Examination III

(Biochemistry I, CHM4304)
Florida International University
April 12, 2010
11:00 to 11:50 am

Name:_____

Panther ID:_____

Signature: _____

All answers should be written on this exam. *Clearly* indicate your answers in the spaces provided; if we have to guess as to what or where your answer is, it's wrong. Where applicable, outline the logic or principle you used to arrive at your answer, as partial credit may be awarded for correct approaches. Work pages are provided at the end of the exam; if you need more ask. Make sure your name is on each page of the examination; the management is not responsible for lost pages. Your signature above is your assurance that you have worked independently without help from anyone besides the professor for CHM4304 or any other outside source such as notes or electronic devices including cell phones. **All students are deemed by the University to understand that if they are found responsible for academic misconduct, they will be subject to the Academic Misconduct procedures and sanctions, as outlined in the Student Handbook.**

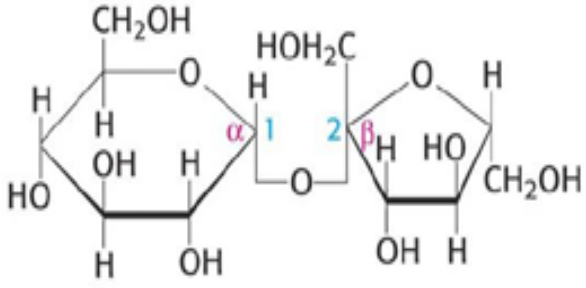
Simple calculators are allowed. Cell phones and computers are not allowed.

Answer all questions:

1. Carbohydrates (25 points)

A) Please draw the chemical structure of sucrose (α-D-Glucopyranosyl-(1,2)-β-D-fructofuranose). (10 points)

Answer:



Sucrose
(α-D-Glucopyranosyl-(1→2)-β-D-fructofuranose

B) The human ABO blood types are caused by the carbohydrates attached to proteins and lipids in the surfaces of red blood cells. For one type of blood group, one of the three different carbohydrate structures, termed A, B, and O, may be present. The structures have in common an oligosaccharide foundation called the O antigen. The A and B antigens are formed by the addition of one extra monosaccharide, either N-acetylgalactosamine (for A) or galactose (for B), through an α-1,3 linkage to a galactose moiety of the O antigen. What is the enzyme responsible for adding the extra monosaccharide to the O antigen? What causes the O phenotype, i.e., O blood type? (7.5 points)

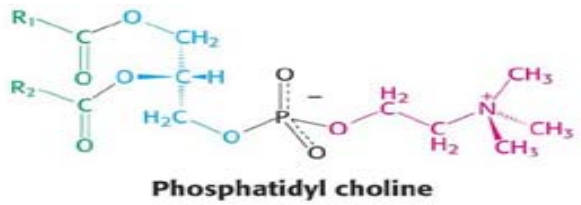
Answer: Specific glycosyltransferases are the enzymes responsible for adding the extra monosaccharide to the O antigen. The O phenotype is the result of mutations that prevent the synthesis of a functional glycosyltransferase required to add additional carbohydrates.

C) I-cell disease (mucolipidosis II) is a severe inherited human disease, which is a result of deficiency of an enzyme catalyzing an important reaction for the marker that normally directs many hydrolytic enzymes from the Golgi complex to lysosomes. What enzyme is deficient in I-cell patients? What is the marker that directs many hydrolytic enzymes from the Golgi complex to lysosomes? (7.5 points)

Answer: deficient in the phosphotransferase catalyzing the first step in the addition of the phosphoryl group; mannose-6-phosphate is the marker that directs the hydrolytic enzymes from the Golgi complex to lysosomes.

2. Lipids and Cell Membranes (20 points)

A) Please draw the chemical structure of phosphatidylcholine (a glycerol-based phospholipid) (10 points)



B) How many phospholipid melecules are there in a 2-μm^2 region of a phospholipid membrane? Assume that a phospholipid molecule occupies 70 $Å^2$ of the surface (Hint: 1 nm = 10 Å and membrane has two layers of phospholipids) (10 points)

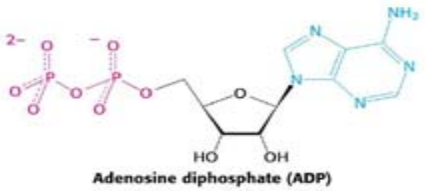
Answer: 2-μm^2 = 2 × $(10^4)^2$ $Å^2$ = 2 × 10^8 $Å^2$

The number of the phospholipid molecules = $2\times(2\times10^8)/70 = 5.71\times10^6$

3. Metabolism: basic concepts and design (15 points)

A) What is the structure motif common to ATP, FAD, NAD^+, and CoA? Please draw the chemical structure of this common motif.

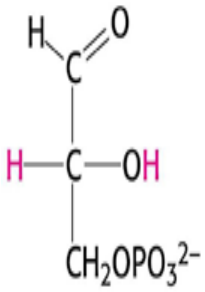
ADP



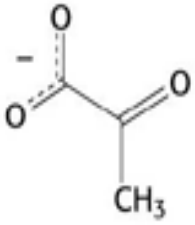
Adenosine diphosphate (ADP)

4. Glycolysis

A) Please draw the chemical structure of Glyceraldehyde 3-phosphate and pyruvate.
Answer:



Glyceraldehyde 3-phosphate



Pyruvate

B) Arsenate (AsO_4^{3-}) closely resembles Pi in structure and reactivity. In the reaction catalyzed by glyceraldehyde 3-phosphate dehydrogenase, arsenate can replace phosphate in attacking the energy-rich thioester intermediate. The product of this reaction, 1-arseno-3-phosphoglycerate, is unstable. It and other acyl arsenates are rapidly and spontaneously hydrolyzed. What is the effect of arsenate on energy generation in a cell under anaerobic condition, i.e., in the absence of O_2?

Answer:

The net reaction in the presence of arsenate is

Glyceraldehyde 3-phosphate + NAD+ + H2O 3-phosphateglycdderate + NADH + 2H+

No ATP is produced for this step and for the glycolysis.

5. Citric acid cycle

Please finish the citric acid cycle (draw chemical structures) (20 points)