

Homework

- Chapter 1: review pages 15 to 17 (Henderson-Hasselbalch equation); page 22, appendix; questions 6-12 (page 24).
- Chapter 2: memorize chemical structures of all 20 natural amino acids.

Homework 2

- Draw the chemical structure of the following peptide: MSWCRGRP;
- Draw five times of the peptide bond; review the unique properties of the peptide bond.
- Review the following concepts: the protein primary structure; the protein secondary structure: α -helix, β -sheet, and the reverse turn.
- Read Appendix of Chapter 2 (pages 61-62).

Homework 2

- Review the Torsion Angles (the angles of rotation): ϕ (phi) and ψ (psi). Review Ramachandran diagram.
- Review the tertiary structure; the quaternary structure; domain.
- Review The Christian Anfinsen's experiments.
- Questions 1, 3, 4, 7, 8, 9, 10, 11, 12, and 13.

Homework 3

- Review protein misfolding and aggregation of chapter 2 (pages 53-54).
- Review protein purification including the procedure, SDS-PAGE, and the quantification of a purification protocol.
- Review amino acid sequencing; review immunology techniques.
- Questions 1, 4, 5, 7, 10, 11, 13, 14, 15, 17, and 18 (pages 104-106).

Homework 4

- Please draw five times of pATGC; pay attention to the linkage of phosphate, sugar, and the bases.
- Memorize ribose, deoxyribose, and the five bases.
- Review the properties of the Watson-Crick model of double-helical DNA; be familiar with the A and Z DNA.
- Review the Meselson and Stahl experiment;
- Questions 1, 2, 3, 4, and 5.

Homework 5

- Review the following concepts: DNA replication; transcription; reverse transcription; definition and functions of mRNA, tRNA, and rRNA; promoters; the genetic code; concepts of exons and introns (splicing).
- Questions 6, 8, 9, 11, 12, 13, 14, 18, 19, 21, 22, and 23.

Homework 6

- Review the following concepts: restriction enzymes, agarose gel electrophoresis, Blotting techniques, Sanger dideoxy method for DNA sequencing, DNA synthesis, polymerase chain reaction, and the recombinant DNA technology.
- Questions 1, 2, 3, and 10.

Home work for chapter 7

- Read the appendix on pages 199-201.
- Review the following concepts: the differences between hemoglobin and myoglobin, heme (Fe-protoporphyrin IX); O₂ binding changes the position of the iron ion; the functions of proximal and distal His; hemoglobin quaternary structure and cooperativity (of binding O₂); the oxygen-binding curve; the MWC model and the sequential models; the function of 2,3-BPG; the Bohr effect and explanation; transfer CO₂; Sickle-cell anemia and thalassemia; AHSP.
- Questions 1, 2, 5, 6, 8, and 10.

Homework for chapter 8

- Please review the following concepts: Enzymes are powerful and highly specific catalysts; cofactors, coenzymes, apoenzyme, prosthetic group, and holoenzyme; the Gibbs free energy; the classification of enzymes; enzymes alter only the reaction rate and not the reaction equilibrium; the active sites of enzymes.
- Please review enzyme kinetics: the Michaelis-Menten kinetics (equation and plot); the concept of reaction rate; three assumptions for deriving the Michaelis-Menten equation; derivation of the Michaelis-Menten equation; Graphical analysis: Lineweaver-Burk plot; the meaning of K_M (including f_{es}), V_{max} , and k_{cat} ; the k_{cat}/K_M criterion.
- Pages 238-240, questions 1, 2, 6, 10, and 13.

Homework for chapter 8-2

- Review the following concepts: reversible inhibitor: competitive, uncompetitive, and noncompetitive inhibitors; Lineweaver-Burk analysis of different inhibition; the function and mechanism of penicillin.
- Pages 238-240, questions 2, 4, 5, 11, 14, and 15.

Homework for chapter 8-3

Question 1: suppose that the data shown below are obtained for an enzyme-catalyzed reaction.

[S] (mM)	V (mmol ml ⁻¹ min ⁻¹)
0.1	3.33
0.2	5.00
0.5	7.14
0.8	8.00
1.0	8.33
2.0	9.09

- (a) From a double-reciprocal or Lineweaver-Burk plot of the data, determine K_M and V_{max} .
 (b) Assuming that the enzyme present in the system had a concentration of 10^{-6} M, calculate its turnover number (k_{cat}).

Question 2. Suppose that the data shown below are obtained for an enzyme-catalyzed reaction in the presence and absence of an inhibitor X.

[S] (mM)	V (mmol ml ⁻¹ min ⁻¹) Without X	V (mmol ml ⁻¹ min ⁻¹) With X
0.2	5.0	3.0
0.4	7.5	5.0
0.8	10.0	7.5
1.0	10.7	8.3
2.0	12.5	10.7
4.0	13.6	12.5

- (a) Using double-reciprocal or Lineweaver-Burk plots of the data, determine the type of inhibition that has occurred.
 (b) Does inhibitor X combine with E, with ES, or with both? Explain.
 (c) Calculate the inhibitor constant K_i for substance X, assuming that final concentration of X in the reaction mixture was 0.2 mM.

Homework for Chapter 9

- Understand the mechanism by which chymotrypsin hydrolyzes a peptide bond: the specificity, the catalytical triad, the mechanism (tetrahedral intermediate, oxyanion hole, acyl-enzyme), the S1 pockets and the specificity of trypsin, chymotrypsin, and elastase, and the application of site-directed mutagenesis in study of enzyme specificity.
- Review the following concepts: other proteases and design of anti-HIV drugs; the mechanism of carbonic anhydrase: the role of Zinc ion, the pH dependence, and the histidine proton shuttle; the mechanism of restriction enzyme EcoRV: the mechanism (direct hydrolysis and the role of Mg⁺⁺ ion), cognate and nonspecific DNA binding, the role of methylation; the mechanism of nucleotide monophosphate kinase: the P-loop, the induced fit, and the role of Mg⁺⁺ ion.
- Questions 3, 4, 5, 6, 7, 11, 12, and 13.

Homework for chapter 10

- Review the following concepts: **Aspartate transcarbamoylase (ATCase)**: allosterically inhibited by CTP (the first committed step; chemical structure of CTP); catalytic and regulatory subunits; Locating of the active sites(PALA); conformational change of the enzyme; T and R states; the concerted model: MWC model; explain why it does not follow Michaelis-Menten kinetics; **Isozymes and covalent modifications**: definition; kinases vs. phosphatases; advantages of Phosphorylation; flight and fight; **Zymogen**: Definition; the digestive enzymes in the stomach and pancreas; chymotrypsinogen to chymotrypsin; trypsin inhibitor. **Blood clotting**: blood clotting cascade and amplification effect; Fibrinogen is converted by thrombin into a fibrin clot; Prothrombin is readied for activation by a vitamin K-dependent modification; the clotting process must be precisely regulated: tissue-type plasminogen activator (TPA).
- Questions 1, 3, 4, 5, 7, 9, 10, and 19.

Homework for Chapter 11

- Please draw 10 times of the chemical structures of the following sugars: D-Glyceraldehyde, dihydroxyacetone, D-ribose, D-glucose, D-mannose, D-galactose, D-fructose, sucrose, lactose, and maltose.
- Please review the following concepts: definitions of carbohydrates; glycogen, starch, and cellulose; Fisher projection, Haworth projections; Hemiacetal and hemiketal; α and β configurations; Conformation of pyranose and furanose ring; O- and N-glycosidic bonds; general form of a glycosyltransferase; O, A, and B antigens. **Glycoproteins:** N-linkage and O-linkage; locations of Protein glycosylation, i.e. ER and Golgi complex; Mannose 6-phosphate targets lysosomal enzymes to their destinations (I-cell disease); lectins.
- Problems 3, 4, 5, 8, 9, 10, 12, 13

Homework for Chapter 12

- **Please review common features of membrane:** Sheetlike structure, only two molecules thick, 60 to 100 Å; Contain lipids and proteins (1:4 to 4:1); Have hydrophilic and hydrophobic moieties; Noncovalent assemblies; asymmetric and fluid structures; Electrically polarized.
- **Fatty acids:** definition; systematic name; double bonds.
- **Three common types of membrane lipids:** Phospholipids: glycerol based or sphingosine based, chemical structures; Glycolipids; Cholesterol; common properties; Formation of membrane of phospholipids and glycolipids in aqueous solutions.
- **Trans-membrane proteins and membrane associated proteins:** Proteins can span the membrane with alpha helices: the most common motifs in membrane proteins; A channel protein can be formed from beta sheet; Embedding part of a protein in a membrane can link it to Membrane surface; Some proteins associate with membranes through covalently attached hydrophobic groups; Diffusion in membranes; Fluid mosaic model; Membrane fluidity is controlled by fatty acid composition and cholesterol content; Cell plasma membrane, mitochondria membrane, ER, nuclear membrane, and etc; •Proteins are targeted to specific compartments by signal sequences such as nucleus localization signal: -KKXK or -(K/R)-X10-12-(K/R)-.
- **Membrane channels and pumps.**
- **Problems 1, 5, 6, 7, 9, 11, 12, and 13.**

Homework for Chapter 15

- Please draw five times of the chemical structures of the following molecules: ATP, NADH, CoA-SH, and cAMP.
- Please review the following concepts: catabolism vs. anabolism; reactions coupling; high energy bonds of ATP; ATP hydrolysis and the coupled reactions; other high phosphoryl transfer potential compounds; activated carriers; metabolic regulation; energy status; signal transduction pathway: the second messengers; seven transmembrane helix receptor; G proteins; how does the signal transduction pathways pass and amplify the information.
- Problems 1, 3, 8, and 12.

Homework for Chapter 16

- Please draw three times of the chemical structures of glycolysis. Please also draw catalytic mechanisms of triose phosphate isomerase and glyceraldehyde 3-phosphate dehydrogenase.
- Please review the chemical reactions and enzymes of glycolysis; NAD⁺ regeneration; Intolerant of milk; the regulation of glycolysis: muscle and liver.
- Problems 1, 2, 5, 8, 13, and 19.

Homework for Chapter 17

- Please draw five times of the chemical structures of Acetyl CoA, thiamine pyrophosphate (TPP), and lipoamide.
- Please draw the citric acid cycle including all chemical structures and enzymes.
- Please draw the catalytical mechanism of pyruvate dehydrogenase (the synthesis of acetyl CoA from pyruvate).
- Please draw the mechanism of synthesis of citryl CoA by citrate synthase.
- Please draw the reaction mechanism of succinyl CoA synthetase.
- Please review how the citric acid cycle is regulated.
- Problems 5, 9, 11, 12, and 13.

Homework for Chapter 18

- Please draw five times of the chemical structure of ubiquinone (coenzyme Q or Q).
- Please review the following concepts: **Mitochondria and its components. Electron carriers:** In addition to NAD and flavoproteins, three other types of electron-carrying molecules function in the respiration chain: ubiquinone (coenzyme Q or Q) and two types of iron-containing proteins (cytochromes and iron-sulfur proteins). The standard reduction potentials of respiratory chain and the related electron carriers. The sequence of electron carriers. The electron carriers of the respiratory chain are organized into four membrane-embedded supramolecular complexes: complex I, II, III, & IV. Mechanisms of four complexes, such as Q cycle. The energy of electron transfer is efficiently conserved in a proton gradient: the calculation. **ATP synthase:** The chemiosmotic model proposed by Peter Mitchell. ATP synthase. The mechanism. Shuttles systems for transporting NADH. **Regulation of oxidative phosphorylation and mitochondria diseases and the evolution.**
- Problems 1, 3, 4, 6, 10, 11, 14, 15, 17, 18, and 20.