

## LEC 15 META Q:

**1. What is the main source of glucose for the brain during fasting or prolonged exercise?**

- a) Fatty acids
- b) Lactate
- c) Amino acids
- d) Gluconeogenesis

**2. What is the primary reason fatty acids are not converted into glucose?**

- a) Lack of necessary enzymes
- b) The inefficiency of fat as a glucose precursor
- c) Fatty acids increase ketone body formation during prolonged fasting
- d) They are primarily used for ATP production in muscles

**3. Which of the following is NOT a precursor for gluconeogenesis?**

- a) Glycerol
- b) Lactate
- c) Glucose
- d) Alanine

**4. Which organ is the primary site of gluconeogenesis during overnight fasting?**

- a) Muscle
- b) Liver
- c) Adipose tissue
- d) Kidneys

**5. Which of the following statements is correct regarding the storage efficiency of fat versus glycogen?**

- a) Fat has a higher energy density and does not attract water
- b) Fat storage increases body mass due to water attraction
- c) Glycogen is more efficient for long-term energy storage than fat
- d) Glycogen does not require any energy to store

**6. How is glycerol utilized in gluconeogenesis?**

- a) It is converted to pyruvate and enters the Krebs cycle
- b) It is converted to triose phosphates after phosphorylation and oxidation
- c) It is converted directly to glucose without the need for phosphorylation
- d) It is used to form ketone bodies in the liver

**7. What is the role of glucagon in gluconeogenesis?**

- a) Stimulates glycogen synthesis
- b) Inhibits the activity of phosphoenolpyruvate carboxykinase (PEPCK)
- c) Activates lipolysis and promotes gluconeogenesis by increasing substrate availability
- d) Increases insulin secretion

**8. What happens to the liver and kidneys' contribution to gluconeogenesis during prolonged fasting?**

- a) Liver's contribution decreases while the kidneys take over
- b) The liver and kidneys equally contribute to gluconeogenesis
- c) Kidneys start contributing significantly, up to 40% of glucose production
- d) The liver completely stops producing glucose

**9. Which enzyme is responsible for converting fructose-1,6-bisphosphate to fructose-6-phosphate in gluconeogenesis?**

- a) Phosphofructokinase-1 (PFK-1)
- b) Fructose-1,6-bisphosphatase
- c) Pyruvate carboxylase
- d) Glyceraldehyde 3-phosphate dehydrogenase

**10. Why does fructose metabolism occur faster than glucose metabolism in the liver?**

- a) Fructose metabolism bypasses the glycolysis rate-limiting step, PFK-1
- b) Fructose is metabolized exclusively via oxidative pathways
- c) Fructose activates pyruvate kinase, enhancing glycolysis
- d) Fructose enters glycolysis directly as fructose-6-phosphate

**11. Which of the following is the main enzyme involved in the phosphorylation of fructose to form fructose-1-phosphate?**

- a) Hexokinase
- b) Fructokinase
- c) Aldolase A
- d) Phosphofructokinase-1

**12. Which of the following substrates is most crucial for the conversion of pyruvate to oxaloacetate during gluconeogenesis?**

- a) Acetyl-CoA
- b) ATP
- c) Citrate
- d) GTP

**13. Which enzyme is responsible for the conversion of pyruvate to phosphoenolpyruvate (PEP) in gluconeogenesis?**

- a) Pyruvate dehydrogenase
- b) Pyruvate carboxylase
- c) Phosphoenolpyruvate carboxykinase
- d) Fructose-1,6-bisphosphatase

**14. What is the role of AMP in regulating gluconeogenesis?**

- a) AMP activates pyruvate carboxylase
- b) AMP inhibits fructose-1,6-bisphosphatase
- c) AMP activates phosphoenolpyruvate carboxykinase
- d) AMP stimulates glucose-6-phosphatase activity

**15. Which of the following compounds does NOT serve as a precursor for gluconeogenesis in the liver?**

- a) Glycerol
- b) Lactate
- c) Alanine
- d) Glucose

**16. Which of the following enzymes is inhibited by the phosphorylated form of pyruvate kinase during gluconeogenesis?**

- a) Phosphofructokinase-1
- b) Phosphoglucose isomerase
- c) Pyruvate kinase
- d) Glucose-6-phosphatase

**17. Which of the following statements is true regarding fructose intolerance?**

- a) It is caused by decreased activity of aldolase A
- b) It leads to bloating, abdominal pain, and diarrhea
- c) It results in an inability to convert fructose-1,6-bisphosphate to DHAP
- d) It is caused by a deficiency in fructokinase activity

**18. What is the primary function of the bifunctional enzyme in the regulation of gluconeogenesis?**

- a) Stimulates glucose uptake
- b) Activates glycolysis by phosphorylating PFK-2
- c) Inhibits gluconeogenesis by activating fructose-2,6-bisphosphatase
- d) Regulates fructose-1,6-bisphosphate metabolism

**19. What does fructose metabolism in the liver primarily bypass?**

- a) The hexokinase step
- b) The PFK-1 step
- c) The aldolase A cleavage
- d) The pyruvate dehydrogenase step

**20. How does glyceraldehyde contribute to gluconeogenesis and lipid synthesis?**

- a) It is converted directly to glucose
- b) It is converted to glycerol, which then enters glycolysis
- c) It forms glycerol phosphate, which is used to synthesize fats
- d) It is converted into acetyl-CoA for the Krebs cycle

**ANSWERS:**

- 1. d
- 2. a
- 3. c
- 4. b
- 5. a
- 6. b

7. c
8. c
9. b
10. a
11. b
12. a
13. c
14. b
15. d
16. c
17. b
18. b
19. b
20. c

**21. Which of the following is the primary source of glucose for the brain during prolonged fasting?**

- a) Muscle glycogen
- b) Liver glycogen
- c) Gluconeogenesis from lactate
- d) Gluconeogenesis from amino acids

**22. Why is fat a more efficient energy storage molecule than glycogen?**

- a) Fat stores less water per gram compared to glucose.
- b) Fat stores more energy per gram and has no water association.
- c) Fat is more metabolically active than glycogen.
- d) Glycogen is only stored in muscle tissue, not liver.

**23. Which enzyme is responsible for converting pyruvate to oxaloacetate in gluconeogenesis?**

- a) Pyruvate kinase
- b) Phosphoenolpyruvate carboxykinase
- c) Pyruvate carboxylase
- d) Fructose-1,6-bisphosphatase

**24. During fasting, which of the following metabolites is most critical for the production of glucose through gluconeogenesis?**

- a) Fatty acids
- b) Glycerol
- c) Glutamine
- d) Acetyl-CoA

**25. The formation of glucose from pyruvate via gluconeogenesis requires which of the following energy molecules?**

- a) ATP and NADH
- b) GTP and ATP
- c) NADH and FADH<sub>2</sub>
- d) ATP and NADPH

**26. In the gluconeogenesis pathway, which of the following compounds is used to bypass the irreversible step catalyzed by phosphofructokinase-1 in glycolysis?**

- a) Fructose-6-phosphate
- b) Fructose-1,6-bisphosphate
- c) Glycerol-3-phosphate
- d) Dihydroxyacetone phosphate

**27. How does glucagon regulate gluconeogenesis during fasting?**

- a) By promoting insulin secretion
- b) By increasing the activity of pyruvate kinase
- c) By inhibiting phosphofructokinase-1
- d) By decreasing the release of glycerol

**28. Which of the following substrates directly enters gluconeogenesis after being phosphorylated to form triose phosphates?**

- a) Alanine
- b) Lactate
- c) Glycerol
- d) Fatty acids

**29. Which of the following best describes the function of the malate shuttle in gluconeogenesis?**

- a) It transports glucose from the cytoplasm to the mitochondria.
- b) It carries oxaloacetate from the mitochondria to the cytoplasm.
- c) It converts glucose-6-phosphate to glucose.
- d) It facilitates the dephosphorylation of fructose-1,6-bisphosphate.

**30. In gluconeogenesis, the enzyme fructose-1,6-bisphosphatase is inhibited by:**

- a) ATP
- b) AMP
- c) Citrate
- d) GTP

**31. The primary role of glycerol in gluconeogenesis is:**

- a) To provide energy through its oxidation
- b) To act as a direct substrate for glycolysis
- c) To form glucose after phosphorylation and oxidation
- d) To contribute to fatty acid synthesis

**32. Which of the following is true about the regulation of gluconeogenesis during fasting?**

- a) It is upregulated by high insulin levels.
- b) It is primarily controlled by high glucose levels.
- c) Glucagon plays a critical role in activating gluconeogenesis.
- d) Glucose-6-phosphatase activity is inhibited by glucagon.

**33. What is the role of acetyl-CoA in the regulation of gluconeogenesis?**

- a) It inhibits pyruvate carboxylase during fasting.
- b) It activates pyruvate carboxylase to stimulate gluconeogenesis.
- c) It provides the energy for converting lactate to glucose.
- d) It directly contributes to glucose synthesis from fatty acids.

**34. Which of the following metabolic intermediates is produced during anaerobic metabolism and contributes to gluconeogenesis?**

- a) Glycerol
- b) Lactate

- c) Fatty acids
- d) Acetyl-CoA

**35. Which of the following enzymes is responsible for the conversion of fructose-1,6-bisphosphate to fructose-6-phosphate in gluconeogenesis?**

- a) Fructose-1,6-bisphosphatase
- b) Phosphofructokinase-1
- c) Pyruvate kinase
- d) Glyceraldehyde-3-phosphate dehydrogenase

**36. The process of gluconeogenesis during fasting is energy-intensive. Which of the following energy requirements are involved in the conversion of pyruvate to phosphoenolpyruvate (PEP)?**

- a) 2 ATP and 2 GTP
- b) 4 ATP and 2 NADH
- c) 3 ATP and 1 GTP
- d) 2 ATP and 1 GTP

**37. What would be the consequence of a deficiency in glucose-6-phosphatase in muscle tissue?**

- a) The muscle would have a decreased ability to store glycogen.
- b) The muscle would be unable to release glucose into the bloodstream.
- c) Glycogen breakdown would be completely inhibited in muscle cells.
- d) Muscle cells would not be able to utilize lactate for energy production.

**38. Which of the following statements about lactate in gluconeogenesis is correct?**

- a) Lactate enters gluconeogenesis after being converted to pyruvate, which is then converted to glucose.
- b) Lactate is an inefficient precursor for gluconeogenesis.
- c) Lactate cannot be used for gluconeogenesis in the liver.
- d) Lactate contributes directly to ketone body formation during fasting.

**39. In which organ does the majority of fructose metabolism take place?**

- a) Small intestine
- b) Liver
- c) Muscle
- d) Kidney

**40. What effect does fructose have on insulin secretion compared to glucose?**

- a) Fructose promotes insulin secretion more than glucose.
- b) Fructose does not significantly promote insulin secretion.
- c) Both fructose and glucose stimulate equal amounts of insulin release.
- d) Fructose inhibits insulin secretion entirely.

**Answers:**

- 21: d
- 22: b
- 23: c
- 24: b
- 25: b
- 26: a

- 27: c
- 28: b
- 29: b
- 30: b
- 31: c
- 32: c
- 33: b
- 34: b
- 35: a
- 36: a
- 37: b
- 38: a
- 39: b
- 40: b

**41. Which of the following molecules is a key regulatory factor in the conversion of pyruvate to acetyl-CoA and impacts gluconeogenesis during fasting?**

- a) NAD<sup>+</sup>
- b) Acetyl-CoA
- c) AMP
- d) Citrate

**42. In the process of gluconeogenesis, which of the following enzymes catalyzes the conversion of oxaloacetate to phosphoenolpyruvate?**

- a) Phosphoenolpyruvate carboxykinase (PEPCK)
- b) Pyruvate carboxylase
- c) Glucose-6-phosphatase
- d) Aldolase

**43. Which of the following molecules directly activates fructose-1,6-bisphosphatase in the gluconeogenesis pathway?**

- a) AMP
- b) Fructose-2,6-bisphosphate
- c) Citrate
- d) NADH

**44. What is the role of the enzyme pyruvate carboxylase in gluconeogenesis, and where is it located in the cell?**

- a) It converts acetyl-CoA to pyruvate in the mitochondria.
- b) It converts pyruvate to oxaloacetate in the mitochondria.
- c) It dephosphorylates glucose-6-phosphate in the cytoplasm.
- d) It converts glycerol to glucose in the endoplasmic reticulum.

**45. In the context of fasting, which of the following metabolites accumulates in the liver and suppresses pyruvate dehydrogenase complex (PDC) activity, thereby promoting gluconeogenesis?**

- a) Acetyl-CoA
- b) NADH
- c) AMP
- d) Glucose-6-phosphate

**46. The malate-aspartate shuttle is crucial for the transport of oxaloacetate from the mitochondria to the cytoplasm during gluconeogenesis. Which molecule is exchanged with oxaloacetate in this shuttle?**

- a) Pyruvate
- b) Malate
- c) Acetyl-CoA
- d) Citrate

**47. Which of the following statements is true regarding the regulation of gluconeogenesis in the liver during periods of fasting?**

- a) Elevated insulin levels stimulate gluconeogenesis.
- b) High levels of fructose-2,6-bisphosphate promote gluconeogenesis.
- c) Glucagon and cortisol both enhance the expression of key gluconeogenic enzymes.
- d) High glucose levels activate gluconeogenesis by inhibiting glucose-6-phosphatase.

**48. Which intermediate is formed during the metabolism of glycerol and is a precursor for glucose synthesis in the liver?**

- a) Dihydroxyacetone phosphate (DHAP)
- b) Acetyl-CoA
- c) Glyceraldehyde-3-phosphate (G3P)
- d) Fructose-6-phosphate

**49. Which of the following best describes the role of AMP in the regulation of gluconeogenesis?**

- a) AMP activates key enzymes such as fructose-1,6-bisphosphatase.
- b) AMP inhibits key enzymes like phosphofructokinase-1 (PFK-1) in glycolysis.
- c) AMP stimulates the conversion of glucose to glucose-6-phosphate.
- d) AMP enhances the activity of glucose-6-phosphatase in the liver.

**50. What is the primary function of fructose-2,6-bisphosphate in the regulation of gluconeogenesis?**

- a) It inhibits phosphoenolpyruvate carboxykinase.
- b) It activates phosphofructokinase-1, promoting glycolysis.
- c) It stimulates the activity of glucose-6-phosphatase.
- d) It deactivates pyruvate kinase, preventing glycolysis.

**51. Which of the following molecules serves as a source of amino acids for gluconeogenesis, particularly in prolonged fasting?**

- a) Alanine
- b) Glutamine
- c) Lysine
- d) Serine

**52. Which enzyme catalyzes the final step of gluconeogenesis, converting glucose-6-phosphate to glucose?**

- a) Glucose-6-phosphatase
- b) Glucokinase
- c) Phosphoglucoisomerase
- d) Glutaminase

**53. The role of cortisol during fasting is to:**

- a) Stimulate glycogen synthesis
- b) Increase glucose uptake by muscle tissue



- c) Enhance the expression of gluconeogenic enzymes
- d) Decrease fatty acid oxidation

**54. Which of the following steps in gluconeogenesis requires both ATP and GTP?**

- a) Conversion of pyruvate to oxaloacetate
- b) Conversion of oxaloacetate to phosphoenolpyruvate
- c) Conversion of fructose-1,6-bisphosphate to fructose-6-phosphate
- d) Conversion of glucose-6-phosphate to glucose

**55. Which of the following substrates can be converted into glucose via gluconeogenesis, but cannot enter the citric acid cycle directly?**

- a) Lactate
- b) Acetyl-CoA
- c) Pyruvate
- d) Acetoacetate

**56. Which of the following changes would be most likely to occur in a fasting individual who has a defect in the enzyme glucose-6-phosphatase?**

- a) Decreased ability to break down muscle glycogen
- b) Reduced capacity to synthesize glucose from lactate
- c) Accumulation of glucose-6-phosphate in the liver
- d) Enhanced gluconeogenesis from glycerol

**57. The regulation of pyruvate carboxylase is largely influenced by the concentration of which of the following molecules during gluconeogenesis?**

- a) ATP
- b) AMP
- c) Acetyl-CoA
- d) NADH

**58. In the context of gluconeogenesis, which of the following is the most important role of the enzyme glucose-6-phosphatase in the liver?**

- a) It catalyzes the hydrolysis of glucose-6-phosphate to release glucose into the bloodstream.
- b) It activates the transport of glucose into liver cells from the bloodstream.
- c) It dephosphorylates glucose to form glycogen.
- d) It promotes the breakdown of triglycerides into fatty acids.

**59. During gluconeogenesis, which of the following substrates can contribute to the formation of oxaloacetate for further conversion to phosphoenolpyruvate?**

- a) Acetyl-CoA
- b) Lactate
- c) Glycerol
- d) Fatty acids

**60. Which of the following regulatory mechanisms prevents excessive gluconeogenesis during periods of refeeding after fasting?**

- a) Increased glucagon levels
- b) Activation of phosphofructokinase-1
- c) Decreased insulin sensitivity
- d) Inhibition of glucose-6-phosphatase

**Answers:**

- 41: b
- 42: a
- 43: c
- 44: b
- 45: a
- 46: b
- 47: c
- 48: a
- 49: b
- 50: b
- 51: a
- 52: a
- 53: c
- 54: b
- 55: a
- 56: c
- 57: c
- 58: a
- 59: b
- 60: b

**61. In gluconeogenesis, which of the following is the primary function of the enzyme fructose-1,6-bisphosphatase (FBPase-1)?**

- a) It converts fructose-6-phosphate to fructose-1,6-bisphosphate.
- b) It catalyzes the hydrolysis of fructose-1,6-bisphosphate to fructose-6-phosphate.
- c) It inhibits phosphofructokinase-1 (PFK-1) during fasting.
- d) It converts glucose-6-phosphate to glucose.

**62. Which of the following is NOT a substrate for gluconeogenesis in the liver?**

- a) Lactic acid
- b) Glycerol
- c) Fatty acids
- d) Glutamine

**63. How does the regulation of phosphofructokinase-2 (PFK-2) impact gluconeogenesis?**

- a) Activation of PFK-2 increases fructose-2,6-bisphosphate levels, promoting glycolysis.
- b) Inhibition of PFK-2 decreases fructose-2,6-bisphosphate levels, promoting gluconeogenesis.
- c) PFK-2 enhances the conversion of pyruvate to oxaloacetate.
- d) PFK-2 is directly responsible for activating glucose-6-phosphatase.

**64. During starvation, fatty acids are released from adipose tissue and used as an alternative fuel. Which of the following best explains how fatty acids support gluconeogenesis?**

- a) Fatty acids are converted to glucose in the liver.
- b) Fatty acids enter the citric acid cycle and provide NADH, which is used for gluconeogenesis.
- c) Fatty acids are converted to acetyl-CoA, which is used to form glucose.
- d) Fatty acids are incorporated into glycerol for glucose synthesis.

**65. Which of the following substrates is utilized by the liver during gluconeogenesis to form glucose, but requires the process of transamination before being converted?**

- a) Lactate
- b) Pyruvate
- c) Alanine
- d) Glycerol

**66. Which of the following best describes the regulatory role of glucagon in the liver during fasting conditions?**

- a) It activates glycogen synthase, increasing glycogen storage.
- b) It increases the activity of gluconeogenic enzymes like PEPCK and FBPase-1.
- c) It enhances glycolysis by activating PFK-1.
- d) It directly inhibits glucose-6-phosphatase to prevent glucose release.

**67. In the liver, how does increased acetyl-CoA during fasting conditions affect gluconeogenesis?**

- a) Acetyl-CoA inhibits pyruvate carboxylase, reducing gluconeogenesis.
- b) Acetyl-CoA activates pyruvate dehydrogenase, promoting gluconeogenesis.
- c) Acetyl-CoA activates pyruvate carboxylase, promoting gluconeogenesis.
- d) Acetyl-CoA inhibits fructose-1,6-bisphosphatase, preventing gluconeogenesis.

**68. The enzyme pyruvate carboxylase plays a key role in gluconeogenesis. Which of the following is required as a cofactor for this enzyme to function properly?**

- a) Biotin
- b) Vitamin B12
- c) Folate
- d) Niacin

**69. In the process of gluconeogenesis, which of the following pathways is required for the conversion of lactate to glucose?**

- a) The Cori cycle
- b) The urea cycle
- c) The pentose phosphate pathway
- d) The malate-aspartate shuttle

**70. Which of the following is the main determinant in the decision to use amino acids or fatty acids for gluconeogenesis during prolonged fasting?**

- a) The availability of glucose from dietary intake
- b) The activation of protein kinases in the liver
- c) The ratio of insulin to glucagon
- d) The presence of ketone bodies in the blood

**71. What is the role of the pentose phosphate pathway in supporting gluconeogenesis?**

- a) It generates NADH, which is used directly in gluconeogenesis.
- b) It provides ribose-5-phosphate for nucleic acid synthesis during fasting.
- c) It produces NADPH, which is used in anabolic reactions.
- d) It generates intermediates like ribulose-5-phosphate that can enter glycolysis and gluconeogenesis.

**72. Which of the following is true regarding the impact of insulin on gluconeogenesis?**

- a) Insulin directly stimulates the activity of gluconeogenic enzymes such as PEPCK.
- b) Insulin increases the transcription of genes involved in gluconeogenesis.
- c) Insulin inhibits gluconeogenesis by deactivating fructose-1,6-bisphosphatase.
- d) Insulin increases glucose production by activating glycogen phosphorylase.

**73. Which of the following metabolic shifts happens in the liver during the transition from a well-fed state to fasting?**

- a) Increased glycolysis and decreased gluconeogenesis
- b) Increased gluconeogenesis and decreased glycolysis
- c) Decreased fatty acid oxidation and increased gluconeogenesis
- d) Decreased glycogen breakdown and increased glycolysis

**74. What is the primary role of the enzyme glucose-6-phosphatase in gluconeogenesis?**

- a) It dephosphorylates glucose-6-phosphate to release free glucose into the bloodstream.
- b) It phosphorylates glucose to glucose-6-phosphate to promote storage as glycogen.
- c) It converts glucose-6-phosphate to fructose-6-phosphate to continue gluconeogenesis.
- d) It breaks down glycogen into glucose-6-phosphate for use in glycolysis.

**75. Which of the following accurately describes the contribution of the liver to glucose homeostasis during fasting?**

- a) The liver produces glucose primarily from glycogen stores and reduces gluconeogenesis.
- b) The liver synthesizes glucose exclusively from amino acids and glycerol, inhibiting glycogen breakdown.
- c) The liver produces glucose through gluconeogenesis and glycogenolysis, providing glucose to peripheral tissues.
- d) The liver reduces glucose production and promotes glucose uptake during fasting.

**76. How does the presence of acetyl-CoA influence the activity of pyruvate carboxylase in gluconeogenesis?**

- a) Acetyl-CoA inhibits pyruvate carboxylase to prevent gluconeogenesis.
- b) Acetyl-CoA activates pyruvate carboxylase, stimulating gluconeogenesis.
- c) Acetyl-CoA inactivates pyruvate carboxylase to favor fatty acid oxidation.
- d) Acetyl-CoA has no effect on pyruvate carboxylase activity.

**77. Which of the following is the direct result of increased levels of fructose-2,6-bisphosphate in the liver during fed conditions?**

- a) It promotes gluconeogenesis by inhibiting PFK-1.
- b) It activates phosphofruktokinase-1 (PFK-1), inhibiting gluconeogenesis.
- c) It stimulates glucose-6-phosphatase to release glucose into the bloodstream.
- d) It inhibits glycogen synthase activity to store glucose.

**78. Which of the following intermediates in gluconeogenesis can be derived from the breakdown of odd-chain fatty acids?**

- a) Acetyl-CoA
- b) Propionyl-CoA
- c) Glycerol
- d) Succinyl-CoA

**79. What effect does the accumulation of AMP in the liver have on gluconeogenesis?**

- a) It stimulates gluconeogenesis by increasing the activity of PEPCK.
- b) It inhibits gluconeogenesis by activating AMP-activated protein kinase (AMPK).
- c) It enhances gluconeogenesis by increasing the transcription of gluconeogenic genes.
- d) It decreases gluconeogenesis by increasing insulin secretion.

**80. Which of the following is a direct result of the activation of AMP-activated protein kinase (AMPK) during low-energy conditions in the liver?**

- a) Activation of gluconeogenesis through the upregulation of PEPCK.
- b) Inhibition of gluconeogenesis by phosphorylating key enzymes like fructose-1,6-bisphosphatase.

- c) Stimulation of fatty acid synthesis for energy storage.
- d) Promotion of glycogen synthesis by deactivating glycogen phosphorylase.

**Answers:**

- 61: b
- 62: c
- 63: b
- 64: b
- 65: c
- 66: b
- 67: c
- 68: a
- 69: a
- 70: c
- 71: d
- 72: c
- 73: b
- 74: a
- 75: c
- 76: b
- 77: b
- 78: b
- 79: b
- 80: b

**81. Which of the following compounds can directly inhibit pyruvate kinase during fasting to promote gluconeogenesis?**

- a) Acetyl-CoA
- b) Fructose-1,6-bisphosphate
- c) ATP
- d) Citrate

**82. The conversion of oxaloacetate to phosphoenolpyruvate (PEP) in gluconeogenesis requires which of the following coenzymes for its enzyme, PEP carboxykinase (PEPCK)?**

- a) NADH
- b) ATP
- c) GTP
- d) FADH<sub>2</sub>

**83. Which of the following is a key regulatory mechanism that ensures the coordination between gluconeogenesis and glycolysis?**

- a) The use of fructose-2,6-bisphosphate as a dual regulator for PFK-1 and FBPase-1.
- b) The reciprocal regulation of phosphoenolpyruvate carboxykinase (PEPCK) and hexokinase.
- c) The inhibition of pyruvate kinase by acetyl-CoA.
- d) The activation of AMP-activated protein kinase (AMPK) during periods of low glucose availability.

**84. Which of the following enzymes in gluconeogenesis is activated by glucagon and epinephrine to promote the production of glucose in the liver?**

- a) Pyruvate carboxylase
- b) Phosphofruktokinase-1 (PFK-1)
- c) Fructose-1,6-bisphosphatase
- d) Hexokinase

**85. What is the key difference between the metabolic fates of pyruvate in the liver during fasting versus after a carbohydrate meal?**

- a) During fasting, pyruvate is primarily converted to lactate; after a meal, it enters the citric acid cycle.
- b) During fasting, pyruvate is converted to oxaloacetate for gluconeogenesis; after a meal, it is used for glycogen synthesis.
- c) During fasting, pyruvate is directly converted to glucose in the cytoplasm; after a meal, it is converted to acetyl-CoA.
- d) During fasting, pyruvate is primarily converted to acetyl-CoA for energy; after a meal, it is used for fatty acid synthesis.

**86. Which of the following best describes the role of the Cori cycle in supporting gluconeogenesis?**

- a) It directly converts lactate to glucose in the muscles.
- b) It produces glucose from lactate in the liver, which is then returned to muscles for energy.
- c) It produces acetyl-CoA from lactate to fuel gluconeogenesis.
- d) It transfers amino acids from the liver to the muscles for gluconeogenesis.

**87. In the context of gluconeogenesis, what is the effect of an increase in the NADH/NAD<sup>+</sup> ratio within the liver?**

- a) It stimulates the conversion of lactate to pyruvate and promotes gluconeogenesis.
- b) It inhibits the conversion of pyruvate to oxaloacetate and slows gluconeogenesis.
- c) It activates pyruvate carboxylase and enhances gluconeogenesis.
- d) It increases the activity of fructose-1,6-bisphosphatase to enhance glucose production.

**88. How does the accumulation of ketone bodies during prolonged fasting influence gluconeogenesis?**

- a) Ketone bodies inhibit the enzyme pyruvate carboxylase, reducing gluconeogenesis.
- b) Ketone bodies provide an alternative energy source, decreasing the need for gluconeogenesis.
- c) Ketone bodies directly promote the synthesis of glucose from amino acids.
- d) Ketone bodies activate the enzyme glucose-6-phosphatase, increasing glucose production.

**89. In gluconeogenesis, the bypass of the pyruvate kinase reaction is achieved by which of the following enzymes?**

- a) Phosphoenolpyruvate carboxykinase (PEPCK)
- b) Pyruvate dehydrogenase
- c) Lactate dehydrogenase
- d) Fructose-1,6-bisphosphatase

**90. The enzyme glucose-6-phosphatase is primarily located in which of the following cellular compartments to support gluconeogenesis?**

- a) Nucleus
- b) Endoplasmic reticulum
- c) Mitochondrion
- d) Golgi apparatus

**91. During fasting, which of the following hormones is primarily responsible for activating gluconeogenesis in the liver by enhancing the transcription of key enzymes like PEPCK and G6Pase?**

- a) Insulin
- b) Glucagon
- c) Cortisol
- d) Epinephrine

**92. Which of the following compounds is a precursor for both gluconeogenesis and the synthesis of ketone bodies during fasting?**

- a) Acetyl-CoA
- b) Lactic acid
- c) Oxaloacetate
- d) Alanine

**93. Which of the following molecules can act as an allosteric activator of fructose-1,6-bisphosphatase during gluconeogenesis?**

- a) ATP
- b) AMP
- c) Citrate
- d) ADP

**94. What effect does a decrease in the insulin/glucagon ratio have on gluconeogenesis during fasting?**

- a) It activates gluconeogenesis by increasing the activity of key enzymes like PEPCK and FBPase-1.
- b) It inhibits gluconeogenesis by suppressing the transcription of gluconeogenic enzymes.
- c) It stimulates glycolysis by activating PFK-1 and inhibiting FBPase-1.
- d) It activates glycogen synthesis and inhibits gluconeogenesis.

**95. Which of the following best describes the role of amino acids, especially alanine, in gluconeogenesis during prolonged fasting?**

- a) They directly serve as substrates for the synthesis of glucose through the urea cycle.
- b) They provide carbon skeletons that can be converted into glucose in the liver.
- c) They are converted to acetyl-CoA to fuel gluconeogenesis.
- d) They activate the enzyme hexokinase, promoting glucose uptake by the liver.

**96. In gluconeogenesis, which of the following enzymes is most responsible for catalyzing the conversion of pyruvate to oxaloacetate?**

- a) Pyruvate carboxylase
- b) Lactate dehydrogenase
- c) PEP carboxykinase
- d) Phosphofructokinase-1

**97. Which of the following is true regarding the process of gluconeogenesis in skeletal muscle?**

- a) Skeletal muscle cannot perform gluconeogenesis, as it lacks the necessary enzymes like glucose-6-phosphatase.
- b) Skeletal muscle synthesizes glucose from lactate and releases it into the bloodstream.
- c) Skeletal muscle performs gluconeogenesis using fatty acids as the primary carbon source.
- d) Skeletal muscle uses acetyl-CoA to produce glucose, which is then stored in muscle tissue.

**98. What is the primary purpose of the pentose phosphate pathway during gluconeogenesis in the liver?**

- a) To generate ATP and NADH for glycolysis
- b) To provide ribose-5-phosphate for nucleotide synthesis
- c) To generate intermediates for the citric acid cycle
- d) To provide NADPH and ribose for biosynthetic pathways and oxidative stress defense

**99. The process of gluconeogenesis is tightly regulated to prevent futile cycles. Which of the following reactions is inhibited by the product of the opposing pathway, glycolysis?**

- a) Fructose-1,6-bisphosphatase is inhibited by fructose-2,6-bisphosphate.
- b) Phosphoenolpyruvate carboxykinase is inhibited by ATP.
- c) Pyruvate carboxylase is inhibited by NADH.
- d) Glucose-6-phosphatase is inhibited by glucose-6-phosphate.

**100. Which of the following is true about the use of glycerol as a substrate for gluconeogenesis?**

- a) Glycerol can be converted to glucose via the conversion of glycerol-3-phosphate to dihydroxyacetone phosphate (DHAP).
- b) Glycerol is first converted to pyruvate before entering gluconeogenesis.
- c) Glycerol is only used for gluconeogenesis under anaerobic conditions.
- d) Glycerol is mainly converted to lactate during gluconeogenesis.

**Answers:**

- 81: a
- 82: c
- 83: a
- 84: c
- 85: b
- 86: b
- 87: c
- 88: b
- 89: a
- 90: b
- 91: b
- 92: a
- 93: c
- 94: a
- 95: b
- 96: a
- 97: a
- 98: d
- 99: a
- 100: a

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