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# MedBiochem Exam 1, 1998

**For each of the following questions, choose the one best answer.**

(Answer key and results of the exam liaison meeting are posted at the bottom of the page.)

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**1. What is the approximate ratio of lactic acid molecules to lactate ions in a urine sample at pH 3.9? (Lactic acid pK = 3.9)**

A. 1 : 1

B. 0.1 : 1

C. 1 : 0.1

D. 99 : 1

E. 1 : 99

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**2. All of the following substances are intermediates in the formation of glucuronic acid from glucose EXCEPT**

A. UDP-glucose.

B. UDP-galactose.

C. UDP-glucuronic acid.

D. glucose 6-phosphate.

E. glucose 1-phosphate.

---

**3. What is the net yield of NADH when glucose 6-phosphate is catabolized by anaerobic glycolysis to yield lactate?**

- A. 0 NADH/glucose 6-phosphate**
  - B. 1 NADH/glucose 6-phosphate**
  - C. 2 NADH/glucose 6-phosphate**
  - D. 3 NADH/glucose 6-phosphate**
  - E. 4 NADH/glucose 6-phosphate**
- 

**4. A congenital defect in which enzyme may cause hemolytic anemia following administration of the antimalarial drug, primaquine?**

- A. hexokinase**
  - B. pyruvate kinase**
  - C. glucose 6-phosphate dehydrogenase**
  - D. phosphofructokinase**
  - E. glyceraldehyde 3-phosphate dehydrogenase**
- 

**5. Which of the following best applies to glucokinase?**

- A. The  $K_m$  is above the fasting concentration of glucose in the blood.**
  - B. Found only in muscle.**
  - C. Stimulated in response to fructose 2,6-bisphosphate.**
  - D. Inhibited by glucose 6-phosphate**
  - E. phosphorylates fructose and galactose.**
- 

**6. Which of the following is the first enzyme unique to the pentose phosphate pathway?**

- A. lactonase**

- B. 6-phosphogluconate dehydrogenase**
  - C. transaldolase**
  - D. glucose 6-phosphate dehydrogenase**
  - E. phosphoglucoisomerase**
- 

**7. All of the following statements about glycolysis and gluconeogenesis are true EXCEPT:**

- A. High concentrations of acetyl-CoA inhibit acetyl-CoA formation from pyruvate.**
  - B. High citrate concentrations in the cytosol can inhibit PFK activity.**
  - C. High concentrations of acetyl-CoA stimulate carboxylation of pyruvate.**
  - D. Oxaloacetate is formed from the condensation of two acetyl CoA molecules.**
  - E. NADH is required for the formation of glucose from pyruvate.**
- 

**8. Which of the following enzymes is missing in galactosemia?**

- A. UDP-galactose pyrophosphorylase**
  - B. UDP-glucose-4-epimerase**
  - C. Galactose 1-phosphate uridylyltransferase**
  - D. lactase**
  - E. UDP-galactose 4-epimerase**
- 

**9. Other than hexokinase, where is ATP consumed in glycolysis?**

- A. pyruvate kinase**

- B. phosphoglycerate kinase**
  - C. glyceraldehyde 3-phosphate dehydrogenase**
  - D. enolase**
  - E. phosphofructokinase**
- 

**10. In liver, the initial step in the utilization of fructose is phosphorylation to fructose 1-phosphate. This is followed by**

- A. phosphorylation to fructose 1,6-bisphosphate.**
  - B. aldol cleavage to form glyceraldehyde and dihydroxyacetone phosphate.**
  - C. conversion to fructose 6-phosphate by action of a phosphofructomutase.**
  - D. isomerization to glucose 1-phosphate.**
  - E. hydrolysis to fructose followed by isomerization to glucose.**
- 

**11. Glycolysis:**

- A. is necessary to maintain reduced glutathione in the red cell.**
  - B. is accelerated in muscle when the tissue becomes aerobic.**
  - C. is the sole source of ATP in erythrocytes.**
  - D. consumes more energy than it produces.**
  - E. provides NADPH which is required by the hexose monophosphate pathway.**
- 

**12. A major contributing factor to cataract formation in diabetes may be the accumulation of sorbitol in the lens. For that to occur, which of the following enzymes is required?**

- A. glucose oxidase.**
  - B. aldose reductase.**
  - C. fructose dehydrogenase.**
  - D. hexokinase and glucose 6-phosphate dehydrogenase.**
  - E. hexokinase and phosphohexose isomerase.**
- 

**13. Which citric acid cycle enzyme produces ATP by substrate level phosphorylation?**

- A. aconitase**
  - B. succinate dehydrogenase**
  - C. isocitrate dehydrogenase**
  - D. succinate thiokinase**
  - E. fumarase**
- 

**14. Thiamine pyrophosphate participates in the reaction catalyzed by**

- A. transketolase.**
  - B. transaldolase.**
  - C. pyruvate carboxylase.**
  - D. isocitrate dehydrogenase.**
  - E. lactate dehydrogenase.**
- 

**15. Which of the following is absent in muscle, but is present the liver?**

- A. pyruvate carboxylase.**
- B. glucose 6-phosphatase.**

- C. lactate dehydrogenase.**
  - D. pyruvate dehydrogenase.**
  - E. glycogen phosphorylase.**
- 

**16. The immediate products of oxidation of one mole of glucose 6-phosphate through the oxidative portion of the pentose phosphate pathway are**

- A. one mole of ribulose 5-phosphate, one mole of carbon dioxide and two moles of NAD.**
  - B. one mole of ribose 5-phosphate, one mole of carbon dioxide and two moles of NADP.**
  - C. one mole of xylulose 5-phosphate, one mole of carbon dioxide and two moles of NADPH.**
  - D. one mole of ribulose 5-phosphate, one mole of carbon dioxide and two moles of NADPH.**
  - E. one mole of fructose 6-phosphate and two moles of NADP.**
- 

**17. During gluconeogenesis, which enzyme must be present in addition to the glycolytic enzymes?**

- A. phosphofructokinase**
  - B. glucose 6-phosphate dehydrogenase**
  - C. phosphoenolpyruvate carboxykinase**
  - D. pyruvate kinase**
  - E. aldolase**
- 

**18. Ethanol and ethylene glycol are both metabolized by aldehyde dehydrogenase. Occasionally alcoholics will consume ethylene glycol**

**in place of ethanol. Ethanol is administered as a treatment in cases of ethylene glycol poisoning. Which of the following is the most likely explanation of why ethanol is effective as a treatment?**

- A. Ethanol induces another enzyme that is capable of metabolizing ethylene glycol.**
  - B. Ethanol combines with the toxic products of ethylene glycol which renders them inactive.**
  - C. Ethanol is an allosteric effector of aldehyde dehydrogenase in addition to being a substrate**
  - D. Aldehyde dehydrogenase has a lower Michaelis constant ( $K_m$ ) for ethanol than for ethylene glycol**
  - E. Ethanol acts as a transition state analog and inhibits the aldehyde dehydrogenase from acting on ethylene glycol**
- 

**19. Which gluconeogenic enzyme would be impaired in a biotin deficiency?**

- A. aldolase**
  - B. pyruvate kinase**
  - C. lactate dehydrogenase**
  - D. pyruvate carboxylase**
  - E. malate dehydrogenase**
- 

**20. All of the following statements about ATP are correct EXCEPT**

- A. ATP is the principle donor of free energy in biologic systems**
- B. ATP is used by enzymes to phosphorylate proteins**
- C. Creatine phosphate has a higher free energy of hydrolysis than ATP**

**D. ATP is regenerated in cells by the action of adenylate kinase**

**E. ATP hydrolysis is considered to be exergonic because the products of the hydrolysis of ATP to ADP and Pi are less stable**

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**21. Which of the following enzymes forms alpha-1,6 linkages in glycogen?**

**A.  $\alpha$ -1,6 glucosidase**

**B. glycogen synthase**

**C. glycogen branching enzyme**

**D. glucose 6-phosphatase**

**E. phosphorylase kinase**

---

**22. All of the statements about Coenzymes are true EXCEPT**

**A. coenzymes are the non-protein portion of an enzyme**

**B. cosubstrates that associate transiently with the active site of the enzyme**

**C. cosubstrates that undergo an alteration following completion of the reaction**

**D. prosthetic groups are the non protein portion of enzymes that associate transiently with the active site of the enzyme**

**E. vitamins are important constituents of prosthetic groups**

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**23. Which of the following statements apply to glycogen phosphorylase?**

**A. ADP is one of the substrates of this enzyme.**

**B. Its activity is increased by high levels of glucose 6-phosphate.**

- C. The inactive form is phosphorylated.**
  - D. The liver enzyme is activated primarily by epinephrine.**
  - E. It produces glucose 1-phosphate.**
- 

**24. All of the following statements about the Michaelis constant are correct EXCEPT**

- A. the  $K_m$  is the substrate concentration that produces half maximum velocity**
  - B. the  $K_m$  is affected by competitive inhibition**
  - C. the  $K_m$  is a measurement of the velocity of the reaction**
  - D. higher  $K_m$  corresponds to lower affinity**
  - E. the  $K_m$  of an enzyme can be determined by measuring reactions at different substrate concentrations**
- 

**25. Each of the following is involved in the conversion of glucose to glycogen in the liver EXCEPT**

- A. glycogenin**
  - B. phosphorylase kinase**
  - C. glucose 1-phosphate uridylyltransferase**
  - D. phosphoglucomutase**
  - E. glucokinase**
- 

**26. Which statement concerning enzyme catalyzed reactions is correct**

- A. the free energy of activation ( $\Delta G_{act}$ ) is the difference in free energy in the substrate (initial state) and the free energy in the product**

- B. the transition state is a stable form of the enzyme and substrate**
  - C. enzymes decrease the free energy of activation ( $\Delta G_{act}$ )**
  - D. enzymes are consumed while catalyzing a reaction**
  - E. enzymes alter the equilibrium constant**
- 

**27. Which intermediate in glycolysis activates the phosphorylated form of glycogen synthase?**

- A. glyceraldehyde 3-phosphate**
  - B. fructose 2,6-bisphosphate**
  - C. fructose 6-phosphate**
  - D. glucose 6-phosphate**
  - E. glucose 1-phosphate**
- 

**28. An allosteric effector influences the enzyme activity by**

- A. covalently modifying the enzyme**
  - B. binding to the substrate and altering its conformation**
  - C. competing for the catalytic site with the substrate**
  - D. changing the specificity of the enzyme for its substrate**
  - E. binding to a site on the enzyme distinct from the catalytic site**
- 

**29. Which enzyme in muscle glycogen metabolism is activated by calcium?**

- A. phosphorylase kinase a**
- B. phosphorylase kinase b**

- C. glycogen synthase b**
  - D. branching enzyme**
  - E. phosphorylase a**
- 

**30. The following statement best describes zero order reaction conditions**

- A. the reaction rate is directly proportional to the substrate concentration**
  - B. the rate of the reaction is increasing linearly**
  - C. the reaction rate is constant and independent of the concentration of the substrate**
  - D. the reaction only occurs at low substrate concentration**
- 

**31. Which one of the following statements describes the side chain of the amino acid serine?**

- A. Can form hydrogen bonds**
  - B. Can form disulfide bonds**
  - C. Can participate in hydrophobic forces**
  - D. Is charged at physiologic pH**
  - E. Contains a primary amino group**
- 

**32. Which statement about the Induced Fit Model is correct**

- A. the substrate changes shape once the enzyme has bound**
- B. the active site of the enzyme is complementary in conformation to the substrate**

**C. the conformation of the enzyme changes after binding to the substrate**

**D. the active site of the enzyme alternates in conformation between opened or closed**

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**33. When dinitrophenol is added to mitochondria, it**

**A. decreases the flow of electrons through cytochrome oxidase.**

**B. results in an increase in the intramitochondrial ratio of ATP/ADP.**

**C. uncouples oxidative phosphorylation.**

**D. increases the rate of ATP formation.**

---

**34. All of the following statements about enzymes are correct EXCEPT**

**A. enzymes are usually protein in nature and cause reactions to occur**

**B. enzymes form complexes with substrates and products**

**C. enzymes affect the rate of reactions and are not permanently altered during a reaction**

**D. enzymes can undergo structural modification during a reaction**

**E. enzyme specificity requires specific functional groups on the enzyme and substrate**

---

**35. When oxidative phosphorylation and electron transport are tightly coupled**

**A. ubiquinone transfers electrons from Complex I to Complex II.**

**B. oligomycin will cause an inhibition of electron transport.**

**C. the electrons transported from one  $\text{FADH}_2$  will produce 3 ATP.**

**D. a decrease oxygen supply increases the flow of the electron transport system.**

**E. an increase in the rate of ATP synthesis will automatically decrease electron transport**

---

**36. Coupled reactions involved in the trapping of free energy from fuel molecules consist of**

**A. two endergonic reactions, one of which has a higher standard free energy change ( $\Delta G^{\circ}$ ) than the other**

**B. two exergonic reactions, one of which has a lower  $\Delta G^{\circ}$  than the other**

**C. one exergonic reaction coupled to an endergonic reaction, which has a lower  $\Delta G^{\circ}$  than the exergonic reaction**

**D. one endergonic reaction coupled to an exergonic reaction, which has a lower  $\Delta G^{\circ}$  than the endergonic reaction**

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**37. Relative to the normal state, what would be the redox state of the cytochromes of a patient who has accidentally ingested a large amount of sodium azide?**

**A. more oxidized**

**B. more uncoupled**

**C. unchanged**

**D. cytochrome c more oxidized than Complex I.**

**E. more reduced**

---

**38. If a reaction is at equilibrium, the free energy change ( $\Delta G$ ) is**

**A. Equal to  $-RT \times \ln K_{eq}$**

- B. Equal to the concentrations of the substrate and product**
  - C. Equal to the  $\Delta G$  under standard conditions**
  - D. Equal to zero**
  - E. equal to the change in entropy**
- 

**39. In mammalian cells, the pyruvate dehydrogenase multienzyme complex**

- A. catalyzes a reversible reaction.**
  - B. is regulated by phosphorylation-dephosphorylation.**
  - C. is a cytoplasmic enzyme.**
  - D. is inhibited by high levels of pyruvate.**
  - E. attaches carbon dioxide to pyruvate producing oxaloacetate**
- 

**40. The normal concentration of glucose 6 phosphate (G6P) and fructose 6 phosphate (F6P) in human erythrocytes are  $1 \times 10^{-5}$  M and  $1 \times 10^{-6}$ , respectively. If the standard free energy change ( $\Delta G^{\circ}$ ) for the reaction**

**G6P-----> F6P is + 0.4 kcal/mol, which of the following statements is correct?**

- A. The equilibrium constant for the reaction G6P-----> F6P is 1**
  - B. The reaction as written cannot occur in the erythrocyte**
  - C. The  $\Delta G^{\circ}$  for the reverse reaction is - 0.4 kcal/mol**
  - D. The  $\Delta G^{\circ}$  is about -1 kcal /mol**
  - E. The reaction will only occur in the reverse direction**
-

**41. The chemiosmotic hypothesis for oxidative phosphorylation proposes that the mechanism for the formation of ATP involves**

- A. a change in the hydrogen bonds and hydrophobic bonds between proteins within the mitochondrial membrane.**
  - B. the joining of protons and oxygen to form water.**
  - C. the formation of a high energy bond between Pi and a protein in the mitochondrial membrane.**
  - D. the pumping of water through the mitochondrial membrane.**
  - E. the flow of protons through ATP synthase in the mitochondrial membrane.**
- 

**42. Which of the following describes the side chain of valine?**

- A. contains sulfur**
  - B. contains a branched chain hydrocarbon**
  - C. contains an aromatic ring**
  - D. cyclic**
  - E. unbranched with primary amine**
- 

**43. The activity of which enzyme would be expected to increase as levels of insulin increase?**

- A. pyruvate dehydrogenase**
- B. glucose 6-phosphate dehydrogenase**
- C. glucose 6-phosphatase**
- D. glycogen phosphorylase**
- E. PEP carboxykinase**

---

**44. One form of glycogen synthase has a requirement for glucose 6-phosphate (G6P). This is because**

- A. G6P is a feedback inhibitor of the enzyme.**
  - B. G6P is required for activation of the enzyme by cAMP.**
  - C. G6P is a substrate for the enzyme.**
  - D. G6P is an allosteric activator of glycogen synthase *b*.**
  - E. G6P is a substrate for branching enzyme.**
- 

**45. Factors contributing to an increase in the concentration of glucose in the blood include**

- A. insulin effects on liver glycogen.**
  - B. synthesis of glucose from acetyl CoA precursors.**
  - C. increased glucagon/insulin ratio.**
  - D. breakdown of muscle glycogen to yield free glucose.**
- 

**46. During the breakdown of glycogen, free glucose is formed from**

- A. the reducing end.**
  - B. the non-reducing end.**
  - C. glucose residues in an  $\alpha$  1-->4 linkage to the chain.**
  - D. glucose residues in an  $\alpha$  1-->6 linkage to the chain.**
  - E. hydrolysis of glucose 1-phosphate.**
- 

**47. In aerobic tissues, NADH in the cytoplasm**

**A. is recycled by lactate dehydrogenase to produce  $\text{NAD}^+$  for glycolysis.**

**B. can reduce dihydroxyacetone phosphate to glycerol phosphate which can be oxidized by a flavoprotein in the inner mitochondrial membrane.**

**C. can reduce malate to oxaloacetate for transport across the inner mitochondrial membrane.**

**D. can be transported into the mitochondrion by an  $\text{NADH/NAD}^+$  translocase.**

---

**48. You are presented with the following information about a peptide composed of five amino acids:**

**(a) Amino acid analysis gives equimolar amounts of Ala, Glu, Gly, Lys, and Met.**

**(b) Digestion of the original peptide with trypsin gives rise to one free amino acid.**

**(c) Digestion of the original peptide with cyanogen bromide generates two fragments, one of which moves toward the anode and the other toward the cathode under electrophoresis at pH 7.**

**Which one of the following best describes the structure of the peptide?**

**A. Lys-Gly-Met-Glu-Ala**

**B. Gly-Lys-Met-Glu-Ala**

**C. Lys-Glu-Met-Ala-Gly**

**D. Gly-Glu-Met-Ala-Lys**

**E. Glu-Gly-Met-Ala-Lys**

---

**49. Which one of the following amino acids is most likely to be found in the interior of a typical globular protein?**

- A. Leucine**
  - B. Glutamate**
  - C. Threonine**
  - D. Lysine**
  - E. Arginine**
- 

**50. The isoelectric point of a protein is defined as:**

- A. the pH at which the net charge on the molecule is 0.**
  - B. the pH at which all groups are protonated.**
  - C. the pH at which all groups are unprotonated.**
  - D. the pH at which each acidic group is protonated and each basic group is unprotonated**
- 

**51. The beta-conformation structure of a protein can be considered an example of:**

- A. primary structure.**
  - B. secondary structure.**
  - C. tertiary structure.**
  - D. quaternary structure.**
  - E. zero order structure.**
- 

**52. Which one of the following statements about protein structure is correct?**

- A. The alpha-helix is stabilized primarily by ionic interactions between the side chains of amino acids.**

- B. The formation of a disulfide bond in a protein requires that the two participating cysteine residues be adjacent to each other in the primary sequence of the protein.**
- C. The stability of tertiary structure in proteins is mainly due to covalent bonds among the subunits.**
- D. Denaturation of proteins is induced by temperatures below the temperature optimum.**
- E. The information for the correct folding of a protein is contained in the specific sequence of amino acids in the primary structure.**
- 

**53. The pH of a buffer solution can be determined by**

- A.  $-\log [\text{base}]/[\text{acid}]$**
- B.  $-\log [\text{acid}]/[\text{base}]$**
- C.  $-\log [\text{acid}-\text{base}]$**
- D.  $\text{pK} + \log [\text{base}]/[\text{acid}]$**
- E.  $\text{pK} + \log [\text{acid}]/[\text{base}]$**
- 

**54. Which has the greatest oxygen affinity?**

- A. myoglobin**
- B. HbA + DPG**
- C. HbA**
- D. HbA<sub>2</sub>**
- E. HbF**
- 

**55. What is the ratio of the conjugate base to the conjugate acid of the carboxylic acid side chain of aspartate-102 in the protein,**

medstudentin, at pH 6.0, if the pKa for the group is 4.0?

- A. 10 to 1
  - B. 1 to 10
  - C. 100 to 1
  - D. 1 to 100
  - E. 1 to 1000
- 

**56. A titration curve for an amino acid**

- A. is generally a straight line
  - B. shows buffering of the change in pH near the pK of each dissociable group
  - C. shows buffering of the change in pH far from the pK of each dissociable group
  - D. has two inflection points for each functional group.
  - E. is usually hyperbolic.
- 

**57. All of the following are functions of the tricarboxylic acid cycle in mammals EXCEPT**

- A. the formation of GTP from GDP.
  - B. the net synthesis of oxaloacetate from acetyl-CoA.
  - C. the oxidation of acetyl-CoA.
  - D. the formation of alpha-ketoglutarate.
  - E. the generation of NADH and reduced flavins.
-

**58. Which of the following is responsible for the maintenance of protein primary structure?**

- A. hydrophobic interactions**
  - B. van der Waals forces**
  - C. salt bridges**
  - D. hydrogen bonds**
  - E. covalent bonds**
- 

**59. The tricarboxylic acid cycle is initiated by the condensation of**

- A. NAD and malate.**
  - B. pyruvate and oxaloacetate**
  - C. NAD and citrate.**
  - D. acetyl-CoA and oxaloacetate.**
  - E. acetyl-CoA and pyruvate.**
- 

**60. Which reaction of the Krebs cycle is not physiologically reversible?**

- A. the reduction of oxaloacetate**
  - B. the oxidation of succinate**
  - C. the oxidation of malate**
  - D. the reduction of fumarate**
  - E. the formation of succinyl CoA**
- 

**61. Denaturation of a protein usually involves the disruption of all of**

**the following types of interactions EXCEPT**

- A. electrostatic bonds**
  - B. quaternary structure**
  - C. hydrogen bonds**
  - D. peptide bonds**
  - E. tertiary structure**
- 

**62. The peptide bond**

- A. is disrupted in low salt concentrations.**
  - B. is stabilized in a spiral configuration.**
  - C. is favored in the *trans* (flat) configuration.**
  - D. is readily broken by temperatures near the boiling point of water.**
  - E. has both a positive and negative charge at physiologic pH.**
- 

**63. Which amino acid has a side chain cyclized with the alpha amino group?**

- A. Serine**
  - B. Glutamic acid**
  - C. Glutamine**
  - D. Proline**
  - E. Glycine**
- 

**64. The enzyme that catalyzes the substrate-level phosphorylation of GDP to GTP in the TCA cycle is**

- A. 3-phosphoglycerate kinase.**
  - B. succinyl-CoA synthase.**
  - C. pyruvate kinase.**
  - D. alpha ketoglutarate dehydrogenase.**
  - E. succinate thiokinase**
- 

**65. Which of the following is produced during aerobic glycolysis of glucose to acetyl CoA**

- A. NADPH,  $\text{NAD}^+$ , ATP.**
  - B. lactate,  $\text{NAD}^+$ , ATP.**
  - C. lactate, ATP,  $\text{CO}_2$ .**
  - D. NADH, ATP,  $\text{CO}_2$ .**
  - E. lactate, ATP,  $\text{CO}_2$ .**
- 

**66. Why does fetal hemoglobin have a higher affinity for oxygen than adult hemoglobin?**

- A. Fetal hemoglobin has a greater affinity for BPG than adult hemoglobin.**
  - B. Fetal BPG has fewer negative charges than adult BPG.**
  - C. Fetal blood has a lower pH than adult blood.**
  - D. Fetal erythrocytes make less BPG than maternal erythrocytes.**
  - E. Fetal hemoglobin has a lower affinity for BPG than adult hemoglobin.**
-

**67. Which of the following decreases the binding of oxygen to hemoglobin?**

- A. increased pH**
  - B. decreased CO<sub>2</sub>**
  - C. increased H<sup>+</sup> concentration**
  - D. breaking of salt bridges between globin subunits.**
- 

**68. Which of the following statements concerning the properties of heme is correct?**

- A. The heme in myoglobin must be in the Fe<sup>+++</sup> state to bind O<sub>2</sub>.**
  - B. The heme iron is oxidized as it binds O<sub>2</sub>.**
  - C. In oxyhemoglobin, the sixth coordination bond of Fe<sup>++</sup> is occupied by oxygen.**
  - D. The fifth coordination bond of the Fe<sup>+2</sup> is hydrogen bonded to a serine side chain.**
  - E. Fe<sup>++</sup> has eight coordination bonds, four of which are occupied by histidine side chains.**
- 

**69. Cooperativity refers to**

- A. binding of an allosteric effector.**
- B. reduction of the activation energy.**
- C. dissociation of subunits from each other.**
- D. conversion from tense to relaxed forms.**
- E. stabilization of the enzyme substrate complex.**

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**70. Which of the following cofactors are required during the reduction of coenzyme Q with electrons from complex II?**

- A. FAD**
  - B. Copper**
  - C. Iron-Porphyrin**
  - D. Cytochrome a**
  - E. FMN**
- 

**71. Uncoupling of oxidative phosphorylation**

- A. decreases the oxygen consumption.**
  - B. releases heat.**
  - C. occurs during hypoxia.**
  - D. causes a buildup of NADH.**
  - E. is most easily accomplished with electron transport blockers.**
- 

**72. What is the value of  $\Delta G^{0'}$  for the pathway  $B \rightleftharpoons A \rightleftharpoons C \rightleftharpoons D$ ?**

**Reaction  $\Delta G^{0'}$**

**B  $\rightleftharpoons$  A +5 kcal/mol**

**C  $\rightleftharpoons$  A +5 kcal/mol**

**C  $\rightleftharpoons$  D -15 kcal/mol**

**A. +10**

**B. +5**

**C. -10**

**D. -5**

**E. -15**

---

**73. What is the pH of a buffer solution (HA and A<sup>-</sup>) where HA is 100X the concentration of A<sup>-</sup>? (pK of HA is 6.8.)**

**A. 4.8**

**B. 6.8**

**C. 5.8**

**D. 7.8**

**E. 8.8**

---

**74. Which of the following is true for a mitochondrial disease?**

**A. It is determined by contributions from both the maternal and paternal chromosomes.**

**B. The mutation resides on a circular chromosome.**

**C. The defect only affects one mitochondrion in each cell.**

**D. Effects are on the muscular system only, other tissues are not affected.**

**E. It is brought about by poisons such as rotenone or azide.**

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**75. Which of the following describes the action of superoxide dismutase?**

**A. Converts H<sub>2</sub>O<sub>2</sub> to H<sub>2</sub>O and O<sub>2</sub>**

**B. Converts superoxide to  $H_2O_2$**

**C. Converts oxidized glutathione to reduced glutathione**

**D. Converts superoxide to  $H_2O$**

**E. Converts hydroxy radicals to  $H_2O$  and  $O_2$**

Liaison committee results:

13. ATP was a typo, should have been GTP. This question will be counted as a bonus. Question is dropped, then those who got it right will have credit added back to their grade.

20. Use of term 'higher' in answer C was ambiguous. Will accept C as correct for this exam only.

22. Text states that coenzymes undergo alteration *during* the reaction, causing some students to bite on answer C. Answer C also accepted for this test only.

25. Glucose 1-phosphate uridylyltransferase is an out-of-date term that found its way into this exam. Tsk! Answer C also accepted.

36. The term 'lower' in answers C and D was ambiguous. Both C and D accepted as correct.

62. Charge properties not presented in lecture nor addressed in learning objectives. Also, clever argument showing charge properties of resonance structure impressed the jury. Find in favor of the defendant, accept answer E as correct.

69. Cooperativity was mentioned in lecture in context of allosteric effector. Accept A as alternate answer for this test only.

1. A	11. C	21. C	31. A	41. E	51. B	61. D	71. B
2. B	12. B	22. D	32. C	42. B	52. E	62. C	72. E
3. A	13.	23.	33.	43.	53.	63.	73.

	<b>D</b>	<b>E</b>	<b>C</b>	<b>A</b>	<b>D</b>	<b>D</b>	<b>A</b>
<b>4. C</b>	<b>14. A</b>	<b>24. C</b>	<b>34. A</b>	<b>44. D</b>	<b>54. A</b>	<b>64. E</b>	<b>74. B</b>
<b>5. A</b>	<b>15. B</b>	<b>25. B</b>	<b>35. B</b>	<b>45. C</b>	<b>55. C</b>	<b>65. D</b>	<b>75. B</b>
<b>6. D</b>	<b>16. D</b>	<b>26. C</b>	<b>36. C</b>	<b>46. D</b>	<b>56. B</b>	<b>66. E</b>	
<b>7. D</b>	<b>17. C</b>	<b>27. D</b>	<b>37. E</b>	<b>47. B</b>	<b>57. B</b>	<b>67. C</b>	
<b>8. C</b>	<b>18. D</b>	<b>28. E</b>	<b>38. D</b>	<b>48. A</b>	<b>58. E</b>	<b>68. C</b>	
<b>9. E</b>	<b>19. D</b>	<b>29. B</b>	<b>39. B</b>	<b>49. A</b>	<b>59. D</b>	<b>69. D</b>	
<b>10. B</b>	<b>20. E</b>	<b>30. C</b>	<b>40. C</b>	<b>50. A</b>	<b>60. E</b>	<b>70. A</b>	<b>80.</b>

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