

Name _____
Write your name on the back of the exam

Physiological Chemistry II
Exam IV
Dr. Melissa Kelley
April 13, 2004

This examination consists of forty-four questions, each having 2 points. The remaining questions have point values listed by the question. Provide the one best answer for each, following the instructions given in each section of the exam. You have 75 minutes to complete the exam.

Short essay. Questions 1-4.

1. (4 points) Name two pathways in which oxaloacetate serves as an intermediate. What is the significance of these pathways.
2. (4 points) Name the compound that is the energy currency of the cell and specify what type of bond is responsible for this type of high energy currency.
- 3.(4 points) Muscle soariness is from lactate accumulation. Explain how lactate is metabolized.
4. (2 points) Lipids, proteins and carbohydrates all breakdown to a common intermediate. Name this common intermediate and draw its structure.

Associate the Pathways with the Reactions Presented. Questions 5-9.

_____5. Pentose phosphate pathway

_____6. Glycolysis

_____7. Gluconeogenesis

_____8. Glycogen degradation

_____9. Glycogen synthesis

A. $\text{CO}_2 + \text{ATP} + \text{NADPH} \rightarrow \text{Glucose} + \text{O}_2$

B. $2 \text{ Lactate} + 6 \text{ ATP} \rightarrow \text{Glucose}$

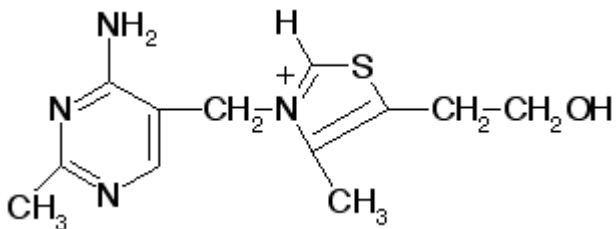
C. $\text{Glycogen} + \text{Pi} \rightarrow \text{Glucose-1-phosphate}$

D. $\text{Glucose} \rightarrow 2 \text{ Pyruvate} + 2 \text{ ATP}$

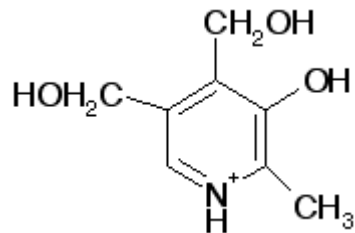
E. $\text{Glucose-6-phosphate} + 2 \text{ NADP} \rightarrow \text{Ribose-5-phosphate} + 2 \text{ NADPH}$

F. $\text{Glucose-1-phosphate} + \text{UTP} \rightarrow \text{UDP-glucose} + \text{PPi}$

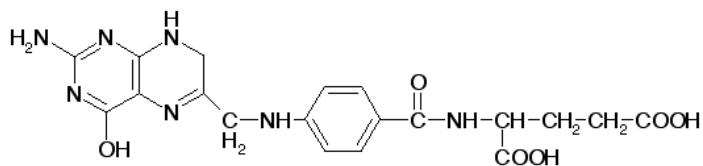
Name the following compounds. Questions 10-20.



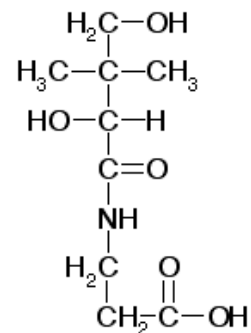
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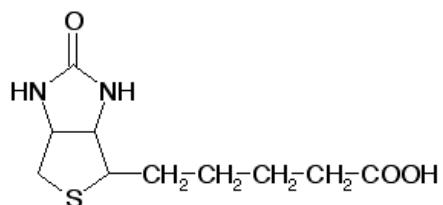
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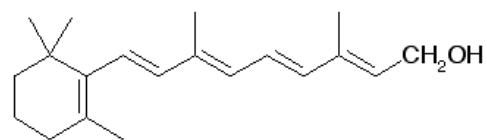
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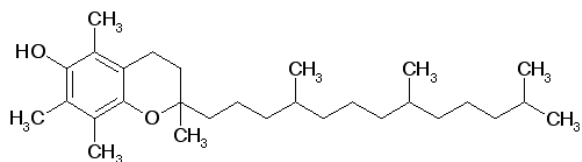
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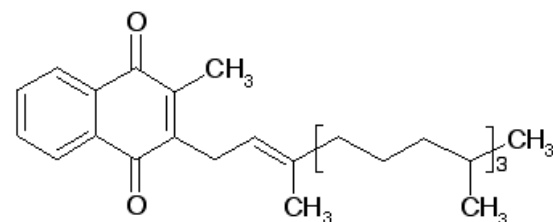
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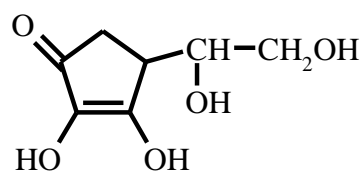
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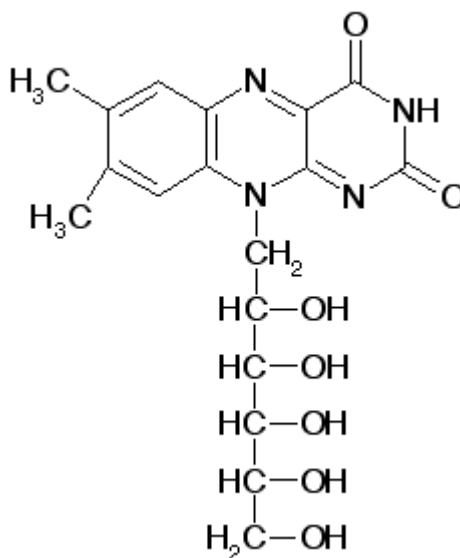
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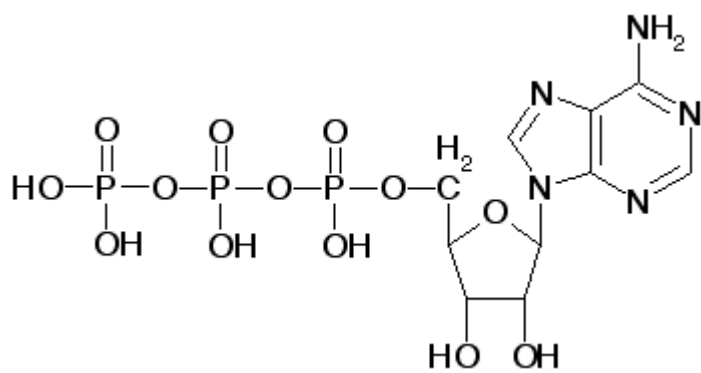
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18. _____



19. _____



20. _____

Multiple Choice. Select the one best answer to each question. Questions 21-48.

- _____ 21. Which of the following statements about Acetyl-CoA is **incorrect**?
- Acetyl-CoA is a thioether.
 - It is a major intermediate in the metabolism of sugars, fats, and proteins.
 - The Coenzyme A portion of Acetyl-CoA is derived from a vitamin.
 - Acetyl-CoA is condensed with oxaloacetate in the first step of the TCA cycle.
- _____ 22. Two compounds from the light reactions in photosynthesis are needed for carbon fixation in the dark reaction in plants. The two molecules produced from the light reactions and required for the dark reactions are:
- ATP and FADH₂
 - GTP and NADH
 - ATP and NADPH
 - ATP and Acetyl-CoA
- _____ 23. Which of the following statements concerning electron transport and oxidative phosphorylation is **incorrect**?
- Electron transport and oxidative phosphorylation are usually tightly coupled.
 - Protons are pumped from the mitochondrial matrix to the intermembrane space in the mitochondria.
 - Electrons are passed from protein complexes in the innermembrane of the mitochondria.
 - Oxidative phosphorylation involves movement of H⁺ from low H⁺ concentration in the intermembrane space to high H⁺ in the matrix to drive the synthesis of ATP.
- _____ 24. Shown below are two reactions that are coupled. The free energy is given for each reaction. Which of the following is true about the net energy and overall reaction?
- | | | | |
|-------------------------------|---|----------------|---------------------------------|
| Creatine phosphate | ? | Creatine | $\Delta G = -10.3 \text{ kcal}$ |
| ADP + Pi | ? | ATP | $\Delta G = +7.3 \text{ kcal}$ |
| Creatine phosphate + ADP + Pi | ? | Creatine + ADP | $\Delta G = ?$ |
- $\Delta G = -3.0 \text{ kcal}$, the reaction is endergonic and it favors the reactants.
 - $\Delta G = -3.0 \text{ kcal}$, the reaction is exergonic and it favors the products.
 - $\Delta G = +17.6 \text{ kcal}$, the reaction is endergonic and it favors the reactants.
 - $\Delta G = +17.6 \text{ kcal}$, the reaction is exergonic and it favors the products.
- _____ 25. Which of the following pathways are used to make glucose from amino acids?
- Glycogen synthesis
 - Glycogen degradation
 - Glycolysis
 - Gluconeogenesis
- _____ 26. Which of the following statements is **not correct**?
- In the TCA cycle, energy is captured in oxidized coenzymes.
 - In the TCA cycle, acetyl-CoA is oxidized to CO₂.
 - In the TCA cycle, there are 3 NADH, 1 FADH₂ and 1 ATP produced per one Acetyl-CoA.
 - In the TCA cycle, there are 8 steps and oxaloacetate is the first reactant and the last product.

- _____ 27. UDP-glucose is an activated form of glucose and is used in which of the following pathways?
- A. Glycogen synthesis
 - B. Glycogen degradation
 - C. Gluconeogenesis
 - D. Glycolysis
- _____ 28. Which of the following is an aerobic fate of pyruvate?
- A. Lactate
 - B. Acetaldehyde
 - C. Ethanol
 - D. Acetyl-CoA
- _____ 29. Which of the following statements is **correct**?
- A. Insulin turns on glycogen phosphorylase and activates glycogen degradation.
 - B. Glucagon turns on glycogen phosphorylase and activates glycogen degradation.
 - C. Insulin turns on glycogen phosphorylase and activates glycogen synthesis.
 - D. Glucagon turns on glycogen phosphorylase and activates glycogen synthesis.
- _____ 30. Which of the following polysaccharides is used as energy storage in animals?
- A. Amylose
 - B. Glycogen
 - C. Glucose
 - D. TAG
- _____ 31. Which of the following is **not true** about catabolism of biomolecules?
- A. Catabolism of biomolecules produces oxygen and energy.
 - B. Lipids, carbohydrates, and proteins have a common intermediate which is Acetyl-CoA.
 - C. The carbons of Acetyl-CoA are converted to CO₂.
 - D. NADH and FADH₂ are considered electron carriers.
- _____ 32. Glucose, a six carbon sugar, is split into 3 carbon compounds to generate pyruvate. Which of the following pathways is used for this process?
- A. Gluconeogenesis
 - B. Glycolysis
 - C. Glycogen degradation
 - D. Pentose phosphate pathway
- _____ 33. Which of the following statements is **not true**?
- A. ATP hydrolysis can be used to drive some unfavorable reactions.
 - B. There are other high energy compounds in the cell which serve to drive ATP synthesis in coupled reactions.
 - C. The phosphate ester is the bond that is responsible for the energy currency of ATP.
 - D. Hydrolysis of ATP is an exergonic reaction.
- _____ 34. Which of the following is **not** an intermediate of the TCA cycle?
- A. Succinate
 - B. Malate
 - C. Oxaloacetate
 - D. Glucose-6-phosphate

- _____ 35. Which of the following is **not true** of electron transport and oxidative phosphorylation?
- A. Oxidized coenzymes from the TCA cycle are used to generate ATP in the electron transport chain.
 - B. Electrons are passed through proteins complexes containing cytochromes.
 - C. Protons are pumped across the membrane from low concentration to high concentration.
 - D. Oxidative phosphorylation involves the formation of ATP.
- _____ 36. TAG is metabolized to which of the following compounds?
- A. Pyruvate
 - B. Oxaloacetate
 - C. Acetyl-CoA
 - D. Glycogen
- _____ 37. Which of the following statements is **not correct**?
- A. Insulin indicates a well-fed state.
 - B. Insulin is involved in the uptake of glucose in cells.
 - C. Insulin stimulates glycogen degradation.
 - D. Insulin stimulates glycogen synthesis.
- _____ 38. Which of the following is an intermediate in glycogen degradation?
- A. Glucose-6-phosphate
 - B. Phosphoenolpyruvate
 - C. UDP-glucose
 - D. Oxaloacetate
- _____ 39. Which of the following statements is **not true**?
- A. Coenzyme Q is a mobile electron carrier in electron transport.
 - B. Cytochromes contain a heme
 - C. Many of the protein complexes in electron transport contain iron-sulfur complexes.
 - D. Cytochromes serve to transport ATP.
- _____ 40. Which of the following intermediates **are not** found in glycolysis?
- A. Glucose-6-phosphate
 - B. Phosphoenolpyruvate
 - C. Oxaloacetate
 - D. 2-phosphoglycerate
- _____ 41. Which of the following pathways is used to make glucose from glycerol?
- A. Glycogen synthesis
 - B. Gluconeogenesis
 - C. Glycolysis
 - D. Pentose phosphate pathway
- _____ 42. NADPH is required for lipogenesis. Which of the following pathways produces NADPH?
- A. Glycolysis
 - B. Gluconeogenesis
 - C. Pentose phosphate pathway
 - D. Glycogen synthesis

- _____ 43. Which of the following statements is **incorrect**?
- A. In glycolysis, a six carbon sugar is converted to two pyruvate molecules.
 - B. In glycolysis a net two ATP are produced.
 - C. In glycolysis, the intermediates in the pathway are phosphorylated.
 - D. An aerobic fate of pyruvate is the production of lactate.
- _____ 44. Alanine can be converted to pyruvate to make glucose. Which of the following pathways would be responsible for that conversion?
- A. Gluconeogenesis
 - B. Pentose phosphate pathway
 - C. TCA cycle
 - D. Glycogen degradation
- _____ 45. Malate is converted to which of the following products in the TCA cycle?
- A. Fumerate + CO₂
 - B. α -ketogluterate + NADH
 - C. Oxaloacetate + NADH
 - D. Isocitrate + NADH
- _____ 46. Which of the following intermediates are found in gluconeogenesis?
- A. Fumerate
 - B. Oxaloacetate
 - C. UDP-glucose
 - D. Glucose-1-phosphate
- _____ 47. Ribose can be converted to glucose by which of the following pathways?
- A. Oxidative phosphorylation
 - B. Pentose phosphate pathway
 - C. Gluconeogenesis
 - D. Glycogen degradation