

MCB 102 Fatty Acid Oxidation and Urea Production Worksheet: ANSWERS

1. Free fatty acids in the bloodstream are:

- A) bound to hemoglobin.
- B) carried by the protein serum albumin. *
- C) freely soluble in the aqueous phase of the blood.
- D) nonexistent; the blood does not contain free fatty acids.
- E) present at levels that are independent of epinephrine.

2. The role of hormone-sensitive triacylglycerol lipase is to:

- A) hydrolyze lipids stored in the liver.
- B) hydrolyze membrane phospholipids in hormone-producing cells.
- C) hydrolyze triacylglycerols stored in adipose tissue. *
- D) synthesize lipids in adipose tissue.
- E) synthesize triacylglycerols in the liver.

3. Transport of fatty acids from the cytoplasm to the mitochondrial matrix requires:

- A) ATP, carnitine, and coenzyme A. *
- B) ATP, carnitine, and pyruvate dehydrogenase.
- C) ATP, coenzyme A, and hexokinase.
- D) ATP, coenzyme A, and pyruvate dehydrogenase.
- E) carnitine, coenzyme A, and hexokinase.

4. What is the correct order of function of the following enzymes of β oxidation?

1. β -Hydroxyacyl-CoA dehydrogenase
2. Thiolase
3. Enoyl-CoA hydratase
4. Acyl-CoA dehydrogenase

- A) 4, 3, 1, 2 *

5. If the 16-carbon saturated fatty acid palmitate is oxidized completely to carbon dioxide and water (via the β -oxidation pathway and the citric acid cycle), and all of the energy-conserving products are used to drive ATP synthesis in the mitochondrion, the net yield of ATP per molecule of palmitate is:

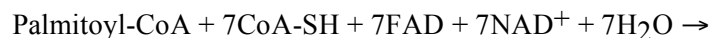
- A) 3.
- B) 10.
- C) 25.
- D) 108. *
- E) 1,000.

6. Saturated fatty acids are degraded by the stepwise reactions of β oxidation, producing acetyl-CoA. Under aerobic conditions, how many ATP molecules would be produced as a consequence of removal of each acetyl-CoA?

- 4 *

7. Write a balanced equation for the β oxidation of palmitoyl-CoA, a 16-carbon, fully saturated fatty acid, and indicate how much of each product is formed.

Ans: The overall reaction is:



8. For each two-carbon increase in the length of a saturated fatty acid chain, how many additional moles of ATP can be formed upon complete oxidation of one mole of the fatty acid to CO_2 and H_2O ?

Ans: Each $-\text{CH}_2-\text{CH}_2-$ unit yields 14 extra ATP molecules. The two oxidations of the β -oxidation pathway produce 1 FADH_2 and 1 NADH , which yield 1.5 and 2.5 ATP, respectively, by oxidative phosphorylation. The extra acetyl-CoA, when oxidized via the citric acid cycle, yields another 10 ATP equivalents: 3 NADH , 1 FADH_2 , and 1 ATP or GTP.

9. The carbon atoms from a fatty acid with an odd number of carbons will enter the citric acid cycle as acetyl-CoA and:

- A) butyrate.
- B) citrate.
- C) malate.
- D) succinyl-CoA. *
- E) α -ketoglutarate.

10. If you received a laboratory report showing the presence of a high concentration of ketone bodies in the urine of a patient, what disease would you suspect? Why do ketone bodies accumulate in such patients?

Ans: The patient is probably an untreated diabetic, but the condition might also result from fasting. In either case, the unavailability of glucose from the blood stimulates gluconeogenesis in the liver. As the substrate for glucose formation, oxaloacetate is withdrawn from the citric acid cycle, bringing that cycle to a near halt. The fatty acids being oxidized in the liver yield acetyl-CoA, which now cannot be oxidized via the citric acid cycle. Reversal of the thiolase reaction produces acetoacetyl-CoA, which is then converted into ketone bodies and exported from the liver. See Fig. 17-18, p. 651.

11. Glutamate is metabolically converted to α -ketoglutarate and NH_4^+ by a process described as:

- A) deamination.
- B) hydrolysis.
- C) oxidative deamination. *
- D) reductive deamination.
- E) transamination.

12. Urea synthesis in mammals takes place primarily in tissues of the:

- A) brain.
- B) kidney.
- C) liver. *
- D) skeletal muscle.
- E) small intestine.

13. If a person's urine contains unusually high concentrations of urea, which one of the

following diets has he or she probably been eating recently?

- A) High carbohydrate, very low protein
- B) Very high carbohydrate, no protein, no fat
- C) Very very high fat, high carbohydrate, no protein
- D) Very high fat, very low protein
- E) Very low carbohydrate, very high protein *

14. Transamination reactions are catalyzed by a family of enzymes, all of which require _____ as a coenzyme. In the first step of a transamination, the coenzyme in the aldehyde form condenses with the _____ group of an amino acid to form a(n) _____.

Ans: pyridoxal phosphate (PLP); α -amino; Schiff base (or imine or aldimine)

15. Give the name and draw the structure of the α -keto acid resulting when the following amino acids undergo transamination with α -ketoglutarate: (a) aspartate; (b) alanine.

Ans: (a) oxaloacetate; (b) pyruvate; see Fig. 18-4, p. 660.

16. Why does a mammal go to all of the trouble of making urea from ammonia rather than simply excreting ammonia as many bacteria do?

Ans: When bacteria release ammonia into the surrounding medium, it is diluted enormously to nontoxic levels. The ammonia produced by amino acid catabolism in mammals cannot be sufficiently diluted in the tissues and the blood to avoid accumulating at toxic levels. Urea is much less toxic than ammonia.