Major Topics for Exam 3 – Chem 309

Be able to:

1. explain the biological and chemical roles of proteins, carbohydrates, lipids, and nucleic acids
2. write the structure of an amino acid at physiological pH
3. identify the sides chains of amino acids as non-polar, polar, acidic, or basic
4. recognize chiral carbons and pairs of enantiomers
5. explain what a racemic mixture is
6. write the structure for a tripeptide given the amino acid sequence and vice versa
7. identify and explain the IMFs of 2° and 3° structure of proteins
8. distinguish between α-helixes and β-sheets
9. explain the process of protein denaturation
10. distinguish between the 3 general classes of proteins (fibrous, globular, and membrane)
11. explain the E-S complex and its effect on reaction rates
12. recognize which class of enzyme is catalyzing a biochemical reaction
13. identify and predict the cofactors and coenzymes in a biochemical reaction
14. explain and predict the effects from nonspecific enzyme inhibition
15. explain and predict the effects from specific enzyme inhibition (competitive inhibition, non-competitive inhibition, positive allosteric control, and negative allosteric control)
16. recognize and draw the Fischer and Haworth structures for glucose, galactose, fructose, ribose, lactose, maltose, and sucrose
17. distinguish between D- and L- sugars
18. recognize the anomeric carbon and distinguish between the α and β-anomers
19. recognize and classify glycosidic bonds (α or β - #,#)
20. predict the products of the hydrolysis of peptides, lactose, maltose, sucrose, and triglycerides
21. explain mutarotation and its consequences
22. explain the role of starch, glycogen and cellulose in plants and/or animals
23. recognize the chemical reactions that occur during glycolysis and their associated energy
24. describe and explain the fate of pyruvate under aerobic and anaerobic conditions
25. recognize the pathways using glucose: glycogenesis, glycogenolysis, and gluconeogenesis.
26. Describe the chemical structure and general properties of fatty acids, waxes, fats, oils, glycerophospholipids, sphingolipids, and glycolipids
27. Compare the properties of saturated and unsaturated fatty acids; and cis vs. trans fatty acids.
28. Name two essential fatty acids and identify using either the omega or delta system.
29. Characterize the structure of a cell membrane and give a general explanation of how molecules and ions get into and out of the cell.
30. Explain the role of cholesterol in membrane structure and in steroid hormone synthesis.
31. Distinguish between types of lipoproteins and their role in cholesterol transport in the body.
32. Give examples of steroid hormones and their role in the body.
33. Characterize the structure and function of bile salts.
34. Describe the structure and function of eicosanoids. What fatty acid(s) are they made from?
35. Describe the process of fatty acid activation. Where in the cell does it occur?
36. Explain why fatty acid oxidation is called beta oxidation. Where does fatty acid oxidation occur?
37. Predict the number of spirals of beta oxidation that would be needed for a given fatty acid and how many acetyl-CoA molecules are produced.

38. Describe how the condition of ketoacidosis occurs. What chemical compound is in short supply? Excess? What are ketone bodies?
39. Explain role of Gibbs free energy change (ΔG) in determining if a reaction is exergonic or endogonic, spontaneous or non-spontaneous.
40. Interpret reaction energy diagrams (ΔG vs. reaction progress).
41. Characterize the thermodynamic contributors to reaction spontaneity (ΔH and ΔS).
42. Provide an overview of the sources of our energy and determine the net reaction when two reactions are coupled.
43. Distinguish between catabolic and anabolic reactions. Include the role of energy in these processes.
44. Map out the basic cellular anatomy involved in the generation of biochemical energy in humans.
45. Explain the three major stages of the production of biochemical energy from food. (For each stage state the starting materials and the products, what happens in that stage, and its connection to the overall process.)
46. Explain the significance of the acetyl group in acetyl-CoA. What is an acetyl group? Where do the carbon atoms come from? What is its role in the citric acid cycle?
47. Recognize the structural features and give the complete name of ATP.
48. Distinguish between a reduced and an oxidized coenzyme.
49. State the main function of the citric acid cycle and list its end products.
50. Provide a general scenario of electron transport. Include a description of its participants – reduced coenzymes, protein complexes, electron carriers (including mobile electron carriers).
51. State the main function of oxidative phosphorylation and explain why it is coupled with electron transport. Use the terms electrochemical gradient, proton gradient, potential energy, flow, ATP synthase, driving force, ion channel.
52. identify the nitrogen base, monosaccharide and phosphate group in a nucleotide
53. distinguish between DNA and RNA and the 3′ and 5′ alcohols
54. predict the complimentary bases for DNA replication, transcription to mRNA, and translation to tRNA
55. explain the role of IMFs in creating DNA structure
56. compare and contrast the roles of DNA, mRNA, tRNA, and rRNA
57. identify the enzyme needed for DNA replication and protein synthesis
58. explain translation – the process of building a protein from an mRNA template