Biochemistry Sample Items

1. In order to determine the rate of DNA synthesis in various mammalian tissues, the administration of which of the following labeled substances would be most specific in labeling DNA?

   (A) Adenosine
   (B) Cytosine
   (C) Guanosine
   (D) Thymidine
   (E) Uridine

2. A 2-year-old boy who recently emigrated from Somalia is brought to the physician because of a 1-day history of pain of his arms and legs. Physical examination shows pale mucous membranes and hepatosplenomegaly. Laboratory studies show a hemoglobin concentration of 8 g/dL. A peripheral blood smear shows sickle cells. Genetic analyses show a point mutation in the β-globin gene leading to a change of a GAG codon (glutamate) to a GUG codon (valine). Which of the following anticodons is most likely in the tRNA for valine?

   (A) CAC
   (B) CTU
   (C) CUC
   (D) GAC
   (E) GCC

3. Which of the following post-translational modifications is most likely to be found on a cyclin B protein that is targeted for degradation?

   (A) Acetylated lysine residues
   (B) Phosphorylated serine residues
   (C) Phosphorylated threonine residues
   (D) Phosphorylated tyrosine residues
   (E) Ubiquitinated lysine residues

4. A previously healthy 16-year-old girl is brought to the physician because of abdominal cramps, bloating, and loose stools for 6 months. These symptoms began after she ingested skim milk in an attempt to lose weight. She is at the 50th percentile for height and 75th percentile for weight. Physical examination shows no abnormalities. Stool studies show a 3+ Clinitest reagent response and pH of 5. After the patient ingests milk, there is an increased hydrogen concentration in expired air. A deficiency of which of the following enzyme activities is the most likely cause of the gastrointestinal symptoms in this patient?

   (A) Amylase
   (B) Carboxypeptidase
   (C) Fructose-1,6-bisphosphate aldolase
   (D) Galactokinase
   (E) Lactase
   (F) Sucrase

5. A married couple is screened to assess the risk for Gaucher disease in their children. The activities of glucocerebrosidase in the sera of the mother and father are 45% and 55%, respectively, of the reference value. The couple has one child. Which of the following is the probability of the child possessing one or more alleles of the Gaucher mutation?

   (A) 0
   (B) 0.25
   (C) 0.5
   (D) 0.75
   (E) 1.0

6. The release of epinephrine from the chromaffin granules of the adrenal medulla into the bloodstream in response to neural stimulation is mediated by which of the following?

(A) Acetylcholine
(B) γ-Aminobutyric acid (GABA)
(C) Cortisol
(D) Dopamine
(E) Serotonin

7. During normal screening for phenylketonuria, a male newborn has a serum phenylalanine concentration of 35 mg/dL (greater than 20 mg/dL is considered a positive test). Signs of tyrosine deficiency also are apparent. Enzymatic analysis using cultured fibroblasts, obtained after circumcision, shows normal activity of phenylalanine hydroxylase. A possible explanation for these findings is a deficiency in function of which of the following coenzymes?

(A) Adenosylcobalamin
(B) Biopterin
(C) Dihydroquinone
(D) Pyridoxal phosphate
(E) Tetrahydrofolic acid

8. A 2-year-old boy with intellectual developmental disorder has chewed the tips of his fingers on both hands and a portion of his lower lip. His serum uric acid concentration is increased, and he has a history of uric acid renal calculi. His 5-year-old brother has similar findings. Which of the following abnormal enzyme activities is the most likely cause of these findings?

(A) Decreased adenine phosphoribosyltransferase
(B) Decreased adenosine deaminase
(C) Decreased hypoxanthine-guanine phosphoribosyltransferase
(D) Increased phosphoribosylpyrophosphate synthetase
(E) Increased xanthine oxidase

9. A 14-year-old girl is brought to the physician because of a recent growth spurt of 15 cm (6 in) during the past year. She also has had increasing fatigue and palpitations during this period. Her paternal aunt has a history of palpitations and severe myopia. She is at the 95th percentile for height and 50th percentile for weight. Physical examination shows a long, thin face. Ophthalmologic examination shows dislocated lenses. Cardiac examination shows a hyperdynamic precordium with early click and systolic murmur. Echocardiography shows an enlarged aortic root and mitral valve prolapse. Abnormal synthesis of which of the following proteins is the most likely cause of this patient's disorder?

(A) Collagen, type I
(B) Elastin
(C) Fibrillin-1
(D) Fibroblast growth factor R3
(E) Laminin
(F) Neurofibromin
(G) PAX 6

10. Native collagen is composed almost entirely of which of the following types of structures?

(A) α-Helix
(B) β-Pleated sheet
(C) Random coils
(D) Triple helix
(E) Two peptides connected by a disulfide bond

11. An otherwise healthy 20-year-old woman of Mediterranean descent is given sulfamethoxazole to treat a bladder infection. Three days after beginning the antibiotic regimen, the patient has moderately severe jaundice and dark urine. Pain with urination and a low-grade fever have resolved. Her hematocrit is 20%. Substantial numbers of erythrocytes contain Heinz bodies. Her condition worsens until day 6 of antibiotic therapy, when it begins to resolve. Symptoms are completely gone by day 9 of continued antibiotic therapy. Which of the following conditions is the most likely explanation for these findings?

(A) Aplastic anemia
(B) Generalized cytochrome-b_5 reductase deficiency
(C) Glucose-6-phosphate dehydrogenase deficiency
(D) Pyruvate kinase deficiency
(E) Systemic infection cured by antibiotic therapy

12. A 45-year-old woman has the sudden onset of severe headaches. During one of these episodes, her blood pressure is 190/115 mm Hg. Her usual blood pressure is 130/90 mm Hg. Her sister had similar episodes several years ago. Urinalysis shows increased concentrations of metanephrine and vanillylmandelic acid. The patient is most likely to have a neoplasm that secretes which of the following?

(A) ACTH
(B) Aldosterone
(C) Cortisol
(D) Epinephrine
(E) Renin

13. An inherited disorder of carbohydrate metabolism is characterized by an abnormally increased concentration of hepatic glycogen with normal structure and no detectable increase in serum glucose concentration after oral administration of fructose. These two observations suggest that the disease is a result of the absence of which of the following enzymes?

(A) Fructokinase
(B) Glucokinase
(C) Glucose-6-phosphatase
(D) Phosphoglucomutase
(E) UDP glucose

14. A 15-year-old girl limits her diet to carrots, tomatoes, green vegetables, bread, pasta, rice, and skim milk. She has an increased risk for vitamin A deficiency because its absorption requires the presence of which of the following?

(A) Heme
(B) Intrinsic factor
(C) Phosphatidylcholine
(D) Protein
(E) Triglyceride

15. An increased concentration of fructose 2,6-bisphosphate in hepatocytes will have a positive regulatory effect on which of the following?

(A) Gluconeogenesis and glucose-6-phosphatase
(B) Gluconeogenesis and phosphoenolpyruvate carboxykinase
(C) Glycolysis and glucokinase
(D) Glycolysis and phosphofructokinase 1

16. During the processing of particular N-linked glycoproteins, residues of mannose 6-phosphate are generated. Which of the following proteins is most likely to undergo this step in processing?

(A) Apo B receptor
(B) The citrate transport protein of the inner mitochondrial membrane
(C) IgG
(D) Lysosomal α-fucosidase
(E) Mitochondrial isocitrate dehydrogenase

17. A 65-year-old man with coronary artery disease comes to the physician for a follow-up examination. He is 183 cm (6 ft) tall and weighs 84 kg (185 lb); BMI is 25 kg/m^2. His blood pressure is 130/80 mm Hg. The lungs are clear to auscultation. Cardiac examination shows no point of maximal impulse. Serum studies show a glucose concentration of 95 mg/dL and homocysteine concentration of 19.3 µmol/L (N=5–15). Serum lipid concentrations are within the reference range. Which of the following amino acids is most likely to be decreased in this patient?

(A) Arginine
(B) Leucine
(C) Lysine
(D) Methionine
(E) Ornithine

18. Which of the following is required to transport fatty acids across the inner mitochondrial membrane?

(A) Acyl carrier protein
(B) Albumin
(C) Carnitine
(D) Chylomicrons
(E) Creatinine
(F) Lecithin-cholesterol acyltransferase

19. Failure to bind LDL to its receptor results in uncontrolled synthesis of cholesterol. This occurs because synthesis of which of the following enzymes is not repressed?

(A) Acyl CoA cholesterol acyltransferase
(B) 3-Hydroxy-3-methylglutaryl (HMG)-CoA reductase
(C) Lecithin-cholesterol acyltransferase
(D) Lipoprotein lipase
(E) Lysosomal protease

20. A 67-year-old man has a restricted diet that includes no fresh citrus fruits or leafy green vegetables. His teeth are loose and his gums bleed easily. This patient's disorder most likely results from a defect in collagen synthesis that involves which of the following amino acids?

(A) Arginine
(B) Cysteine
(C) Histidine
(D) Hydroxyproline
(E) Leucine
(F) Methionine
(G) Serine
(H) Tryptophan

Answer Form for Biochemistry Sample

Questions (Questions 1–20)

1. ____
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19. ____
20. ____

Answer Key for Biochemistry Sample Questions

(Questions 1–20)

1.	D
2.	A
3.	E
4.	E
5.	D
6.	A
7.	B
8.	C
9.	C
10.	D
11.	C
12.	D
13.	C
14.	E
15.	D
16.	D
17.	D
18.	C
19.	B
20.	D