Please be aware of the following instructions:

- Read the questions very carefully!
- Include your answer(s) between the individual questions. There is enough space. Be very short, b
  cise in your answers. Avoid telling stories!
- The full point(s) are given, see in square bracket, when the question is precisely answered. In the
  that the question was not answered precisely leads to the deduction of points in 0.5 increments.
- Good luck!

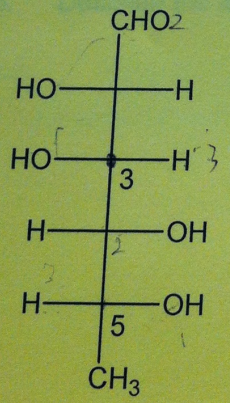
1. Carbohydrate Chemistry

1.1. Define the difference between diastereoisomers and enantiomers? [1]

1.2. Rhamnose, a naturally occurring deoxy-sugar: [3]

1.2.1. Is rhamnose a chiral compound?

1.2.2. Designate the R/S conformation of C-3 and C-5 in D-rhamnose?



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2. α-D-glucopyranose: (a) what is an anomeric C and (b) why does the anomeric C experience a downfield shift (~ 5.2 ppm vs. 3.7 ppm) in the ^{1}H-NMR spectrum compared to the other protons? [2]

3. Please list 4 important aldoses which are present in lignocellulosic substrates? [1]

4. Describe in brief two different glycosylation reactions? [2]

5. Lignin Chemistry

6. Describe the acidolysis method used for the isolation of lignin from wood or pulp? [2]

6.1. Please list the 5 most important bonds between lignin units? [2]

6.2. Which information can be obtained from nitrobenzene oxidation? [1]

6.3. What is the chemical reason why grass lignin has a much higher alkali solubility than wood lignin? And how can this be determined? [1]

6.4. What is HSQC NMR spectroscopy (two sentences)? Which basic information can be obtained from HSQC spectroscopy of a lignin sample? [2]

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7. Extractives

7.1. Steps of CTO production? [2]

7.2. What is the basic chemical structure of flavonoids? [1]

8. Chemistry of alkaline treatments of biomass

8.1. Describe the peeling/stopping mechanisms? [3]

8.2. Describe the *Lobry de Bryn-Alberda van Ekenstein* rearrangement? [2]

8.3. What are the structural prerequisites for a *retroaldol* reaction? [1]

8.4. Describe the phenomenon of *xylan redeposition*? [1]

8.5. Composition of white liquor? Effective cooking chemicals? [1]

8.6. Origin of the strong smell of a kraft pulp mill? [1]

8.7. What is the H-factor concept? For what H-factor control is used? [1]

9. Donnan equilibrium in kraft pulping: What happens with the [OH-] in the fiber wall when an inert Na salt, e.g. NaCl, is added to the kraft cooking liquor? And why? [2]

10. Additives to alkaline cooking

10.1. Why is the yield of a birch kraft pulp higher than the yield of a birch sulphite pulp? [1]

10.2. How to prepare a polysulfide solution in industry? [2]

11. Acid Sulfite Pulping

11.1. Which base is primarily used in acid sulphite cooking and why? [1]

11.2. What is the major benefit of sulphite pulping over kraft pulping? [1]

11.3. Please explain the two limitations of acid sulphite cooking? [2]

12. Organosolv pulping

12.1. Describe the principle pathway of the classical organosolv process? [1]

12.2. Describe the biorefinery concept of an organosolv process? [2]

13. Hydrothermolysis

13.1. Lignin fragmentation pathways under mild acidic conditions as obtained under hydrothermal conditions? [2]

14. Ionic liquids

14.1. Name at least 2 ionic liquids? [2]

14.2. Properties of ionic liquids? [1]

14.3. Purpose of the use of ionic liquids in biomass fractionation? [1]

Grading:

Total number of questions: 32

Total number of points: 48

5>42.0

42.0≥ **4**>36.0

36.0≥ **3**>29.5

9.5≥ **2**>24.0

24.0≥ **1**>19.0

0≤19.0