MCB 102: Pantea's Sxn **Chapter 18 Problem Set Answer Key**

1) Page: 660 Ans: E
In amino acid catabolism, the first reaction for many amino acids is a(n):

A) decarboxylation requiring thiamine pyrophosphate (TPP).
B) hydroxylation requiring NADPH and O_2.
C) oxidative deamination requiring NAD^+.
D) reduction requiring pyridoxal phosphate (PLP).
E) **transamination requiring pyridoxal phosphate (PLP).**

2) Page: 660 Ans: D
Transamination from alanine to α-ketoglutarate requires the coenzyme:

A) biotin.
B) NADH.
C) No coenzyme is involved.
D) **pyridoxal phosphate (PLP).**
E) thiamine pyrophosphate (TPP).

3) Page: 663 Ans: D
The conversion of glutamate to an α-ketoacid and NH_4^+:

A) does not require any cofactors.
B) is a reductive deamination.
C) is accompanied by ATP hydrolysis catalyzed by the same enzyme.
D) **is catalyzed by glutamate dehydrogenase.**
E) requires ATP.

4) Page: 665 Ans: C
Urea synthesis in mammals takes place primarily in tissues of the:

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

5) Page: 666 Ans: D
Which substance is *not* involved in the production of urea from NH_4^+ via the urea cycle?

A) Aspartate
B) ATP
C) Carbamoyl phosphate
D) **Malate**
E) Ornithine

6) Page: 669 Ans: E
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**

7) Pages: 674-675 Ans: B

The amino acids serine, alanine, and cysteine can be catabolized to yield:

A) fumarate.
B) **pyruvate.**
C) succinate.
D) α-ketoglutarate.
E) none of the above.

8) Page: 659

Define zymogen and describe the role of one zymogen in protein digestion.

Ans: A zymogen is an inactive form of an enzyme that can be activated by proteolytic cleavage. The pancreatic enzymes pepsinogen, chymotrypsinogen, trypsinogen, and procarboxypeptidases A and B are all inactive forms of proteases, which are activated by proteolytic cleavage after their release into the small intestine.

9) Pages: 662-66

Describe the roles of glutamine synthetase and glutaminase in the metabolism of amino groups in mammals.

Ans: In tissues that are metabolizing the carbon skeletons of amino acids, the amino groups are transferred by transamination to glutamate, then released as ammonia. Ammonia, which is toxic, is then combined with glutamate to form glutamine; the reaction is catalyzed by glutamine synthetase and requires ATP. Glutamine is moved from the extrahepatic tissues to the liver and kidneys, where the amino group is released from glutamine by glutaminase; the products are glutamate and ammonia. The ammonia delivered in this way to the liver is converted to urea, then excreted.

10) Page: 663

Show the reaction in which ammonia is formed from glutamate; include any required cofactors.

Ans: This is the reaction catalyzed by glutamate dehydrogenase; see Fig. 18-7, p. 663.

11) Page: 665

Describe the three general mechanisms for disposing of excess nitrogen obtained in the diet. Which organisms use each mechanism?

Ans: (1) Ammonotelic: release into the surrounding medium as NH_4^+ (bacteria and many marine organisms); (2) Uricotelic: production of uric acid (birds and reptiles); (3) Ureotelic: production and excretion of urea (land-dwelling animals).

12) Page: 666

Amino acid catabolism involves the breakdown of 20 amino acids all of which contain nitrogen but have different carbon skeletons. What overall strategy is used to deal with this problem? Illustrate the strategy with two examples.

Ans: Nitrogen is removed by transamination to glutamate. This converts the amino acid to an α-keto acid that either is an intermediate in carbohydrate catabolism or is converted to one. (See Fig. 18-2, p. 658.) Examples are shown in Fig. 18-10, p. 666.

13) Pages: 669-670

Describe (a) the fundamental nutritional problem faced by individuals with genetic defects in enzymes involved in urea formation and (b) two approaches to treatment of these diseases.

Ans: (a) A defect in urea synthesis can result in the formation of toxic blood levels of ammonia from the breakdown of ingested proteins. Thus, it is desirable to limit the intake of amino acids. However, some amino acids are essential for humans (i.e., not biosynthesized) and hence must be ingested in adequate amounts. (b) One approach is to administer compounds that deplete the supply of glycine and glutamine. The replenishment of these amino acids removes ammonia from the blood. Another approach is to administer compounds that allow the liver to bypass the enzyme that is defective in the individual.

14) Page: 671

Name four amino acids that can be converted directly (in one step) into pyruvate or a citric acid cycle intermediate, and name the intermediate formed from each.

Ans: (1) aspartate; oxaloacetate; (2) glutamate; α-ketoglutarate; (3) alanine; pyruvate; (4) serine; pyruvate. (Order is not important.)

15) Page: 671

Name one amino acid whose oxidation proceeds via the intermediate shown: (a) pyruvate; (b) oxaloacetate; (c) α -ketoglutarate; (d) succinyl-CoA; (e) fumarate.

Ans: Possible answers are: (a) alanine, tryptophan, glycine, serine, cysteine; (b) aspartate, asparagine; (c) glutamate, glutamine, arginine, histidine, proline; (d) isoleucine, threonine, methionine, valine; (e) phenylalanine, tyrosine.

16) Pages: 671-672

Degradation of amino acids yields compounds that are common intermediates in the major metabolic pathways. Explain the distinction between glucogenic and ketogenic amino acids in terms of their metabolic fates.

Ans: The glucogenic amino acids are those that are catabolized to intermediates that can serve as substrates for gluconeogenesis: pyruvate and any of the four- or five-carbon intermediates of the citric acid cycle. Ketogenic amino acids are catabolized to yield acetyl-CoA or acetoacetyl-CoA, the precursors for ketone body formation.