

Part I. 30 points. Circle the best answer. Two (2) points each.

1. Which of the following are true about β -oxidation?
- I. occurs in the cytoplasm
 - II. breaks down fatty acyl-CoA molecules in 2-C fragments
 - III. involves the formation of a *cis*- Δ^3 intermediate from a saturated molecule
 - IV. occurs in the mitochondrial matrix
- a) I and II
b) I, II, and III
c) II, III, and IV
d) II and IV
e) III and IV
2. Sphingomyelins consist of:
- a) an amide linkage
 - b) phosphocholine
 - c) ceramide
 - d) sphingosine
 - e) all of the above
3. An enzyme that contains pyridoxal phosphate and whose mechanism includes formation of a Schiff base is a
- a) transport protein
 - b) transcarbamoylase
 - c) transaldolase
 - d) transaminase
 - e) dehydrogenase
4. Pantetheinate is a coenzyme in
- a) succinate dehydrogenase
 - b) coenzyme Q
 - c) pyruvate dehydrogenase
 - d) acyl-carnitine transferase
 - e) acyl carrier protein
5. An enzyme that contains cobalamin (B_{12}) carries out what type of chemistry?
- a) dehydrogenase
 - b) condensation reaction
 - c) intramolecular rearrangement
 - d) carboxylation
 - e) hydration

6. Riboflavin contributes to the structure of which coenzyme?
- NAD
 - pyridoxal phosphate
 - FAD
 - heme
 - cytochrome c
7. During amino acid degradation, amino groups to be donated to make urea are first collected in the form of
- fumarate
 - glutamate
 - glutamine
 - α -ketoglutarate
 - citrulline
8. A glucogenic amino acid is one that
- generates net glucose
 - circumvents the loss of at least one CO_2 molecule
 - generates acetyl-CoA
 - generates ketone bodies and glucose
- I, II, and IV
 - I and II
 - I, III, and IV
 - I and IV
 - I, II, and III
9. Alanine, glutamate, and aspartate correspond to which α -amino acids, respectively?
- α -ketoglutarate, oxaloacetate, and malate
 - pyruvate, α -ketoglutarate, and oxaloacetate
 - succinate, glutamate, and oxaloacetate
 - pyruvate, glutamine, and malate
 - glutamine, pyruvate, and oxaloacetate
10. Fatty acyl CoA synthetase
- activates fatty acids at the expense of 2ATP equivalents
 - activates fatty acids at the expense of 1 ATP molecule
 - is responsible for fatty acid synthesis
 - is found in the mitochondrial matrix
 - is activated by acetyl-CoA
11. In the respiratory chain, coenzyme Q is believed to carry out
- extrusion of H^+ into the cytoplasm
 - transfer of electrons to complex III
 - both (a) and (b)
 - transfer of electrons to O_2
 - ATP synthesis

12. Rotenone is a compound that
- inhibits site II of the respiratory chain
 - inhibits site I of the respiratory chain
 - inhibits site III of the respiratory chain
 - inhibits succinate dehydrogenase
 - inhibits Pi uptake by the mitochondria
13. If the reduction potential for compound A = -0.4 V and B = -0.1 V, then the value for ΔE° equals
- 0.3 V
 - +0.3V
 - 0.3 x Faraday's constant
 - 0.2 V
 - none of the above
14. The carbons of urea originally are part of
- bicarbonate and oxaloacetate
 - bicarbonate
 - bicarbonate and aspartate
 - water
 - amino groups
15. The Cori Cycle is a means by which
- liver regenerates glucose from muscle amino acids
 - muscle regenerates glucose from liver pyruvate
 - liver regenerates glucose from ketone bodies
 - liver recycles lactic acid into glucose for storage as liver glycogen
 - none of the above

PART II, 20 points. Match the enzyme with the type of chemistry that it catalyzes.

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|-----------------------------|-----|----------------------------|
| a) citrate lyase | ___ | deamination |
| b) succinyl-CoA synthase | ___ | oxidative/decarboxylation |
| c) lactate dehydrogenase | ___ | produces NADPH |
| d) malic enzyme | ___ | carboxylation |
| e) glycogen synthase | ___ | cleavage reaction |
| f) glutamate dehydrogenase | ___ | produces NADH |
| g) isocitrate dehydrogenase | ___ | condensation reaction |
| h) pyruvate carboxylase | ___ | produces FADH ₂ |
| i) citrate synthase | ___ | produces GTP |
| j) acyl-CoA dehydrogenase | ___ | releases UDP |

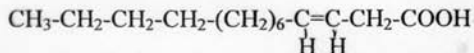
PART III. 14 points.

Fat and glucose metabolic pathways are orchestrated by the physiological needs of the animal. Indicate with an "X" whether the biochemical event is associated with a prolonged fast or the well-fed state.

Biochemical event	Occurs during a prolonged fast	Occurs following a meal
Citrate appears in the cytoplasm	_____	_____
Triacylglyceride acts as a source of glucose	_____	_____
Malonyl-CoA builds up in cytoplasm	_____	_____
Ketone bodies are elevated in blood	_____	_____
AcCoA carboxylase is inactive	_____	_____
Gluconeogenesis is increased	_____	_____
Glucose-alanine cycle	_____	_____

PART IV. 36 points. Provide brief but detailed answers to six (6) of the following questions in the exam booklet. (6 points each)

1. Define the protonmotive force and how it is established.
2. Give the sequence of reactions that are used in a single round of β -oxidation. Give the names and structures of the intermediates and the names of all enzymes and co-enzymes.
3. How many ATP molecules would be produced from the complete oxidation of the C14 *cis*-mono-unsaturated fatty acid shown below? Please show all work.



4. Fatty acid synthesis is regulated by hormone-sensitive lipase and acetyl-CoA carboxylase. Briefly describe the effects of insulin and glucagon on these enzymes and the consequence to fatty acid synthesis overall.
5. Describe the reactions that accompany one cycle of fatty acid synthesis. Use generic chemical structures to illustrate the events.
6. Explain how lactate can build up in cells under anaerobic conditions. Be specific.
7. Describe the "binding change" mechanism of ATP synthesis.
8. Draw the Urea Cycle in detail and indicate its common link with the TCA Cycle.