



WEEK NO.4

الطب



METABOLISM

DOCTOR 2019 | MEDICINE | JU

DONE BY :

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1. After digestion of a piece of cake that contains flour, milk, and sucrose as its primary ingredients, the major carbohydrate products entering the blood are which one of the following? Choose the one best answer.

- (A) Glucose
- (B) Fructose and galactose
- (C) Galactose and glucose
- (D) Fructose and glucose
- (E) Glucose, fructose, and galactose

2-A patient has a genetic defect that causes intestinal epithelial cells to produce disaccharidases of much lower activity than normal. Compared with a normal person, after eating a bowl of milk and oatmeal sweetened with table sugar, this patient will have higher levels of which one of the following? Choose the one best answer.

- (A) Maltose, sucrose, and lactose in the stool
- (B) Starch in the stool
- (C) Galactose and fructose in the blood
- (D) Glycogen in the muscles
- (E) Insulin in the blood

3- An infant, who was nourished by a synthetic formula, had a sugar in the blood and urine. This compound gave a positive reducing-sugar test but was negative when measured with glucose oxidase. Treatment of blood and urine with acid (which cleaves glycosidic bonds) did not increase the amount of reducing sugar measured. Which of the following compounds is most likely to be present in this infant's blood and urine?

- (A) Glucose
- (B) Fructose
- (D) Maltose
- (E) Lactose

4-Which of the following transporters increases its uptake of glucose in response to insulin?

- A)Glut 1
- B)Glut 2
- C)Glut 3
- D)Glut 4

5-The in vitro conversion of glucose to G6P ($\text{glucose} + \text{P}_i \rightleftharpoons \text{G6P} + \text{H}_2\text{O}$) is highly endergonic, though in the setting of glycolysis proceeds in a spontaneous and irreversible fashion. How is this achieved?

- A. High concentrations of H₂O shift equilibrium to favor G-6-P formation.
- B. Endergonic reactions are always spontaneous and irreversible.
- C. Through coupled ATP hydrolysis reactions.
- D. Through coupled ADP condensation reactions.

6-Which of the following organs does NOT require a constant supply of glucose from the blood for energy during a fast?

- A. Red blood cells.
- B. Brain.
- C. Pancreas.
- D. Liver.

7-High free fatty acids are a hallmark of metabolic syndrome, a common precondition of Type II diabetes. High circulating fatty acids chronically cause modified phosphorylation on the intracellular domain of the insulin receptor, with reduced GLUT4 activity. How is low GLUT4 activity relevant to diabetes?

- A. It causes retinopathy
- B. It prevents glucose utilization by cells
- C. It stimulates fructose uptake by cells
- D. It leads to hyper-stimulation of glycolysis

8-One of the following is true about glucose absorption:

- A. Monosaccharaides are transported into absorptive intestinal epithelial cells mainly via GLUT system.**
- B. Monosaccharaides released into the blood via the intestinal epithelial cells are recovered by tissues that use Na⁺ Independent transporters.**
- C. Monosaccharaides are transported into absorptive intestinal epithelial cells via Na⁺ Independent transporters only.**
- D. Monosaccharaides released into the blood via the intestinal epithelial cells are recovered by tissues that use active transport system.**

9-A man collapses while running a marathon and is taken to the emergency room. His blood is found to be somewhat acidic and further tests show increased lactate dehydrogenase activity. This enzyme is involved in which of the following pathways?

- A. Anaerobic glycolysis**
- B. Beta-oxidation of fatty acids.**
- C. Citric acid cycle.**
- D. Pentose Phosphate Pathway.**

10-When insulin is released, it acts to increase the absorption of glucose into skeletal muscle predominantly through which of the following transporters?

- A. GLUT 1**
- B. GLUT2**
- C. GLUT3**
- D. GLUT4**

11-Glucose uptake by:

- A. Brain cells is through energy-requiring (active) transport.**
- B. Intestinal mucosal Cells requires insulin.**
- C. Liver cells through facilitated diffusion involving a glucose transporter.**
- D. Most cells is through simple diffusion up a concentration gradient.**

12-After a large, well-balanced meal, all of the following substances would be expected to be elevated EXCEPT:

- A. Fatty acids.**
- B. Insulin.**
- C. Glucose.**
- D. Glucagon.**

13-In an embryo with a complete deficiency of pyruvate kinase, how many net moles of ATP are generated in the conversion of 1 mole of glucose through the glycolytic pathway?

- (A) 0**
- (B) 1**
- (C) 2**
- (D) 3**
- (E) 4**

14-Which one of following statements about the step in glycolysis catalyzed by hexokinase and in gluconeogenesis by glucose 6-phosphatase is correct?

- A. Because hexokinase has a low K_m its activity in liver increases as the concentration of glucose in the portal blood increases.**
- B. Gluconeogenesis is mainly occur in the muscles .**
- C. If hexokinase and glucose-6-phosphatase are both equally active at the same time there is net formation of ATP from ADP and phosphate.**
- D. Liver contains an isoenzyme of hexokinase, glucokinase, which is especially important in the fed state.**
- E. Muscle can release glucose into the circulation from its glycogen reserves in the fasting state.**

15-The first step in the energy generation phase of glycolysis is:

- a. Reduction of 1, 3-bisphosphoglycerate to glyceraldehyde 3-phosphate**
- b. Oxidation of glyceraldehyde 3-phosphate to 1, 3-bisphosphoglycerate**
- c. Reversible conversion of dihydroxyacetone phosphate to glyceraldehyde 3-phosphate**

d. Irreversible conversion of dihydroxyacetone phosphate to glyceraldehyde 3-phosphate

16-Under anaerobic conditions, skeletal muscle generates lactate from pyruvate to:

- a. lower the pH.**
- b. promote release of oxygen from hemoglobin.**
- c. generate additional ATP.**
- d. be warning of muscle fatigue.**
- e. regenerate NAD⁺ for further glycolysis.**

17-The high free energy change for the conversion of PEP to pyruvate is due largely to the ____ conversion of the relatively unstable ____ tautomer of pyruvate to the more stable ____ form following the phosphoryl group transfer step.

- a. unfavorable; enol; keto**
- b. unfavorable; keto; aldol**
- c. favorable; keto; enol**
- d. favorable; enol; keto**
- e. favorable; enol; aldol**

18-PEP and 2-PG have similar amounts of potential metabolic energy with respect to decomposition to Pi, CO₂ and H₂O, but the enolase reaction:

- a. creates a much more unstable reactive intermediate.**
- b. rearranges 2-PG into a form from which more potential energy can be released by hydrolysis.**
- c. rearranges 2-PG to a form with greater binding potential to the enzyme.**
- d. changes the G of the reaction to increase the potential energy.**
- e. none are true.**

19-A mutase catalyzes which of the reactions, and belongs to which class of enzymes?

- a. 2-phosphoglycerate \leftrightarrow phosphoenolpyruvate + H₂O; lyase**

- b. pyruvate + NADH + H⁺ <--> lactate + NAD⁺; oxidoreductase
- c. 3-phosphoglycerate <--> 2-phosphoglycerate; isomerase
- d. dihydroxyacetone phosphate <--> glyceraldehyde-3-phosphate; isomerase
- e. glucose-6-phosphate <--> fructose-6-phosphate; isomerase

20-The reaction mechanism for glyceraldehyde-3-phosphate dehydrogenase involves ____ attack by a cysteine -SH group on the ____ carbon of the substrate to form a hemithioacetal.

- a. electrophilic; carbonyl
- b. electrophilic; acidic
- c. nucleophilic; amino
- d. nucleophilic; carbonyl
- e. SN₂; amino

21-The first intermediate of glycolysis with free energy of hydrolysis more negative than that of ATP is:

- a. glucose-6-phosphate.
- b. fructose-6-phosphate.
- c. fructose-1,6-bisphosphate.
- d. dihydroxyacetone phosphate.
- e. 1,3-bisphosphoglycerate.

22-The mechanism of triose phosphate isomerase is very similar in function to:

- a. hexokinase.
- b. phosphoglucoisomerase.
- c. phosphofructokinase.
- d. fructose-1,6-bisphosphate aldolase.
- e. none of the above

23-Dihydroxyacetone phosphate is:

- a. an aldotriose.
- b. an enantiomer of glyceraldehyde-3-phosphate
- c. derived from C4-C6 of fructose-1,6-bisphosphate.
- d. isomerized to glyceraldehyde-3-phosphate by triose phosphate isomerase (TPI).

e. the least abundant component of the TPI reaction at equilibrium.

24-All are characteristics of the phosphofructokinase-1 catalyzed reaction EXCEPT:

- a. exergonic.**
- b. "priming reaction".**
- c. "valve" controlling the rate of glycolysis.**
- d. commits the cell to metabolize glucose.**
- e. all are true**

25-The step that commits glucose to glycolysis is catalyzed by:

- a. hexokinase.**
- b. phosphoglucoisomerase.**
- c. phosphofructokinase-1 (PFK-1).**
- d. glucokinase.**
- e. fructose-1,6-bisphosphate aldolase.**

26-The appropriate sequence of steps in the phosphoglucoisomerase catalyzed reaction on glucose-6-phosphate is:

- A. creation of a carbonyl group at C-2.**
 - B. opening of the pyranose ring.**
 - C. C-2 proton is removed.**
 - D. furanose ring is formed.**
 - E. formation of the enediol.**
- a. A, C, E, B, D**
 - b. B, C, E, A, D**
 - c. C, E, B, D, A**
 - d. D, E, B, A, C**
 - e. A, C, D, E, B**

27- All are important reasons to phosphorylate glucose in the first step of glycolysis EXCEPT:

- a. the large positive free energy is important in getting the pathway started.
- b. glucose-6-phosphate has a negative charge preventing transport out of the cell.
- c. the concentration of free glucose in the cell is lowered favoring influx of glucose.
- d. phosphorylation keeps the glucose in the cell. e. regulatory control can be imposed only at a reaction not at equilibrium

28-For the first five steps of glycolysis, the appropriate sequence of enzymes is:

- A. phosphofructokinase-1 (PFK-1).
 - B. hexokinase / glucokinase.
 - C. fructose bisphosphate aldolase.
 - D. Phosphoglucoisomerase.
 - E. triose phosphate isomerase (TPI).
- a. A, C, B, E, D
 - b. B, C, D, E, A
 - c. B, D, C, A, E
 - d. B, D, A, C, E
 - e. B, D, E, C, A

29-A child was diagnosed after accidentally ingesting a lot of fluoridated water, which of the following enzymes might be affected in this patient?

- A) Pyruvate dehydrogenase
- B) Enolase
- C) PFK-1
- D) PFK-2

30-Which of the following processes is regarded as gluconeogenesis?

- A) Lactate → Glucose
- B) Fructose → Glucose
- C) Galactose → Glucose
- D) Glucose → Glycogen

31-Which one of the following occur during the conversion of pyruvate to glucose by gluconeogenesis?

- (A) Biotin is required as a cofactor.**
- (B) The carbon of CO₂ added in one reaction, appears in the final product.**
- (C) Energy is utilized only in the form of GTP.**
- (D) All of the reactions occur in the cytosol.**
- (E) All of the reactions occur in the mitochondrion.**

32.In glycolysis, the conversion of 1 mol of fructose 1,6-bisphosphate to 2 mol of pyruvate results in the formation of:

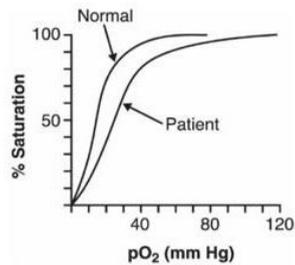
- A. 1 mol NAD⁺ and 2 mol of ATP**
- B. 1 mol NADH and 1 mol of ATP**
- C. 2 mol NAD⁺ and 4 mol of ATP**
- D. 2 mol NADH and 2 mol of ATP**
- E. 2 mol NADH and 4 mol of ATP**

33. Which one of following statements about glucose metabolism is correct?

- A. Glucagon increases the rate of glycolysis.**
- B. Glycolysis requires NADP⁺.**
- C. In glycolysis, glucose is cleaved into two three carbon compounds.**
- D. Substrate level phosphorylation takes place in the electron transport system.**
- E. The main product of glycolysis in red blood cells is pyruvate.**

34:

1. A 10-month-old child is being evaluated for the underlying cause of a hemolytic anemia. In the diagram below, the oxygen dissociation curve for hemoglobin in his erythrocytes is compared with the curve obtained with normal red cells.



A deficiency of which enzyme is most likely to account for the hemolytic anemia in this patient?

- (A) Glucokinase
- (B) Glucose 6-P dehydrogenase
- (C) Pyruvate carboxylase
- (D) Glutathione reductase
- (E) Pyruvate kinase

-THE ANSWERS AND EXPLANATIONS:

1. The answer is E.

The cake contains starch, lactose (milk sugar), and sucrose (table sugar). Digestion of starch produces glucose. Lactase cleaves lactose to galactose and glucose, and sucrase cleaves sucrose to fructose and glucose. Thus, the intestinal epithelial cells will absorb from the intestinal lumen and then secrete into the blood, glucose, galactose, and fructose. The intestinal epithelial cells will not use these sugars as an energy source.

2-The answer is A.

In this patient, starch will be digested by salivary and pancreatic α -amylases to small oligosaccharides and maltose, but a lower than normal amount of glucose will be produced because of the deficiency of the brush border disaccharidases, which have

maltase, isomaltase, sucrase, and lactase activity. Sucrose and lactose will not be cleaved. There will be more maltose, sucrose, and lactose in the stool and less monosaccharides in the blood and tissues. Insulin levels will be lower than normal because of the reduced levels of glucose entering the blood. Muscle glycogen will not increase because there is less glucose in the circulation, and insulin, which is required for glucose entry into the muscle, may not be secreted under these conditions.

3-The answer is B.

Fructose gives a positive result in a reducing-sugar test and a negative result in a glucose oxidase test. It is a monosaccharide and so is not cleaved by acid. Glucose gives a positive test result with the enzyme glucose oxidase. Maltose and lactose are disaccharides that undergo acid hydrolysis, which doubles the amount of reducing sugar. This infant probably has benign fructosuria or the more dangerous condition, HFI. A galactose oxidase test would rule out the possibility that the sugar was galactose.

4- The answer is D

5-The answer is C

Endergonic reactions require energy, and do not proceed spontaneously. Glycolysis is possible by the coupling of energetically unfavorable reactions to highly favorable exergonic reactions. ATP hydrolysis to ADP liberates a great deal of energy (and provides a free phosphate). High concentrations of water would shift equilibrium toward the reverse direction in this instance due to LeChatlier's principle. In the setting of glycolysis, the conversion of glucose to G6P is achieved via coupled ATP hydrolysis reactions.

6-The answer is D

The liver, like all cells, needs a constant supply of glucose. However, it is able to produce its own glucose through gluconeogenesis (cells in the kidney can also complete low levels

of gluconeogenesis). The other cells listed here are absolutely dependent on a glucose source from the blood for energy.

7-The answer is B

GLUT is an abbreviation for glucose transporter and describes a family of sugar transporters with varying distributions and activities. GLUT 4 is found in adipose tissue and muscle, and mediates insulin-stimulated glucose uptake. In fact, it is the only insulin-responsive glucose transporter. Insulin acts via its receptor to translocate GLUT 4 to the plasma membrane. GLUT 4 in skeletal and cardiac muscle is also stimulated by exercise through an insulin-independent pathway.

8-The answer is B

Monosaccharides are transported into absorptive intestinal epithelial cells via active transport systems.

Monosaccharides released into the blood via the intestinal epithelial cells are recovered by tissues that use facilitative transporters.

9-The answer is A

Under normal conditions, when oxygen is readily available, the pyruvate generated in glycolysis enters the mitochondrion and is converted into acetyl-CoA by the action of pyruvate dehydrogenase. During strenuous exercise, particularly by individuals in poor physical condition, the oxygen demands of the skeletal muscle may exceed the ability of the heart and lungs to provide oxygen. In this setting, the muscles switch to anaerobic glycolysis, and the pyruvate that is produced is converted to lactate by the action of lactate dehydrogenase.

10-The answer is D

GLUT is an abbreviation for glucose transporter and describes a family of sugar transporters with varying distributions and activities. GLUT 4 is found in adipose

tissue and muscle, and mediates insulin-stimulated glucose uptake; in fact, it is the only insulin-responsive glucose transporter. Insulin acts via its receptor to translocate GLUT 4 to the plasma membrane. GLUT 4 in skeletal and cardiac muscle is also stimulated by exercise through an insulin-independent pathway

11- The answer is C

Glucose uptake in the liver, brain, muscle, and adipose tissue is down a concentration gradient, and the diffusion is facilitated by tissue-specific glucose transporters (GLUT). Moving glucose against a concentration gradient requires energy and is seen with the sodium-dependent glucose co-transporter of intestinal mucosal cells.

12-The answer is D

After a large meal, one would expect blood to contain high levels of nutrients, such as glucose (choice (C)) and fatty acids (choice (A)), as well as regulators telling the body to utilize and store this fuel, like insulin (choice (B)). Glucagon is a peptide hormone used to raise blood sugar levels by promoting other processes.

13-13-The answer is A.

Normally, 1 mole of ATP is used to convert 1 mole of glucose to 1 mole of glucose-6-phosphate and a second to convert 1 mole of fructose-6-phosphate to the bisphosphate. Two triose phosphates are produced by cleavage of fructose-1,6-bisphosphate. Because the two triose phosphates are converted to pyruvate, four ATPs are generated: two by phosphoglycerate kinase and two by pyruvate kinase. Net, two ATPs are produced. If pyruvate kinase is completely deficient, two less ATPs will be produced, and thus, the net ATP production will be zero. It is Unlikely that the embryo would survive with a complete deficiency of this enzyme.

14-D

15-B

16-E

17-D

18-B
19-C
20-D
21-E
22-B
23-D
24-E
25-C
26-B
27-A
28-D
29-B
30-A

31-The answer is A.

In the mitochondria, CO₂ is added to pyruvate to form oxaloacetate. The enzyme is pyruvate carboxylase, which requires biotin and ATP. Oxaloacetate leaves the mitochondrion as malate or aspartate and is regenerated in the cytosol. Oxaloacetate is converted to PEP by a reaction that utilizes GTP and releases the same CO₂ that was added in the mitochondrion. The remainder of the reactions occur in the cytosol.

32.E

33.C

34.E

A right shift in the O₂ binding curve is indicative of abnormally elevated 2,3-BPG secondary to a defect in red cell anaerobic glycolysis. Only pyruvate kinase participates in this pathway.

-THE SOURCES:

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-LIPPINCOTT'S QUESTION:

2-Which of the following statements is true for anabolic pathways only?

- A. Their irreversible (nonequilibrium) reactions are regulated.**
- B. They are called cycles if they regenerate an intermediate.**
- C. They are convergent and generate a few simple products.**
- D. They are synthetic and require energy.**

E. They typically require oxidized coenzymes.

3-Compared with the resting state, vigorously contracting skeletal muscle shows:

- A. decreased AMP/ATP ratio.**
- B. decreased levels of fructose 2,6-bisphosphate.**
- C. decreased NADH/NAD⁺ ratio**
- D. increased oxygen availability.**
- E. increased reduction of pyruvate to lactate**

4-Glucose uptake by:

- A. liver cells is through facilitated diffusion involving a glucose transporter.**
- B. intestinal mucosal cells requires insulin.**
- C. brain cells is through energy-requiring (active) transport.**
- D. most cells is through simple diffusion up a concentration gradient.**

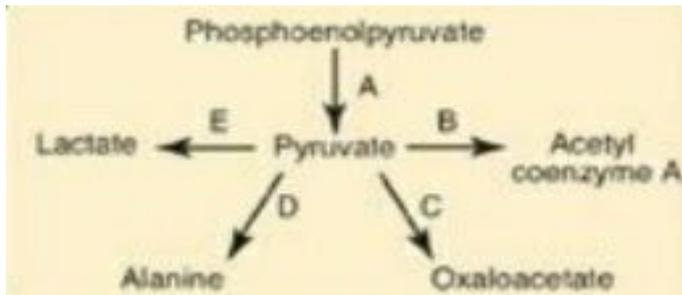
5-Given that the K_m of glucokinase for glucose is 10 mM whereas that of hexokinase is 0.1 mM, which isozyme will more closely approach V_{max} at the normal blood glucose concentration of 5 mM?

6-In patients with whooping cough, Gai is inhibited. How does this lead to a rise in cyclic AMP?

7-Which one of the following statements concerning gluconeogenesis is correct?

- A. It is an energy-producing (exergonic) process.**
- B. It is important in maintaining blood glucose during a fast.**
- C. It is inhibited by a fall in the insulin-to-glucagon ratio.**
- D. It occurs in the cytosol of muscle cells.**
- E. It uses carbon skeletons provided by fatty acid degradation.**

8-Which reaction in the diagram below would be inhibited in the presence of large amounts of avidin, an egg white protein that binds and sequesters biotin?



9-Which one of the following reactions is unique to gluconeogenesis?

- A. 1,3-Bisphosphoglycerate \rightarrow 3-phosphoglycerate
- B. Lactate \rightarrow pyruvate
- C. Oxaloacetate \rightarrow phosphoenolpyruvate
- D. Phosphoenolpyruvate \rightarrow pyruvate

11-The metabolism of ethanol by alcohol dehydrogenase produces reduced nicotinamide adenine dinucleotide (NADH). What effect is the change in the NAD⁺/NADH ratio expected to have on gluconeogenesis? Explain

13-Which of the following statements best describes glucose?

- A. It is a C-4 epimer of galactose.
- B. It is a ketose and usually exists as a furanose ring in solution.
- C. It is produced from dietary starch by the action of α -amylase.
- D. It is utilized in biological systems only in the L-isomeric form.

14-A young man entered his physician's office complaining of bloating and diarrhea. His eyes were sunken, and the physician noted additional signs of dehydration. The patient's temperature was normal. He explained that the episode had occurred following a birthday party at which he had participated in an ice cream-eating contest. The patient reported prior episodes of a similar nature following ingestion of a significant amount of dairy products. This clinical picture is most probably due to a deficiency in the activity of:

- A. isomaltase.

- B. lactase.**
- C. pancreatic α -amylase.**
- D. salivary α -amylase.**
- E. sucrase.**

15-Routine examination of the urine of an asymptomatic pediatric patient showed a positive reaction with Clinitest (a copper reduction method of detecting reducing sugars) but a negative reaction with the glucose oxidase test for detecting glucose. Using these data, show on the chart below which of the sugars could (YES) or could not (NO) be present in the urine of this individual.

SUGAR	YES	NO
Fructose		
Galactose		
Glucose		
Lactose		
Sucrose		
Xylose		

16-Why are α -glucosidase inhibitors that are taken with meals, such as acarbose and miglitol, used in the treatment of diabetes? What effect should these drugs have on the digestion of lactose?

- Answers and Explanations

1- C.

In the period immediately following a meal, blood glucose levels and hepatic uptake of glucose increase. The glucose is phosphorylated to glucose 6-phosphate and used in glycolysis. In response to the rise in blood glucose, the insulin-to-glucagon ratio increases. As a result, the kinase domain of PFK-2 is dephosphorylated and active. Its product, fructose 2,6-bisphosphate, allosterically activates PFK-1. (PFK-1 is not covalently regulated.) Active PFK-1 produces fructose

1,6-bisphosphate that is a feedforward activator of pyruvate kinase. Hepatic pyruvate kinase is covalently regulated, and the rise in insulin favors dephosphorylation.

2-D.

Anabolic processes are synthetic and energy requiring (endergonic). Statements A and B apply to both anabolic and catabolic processes, whereas C and E apply only to catabolic processes.

3-E.

Vigorously contracting muscle shows an increase in the reduction of pyruvate to lactate compared with resting skeletal muscle. The levels of adenosine monophosphate (AMP) and reduced nicotinamide adenine dinucleotide (NADH) increase, whereas change in the concentration of fructose 2,6-bisphosphate is not a key regulatory factor in skeletal muscle. The rise in the NADH to NAD⁺ ratio exceeds the oxidative capacity of the respiratory chain.

4-A.

Glucose uptake in the liver, brain, muscle, and adipose tissue is down a concentration gradient, and the diffusion is facilitated by tissue-specific glucose transporters (GLUTs). In adipose and muscle, insulin is required for glucose uptake. Moving glucose against a concentration gradient requires energy, and is seen with sodium-dependent glucose transporter-1 (SGLT-1) of intestinal mucosal cells.

5-Hexokinase.

K_m is that substrate concentration that gives 1/2 V_{max}. When blood glucose concentration is 5 mM, hexo-kinase (K_m = 0.1 mM) will be saturated, but glucokinase (K_m = 10 mM) will not.

6-

Liganded G proteins of the G_{ai} type inhibit adenylyl cyclase.

If Gai is inhibited by toxin, adenylyl cyclase production of cyclic adenosine monophosphate (cAMP) is inappropriately activated.

7- B.

During a fast, glycogen stores are depleted, and gluconeogenesis maintains blood glucose. Gluconeogenesis is an energy-requiring (endergonic) pathway (both ATP and GTP get hydrolyzed) that occurs in liver, with kidney becoming a major glucose-producing organ in prolonged fasting. It utilizes both mitochondrial and cytosolic enzymes. Gluconeogenesis is stimulated by a fall in the insulin/glucagon ratio. Fatty acid degradation yields acetyl coenzyme A (CoA), which cannot be converted to glucose. This is because there is no net gain of carbons from acetyl CoA in the tricarboxylic acid cycle, and the pyruvate dehydrogenase reaction is physiologically irreversible. It is the carbon skeletons of most amino acids that are gluconeogenic.

8-C.

Pyruvate is carboxylated to oxaloacetate by pyruvate carboxylase, a biotin-requiring enzyme. B (PDH complex) requires thiamine pyrophosphate, lipoic acid, FAD, coenzyme A, NAD; D (transaminase) requires pyridoxal phosphate; E (lactate dehydrogenase) requires NADH.

9-C.

The other reactions are common to both gluconeogenesis and glycolysis.

11-

The increase in NADH as ethanol is oxidized will decrease the availability of oxaloacetate (OAA) because the reversible oxidation of malate to OAA by malate dehydrogenase of the tricarboxylic acid cycle is driven in the reverse direction by the high availability of NADH. Additionally, the reversible reduction of pyruvate to lactate

by lactate dehydrogenase of glycolysis is driven in the forward direction by NADH.

Thus, two important gluconeogenic substrates, OAA and pyruvate, are decreased as a result of the increase in NADH during ethanol metabolism. This results in a decrease in gluconeogenesis.

12-Acetyl coenzyme A inhibits the pyruvate dehydrogenase complex and activates pyruvate carboxylase, pushing pyruvate to gluconeogenesis and away from oxidation.

13-A.

Glucose and galactose differ only in configuration around carbon 4 and so are C-4 epimers that are interconvertible by the action of an epimerase. Glucose is an aldose sugar that typically exists as a pyranose ring in solution. Fructose, however, is a ketose with a furanose ring. α -Amylase does not produce monosaccharides.

The D-isomeric form of carbohydrates is most typically the form found in biologic systems, in contrast to amino acids.

14-B.

The physical symptoms suggest a deficiency in an enzyme responsible for carbohydrate degradation. The symptoms observed following the ingestion of dairy products suggest that the patient is deficient in lactase.

15-

Each of the listed sugars, except for sucrose and glucose, could be present in the urine of this individual. Clinitest is a nonspecific test that produces a change in color if urine is positive for reducing substances such as reducing sugars (fructose, galactose, glucose, lactose, xylulose). Because sucrose is not a reducing sugar, it is not detected by

Clinitest. The glucose oxidase test will detect only glucose, and it cannot detect other sugars. The negative glucose oxidase test in the face of a positive reducing sugar test means that glucose cannot be the reducing sugar in the patient's urine.

16-

α -Glucosidase inhibitors slow the production of glucose from dietary carbohydrates, thereby reducing the postprandial rise in blood glucose and facilitating better blood glucose control in diabetics. These drugs have no effect on lactose digestion because the disaccharide lactose contains a β -glycosidic bond, not an α -glycosidic bond.

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