CHM 321: Exam 2.1 **name: _____**

I. Short Answers & Graphs

1. Include your Lineweaver-Burk plots from question 75 in Section 2.2, and provide the following: (10 points)

a. Labels for each plot.
b. Label the positions on the plot, and corresponding equations, that provide the V_{max} values.
c. Label the positions on the plot, and corresponding equations, that provide the K_m values.

2. What is the sequence for the following HEXAPEPTIDE? (10 points)

- ***be sure to provide WORK/ANSWER for Points B-F!***

Observations from Sequencing Experiments

A. amino acid content: Y, R, M, K, G, D
B. Reaction with 1-fluoro-2,4-dinitrobenzene yielded DNP-G.
C. Treatment with chymotrypsin yielded two tripeptides.
D. Treatment with trypsin yielded three dipeptides.
E. Treatment with carboxypeptidase yielded methionine.
F. N-terminal sequencing of one the chymotrypsin-produced tripeptides yielded DNP-K.

Explanation and Summary of Protein Sequencing Techniques

1. *1-fluoro-2,4-dinitrobenzene* (DNFB) is used to identify the N-terminal amino acid of a peptide, and provides the following product: DNP-AA (where AA = the N-terminal amino acid of the peptide).

2. *Trypsin* is an enzyme that cleaves a peptide at the C-terminal side of R and K.

3. *Chymotrypsin* is an enzyme that cleaves a peptide at the C-terminal side of F, Y, and W.

4. *Carboxypeptidase* is an enzyme that cleaves off the C-terminal amino acid of any peptide.

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I. Fragen von biochimie: (80 points)

1. The entire set of proteins contained in an organism is called the:
A. proteogroup B. proteome C. proteocity D. proteoset E. proteocluster

2. Which of the following amino acids is <u>NOT</u> destabilizing for alpha helices.
A. glycine B. proline C. alanine D. tryptophan E. 4-hydroxyproline

3. Which class defines the following enzyme: Aconitase?
A. lyase B. oxidoreductase C. hydrolase D. ligase E. transferase

4. Which class defines the following enzyme: Lipoxygenase?
A. lyase B. oxidoreductase C. hydrolase D. ligase E. transferase

5. For an enzyme with a k_{cat} of 560 s^{-1}, how many substrates are converted to product per second by every one enzyme?
A. 560 B. 56 C. 5.6 D. 0 E. none of the above

6. Ribulofuranose contains which functional group?
A. acetal B. hemiacetal C. ketal D. hemiketal E. ketone

7. Mutorotation refers to an inversion of configuration at the:
A. anomeric carbon B. alpha carbon C. terminal carbon
D. nucleophilic carbon E. carbohydrate carbon

8. When compared to cellulose, chitin is a unique due to the presence of which functional group?
A. ester B. ketal C. thioester D. phosphate E. amide

9. What type of glycosidic bond occurring between a ketose and ketose would yield a non-reducing disaccharide?
A. (1,2) B. (1,1) C. (1,4) D. (2,2) E. (4,4)

10. Disaccharides that contain repeating uronic acids and hexosamines are typically referred to as what type of biological molecules?
A. lipopolysaccharide B. isoprenoid C. neuropeptides
D. oxidized hexoses E. glycosoaminoglycan

11. Antibodies are characterized as _____ and possess oligosaccharides bonded to the amino acid of _____.
A. O-linked; serine B. O-linked; asparagine C. O-linked; threonine
D. N-linked; glutamine E. N-linked; asparagine

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12. Gram-positive bacteria possess which glycoconjugate on their outer surface?

A. glycopeptides B. lipopolysaccharide C. proteoglycan
D. peptidoglycan E. glyconucleotide

13. Amylopectin is a branched polysaccharide with which glycosidic linkages?

A. α(1,4) and α(1,6) B. C. β(1,4) and β(1,6)
C. α(1,2) and α(1,6) D. α(1,2) and α(1,6)

14. The ribose sugar within the structure of DNA is a modified in which way?

A. an extra carbon B. it is lacking a OH at the 5' position C. it a ketose
D. it is lacking a OH at the 2' position E. it is lacking a OH at the 3' position

15. In RNA, the base is connected to which carbon of ribose in the nucleotide structure?

A. 1 B. 1' C. 2 D. 2' E. 5'

16. For a glucose homopolysaccharide, which of the following glycosidic linkages would promote the formation of a helical structure?

A. α(1,4) B. β(1,4) C. β(1,6) D. α(1,6) E. α(1,2)

17. Which class of glycoconjugates contain both *D* and *L*-amino acids?

A. glycolipids B. peptidoglycans C. glycolipid D. lipopolysaccharide E. lipoprotein

18. Which class of lipids are the main components of cell membranes?

A. isoprenoids B. wax esters C. sphingolipids D. phospholipids E. none of these

19. Which fatty acid would have the higher melting point?

A. 20:0 B. $20{:}1^{\Delta 9}$

20. Which of the following lipid derivatives is classified as an eicosanoid?

A. oleic acid B. carotenoids C. phospholipids D. sphingomyelin E. leukotriene

21. Which of following structures contains a hydrophilic interior?

A. micelles B. hemoglobin C. myoglobin D. liposome E. DNA

22. Terpenes and carotenoids are biosynthesized from which lipids?

A. isoprenoids B. wax esters C. sphingolipids D. phospholipids E. triacylglycerols

23. The prosthetic group on sphingolipids are:

A. amino acids B. a peptide C. carbohydrates D. a heme group E. zinc

24. Neutral lipids are normally associated with which purpose:

A. signaling B. structure C. catalysis D. energy E. information storage

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25. The active transport of solutes across a membrane is typically coupled to which type of reaction?

A. exergonic B. endergonic C. non-spontaneus D. entropically negative E. exothermic

26. The membrane spanning portions of transmembrane proteins are often composed of what type of supersecondary and/or 2˚ structures?

A. beta-barrels & alpha-helices B. Greek key & beta turns C. beta-barrels & Greek keys
D. double helices and alpha-helices E. beta-meander and alpha-helices

27. Which of the following statements best describes the Na-glucose transporter of the intestinal epithelia?

A. The active transport mechanism transports both glucose and Na into the intestinal lumen.
B. The passive transport mechanism transports both glucose and Na into the intestinal lumen.
C. The active transport mechanism transports both glucose and Na into the intestinal epithelia.
D. The active transport mechanism transports glucose into the intestinal epithelia and Na into the intestinal lumen.
E. The passive transport mechanism transports glucose into the intestinal epithelia and Na into the intestinal lumen.

28. At low temperatures, bacteria will increase the number of _____ lipids in their membranes in order to increase the fluidity, or liquid nature, of the membrane.

A. saturated B. unsaturated C. glyco- D. poly- E. shorter

29. Eicosanoids that contains cyclic ether functional groups are known as _____.

A. prostaglandins B. leukotrienes C. thromboxins D. cyclic lipids E. lipocyclams

30. Which enzyme catalyzes the transverse diffusion of lipids?

A. lipidase B. transversase C. switchase D. flippase E. bilayerase

31. Peripheral proteins typically use which type of amino acids to bind to the surface of a lipid bilayer?

A. non-polar B. polar C. basic D. acidic E. cystine

32. Which reagent is needed for the removal of transmembrane proteins from a lipid bilayer?

A. low pH, HCl B. high pH, NaOH C. detergent D. NaCl E. Urea

33. Which functional group holds together the nucleotide units in DNA?

A. phosphodiester B. phosphate C. hemiacetal D. ester E. amide

34. Which of the following metabolic processes occurs in the nucleus?

A. ETC B. transcription C. translation D. glycolysis E. β-oxidation

35. There are approximately how many base pairs/turn in B-DNA?

A. 8 B. 9 C. 10.5 D. 11 E. 3.4

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36. DNA sequences should be read in which direction?

A. 5′→3′ B. 3′→5′

37. Cations such as Mg^{2+} and Ca^{2+} can help to stabilize duplex DNA.

A. True B. False

38. The two strands in duplex DNA are held together by which type of bonds?

A. H-bonds and salt bridges B. H-bonds and dipole-dipole interactions
C. H-bonds and π–stacking D. π–stacking and salt bridges
E. H-bonds only

39. The 'bicyclic' bases of nucleic acids are known as _____.

A. pyrimidines B. purine

40. Which of the following bases is NOT found in ribonucleic acids?

A. adenine B. thymine C. uridine D. cytosine E. guanine

41. Which form of DNA is classified as a left-handed double helix?

A. A-DNA B. B-DNA C. Z-DNA D. cruciform DNA E. hairpin DNA

42. What is the configuration at the anomeric carbon of all nucleotides?

A. Beta B. Trans C. Puckered D. Cis E. Alpha

43. Which of the following reaction types is used to gain energy during metabolism?

A. combustion B. esterification C. hydrolysis D. reduction E. protonation

44. The energy used in metabolism is best described by which term?

A. Gibbs free energy B. enthalpy C. entropy D. heat E. internal energy

45. Aerobic respiration relies on the use of oxygen as an electron donor.

A. True B. False

46. Which of the following metabolic pathways DO NOT occur in the mitochondria.

A. pyruvate dehydrogenase complex B. TCA C. ETC
D. Oxidative Phosphorylation E. Glycolysis

47. Pyruvate dehydrogenase catalyzes the conversion of pyruvate to:

A. acetyl-CoA B. HS-CoA C. lactate D. ethanol E. acetic acid

48. What is the primary way in which glycolysis is regulated?

A. competitive inhibition B. transcriptional control
C. translational control D. allosteric inhibition

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49. GTP is produced by which of the following metabolic pathways?

A. glycolysis B. TCA C. lipolysis D. ETC E. Oxidative Phosphorylation

50. The enzyme complexes associated with the <u>electron transport chain</u> are dominantly made up of which class of enzymes?

A. ligases B. lyases C. hydrolases D. transferases E. oxidoreductases

51. For every one glucose that is metabolized, how many net ATP are produced by just glycolysis?

A. 1 B. 2 C. 3 D. 4 E. 5

52. For every one glucose that is metabolized, how many net ATP are produced by aerobic respiration (glycolysis, TCA, ETC, and Oxidative Phosphorylation)?

A. ~5 B. ~10 C. ~20 D. ~30 E. ~40

53. Which of the following cofactors <u>cannot</u> undergo a one electron reduction?

A. FADH• B. FAD C. UQ D. NAD^+ E. $UQH•^-$

54. What is the purpose of the electron transport chain?

A. to pump electrons out of the matrix B. to pump protons out of the matrix
C. to bring electrons into the matrix D. to bring protons into the matrix
E. none of these

55. As a result of the ETC, an osmotic difference is created between the matrix and the _____.

A. cytoplasm B. matrix C. nucleus D. innermembrane space E. outermembrane

56. During <u>heavy exercise</u>, pyruvate is metabolized by which pathway in an effort to regenerate NAD^+?

A. lactic acid fermentation B. alcoholic fermentation C. TCA cycle
D. oxidative phosphorylation E. pyruvate dehydrogenase complex

57. During oxidative phosphorylation, where is the energy for synthesizing ATP gained?

A. through exergonic reactions B. oxidation of Cyt C C. oxidation of ethanol
D. electronmotive force E. protonmotive force

58. Which of the following biochemicals is used to store electrons?

A. NADH B. ATP C. Acetyl-CoA D. hemoglobin E. sphingolipids

59. The fluid mosaic model governs the diffusion of which of the following biochemicals?

A. CoQ B. steroids C. phospholipids D. sphingolipids E. all of these biochemicals

60. The complete β–oxidation of an acyl-CoA, that contains a 18:0 fatty acid, would yield how many acetyl-CoA?

A. 1 B. 18 C. 0 D. 9 E. 20

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61. During hibernation, thermogenin is a protein that has what property and function?

A. integral protein that channels protons to the matrix
B. peripheral protein that obtains electrons from the ETC
C. integral protein that channels protons into the cytosol
D. peripheral protein that channels electrons into the cytosol
E. integral protein that channels protons into the innermembrane space

62. Organic molecules that uncouple the electron transport chain from ATP synthesis have what major properties?

A. hydrophilic & basic B. hydrophobic & basic C. hydrophilic & nucleophilic
D. hydrophobic & nucleophilic E. hydrophobic & hydrophilic

63. What is the chemical function of the biological cofactor coenzyme A?

A. activation of carbonyl-containing groups B. 1 electron transfers
C. hydride transfers D. methyl transfers E. breaking bonds to carbonyls

64. For the pyruvate dehydrogenase complex, what is the specific chemical function of the thiamine pyrophosphate cofactor?

A. activation of acetyl-CoA B. oxidation of lipoic acid
C. reduction of NAD^+ D. transfer of the acetyl group to CoA E. decarboxylation of pyruvate

65. For the pyruvate dehydrogenase complex, what is the specific chemical function of the lipoic acid cofactor?

A. activation of acetyl-CoA B. oxidation of lipoic acid
C. reduction of NAD^+ D. transfer of the acetyl group to CoA E. decarboxylation of pyruvate

66. For the pyruvate dehydrogenase complex, what is the specific chemical function of the FAD cofactor?

A. activation of acetyl-CoA B. oxidation of lipoic acid
C. reduction of NAD^+ D. transfer of the acetyl group to CoA E. decarboxylation of pyruvate

67. When carbon is a limiting factor, many organisms will skip which steps in the Tricarboxylic Acid Cycle?

A. the steps liberating CO_2 B. the hydrolysis steps
C. the formation of GTP D. the loss of CoA E. all steps producing NADH

68. What is the pH of 10.0 mL solution of 0.75 M acetate after adding 5.0 mL of 0.10 M HCl (assume a K_a of acetic acid of 1.78×10^{-5})?

A. 3.60 B. 3.87 C. 5.90 D. 5.62 E. 4.45

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69. In signal transduction, how can a single molecular event, or binding of an agonist, result in significant changes to cell metabolism or function?

A. Through activation of enzyme cascades.
B. By promoting rapid changes in ion flux in/out of the cell.
C. By inducing conformational changes that alter cytoskeletal interactions.
D. None of these answers are correct.
E. All of these answers are correct.

70. G-proteins can be described by all of the following properties except _____.

A. G-proteins are trimeric.
B. G-proteins bind to magnesium.
C. G-proteins bind to GDP.
D. G-proteins bind to GTP.
E. G-proteins possess 7 transmembrane alpha helices.

71. Binding of agonists to protein membrane receptors can result in which of the following events?

A. Conformational changes
B. Intracellular release GDP
C. Intracellular activation of kinase activity
D. Intracellular formation of cGMP and/or cAMP
E. All of these events can occur upon agonist binding.

72. Which of the following combination of events are associated with activation of the β–adrenergic receptor pathway?

I. Binding of an antagonist.
II. Binding of an agonist.
III. Ligand-induced membrane spanning conformational changes.
IV. Ligand-induced conformational changes that occur only in extracellular region of the receptor.
V. An increased association between the receptor protein and G protein.
VI. An increased dissociation between the receptor protein and G protein.
VII. Association of multiple subunits to form a trimeric G protein.
VIII. Dissociation of the trimeric G protein.
IX. Conversion of G_α(GDP) to G_α(GTP).
X. Conversion of G_β(GDP) to G_β(GTP).

A. I, III, VI, VIII, & IX
B. II, III, VI, VIII, & IX
C. II, IV, VI, VIII, & IX
D. II, III, VI, VIII, & X
E. II, III, V, VII, & XI

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73. Several prostaglandin derivatives were synthesized in the lab and tested for their ability to sensitize a prostaglandin-specific G-protein coupled receptor and modulate cholesterol metabolism. According to the information below, which of the prostaglandin derivatives (PD) would form the most stable complex with the receptor?

A. PD1, K_D = 1 nM
B. PD2, K_D = 1 μM
C. PD1, K_M = 1 nM
D. PD2, K_M = 1 μM

74. In the cAMP-dependent activation of pyruvate kinase, which of the following amino acids is phosphorylated?

A. His B. Thr C. Tyr D. Ser E. Lys

75. The following table provides the rates of reaction for an enzyme measured in the absence and presence of an inhibitor. According to this information, what is the mechanism of inhibition? (Hint, make Lineweaver-Burk plots and see Chapter 7 of the textbook.)

A. competitive B. uncompetitive C. noncompetitive
D. allosteric E. irreversible inhibition

[S] (mM)	Rate w/o Inhibitor (μM/s)	Rate w/ Inhibitor (μM/s)
1.3	2.5	1.17
2.6	4	2.1
6.5	6.3	4
13	7.6	5.9
26	9	7

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76-80. Identify the class of enzymes responsible for each of the following reactions:

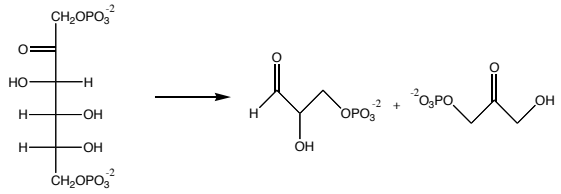
--PROVIDE ANSWERS ON SCANTRON—

A. Oxidoreductase B. Transferase C. Hydrolase D. Lyase E. Ligase

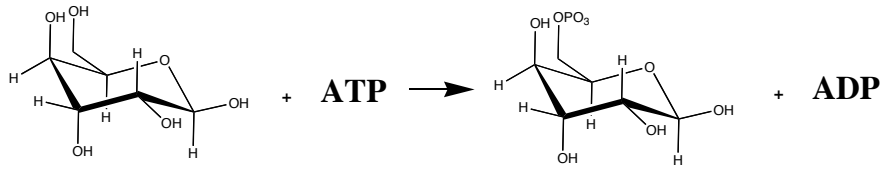
76. Reaction 1:

M-F-R-I-L-P-K ⟶ M-F + R-I-L-P-K

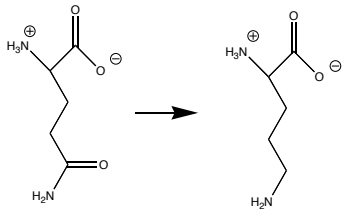
77. Reaction 2:



78. Reaction 3:



79. Reaction 4:



80. Reaction 5:

G-A-T-T-A + C-A → G-A-T-T-A-C-A (an oligonucleotide)