{-NO}_2$ )oxidation 시켰을 때 최종 product의 차이점은?(6)
4. Softwood extractives와 hardwood extractives의 차이점은 무엇이며, extractives 중 aliphatic compounds는 어떤 종류가 있는가?(8)
5. Kraft pulping에서 악취(odor)를 야기시키는 물질 생성 과정을 설명하라.(10)
6. Cellulose polymer를 strong alkali와 반응시켰을 때 나타날 수 있는 반응인 peeling reaction 및 stopping reaction의 주요 반응 및 products를 설명하라(12)
7. Hemicellulose와 cellulose의 차이점을 설명하라?(6)
8. 다음에 대하여 각각 설명하라.(20)
  - ① Hibbert Ketones(4개)    ② Flavonoids            ③ Aldoheoses
  - ④ Addition of Cyanide ions to Xylose
  - ⑤ Reaction of Xylose with sodium borohydride( $\text{NaBH}_4$ )



고 cellulose I과 II의 차이점은 무엇인가?(4)

Wood Chemistry & Lab. Midterm

10/13/2003

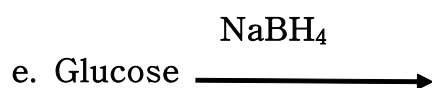
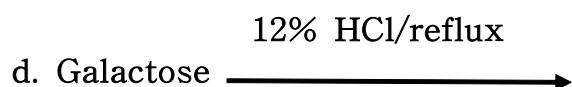
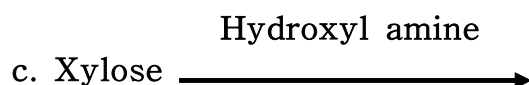
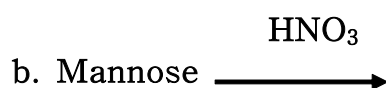
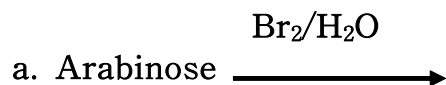
1. Draw a Fischer formula of D-Mannose, and indicate the chiral carbon (asymmetric carbon) using asterisk (\*). Additionally, show its epimer at C2 and enantiomer. (4 points)
2. Illustrate the formation of glycosidic linkage using  $\beta$ -D-galactopyranose and methanol ( $\text{CH}_3\text{OH}$ ) in acidic condition. (6 points)
3. D-Galactose is reacted with  $\text{O}_2$  in the presence of Pt, and then 2 mole of phenylhydrazine added. Draw the expected product. (4 points)
4. In alkaline condition, the sugar is successively carried out the following reactions; epimerization, carbonyl migration,  $\beta$ -elimination reaction, and benzylic acid rearrangement. Draw the successive reaction pathway and final product. (8 points)
5. Draw oxidation products of 2,3-dimethyl-D-mannose by potassium periodate ( $\text{KIO}_4$ ). (4 points)
6. Certain pentose and hexose are oxidized by 12% HCl w/ reflux. What is a difference in their final products? (3 points)
7. The following aldehyde and butanol are reacted in dry HCl. Explain how the hemiacetal and the acetal were formed. (8 points)
8. Enough moles of dimethyl sulfate ( $\text{CH}_3$ )<sub>2</sub>SO<sub>4</sub> are added to the following sugar. Which final product can you expect? (3 points)
9. Give appropriate structural formulas to illustrate each of the following; (2 points each)
  - ① Oxiran
  - ② Aldopentose
  - ③ Furanose
  - ④ Aldonic acid
  - ⑤ Mutarotation

Wood Chemistry & Lab. 2nd Final

12/22/2003

1. Explain the major lignin reaction in sulfite or kraft pulping. (9)

2. Complete the following reactions (4 points each = 20).



3. Draw the oxidation products of 6-O-methyl-D-mannose by potassium periodate( $\text{KIO}_4$ ). (7)

4. Explain how to manufacture the cellulose xanthate using wood pulp. (8)

5. 4-O-methyl-D-xylose is reacted with 2 moles of phenylhydrazine. Show the reaction pathway and final product by Fischer formula (7).

6. Show the reactions forming the  $\beta$ -O-4 and  $\beta$ -1 dimers using coniferyl alcohol radicals through enzymatic dehydrogenative oxidation.(7)

7. Illustrate the peeling and stopping reactions of polysaccharides in kraft pulping. (12)

8. Give the chemical structures of the following compounds. (3 points each)

① Syringyl ② Methyl mercaptan ③ Aldohexoses ④ Guaiacol

⑤ Catechol ⑥ Stilbene ⑦  $\alpha$ -pinene ⑧ Lignan

⑨ Flavonoids ⑩ Furfural

Wood Chemistry & Lab. Final

12/3/2003

1. Show the reactions forming the  $\beta$ -O-4 and  $\beta$ -5 dimers from p-hydroxy

- coumaryl alcohol radicals through enzymatic dehydrogenative oxidation.(8)
2. Consider the following tetralignol :
    - ① What reactions will this model undergo in sulfite pulping? (7)
    - ② What reactions will occur in kraft pulping? (7)
  3. A plant disaccharide has the following structure. What products are formed by reaction with reagents listed? (3 points each = 15)
    - ① 2N H<sub>2</sub>SO<sub>4</sub> with reflux                      ② 12% HCl at 180°C
    - ③ CH<sub>3</sub>OH, dry HCl    ④ Product from ③ followed by KIO<sub>4</sub> treatment
    - ⑤ Product from ④ treated with NaBH<sub>4</sub> then hydrolyzed by acid
  4. Desirable reactions in sulfite pulping are hydrolysis and sulfonation by active chemicals, but sometimes undesirable reaction makes the delignification difficult under different pH condition. Explain this reaction with example. (7)
  5. Using galactoglucomannans which are the principal hemicellulose in softwoods as a model, show the peeling and stopping reactions of polysaccharides that occur in kraft pulping. (12)
  6. Explain how to manufacture the cellulose acetate using wood pulp. (6)
  7. The following lignin model compound is oxidized by permanganate oxidation with methylation, and nitrobenzene oxidation with NaOH, respectively. What final compounds can you expect? (8)
  8. Give the chemical structures of the following compounds. (3 points each)
    - ① Sesquiterpene    ② Methyl mercaptan    ③ β-thujaplicin
    - ④ Flavane    ⑤ Pinoresinol    ⑥ β-pinene
    - ⑦ 5-methyl furfural    ⑧ Veratrole
    - ⑨ O-acetyl-4-O-methylglucurono-β-D-Xylan
    - ⑩ CMC

### Wood Chemistry & Lab. Midterm

2004. 10. 25

1. First, choose one of the major softwood hemicellulose. And in alkaline condition, the sugar is successively carried out the peeling reaction including carbonyl migration, β-elimination reaction, and benzylic acid rearrangement. Draw the successive reaction pathway and final product. (7 points)

2. Illustrate how cellulose fiber is formed, starting from monomeric D-glucose. (5 points)
3. Draw a Fischer formula of D-galactose, and show how to form a cyclized galactopyranose (Haworth formula). And indicate the chiral carbon (asymmetric carbon) using asterisk (\*) in both formulas. (5 points)
4. Explain the formation of acetal and hemiacetal using D-mannose and enough methanol (CH<sub>3</sub>OH) in acidic condition. (6 points)
5. Enough moles of dimethyl sulfate (CH<sub>3</sub>)<sub>2</sub>SO<sub>4</sub> are added to the following sugar. Which final product can you expect? (4 points)
6. Explain how the following cellulose derivatives are formed? (6 points)
7. The following disaccharide is extracted from a species. What products are formed by each reaction with each reagent listed? (3 points each)
  - ① 2N H<sub>2</sub>SO<sub>4</sub> with reflux, ② 12% HCl at 180°C, ③ CH<sub>3</sub>OH, dry HCl
  - ④ Product from ③ treated with enough amount of KIO<sub>4</sub> treatment
8. Illustrate briefly (3 points each)
  - ① What is the characteristic differences between cellulose and hemicellulose?
  - ② What is an aldohexose?
  - ③ What is an epoxide?
  - ④ Structure of galacturonic acid
  - ⑤ Process for producing a sorbitol in industry?

Wood Chemistry & Lab. Final

2004. 12. 8

1. Illustrate the reason why formaldehyde(CH<sub>2</sub>O) is produced from free phenolic structure with  $\alpha$ -aryl ether bond during Kraft pulping condition. (6 points)
2. Show how the following lignin fragment reacts under sulfite pulping condition.(7 points)
3. What is the composition of spent sulfite liquor(SSL)? How can this liquor be used for other purposes? (6 points)
4. Explain the dimerization of sinapyl alcohol to form a  $\beta$ -O-4 dimer, and how will this dimer react under kraft pulping condition.(7 points)
5. Explain briefly how lignin precursors are biosynthesized starting from glucose, moved into cell wall, and then polymerized? (8 points)

6. During pulp bleaching process, explain how the following carbohydrate is changed or decomposed. (6 points)
7. Illustrate the kinds of flavonoids. (6 points)
8. During sulfite pulping, the condensation reaction is competed with the sulfonation. Why? Show an example. (6 points)
9. Explain the demethylation and formation of chromophore under kraft pulping condition. (8 points)
10. Illustrate briefly (3 points each)
  - ① lariciresinol      ② major ions in sulfite pulping
  - ③ triglyceride      ④ How can lignin be preserved during pulp bleaching?
  - ⑤ chlorolignin      ⑥  $\alpha$ -pinene
  - ⑦ oleic, linoleic    ⑧ H (hypochlorite stage) in pulp bleaching
  - ⑨ coniferin          ⑩ veratrole, pyrogallol

### Wood Chemistry & Lab. Midterm

10/19/2005

1. A 6-O-methyl-D-mannose and butanol ( $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ ) are reacted in dry HCl. Explain how the hemiacetal and acetal formation were successively formed. (8 points)
2. Draw a Fischer formula of 2-acetyl-D-glucose, and show how to form a cyclized glucopyranose (Haworth formula). And indicate the chiral center (asymmetric carbon) using asterisk (\*) in both formulas. (6 points)
3. In alkaline condition, the following sugar is successively carried out the peeling reaction including carbonyl migration,  $\beta$ -elimination reaction, and benzylic acid rearrangement. Draw the successive reaction pathway and final product. (8 points)
4. The following disaccharide is extracted from a species. What products are formed by each reaction with each reagent listed? (3 points each = 12)
  - ① 2N  $\text{H}_2\text{SO}_4$  with reflux,    ② 12% HCl at  $180^\circ\text{C}$ ,    ③  $\text{CH}_3\text{OH}$ , dry HCl
  - ④ Product from ③ treated with enough amount of  $\text{KIO}_4$  treatment
5. 3,4-Dimethyl-D-arabinose is reacted with  $\text{O}_2$  in the presence of Pt, and then 2 mole of phenylhydrazine added. Draw the expected product. (6 points)
6. Illustrate briefly (2 points each)
  - ① Cellobiose

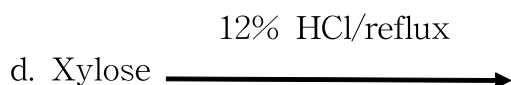
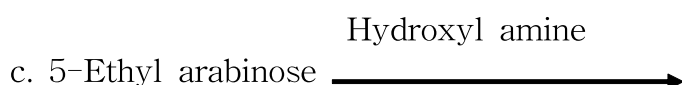


- ② Aldopentose
- ③ Levoglucosan
- ④ Structure of mannuronic acid
- ⑤ Most stable conformation of cellulose in nature

### Wood Chemistry & Lab. - Final

12/12/2005

1. Desirable reactions in sulfite pulping are hydrolysis and sulfonation by active chemicals, but sometimes undesirable reaction makes the delignification difficult under different pH condition. Explain this reaction with example. (5)
2. What are the differences of chemical structure, composition, and biosynthesis pathway between cellulose and hemicellulose? (6)
3. For the production of acetate rayon, what is the starting material and how this is formed? Explain with details. (5)
4. Draw the successive  $\beta$ -5 and  $\beta$ -O-4 reactions from coniferyl alcohol radicals through enzymatic dehydrogenative oxidation, and describe how this trimer will be decomposed under kraft pulping condition.(8)
5. Complete the following reactions. (2 points each = 10)



6. Illustrate briefly. (2 points each = 20)

- ① the composition of spent sulfite liquor(SSL)    ② veratrole and catechol
- ③ CMC            ④  $\beta$ -thujaplicin
- ⑤ the product of 5-ethyl sinapyl alcohol by permanganate oxidation w/ methylation

- ⑥ three enzymes from wood rot fungi    ⑦ flavanone and flavone
- ⑧ the role of laccase mediator during lignin degradation
- ⑨ diglyceride and linoleic acids    ⑩ a determination of woods by FT-IR

### Wood Chemistry & Lab. Midterm

10/24/2006

1. An elementary school student asked, "how can the trunk of tree be thick annually?" What is your answer from the viewpoint of wood chemist? (6 points)
2. An ethyl alcohol and acetaldehyde are reacted in dry HCl to carry out successively the hemiacetal and acetal formation. Explain (5 points)
3. Draw a Fischer formula of 2-acetyl-3-methyl D-glucose, and show how to form a cyclized form (Haworth formula). (4 points)
4. You started the wood chemistry experiment with D-xylose solution, and finally obtained 2-methyl D-mannitol and 2-methyl D-glucitol. Explain what kinds of chemical reactions are included in your experiment. (7 points)
5. You carried out several successive reactions in alkali solution, and obtained the following products. What is the starting material? And explain the reaction pathway. (8 points)
6. 2,3-Dimethyl-L-arabinose was reacted with O<sub>2</sub> in the presence of Pt, and then 2 mole of potassium periodate added. Draw the expected product. (4 points)
7. Illustrate briefly (2 points each)
  - ① Property difference : diastereoisomer vs enantiomer
  - ② Micelle
  - ③ Intra- and intermolecular hydrogen bonds in microfibrils
  - ④ D-glucono- $\delta$ -lactone
  - ⑤ Glycoside
  - ⑥ Z-average molecular weight
  - ⑦ <sup>1</sup>H-NMR spectroscopy
  - ⑧ Ketohexose

## Wood Chemistry & Lab. Final

12/11/2006

1. Draw the reaction pathways and final products of the following compound during sulfite pulping and kraft pulping, respectively? (6 points)
2. Illustrate the kinds of terpenes and flavonoids. (6 points)
3. During sulfite pulping, the condensation reaction is competed with the sulfonation. Why? Show an example. (6 points)
4. Explain how to manufacture the cellulose xanthate using wood pulp(6 points)
5. Briefly explain the differences of chemical structure, composition, and biosynthesis pathway between cellulose and hemicellulose? (6 points)
6. Illustrate briefly or draw the structure. (2 points each)
  - ① veratrole and pyrogallol
  - ② coniferin
  - ③ product of 5-ethyl coniferyl alcohol by permanganate oxidation w/ methylation
  - ④ O(D+C)(E+P+O)D(E+P)D sequences in pulp bleaching
  - ⑤ triglyceride
  - ⑥ methyl mercaptan
  - ⑦ CMC
  - ⑧  $\beta$ -thujaplicin
  - ⑨  $\alpha$ -pinene and  $\beta$ -pinene
  - ⑩ oleic and linoleic acids

## Wood Chemistry & Lab. Midterm

22/10/2007

1. Draw a Fischer formula of 2-methyl-3-ethyl D-glucose, and show how to form a cyclized  $\alpha$ -D-glucofuranose (Haworth formula). And indicate the chiral center (asymmetric carbon) using asterisk (\*) in both formulas. (5 points)
2. 2,3,4-trimethyl-D-xylose was reacted with bromine water, and then 3 mole of potassium periodate added. Draw the expected product. (6 points)
3. You started the carbohydrate chemistry experiment with D-xylose solution, and finally obtained 2-methyl D-gulitol and 2-methyl D-iditol. Explain what kinds of chemical reactions are required for obtaining the above two products. (8 points)

4. The following trisaccharide is divided into two fractions(monosaccharide+disaccharide) and then stabilized in strong alkaline solution by forming saccharinic acid. Explain (8 points)
5. In weak alkaline condition, D-mannose is successively carried out the following reactions; epimerization, carbonyl migration, saccharinic acid formation. Draw the successive reaction pathway and final product. (8 points)
6. Illustrate briefly (3 points each)
  - ① Epimer, enantiomer, diastereomer
  - ② Ester, carbonyl, oxiran
  - ③ Glucuronic acid, galactonic acid, mannaric acid
  - ④ aldohexose, xylitol, sorbitol
  - ⑤ Energy difference : UV, NMR, Microwave

### Wood Chemistry & Lab. Final

12/10/2007

1. Explain the dehydrogenative coupling reaction of sinapyl alcohol to form a  $\beta$ -O-4 dimer, and how will this dimer react under kraft pulping and sulfite pulping, respectively. (6 points)
2. Sometimes undesirable reaction makes the delignification difficult under different pH condition in kraft pulping. Explain this reaction with 2 examples (6 points)
3. Illustrate the reason why formaldehyde( $\text{CH}_2\text{O}$ ) is produced during kraft pulping condition. (4 points)
4. Illustrate the kinds of flavonoids. (4 points)
5. Explain the demethylation by sulfur and the formation of chromophore under kraft pulping condition. (6 points)
6. The major constituents of plant oil (eg. soy bean) are composed of triglycerides which are esterified (ester bonds) by oleic, linoleic, and linolenic fatty acid chains. Draw the structure. (4 points)
7. Illustrate briefly or draw the chemical structure (2 points each, 24 points)
  - ①  $\beta$ -Thujaplicin, ellagic acid
  - ② Stearic acid, abietic acid(diterpene)
  - ③  $\alpha$ -Pinene, 1-menthol
  - ④ TCDD
  - ⑤ Pinosylvin, coniferin
  - ⑥ Isoeugenol, acetosyringone

- ⑦ SSL
- ⑧ What is PAH, and why they are dangerous?
- ⑨ The reason why pretreatment process is necessary for producing methane and ethanol
- ⑩ How can we analyze lignin content by NIR spectroscopy?
- ⑪ The process for determining antifungal activity of certain compounds
- ⑫ What can we detect or analyze by GC/MS and GC-FID?

### Wood Chemistry & Lab. Midterm

10/22/2008

1. A 6-methyl-D-galactose and butanol ( $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ ) are reacted in dry HCl. Explain how the hemiacetal and acetal formation are successively formed. (8 points)
2. The following disaccharide is successively carried out the peeling reaction and stopping reaction. Draw the successive reaction pathway and final product. (8 points)
3. The following disaccharide is extracted from a species. What kind of product(s) is formed by each reaction with each reagent listed? (3 points each)
  - ① 2N  $\text{H}_2\text{SO}_4$  with reflux
  - ② 12% HCl at  $180^\circ\text{C}$
  - ③  $\text{CH}_3\text{OH}$ , dry HCl
  - ④ Product from ③ treated with enough amount of  $\text{KIO}_4$  treatment
4. By using D-arabinose solution, you finally obtained 3-methyl D-mannitol and 4-methyl D-glucitol. Explain what kinds of chemical reactions are included in your experiment. (7 points)
5. 1,4-Dimethyl-D-galactose was reacted with  $\text{O}_2$  in the presence of Pt, and then 1 mole of potassium periodate added. Draw the expected product. (5 points)
6. Illustrate briefly (2 points each)
  - ① Differences between cellulose and hemicellulose
  - ② Functional groups : Carboxyl and O-methyl
  - ③ Galacturonic acid, Sorbitol, Mannaric acid
  - ④ Pentosan
  - ⑤ Instruments for structural study (3 kinds)
  - ⑥ Property difference : diastereoisomer vs enantiomer
  - ⑦ D-glucono- $\delta$ -lactone

- ⑧ Aldohexose
- ⑨ Mutarotation
- ⑩ C2 and C4 epimers of D-glucose

### Wood Chemistry & Lab. Final

12/10/2008

1. The condensation reaction is competed with sulfonation during sulfite pulping. Explain why this happens, and show an example. (5 points)
2. Explain briefly how lignin precursors are biosynthesized starting from glucose, moved into cell wall, and then polymerized (5 points)
3. How molecular structure of cellulose is constructed starting from D-glucose using rosette structure? (5 points)
4. Draw the reaction pathways and final products of the following compound during sulfite pulping and kraft pulping, respectively?(6 points)
5. Explain how to make carboxymethyl cellulose(CMC), and what is its usage? (4 points)
6. During Kraft pulping, explain the production pathway of odorous compounds.(5 points)
7. Illustrate briefly (2 points each)
  - ① What is a difference of final products between methylation-permanganate oxidation and nitrobenzene oxidation of lignin?
  - ②  $\Delta^3$ -carene
  - ③ Matairesinol
  - ④ Prunetin
  - ⑤ Abietic acid
  - ⑥ Cellulose II
  - ⑦ Veratrole
  - ⑧ Polydispersity
  - ⑨ Intermolecular hydrogen bonds
  - ⑩ Ellagic acid
  - ⑪ Octadecadienoic acid
  - ⑫ Kaempferol
  - ⑬ Pectin
  - ⑭ Quercetin
  - ⑮ DS

### Wood Chemistry & Lab. Midterm

10/14/2009

1. The following disaccharide was extracted from wood species. What kind of product(s) is formed by each reaction with each reagent listed? (3 points each)
  - ① 2N H<sub>2</sub>SO<sub>4</sub> with reflux



- ⑦ Role of bulky swelling agents
- ⑧ Pyrogallol
- ⑩ Menthol
- ⑫ CMC
- ⑭ Taxifolin
- ⑮ 3,5-Dimethoxy-4-hydroxy benzaldehyde
- ⑨ Catechin
- ⑪ Octadecatrienoic acid
- ⑬ Mercerization

### Wood Chemistry & Lab. Midterm

10/20/2010

1. 2,3-Dimethyl-D-arabinose was reacted with bromine water, and then 1 mole of potassium periodate( $KIO_4$ ) added. Draw the expected product. (4 points)
2. Draw a Fischer formula of 2,3-dimethyl D-galactose, and show how to form a cyclized  $\alpha$ -D-galactofuranose (Haworth formula). And indicate the chiral center (asymmetric carbon) using asterisk (\*) in both formulas. (4 points)
3. In D-xylose solution, you finally obtained 2-methyl D-gulitol and 2-methyl D-iditol. Explain what kinds of chemical reactions were required for obtaining the above two products. (6 points)
4. One mole of 5-methyl-D-galactose and two moles of propanol ( $CH_3CH_2CH_2OH$ ) were reacted in dry HCl. Explain how the hemiacetal and acetal formation were successively formed. (6 points)
5. The following disaccharide was carried out the peeling reaction and stopping reaction. Draw each reaction pathway and final product. (10 points)
6. Illustrate briefly (2 points each)
  - ① Enantiomer, anomer
  - ② Functional groups : carboxyl and methoxy
  - ③ Galacturonic acid, galactonic acid
  - ④ Glycoside
  - ⑤ Most stable conformation of cellulose in nature
  - ⑥ Property difference : diastereoisomer vs enantiomer
  - ⑦ Aldohexose
  - ⑧ Mutarotation
  - ⑨ Process for producing a xylitol in industry
  - ⑩ C2 and C4 epimers of D-mannose

### Wood Chemistry & Lab. Final

12/6/2010



1. Draw the molecular structure of cellulose microfibrils which have intra- and inter molecular hydrogen bonds. (4 points)
2. Draw the reaction pathways and final products of the following compound during sulfite pulping and kraft pulping, respectively?(8 points)
3. Illustrate the kinds of flavonoids. (6 points)
4. Explain the formation of odorous materials which were derived from lignins by demethylation under kraft pulping condition. (6 points)
5. Explain how to make hydroxyalkyl ethers, and what is its usage? (6 points)
6. Illustrate briefly or draw the chemical structure (2 points each)
 

① Methylmercaptan	② SSL
③ Limonene	④ Lignocerol
⑤ Shikimic acid	⑥ Cellulose II
⑦ Polydispersity	⑧ Pectin
⑨ Isoeugenol	⑩ Stearic acid
⑪ Phenylcoumaran structure	⑫ Anisole
⑬ Technical lignins	⑭ CEHDED (bleaching)
⑮ Coniferin	

## Wood Chemistry & Lab. Midterm

10/19/2011

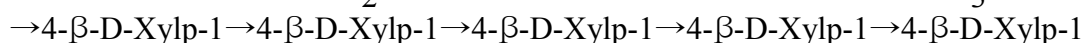
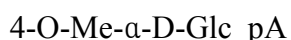
1. Explain the Kiliani-Fischer reaction using D-xylose. And then the above products are reacted with ① Bromine water ② 12% HCl ③ Phenyl hydrazine (4 points). What kind of product(s) is formed by each reaction with each reagent listed? (10 points)
2. The following trisaccharide is in dilute alkaline solution. What kinds of reactions are occurred? Explain all the reaction pathways in detail (6 points).
3. One mole of 3,4-dimethyl-D-galactose were reacted in dry HCl. Explain how the cyclic hemiacetal were formed. And explain the mutarotation using the above product (6 points)
4. The following trisaccharide was subjected to the peeling reaction and stopping reaction, respectively. Draw each reaction pathway and final product. (10 points)
5. The following compound was subjected to the potassium periodate oxidation with excessive amount of  $KIO_4$ . What kinds of final products are occurred? Draw all the products (6 points)
6. Illustrate briefly (2 points each)

- ① Difference of cellulose and hemicellulose
- ② Functional groups : alkoxy
- ③ Chitin
- ④ Levoglucosan
- ⑤ Process for producing a mannitol in lab
- ⑥ Draw a C3 epimer of D-altrose, and name it

## Wood Chemistry & Lab. Final

12/7/2011

1. Cellulose is encrusted with lignin and hemicelluloses. Explain how Lignin Carbohydrate Complex (LCC) is formed. Draw the chemical structure of LCC in detail with especially focusing on linkages between lignin and hemicelluloses. (6 points)
2. What is the name of the following hemicellulose derived from softwoods. Name it and draw the partial chemical structure by Haworth formula. (6 points)



3. Explain how to make cellulose xanthate, and what is its usage? (5 points)
4. Draw the reaction pathways and final products of the following compound during sulfite pulping and kraft pulping, respectively?(8 points)
5. Explain how the condensed  $\alpha$ -5, and  $\alpha$ -1 lignin structures are formed from the following compounds during kraft pulping. (6 points)
6. Illustrate the biosynthetic pathways of cellulose and hemicellulose in wood. (6 points)
7. Illustrate briefly or draw the chemical structure (2 points each)
  - ① Ellagic acid
  - ② Black liquor
  - ③ Menthol
  - ④ Lauric and Linoleic acids
  - ⑤ Guaiacylacetone
  - ⑥ Stilbene quinone
  - ⑦ CED and Cadoxen
  - ⑧ Ozonation
  - ⑨ Chlorine stage in bleaching
  - ⑩ Current issues in pulping industry

## Wood Chemistry & Lab. Midterm

1. The following disaccharide is reacted in dilute alkaline solution(0.1N NaOH). What kinds of reactions are occurred? Explain all the reaction pathways and final products in detail (6 points).
2. Explain the Kiliani-Fischer reaction using D-ribose. And then the above products are reacted with ① Nitric acid ② Methanol in dry HCl ③ KIO<sub>4</sub>(excessive amount). What kind of product(s) are formed by each reaction with each reagent listed? (8 points)
3. The following disaccharide was subjected to the peeling reaction and stopping reaction, respectively. Draw each reaction pathway and final product. (10 points)
4. Illustrate how cellulose is biosynthesized in cell wall. (6 points)
5. You would like to obtain 2,3-dimethyl D-mannitol and 2,3-dimethyl D-glucitol by using D-xylose solution (starting compound). Explain what kinds of chemical reactions are included in your experiment. (6 points)
6. Illustrate briefly.
  - ① Viscosity average MW (2 points)                      ② Secondary alcohol (1 point)
  - ③ Anomer (1 point)
  - ④ Explain why 5-hydroxymethyl furfural (5-HMF) is produced during concentrated acid hydrolysis of wood (2 points)
  - ⑤ Draw the following compounds; L-arabinose, and O-acetyl-4-O-methyl glucuronoxylan (2 points)
  - ⑥ Intermolecular hydrogen bondings in cellulose (2 points)

## Wood Chemistry & Lab. Final

12/9/2013

1. The major constituents of plant oil (eg. rapeseed) are composed of triglycerides which are esterified (ester bonds) by oleic, linoleic, and linolenic fatty acids. Draw the structure of triglyceride. (4 points)
2. Explain the consecutive dehydrogenative coupling reaction of coniferyl alcohol to form a trimer coupled by  $\beta$ -O-4 and  $\beta$ -1 linkages, and how this trimer can react under kraft pulping and sulfite pulping, respectively. (6 points)
3. Explain how the condensed  $\alpha$ -5,  $\alpha$ -1, and diphenyl methane linked lignin

- structures are formed from quinone methides during kraft pulping, respectively. (8 points)
4. Explain the biosynthesis of terpenoids (head to tail coupling mechanism) starting from carbohydrates. (6 points)
  5. Explain the formation of odorous compounds during kraft pulping. (6 points) (8 points)
  6. Illustrate briefly or draw the structure. (2 points each)
 

① Bleaching process : OZEPY	② Muconic acid type
③ $\beta$ -pinene	④ Cellulose II
⑤ Syringol	⑥ Pulping : CTMP
⑦ p-coumaryl aldehyde	⑧ Björkman Lignin
⑨ Quercetin	⑩ Oleoresin

## Wood Chemistry & Lab. Midterm

10/20/2014

1. D-fructose is reacted with  $\text{NaBH}_4$ , and then the product(s) are treated with excessive amounts of  $\text{KIO}_4$ . What kinds of product(s) are formed? (6 points).
2. The following disaccharide is reacted with ① 12% HCl, ② 2N HCl with heat, ③ 0.01N HCl, and ④ 0.1N NaOH. What kinds of product(s) are formed by each reaction with each reagent listed? (8 points)
3. The following disaccharide was subjected to the peeling reaction and stopping reaction, respectively. Draw each reaction pathway and final product. (8 points)
4. Illustrate how primary wall of wood cell wall is biosynthesized. (6 points)
5. What is difference between cellulose and hemicellulose? (6 points)
6. Illustrate briefly. (2 points each)
 

① LCC	② Anomer of 4-O-methyl- $\beta$ -D-glucuronic acid
③ C2 Epimer of 3,4-dimethyl glucopyranose	
④ Explain why furfural (5-HMF) is produced during concentrated acid hydrolysis of wood	
⑤ Phenylosazone	⑥ Polydispersity
⑦ Regenerated cellulose	⑧ Levoglucosan

# Wood Chemistry & Lab. Final

12/8/2014

1. Explain how the lignin carbohydrate complexes in cell wall are formed using coniferyl alcohols, arabinoglucuronoxylan, and cellulose. (7 points)
2. Draw a lignin trimer coupled by  $\beta$ -O-4 and  $\alpha$ -O-1 linkages by consecutive dehydrogenative coupling reaction of syringyl alcohols, and how this trimer can be degraded under kraft pulping and sulfite pulping, respectively. (7 points)
3. Explain head to tail coupling mechanism of farnesylpyrophosphate biosynthesis starting from carbohydrates. (6 points)
4. Illustrate the production processes of cellulose xanthate, and cellulose acetate using wood pulp, respectively. (4 points)
5. Explain briefly how lignin precursors are biosynthesized starting from glucose, moved into cell wall, and then polymerized? (6 points)
6. Illustrate briefly or draw the structure. (2 points each)
  - ① Suberin and cutin
  - ② Trans fat
  - ③  $\beta$ -thujaplicin
  - ④ CAD(Cinnamyl alcohol dehydrogenase)
  - ⑤ Catechol
  - ⑥ Bleaching : CEDPZ
  - ⑦ Phenylcoumaran structure
  - ⑧ CEL (Cellulolytic Enzyme Lignin)
  - ⑨ Flavanol
  - ⑩ Abietic and pimaric acid