

Name _____

Use complete sentences when requested. There are 120 possible points on this exam. Therefore there are 20 bonus points.

Exam Memory Bank

$V_0 = \frac{V_{\max} \times [S]}{K_m + [S]}$ $V_{\max} = k_{\text{cat}} \times E_t$ $k_{\text{cat}} = \frac{kT}{h} \times e^{\frac{-G^\ddagger}{RT}}$ $\Delta G = \Delta H - T\Delta S$	$\Delta G^{\circ'} = -nF\Delta E^{\circ'}$ $\Delta G^{\circ'} = -RT \ln K_{\text{eq}}^{\circ'}$ $\Delta G_t = RT \ln \frac{c_2}{c_1}$ $\Delta G_t = RT \ln \frac{c_2}{c_1} + ZF\Delta\psi$	$R = 8.314 \text{ J/mol}\cdot\text{K}$ $F = 96,500 \text{ J/V}\cdot\text{mol}$ Boltzman constant, $k = 1.381 \times 10^{-23} \text{ J/K}$ Plank's constant, $h = 6.626 \times 10^{-34} \text{ J}\cdot\text{sec}$ Avogadro's number, $6.02 \times 10^{23} / \text{mol}$ $\ln x = 2.303 \log_{10} x$ calorie = 4.184 J
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Multiple choice: Circle the best answer on this exam. There are 12 multiple choice questions, each question is worth 3 points.

- Which process does not generate CO₂?
 - the citric acid cycle
 - the conversion of pyruvate to lactic acid
 - the conversion of pyruvate to acetyl-CoA
 - the conversion of pyruvate to ethanol
 - all of these generate CO₂.
- Glycogen is degraded in a
 - phosphorylation reaction.
 - hydrolysis reaction.
 - dephosphorylation reaction.
 - phosphorolysis reaction
 - none of these
- Which of the following glycolysis steps occurs provides substrate level phosphorylation of ADP to make ATP.
 - the conversion of phosphoenolpyruvate to pyruvate
 - the conversion of fructose 6-phosphate to fructose 1,6-biphosphate
 - the conversion of 1,3 bisphosphoglycerate to 3- phosphoglycerate
 - the conversion of glucose to glucose 6-phosphate
 - None of these
- Under what conditions will lactic acid accumulate in skeletal muscle?
 - when citric acid enzymes are depleted
 - when ATP is depleted
 - when O₂ is depleted
 - when NADH is depleted
 - None of these
- The NADPH produced in the pentose phosphate pathway is used
 - to donate electrons to O₂ in mitochondria.
 - to provide reducing power for biosynthetic reactions.
 - to convert superoxide free radicals ($\cdot\text{O}_2^-$) into hydrogen peroxide (H₂O₂) during detoxification.
 - to provide the energy for catabolic reactions.
 - None of these

6. Which of the following is true about gluconeogenesis?
- A. In mammals, gluconeogenesis occurs predominately in the liver.
 - B. Gluconeogenesis is the pathway by which glucose is converted to glycogen.
 - C. The gluconeogenesis pathway is the glycolysis pathway running in the opposite direction.
 - D. Plants do not undergo gluconeogenesis.
 - E. None of these
7. Rapidly dividing cells have a high need for nucleotide precursors, which are provided by
- A. the Cori cycle.
 - B. the pentose phosphate pathway.
 - C. glycolysis.
 - D. gluconeogenesis.
 - E. None of these
8. Anaplerotic reactions, such as the conversion of pyruvate to oxaloacetate, are useful to the citric acid cycle because they
- A. generate a steady supply of intermediates for the citric acid cycle.
 - B. produce molecules needed to regulate the citric acid cycle.
 - C. link the citric acid cycle to the glyoxylate cycle.
 - D. siphon away excess intermediates from the citric acid cycle.
 - E. None of these
9. Skeletal muscle does not contribute glucose to the blood because
- A. it lacks the enzyme glycogen phosphorylase.
 - B. it cannot store glycogen.
 - C. it lacks the enzyme glucose 6-phosphatase.
 - D. it lacks the enzyme phosphoglucomutase
 - E. None of these
10. In hepatocytes, the enzyme hexokinase IV (glucokinase), which catalyzes the conversion of glucose to glucose 6-phosphate, is regulated by a regulatory protein that
- A. inhibits hexokinase IV when blood glucose levels are high.
 - B. irreversibly inactivates hexokinase IV.
 - C. phosphorylates hexokinase IV.
 - D. binds to and then sequesters hexokinase IV inside the nucleus.
 - E. None of these
11. What effect does glucagon have on carbohydrate metabolism in the liver?
- A. It stimulates glycolysis.
 - B. It inhibits the breakdown of glycogen.
 - C. It decreases blood levels of glucose.
 - D. It stimulates gluconeogenesis
 - E. None of these
12. Stored fat is transported through the blood
- A. as free fatty acids on albumin
 - B. as triglycerides on albumin
 - C. As free fatty acids in chylomicrons
 - D. As triglycerides in low density lipoproteins.
 - E. None of these

End of multiple choice

13. (20 points) Draw all of the structures and name the compounds for glycolysis and gluconeogenesis, include all of the enzymes, cofactors and all of reactants for each reaction.

14. (24 points) Describe how liver cells are controlled so that glycolysis and gluconeogenesis do not occur simultaneously in the liver. Give specific details about the regulation by insulin and glucagon. Give specific details about the reactions that are regulated. What enzyme, how is it regulated? Include details about any of the following control mechanisms that are involved: allosteric modulation, reversible covalent modification, protein-protein binding.

15. (10 points) It is common for people whose ancestors lived near the equator to have only one copy of the gene for glucose-6-phosphate dehydrogenase. Thus, they have low levels of this enzyme in their red blood cells. While this protects them from malaria, it makes them susceptible to poisoning via fava beans. What does this enzyme do? How is it related to fava beans?

16. (10 points) When epinephrine binds to its receptor on a fat cell, the end result is that free fatty acids are released from lipid droplets in the fat cell. Describe the series of reactions that occur when epinephrine starts this signal cascade.

17. (10 points) How does a high intake of dietary carbohydrates increase fat storage?

18. (10 points) There are three steps in the TCA cycle that are the same types of reactions as three steps in β oxidation of fatty acids. Match the enzymes that catalyze the matching reactions.

<u>β oxidation of fatty acid</u>	<u>Letter of Matching (similar reaction) TCA Enzyme</u>
1. acyl CoA dehydrogenase _____	
2. enoyl CoA hydratase _____	
3. β -hydroxy acyl CoA dehydrogenase _____	
4. Thiolase _____	

TCA enzymes

- A. Citrate Synthase
- B. Aconitase
- C. Isocitrate dehydrogenase
- D. α - keto glutamate dehydrogenase
- E. Succinyl CoA synthetase
- F. Succinate dehydrogenase
- G. Fumarase
- H. Malate dehydrogenase