

LEC 11 Q – METABOLISISM :

- 1. What is the primary product of glycolysis?**
 - A) Glucose
 - B) Fructose 1,6-bisphosphate
 - C) Pyruvate
 - D) Acetyl-CoA
- 2. Which metabolic pathway interacts with glycolysis to produce pentose sugars?**
 - A) Urea cycle
 - B) Krebs cycle
 - C) Pentose Phosphate Pathway
 - D) Lipid metabolism
- 3. What is a key characteristic of the irreversible steps in glycolysis?**
 - A) They can proceed in both directions.
 - B) They are highly regulated.
 - C) They require high concentrations of substrates.
 - D) They occur in the mitochondria.
- 4. During which phase of glycolysis is ATP consumed?**
 - A) ATP-Generating Phase
 - B) Preparative Phase
 - C) Both phases
 - D) Neither phase
- 5. Which enzyme catalyzes the conversion of glucose to glucose-6-phosphate?**
 - A) Phosphofructokinase
 - B) Aldolase
 - C) Hexokinase or Glucokinase
 - D) Glycerate kinase
- 6. What type of reaction occurs when glyceraldehyde 3-phosphate is oxidized in glycolysis?**
 - A) Hydrolysis
 - B) Reduction
 - C) Oxidation-Reduction
 - D) Dehydration
- 7. What role does ATP play during the phosphorylation of fructose-6-phosphate?**
 - A) It is only used as a substrate.
 - B) It provides both energy and a phosphate group.
 - C) It is not involved in this reaction.
 - D) It is hydrolyzed to produce ADP.
- 8. Which of the following statements about GPCRs is correct?**
 - A) They consist of three transmembrane domains.
 - B) They are activated by the binding of ligands.

- C) They are only found in liver cells.
D) They are inactivated in the presence of ligands.
9. **What is the primary function of second messengers like cAMP?**
A) They directly bind to DNA.
B) They activate enzymes and ion channels.
C) They are produced only during glycolysis.
D) They inhibit signaling pathways.
10. **In glycolysis, how many total ATP molecules are produced per glucose molecule?**
A) 2
B) 4
C) 6
D) 8

Answers

1. C
2. C
3. B
4. B
5. C
6. C
7. B
8. B
9. B
10. A

11. **What does the urea cycle primarily detoxify?**
A) Glucose
B) Lactic acid
C) Ammonia (NH₃)
D) Pyruvate
12. **Which of the following is NOT a product of glycolysis?**
A) Pyruvate
B) NADH
C) Acetyl-CoA
D) ATP
13. **How many steps are involved in glycolysis?**
A) 5
B) 7
C) 10
D) 12
14. **Which phase of glycolysis involves the conversion of glucose to fructose 1,6-bisphosphate?**
A) ATP-Generating Phase

- B) Preparative Phase
C) Investment Phase
D) Oxidation Phase
15. **What is the significance of the enzyme phosphofructokinase (PFK-1) in glycolysis?**
A) It catalyzes an irreversible step.
B) It is responsible for the cleavage of fructose 1,6-bisphosphate.
C) It has the highest turnover rate of all glycolytic enzymes.
D) It is the first enzyme in the pathway.
16. **Which of the following correctly describes the role of hexokinase and glucokinase?**
A) Both are found in all tissues.
B) Glucokinase has a higher affinity than hexokinase.
C) Hexokinase is active at lower glucose concentrations.
D) Both enzymes are committed steps in glycolysis.
17. **What is produced from the oxidation of glyceraldehyde 3-phosphate during glycolysis?**
A) Fructose 1,6-bisphosphate
B) NADH
C) ATP
D) Pyruvate
18. **How does the cell prevent the simultaneous activation of catabolic and anabolic pathways?**
A) Through the use of ATP
B) By compartmentalization
C) By increasing substrate concentration
D) Through direct phosphorylation
19. **Which of the following best describes the relationship between glycolysis and the Krebs cycle?**
A) Glycolysis only occurs in aerobic conditions.
B) Pyruvate produced in glycolysis is converted to Acetyl-CoA for the Krebs cycle.
C) Both pathways can occur simultaneously.
D) Glycolysis is independent of the Krebs cycle.
20. **What is the fate of dihydroxyacetone phosphate (DHAP) during glycolysis?**
A) It is converted to glucose.
B) It is isomerized to glyceraldehyde 3-phosphate (GAP).
C) It is directly converted to pyruvate.
D) It is oxidized to NADH.

Answers

11. C

- 12. C
- 13. C
- 14. B
- 15. A
- 16. C
- 17. B
- 18. B
- 19. B
- 20. B

21. **Which of the following statements about the commitment of glucose to glycolysis is true?**

- A) The conversion to glucose-6-phosphate is the committed step of glycolysis.
- B) Phosphofructokinase 1 (PFK-1) is the enzyme responsible for the committed step of glycolysis.
- C) Glucose-6-phosphate cannot enter other metabolic pathways.
- D) The first step is the only irreversible reaction in glycolysis.

22. **What effect does a high concentration of ADP have on phosphofructokinase 1 (PFK-1) activity?**

- A) It inhibits the enzyme's activity.
- B) It activates the enzyme, promoting glycolysis.
- C) It has no effect on the enzyme.
- D) It competes with ATP for binding to the active site.

23. **In the context of glycolysis, what is the consequence of NAD⁺ depletion?**

- A) Glycolysis would proceed without any effect.
- B) The conversion of glyceraldehyde 3-phosphate to 1,3-bisphosphoglycerate would halt.
- C) The Krebs cycle would become more active.
- D) Pyruvate would be converted to lactate more efficiently.

24. **Which reaction in glycolysis produces a molecule of NADH?**

- A) The conversion of glucose to glucose-6-phosphate
- B) The oxidation of glyceraldehyde 3-phosphate
- C) The cleavage of fructose 1,6-bisphosphate
- D) The conversion of 3-phosphoglycerate to 2-phosphoglycerate

25. **What is the role of the enzyme aldolase in the glycolytic pathway?**

- A) It catalyzes the phosphorylation of fructose-6-phosphate.
- B) It cleaves fructose 1,6-bisphosphate into two triose phosphates.
- C) It converts glucose to glucose-6-phosphate.
- D) It is responsible for the conversion of dihydroxyacetone phosphate to glyceraldehyde 3-phosphate.

26. **During the glycolytic pathway, what must occur for the reaction catalyzed by glyceraldehyde 3-phosphate dehydrogenase to proceed?**

- A) ATP must be hydrolyzed.
- B) NAD⁺ must be present.

- C) Inorganic phosphate must be excluded.
D) Oxygen must be present.
27. **What is the significance of compartmentalization in metabolic pathways?**
A) It allows for simultaneous activation of catabolic and anabolic pathways.
B) It separates opposing reactions to increase efficiency.
C) It prevents the synthesis of ATP.
D) It ensures that all reactions occur in the mitochondria.
28. **Which statement accurately describes the structure of G-proteins?**
A) They are composed of a single subunit that binds GDP or GTP.
B) They consist of four distinct subunits.
C) They contain three subunits: alpha, beta, and gamma.
D) They are only activated by cAMP binding.
29. **How does the enzyme pyruvate kinase contribute to glycolysis?**
A) It catalyzes the first step of glycolysis.
B) It converts phosphoenolpyruvate to pyruvate while producing ATP.
C) It facilitates the isomerization of dihydroxyacetone phosphate.
D) It activates PFK-1 through phosphorylation.
30. **What determines the net ATP yield from glycolysis per glucose molecule?**
A) The number of NADH molecules produced
B) The ATP investment during the preparative phase compared to the ATP produced in the ATP-generating phase
C) The presence of oxygen
D) The efficiency of the electron transport chain

Answers

21. B
22. B
23. B
24. B
25. B
26. B
27. B
28. C
29. B
30. B

31. **Which factor most directly influences the regulation of glycolysis via feedback inhibition?**
A) Substrate concentration
B) Product concentration
C) Enzyme affinity
D) Temperature

32. **What is the primary function of the enzyme triose phosphate isomerase in glycolysis?**
- A) To phosphorylate fructose-6-phosphate
 - B) To convert dihydroxyacetone phosphate (DHAP) to glyceraldehyde 3-phosphate (GAP)
 - C) To cleave fructose 1,6-bisphosphate
 - D) To oxidize glyceraldehyde 3-phosphate
33. **In which specific cellular compartment does glycolysis occur?**
- A) Mitochondria
 - B) Cytosol
 - C) Nucleus
 - D) Endoplasmic reticulum
34. **What is the role of phosphoglycerate mutase in glycolysis?**
- A) To dehydrate 3-phosphoglycerate
 - B) To transfer phosphate groups within the molecule
 - C) To catalyze the formation of pyruvate
 - D) To phosphorylate fructose-6-phosphate
35. **Which glycolytic enzyme has the highest regulatory importance due to its control over a key irreversible step?**
- A) Aldolase
 - B) Hexokinase
 - C) Phosphofructokinase 1 (PFK-1)
 - D) Pyruvate kinase
36. **Which of the following correctly describes the ATP dynamics in glycolysis?**
- A) 4 ATP consumed and 2 produced, yielding a net gain of 2 ATP
 - B) 2 ATP consumed and 4 produced, yielding a net gain of 2 ATP
 - C) 2 ATP consumed and 2 produced, yielding no net gain
 - D) 2 ATP produced with no consumption
37. **What is the effect of elevated citrate levels on glycolysis?**
- A) It activates PFK-1, promoting glycolysis.
 - B) It inhibits PFK-1, slowing down glycolysis.
 - C) It has no effect on glycolysis.
 - D) It stimulates the conversion of pyruvate to lactate.
38. **Which step in glycolysis is associated with the production of phosphoenolpyruvate (PEP)?**
- A) The conversion of 3-phosphoglycerate to 2-phosphoglycerate
 - B) The dehydration of 2-phosphoglycerate
 - C) The phosphorylation of ADP to ATP
 - D) The oxidation of glyceraldehyde 3-phosphate
39. **Which mechanism allows for the rapid response of metabolic pathways to internal signals?**
- A) Endocrine signaling
 - B) Allosteric regulation

- C) Gap junctions
- D) Paracrine signaling
- 40. **How is pyruvate kinase activated in the presence of fructose 1,6-bisphosphate?**
 - A) Through phosphorylation by PKA
 - B) By binding to NADH
 - C) By forming a complex with PFK-1
 - D) Through allosteric activation

Answers

- 31. B
- 32. B
- 33. B
- 34. B
- 35. C
- 36. B
- 37. B
- 38. B
- 39. B
- 40. D

- 41. **What is the main purpose of the preparative phase of glycolysis?**
 - A) To produce ATP
 - B) To convert glucose to fructose 1,6-bisphosphate
 - C) To oxidize NADH
 - D) To generate pyruvate
- 42. **Which glycolytic enzyme catalyzes the conversion of 1,3-bisphosphoglycerate to 3-phosphoglycerate?**
 - A) Phosphofructokinase
 - B) Glycerate kinase
 - C) Enolase
 - D) Aldolase
- 43. **How is ATP generated in the ATP-generating phase of glycolysis?**
 - A) By substrate-level phosphorylation
 - B) By oxidative phosphorylation
 - C) By coupling with glucose oxidation
 - D) By hydrolysis of NADH
- 44. **What distinguishes glucokinase from hexokinase?**
 - A) Glucokinase is found in all tissues.
 - B) Hexokinase has a higher affinity for glucose.
 - C) Glucokinase is activated at low glucose concentrations.
 - D) Hexokinase is specific only to glucose.

45. **Which of the following describes the role of second messengers in signaling pathways?**
- A) They bind directly to DNA to regulate gene expression.
 - B) They transmit signals from cell surface receptors to internal targets.
 - C) They inhibit the action of G-proteins.
 - D) They directly activate metabolic pathways without intermediaries.
46. **What happens to the NADH produced during glycolysis?**
- A) It is oxidized back to NAD^+ in the mitochondria only.
 - B) It can be converted back to NAD^+ in the cytosol through fermentation processes.
 - C) It is used to directly produce ATP in the cytosol.
 - D) It is stored in the cell for later use.
47. **Why is it critical for glycolysis to be tightly regulated?**
- A) To ensure high energy yield at all times.
 - B) To prevent substrate depletion.
 - C) To avoid simultaneous activation of opposing metabolic pathways.
 - D) To maximize the production of NADH.
48. **Which compound serves as the final electron acceptor in anaerobic glycolysis?**
- A) O_2
 - B) NAD^+
 - C) FAD
 - D) Pyruvate
49. **In the glycolytic pathway, what type of reaction is the conversion of phosphoenolpyruvate to pyruvate?**
- A) Hydrolysis
 - B) Phosphorylation
 - C) Dehydration
 - D) Oxidation
50. **What is the net yield of NADH from one molecule of glucose undergoing glycolysis?**
- A) 1 NADH
 - B) 2 NADH
 - C) 3 NADH
 - D) 4 NADH

Answers

- 41. B
- 42. B
- 43. A
- 44. B
- 45. B
- 46. B

- 47. C
- 48. D
- 49. A
- 50. B

51. Which of the following accurately describes the role of the enzyme enolase in glycolysis?

- A) It catalyzes the conversion of glucose to glucose-6-phosphate.
- B) It facilitates the dehydration of 2-phosphoglycerate to phosphoenolpyruvate.
- C) It is responsible for the phosphorylation of fructose 6-phosphate.
- D) It converts fructose 1,6-bisphosphate into two three-carbon molecules.

52. What is the primary effect of high levels of ATP on phosphofructokinase 1 (PFK-1)?

- A) It activates the enzyme, promoting glycolysis.
- B) It inhibits the enzyme, slowing down glycolysis.
- C) It has no effect on PFK-1 activity.
- D) It enhances substrate binding to PFK-1.

53. During which step of glycolysis is the first ATP molecule consumed?

- A) The phosphorylation of glucose
- B) The conversion of fructose 6-phosphate to fructose 1,6-bisphosphate
- C) The cleavage of fructose 1,6-bisphosphate
- D) The conversion of phosphoenolpyruvate to pyruvate

54. In what form is the energy produced during glycolysis mainly stored?

- A) As NADH
- B) As ATP
- C) As glucose
- D) As phosphocreatine

55. What is the fate of pyruvate in the absence of oxygen?

- A) It enters the Krebs cycle directly.
- B) It is converted to lactate or ethanol.
- C) It is further oxidized to NADH.
- D) It is converted to acetyl-CoA.

56. What is the significance of allosteric regulators in metabolic pathways?

- A) They permanently alter enzyme activity.
- B) They modulate enzyme activity based on cellular conditions.
- C) They ensure that metabolic pathways run continuously.
- D) They directly initiate glycolytic reactions.

57. Which of the following statements about the Krebs cycle is true in relation to glycolysis?

- A) The Krebs cycle is dependent on the production of glucose.
- B) Pyruvate produced from glycolysis directly enters the Krebs cycle as Acetyl-CoA.

- C) Glycolysis occurs only in the mitochondria.
D) The Krebs cycle generates more ATP than glycolysis.
58. **Which of the following best describes the process of substrate-level phosphorylation?**
A) ATP is produced from the transfer of a phosphate group from a high-energy substrate to ADP.
B) ATP is produced from the electron transport chain.
C) ATP is produced using energy from NADH.
D) ATP is generated in the absence of glucose.
59. **How does compartmentalization affect metabolic efficiency?**
A) It slows down all metabolic processes.
B) It allows simultaneous reactions to occur in the same area.
C) It enhances the efficiency of opposing reactions by separating them.
D) It ensures that all pathways are activated simultaneously.
60. **Which reaction in glycolysis is considered the rate-limiting step?**
A) Conversion of glucose to glucose-6-phosphate
B) Conversion of fructose 6-phosphate to fructose 1,6-bisphosphate
C) Cleavage of fructose 1,6-bisphosphate
D) Conversion of phosphoenolpyruvate to pyruvate

Answers

51. B
52. B
53. A
54. B
55. B
56. B
57. B
58. A
59. C
60. B

61. **What type of reaction is catalyzed by glyceraldehyde 3-phosphate dehydrogenase?**
A) Phosphorylation
B) Isomerization
C) Oxidation-reduction
D) Cleavage
62. **Which metabolic pathway directly interacts with the pentose phosphate pathway?**
A) Lipid metabolism
B) Glycolysis

- C) Krebs cycle
 - D) Amino acid metabolism
63. **Which of the following statements is true regarding the steps of glycolysis?**
- A) All steps are irreversible.
 - B) Only the first three steps are irreversible.
 - C) The last five steps are all irreversible.
 - D) There are three key irreversible steps in glycolysis.
64. **In glycolysis, the reaction converting fructose 1,6-bisphosphate to two three-carbon molecules involves which enzyme?**
- A) Phosphofructokinase
 - B) Aldolase
 - C) Triose phosphate isomerase
 - D) Glycerate kinase
65. **What effect does high concentrations of AMP have on phosphofructokinase 1 (PFK-1)?**
- A) It inhibits PFK-1 activity.
 - B) It has no effect on PFK-1.
 - C) It activates PFK-1 activity.
 - D) It causes PFK-1 to degrade.
66. **Which type of signaling involves the secretion of hormones into the bloodstream?**
- A) Paracrine signaling
 - B) Autocrine signaling
 - C) Endocrine signaling
 - D) Juxtacrine signaling
67. **What is the primary reason for the phosphorylation of glucose during its entry into the cell?**
- A) To increase glucose concentration inside the cell
 - B) To prepare glucose for glycolysis
 - C) To prevent glucose from exiting the cell
 - D) To convert glucose to fructose
68. **Which enzyme is primarily responsible for the conversion of pyruvate to acetyl-CoA?**
- A) Pyruvate dehydrogenase
 - B) Lactate dehydrogenase
 - C) Hexokinase
 - D) Aldolase
69. **What is the role of protein phosphatases in signaling pathways?**
- A) They activate signaling pathways by adding phosphates.
 - B) They terminate signaling pathways by removing phosphates.
 - C) They amplify the signaling effect of second messengers.
 - D) They act as second messengers themselves.

70. **In terms of energy yield, how does glycolysis compare to the Krebs cycle?**

- A) Glycolysis produces more ATP than the Krebs cycle.
- B) The energy yield of glycolysis is less than that of the Krebs cycle.
- C) Both pathways yield the same amount of ATP.
- D) Glycolysis does not produce ATP.

Answers

- 61. C
- 62. B
- 63. D
- 64. B
- 65. C
- 66. C
- 67. C
- 68. A
- 69. B
- 70. B

71. **Which of the following is true regarding the irreversible steps of glycolysis?**

- A) They occur at the end of the pathway.
- B) They are highly regulated and crucial for pathway control.
- C) They do not require any enzymes.
- D) They produce pyruvate.

72. **What is the effect of the concentration of enzymes and receptors on metabolic regulation?**

- A) It has no effect on metabolic regulation.
- B) It serves as a feedback mechanism for pathway activation.
- C) It can enhance or inhibit pathway activity depending on availability.
- D) It solely determines the speed of all metabolic processes.

73. **During glycolysis, what occurs in the sixth step?**

- A) Phosphorylation of ADP to produce ATP
- B) Oxidation of glyceraldehyde 3-phosphate with NAD^+ reduction
- C) Isomerization of dihydroxyacetone phosphate to glyceraldehyde 3-phosphate
- D) Cleavage of fructose 1,6-bisphosphate

74. **Which cellular compartment is primarily involved in glycolysis?**

- A) Mitochondria
- B) Nucleus
- C) Cytosol
- D) Endoplasmic reticulum

75. **How does the activity of glyceralate kinase contribute to glycolysis?**

- A) It catalyzes the conversion of glucose to glucose-6-phosphate.

- B) It transfers a phosphate group from 1,3-bisphosphoglycerate to ADP to form ATP.
- C) It facilitates the dehydration of 2-phosphoglycerate to phosphoenolpyruvate.
- D) It is involved in the oxidation of glyceraldehyde 3-phosphate.
76. **What is the main function of the urea cycle in relation to amino acid metabolism?**
- A) To produce glucose from amino acids
- B) To detoxify ammonia generated during amino acid breakdown
- C) To generate ATP from amino acids
- D) To convert pyruvate into acetyl-CoA
77. **What is the relationship between glycolysis and the pentose phosphate pathway?**
- A) They are completely separate pathways without interaction.
- B) Both pathways require the same substrates.
- C) The pentose phosphate pathway produces intermediates that feed into glycolysis.
- D) Glycolysis generates products that inhibit the pentose phosphate pathway.
78. **Which of the following statements about cyclic AMP (cAMP) is true?**
- A) It is produced by the hydrolysis of ATP.
- B) It activates protein phosphatases directly.
- C) It functions as a second messenger in signal transduction.
- D) It is a long-lived signaling molecule that remains active indefinitely.
79. **What is a characteristic of the catabolic pathways?**
- A) They require energy input for reactions.
- B) They result in the synthesis of complex molecules.
- C) They produce energy by oxidizing substrates.
- D) They are always active, regardless of cellular conditions.
80. **Which enzyme is specifically involved in the conversion of fructose 6-phosphate to fructose 1,6-bisphosphate?**
- A) Hexokinase
- B) Phosphofructokinase 1 (PFK-1)
- C) Aldolase
- D) Glycerate kinase

Answers

71. B
72. C
73. B
74. C
75. B
76. B
77. C

78. C
79. C
80. B

81. **Which statement accurately reflects the thermodynamics of the first step of glycolysis?**

- A) It has a negative ΔG , driving the reaction forward without the need for ATP.
B) It has a positive ΔG and requires ATP hydrolysis for the reaction to proceed.
C) It is reversible and does not require any energy input.
D) It produces NADH as a byproduct.

82. **In the context of metabolic regulation, how do allosteric inhibitors function?**

- A) They bind to the active site of an enzyme, reducing its activity.
B) They increase the affinity of enzymes for substrates.
C) They alter the conformation of enzymes, inhibiting their function without competing with the substrate.
D) They promote the phosphorylation of target proteins.

83. **Which of the following mechanisms ensures that catabolic and anabolic pathways do not occur simultaneously?**

- A) Compartmentalization within the cell
B) Feedback inhibition of key enzymes
C) Hormonal regulation through endocrine signaling
D) Equilibrium dynamics of metabolic intermediates

84. **What is the significance of the phosphorylation of fructose 1,6-bisphosphate in glycolysis?**

- A) It marks the committed step of glycolysis and determines the pathway's direction.
B) It initiates the cleavage of fructose into two triose phosphates.
C) It reduces NAD^+ to NADH during the reaction.
D) It is the only irreversible step in the pathway.

85. **Which of the following accurately describes the role of triose phosphate isomerase?**

- A) It catalyzes the phosphorylation of dihydroxyacetone phosphate.
B) It is responsible for the irreversible conversion of GAP to pyruvate.
C) It facilitates the interconversion of DHAP and GAP, allowing both to enter the next steps of glycolysis.
D) It directly consumes ATP in the glycolytic pathway.

86. **What distinguishes the regulatory function of cyclic AMP (cAMP) in cellular signaling?**

- A) It activates phosphatases, leading to the removal of phosphate groups.
B) It acts as a primary messenger that binds directly to membrane receptors.

- C) It amplifies the signal transduction by activating protein kinase A (PKA).
D) It serves as an inhibitor of all metabolic pathways.
87. **In the context of amino acid metabolism, which product is typically generated from the deamination process?**
A) Acetyl-CoA
B) Pyruvate
C) Urea
D) α -Ketoglutarate
88. **During which step of glycolysis is the greatest amount of energy harvested in terms of ATP production?**
A) The conversion of 1,3-bisphosphoglycerate to 3-phosphoglycerate
B) The conversion of phosphoenolpyruvate to pyruvate
C) The cleavage of fructose 1,6-bisphosphate
D) The phosphorylation of glucose
89. **What role does the enzyme pyruvate kinase play in glycolysis?**
A) It catalyzes the irreversible conversion of phosphoenolpyruvate to pyruvate, generating ATP.
B) It phosphorylates glucose to glucose-6-phosphate.
C) It reduces NAD^+ to NADH during the oxidation of GAP.
D) It catalyzes the isomerization of glucose-6-phosphate to fructose-6-phosphate.
90. **How does the mechanism of action of G-protein coupled receptors (GPCRs) exemplify the principles of signal transduction?**
A) They utilize ATP hydrolysis directly for signal propagation.
B) Their activation leads to a cascade of downstream events, involving second messengers like cAMP.
C) They remain in an active state regardless of ligand binding.
D) They inhibit all forms of cellular communication.

Answers

81. B
82. C
83. A
84. A
85. C
86. C
87. C
88. B
89. A
90. B

91. **What is the main consequence of the irreversible nature of the phosphorylation of glucose to glucose-6-phosphate?**

- A) It ensures glucose can exit the cell freely.
B) It allows glucose to enter multiple metabolic pathways simultaneously.
C) It effectively traps glucose within the cell, preventing its efflux.
D) It converts glucose into a form that can be rapidly utilized for energy without regulation.
92. **Which of the following describes the role of enzyme concentration in metabolic regulation?**
A) Higher concentrations always lead to increased metabolic flux.
B) It only affects catabolic pathways, leaving anabolic pathways unchanged.
C) It plays a crucial role in determining the rate of reactions, affecting both pathways equally.
D) It has no impact on the overall metabolism of the cell.
93. **How does the regulation of phosphofructokinase-1 (PFK-1) illustrate feedback inhibition?**
A) It is activated by ATP to increase glycolytic flux.
B) It is inhibited by citrate and ATP, signaling an abundance of energy.
C) It operates independently of any allosteric effectors.
D) It is the only glycolytic enzyme that requires glucose as a substrate.
94. **Which step in glycolysis has the highest ΔG and is thus considered the rate-limiting step?**
A) The conversion of glucose to glucose-6-phosphate
B) The phosphorylation of fructose-6-phosphate to fructose-1,6-bisphosphate
C) The conversion of phosphoenolpyruvate to pyruvate
D) The cleavage of fructose-1,6-bisphosphate
95. **What is the significance of compartmentalization in metabolic pathways?**
A) It enhances the efficiency of opposing pathways occurring simultaneously.
B) It isolates enzymatic reactions to specific cellular areas, optimizing conditions for reactions.
C) It allows all metabolic processes to occur in the mitochondria.
D) It ensures all metabolic intermediates are stored within the cytoplasm.
96. **What distinguishes the catalytic role of glyceraldehyde 3-phosphate dehydrogenase in glycolysis?**
A) It catalyzes the irreversible conversion of DHAP to GAP.
B) It catalyzes the reduction of NAD^+ to NADH while oxidizing GAP, linking oxidation and phosphorylation.
C) It is the only enzyme that can utilize both ADP and ATP as substrates.
D) It solely relies on ATP hydrolysis for its activity.
97. **In which phase of glycolysis is the majority of ATP generated?**
A) Preparative phase
B) ATP-generating phase
C) Urea cycle phase
D) Oxidation phase
98. **Which enzyme is responsible for the conversion of 2-phosphoglycerate to phosphoenolpyruvate, and what type of reaction does it catalyze?**

- A) Phosphoglycerate mutase; an isomerization reaction
 - B) Enolase; a dehydration reaction
 - C) Pyruvate kinase; a phosphorylation reaction
 - D) Aldolase; a cleavage reaction
99. **What is the effect of increased levels of NADH in the cell during glycolysis?**
- A) It stimulates the activity of glycolytic enzymes directly.
 - B) It inhibits the conversion of glyceraldehyde 3-phosphate, affecting ATP yield.
 - C) It has no effect on glycolysis.
 - D) It promotes the rapid degradation of glucose to maintain cellular energy levels.
100. **In the context of cell signaling, what is the role of gap junctions?**
- A) They allow the transfer of large molecules between cells.
 - B) They facilitate direct communication between adjacent cells for coordinated responses.
 - C) They function solely as receptors for hormones.
 - D) They prevent any form of intercellular signaling.

Answers

- 91. C
- 92. C
- 93. B
- 94. B
- 95. B
- 96. B
- 97. B
- 98. B
- 99. B
- 100. B

101. **Which of the following correctly describes the relationship between glycolysis and the Krebs cycle?**
- A) Glycolysis produces Acetyl-CoA exclusively for the Krebs cycle, which requires oxygen to function.
 - B) The Krebs cycle directly converts glucose to pyruvate, which is then used in glycolysis.
 - C) Glycolysis operates independently of the Krebs cycle and does not produce any intermediates for it.
 - D) Pyruvate generated from glycolysis is converted to Acetyl-CoA, linking the two pathways.
102. **What role does the enzyme glucokinase play in glycolysis?**
- A) It is responsible for phosphorylating fructose-6-phosphate.

- B) It has a high K_m , making it active only at high glucose concentrations, primarily in the liver.
- C) It catalyzes the conversion of glucose to pyruvate.
- D) It functions in all tissues with high affinity for glucose regardless of concentration.
103. **In the context of the glycolytic pathway, what is the effect of substrate-level phosphorylation?**
- A) It requires the presence of oxygen to produce ATP.
- B) It generates ATP through direct transfer of a phosphate group from a high-energy substrate to ADP.
- C) It involves the oxidation of NADH to generate ATP indirectly through the electron transport chain.
- D) It is only significant during the preparative phase of glycolysis.
104. **Which metabolic pathway interacts with glycolysis to provide intermediates for lipid synthesis?**
- A) Pentose phosphate pathway
- B) Urea cycle
- C) Amino acid metabolism
- D) Krebs cycle
105. **During glycolysis, what is the primary role of NAD^+ ?**
- A) It serves as a phosphate donor in phosphorylation reactions.
- B) It is reduced to NADH during the oxidation of glyceraldehyde 3-phosphate.
- C) It catalyzes the isomerization of glucose-6-phosphate.
- D) It inhibits the activity of pyruvate kinase.
106. **Which statement accurately describes the process of signal termination in GPCR signaling?**
- A) It involves the continued binding of GTP to the alpha subunit, activating the signaling pathway indefinitely.
- B) Hydrolysis of GTP to GDP inactivates the alpha subunit, which then reassociates with beta and gamma subunits.
- C) It requires the presence of an extracellular ligand to continue signaling.
- D) It is primarily mediated by the production of second messengers.
107. **What is the significance of the irreversible steps in glycolysis, particularly those catalyzed by hexokinase, phosphofructokinase, and pyruvate kinase?**
- A) They ensure that glycolysis can function in the absence of ATP.
- B) They provide critical control points for regulation and determine the pathway's direction.
- C) They generate the majority of the NADH produced in glycolysis.
- D) They allow for the recycling of glucose from pyruvate.
108. **How do internal signals influence metabolic regulation within a cell?**
- A) They act solely based on hormonal signaling from other cells.
- B) They can lead to rapid changes in enzyme activity, impacting metabolic

flux.

C) They are exclusively related to substrate concentrations and have no other roles.

D) They prevent any form of allosteric regulation.

109. **Which of the following accurately describes the enzymatic mechanism of aldolase during glycolysis?**

A) It catalyzes the phosphorylation of glucose-6-phosphate.

B) It cleaves fructose-1,6-bisphosphate into two triose phosphates, one of which must be converted to continue glycolysis.

C) It converts phosphoenolpyruvate to pyruvate.

D) It acts as a regulatory enzyme in the preparative phase of glycolysis.

110. **What metabolic condition can arise from defective GPCR regulation?**

A) Enhanced glucose uptake in muscle tissues

B) Decreased ATP production from glycolysis

C) Continuous activation of signaling pathways leading to uncontrolled cell proliferation, such as in cancer

D) Impaired fatty acid oxidation in the liver

Answers

101. D

102. B

103. B

104. D

105. B

106. B

107. B

108. B

109. B

110. C

111. **What is the primary role of allosteric regulators in the regulation of glycolysis?**

A) They provide energy for phosphorylation reactions.

B) They change the conformation of enzymes, enhancing or inhibiting their activity based on cellular needs.

C) They serve as substrates for glycolytic enzymes.

D) They directly convert glucose into pyruvate without the need for enzymes.

112. **Which metabolic pathway primarily contributes to the production of pentose sugars, and how does it interact with glycolysis?**

A) Glycolysis; it generates pentose sugars directly from glucose.

B) Krebs cycle; it converts pyruvate into pentose sugars.

C) Pentose phosphate pathway; it provides NADPH and ribose-5-phosphate,

which can feed into glycolysis.

D) Urea cycle; it processes ammonia to facilitate pentose production.

113. **During glycolysis, how is the energy investment phase characterized?**
- A) It generates a surplus of ATP without any input.
 - B) It consumes ATP to phosphorylate glucose and fructose-6-phosphate.
 - C) It produces NADH and FADH₂ in excess.
 - D) It occurs exclusively in the mitochondria, requiring oxygen.
114. **What mechanism allows GAP to continue through glycolysis after its production from DHAP?**
- A) DHAP converts back to glucose through gluconeogenesis.
 - B) The equilibrium shifts towards GAP production as it is utilized in subsequent reactions.
 - C) GAP is oxidized to produce lactate, allowing for continuous glycolysis.
 - D) GAP directly enters the Krebs cycle without any further modifications.
115. **What is the significance of compartmentalization in metabolic pathways?**
- A) It restricts all reactions to the mitochondria to maximize ATP production.
 - B) It allows for simultaneous catabolic and anabolic processes in the same cellular space.
 - C) It helps segregate opposing metabolic processes, enhancing reaction efficiency and regulation.
 - D) It prevents the interaction between glycolysis and other metabolic pathways.
116. **What distinguishes the second messenger cAMP in cell signaling?**
- A) It acts independently of G-protein coupled receptors.
 - B) It transmits signals within the cell after hormone binding to cell surface receptors.
 - C) It directly phosphorylates proteins without the involvement of other kinases.
 - D) It is exclusively responsible for the activation of transcription factors.
117. **In glycolysis, which step is most likely to be affected by high levels of ATP?**
- A) Phosphorylation of glucose to glucose-6-phosphate
 - B) Conversion of phosphoenolpyruvate to pyruvate
 - C) Phosphorylation of fructose-6-phosphate to fructose-1,6-bisphosphate
 - D) Oxidation of glyceraldehyde 3-phosphate
118. **Which enzyme plays a crucial role in connecting glycolysis to the Krebs cycle?**
- A) Phosphofructokinase-1
 - B) Pyruvate kinase
 - C) Glyceraldehyde 3-phosphate dehydrogenase
 - D) Pyruvate dehydrogenase

119. **What is the main outcome of the oxidation-reduction reaction catalyzed by glyceraldehyde 3-phosphate dehydrogenase?**

- A) Conversion of pyruvate to Acetyl-CoA
- B) Production of NADH and 1,3-bisphosphoglycerate from GAP
- C) Direct phosphorylation of ADP to ATP
- D) Cleavage of fructose-1,6-bisphosphate

120. **In what way can mutations in GPCRs lead to disease?**

- A) They enhance the binding affinity of hormones, increasing cellular responses.
- B) They can result in continuous activation of pathways, contributing to conditions like cancer.
- C) They prevent the proper communication between cells, leading to cell death.
- D) They only affect metabolic pathways that do not involve cAMP.

Answers

- 111. B
- 112. C
- 113. B
- 114. B
- 115. C
- 116. B
- 117. C
- 118. D
- 119. B
- 120. B

121. **Which factor is a key internal signal for the regulation of glycolysis?**

- A) Hormonal levels in the bloodstream
- B) Availability of substrates and end-products
- C) Temperature changes in the cellular environment
- D) Oxygen availability in the mitochondria

122. **What is the primary function of phosphofructokinase-1 (PFK-1) in glycolysis?**

- A) To convert glucose into glucose-6-phosphate
- B) To catalyze the cleavage of fructose-1,6-bisphosphate
- C) To phosphorylate fructose-6-phosphate, committing it to glycolysis
- D) To convert pyruvate into Acetyl-CoA

123. **How does the structure of G-proteins contribute to their function?**

- A) They are composed of a single subunit that binds ligands directly.
- B) Their three subunits (alpha, beta, gamma) allow for diverse interactions and regulation.

- C) They can function independently without any external signals.
D) Their structure is fixed and does not change upon activation.
124. **What is the significance of the linear nature of glycolysis?**
A) It allows for the efficient recycling of glucose within the cell.
B) Each product is generated directly from the previous substrate without branching.
C) It facilitates the simultaneous operation of multiple pathways.
D) It requires oxygen at every step for ATP generation.
125. **In which cellular location does glycolysis primarily occur?**
A) Mitochondria
B) Nucleus
C) Cytosol
D) Endoplasmic reticulum
126. **What happens to pyruvate produced in glycolysis under anaerobic conditions?**
A) It is immediately converted to Acetyl-CoA for the Krebs cycle.
B) It is converted to lactate or ethanol to regenerate NAD^+ .
C) It is transported to the mitochondria for complete oxidation.
D) It is converted back to glucose through gluconeogenesis.
127. **Which of the following statements about ATP production in glycolysis is accurate?**
A) A net gain of 4 ATP molecules occurs during the entire glycolytic pathway.
B) ATP is produced only during the preparative phase of glycolysis.
C) Glycolysis has a net gain of 2 ATP molecules after accounting for the investment phase.
D) No ATP is produced in glycolysis; it only consumes energy.
128. **What is the role of second messengers like cyclic AMP (cAMP) in signal transduction?**
A) They are responsible for the binding of ligands to receptors.
B) They amplify and propagate the signal within the cell after initial receptor activation.
C) They directly bind to DNA to alter gene expression.
D) They convert ATP to ADP during signaling cascades.
129. **How does the urea cycle interact with glycolysis and amino acid metabolism?**
A) It generates glucose from ammonia produced during amino acid degradation.
B) It detoxifies ammonia, facilitating the entry of amino acids into glycolysis.
C) It provides intermediates for glycolysis that are derived from fatty acids.
D) It produces Acetyl-CoA, which can be used in glycolysis.
130. **What is the effect of high citrate levels on glycolysis?**
A) Citrate activates phosphofructokinase-1, promoting glycolysis.
B) Citrate inhibits glycolysis by signaling a sufficient energy supply.

- C) Citrate has no effect on glycolytic activity.
- D) Citrate is converted to pyruvate, stimulating glycolysis.

Answers

- 121. B
- 122. C
- 123. B
- 124. B
- 125. C
- 126. B
- 127. C
- 128. B
- 129. B
- 130. B

131. **Which of the following accurately describes the commitment step in glycolysis?**

- A) The conversion of glucose to glucose-6-phosphate
- B) The phosphorylation of fructose-6-phosphate to fructose-1,6-bisphosphate
- C) The cleavage of fructose-1,6-bisphosphate into GAP and DHAP
- D) The conversion of pyruvate to Acetyl-CoA

132. **What is the primary function of the pentose phosphate pathway in relation to glycolysis?**

- A) To produce ATP from NADH
- B) To generate pentose sugars and NADPH, which can be used in biosynthetic reactions
- C) To directly convert pyruvate into glucose
- D) To facilitate the oxidation of fatty acids

133. **Which enzyme is responsible for the irreversible conversion of phosphoenolpyruvate (PEP) to pyruvate in glycolysis?**

- A) Phosphofructokinase-1
- B) Hexokinase
- C) Pyruvate kinase
- D) Aldolase

134. **In the context of glycolysis, what is the significance of having both hexokinase and glucokinase?**

- A) They both catalyze the same reactions but in different cellular compartments.
- B) Hexokinase functions in all tissues, while glucokinase is liver-specific, allowing for different regulatory mechanisms.
- C) Both are activated by high glucose concentrations but have different K_m values.

- D) Glucokinase can phosphorylate multiple hexoses, whereas hexokinase cannot.
135. **How does phosphoglycerate mutase contribute to glycolysis?**
A) It catalyzes the conversion of glucose to glucose-6-phosphate.
B) It facilitates the isomerization of 3-phosphoglycerate to 2-phosphoglycerate.
C) It is involved in the oxidative phosphorylation of ADP to ATP.
D) It phosphorylates fructose-1,6-bisphosphate to fructose-2,6-bisphosphate.
136. **Which statement about the ATP-generating phase of glycolysis is true?**
A) It produces ATP exclusively from substrate-level phosphorylation.
B) It requires the presence of oxygen to proceed.
C) It occurs before the preparative phase.
D) It generates more ATP than the preparative phase consumes.
137. **What is the consequence of an irreversible step in a metabolic pathway like glycolysis?**
A) It allows for the immediate recycling of products.
B) It serves as a regulatory point that can be targeted for feedback inhibition.
C) It guarantees that the pathway will always proceed to completion.
D) It prevents the utilization of intermediates in other pathways.
138. **What role do fatty acids and glycerols play in the context of the Krebs cycle and glycolysis?**
A) They are primary products of glycolysis.
B) They can be converted into Acetyl-CoA, which enters the Krebs cycle.
C) They inhibit the activity of glycolytic enzymes.
D) They provide a source of glucose during gluconeogenesis.
139. **What type of signaling mechanism do gap junctions represent?**
A) Endocrine signaling, involving hormones released into the bloodstream
B) Autocrine signaling, where a cell affects itself
C) Paracrine signaling, where signals affect nearby cells
D) Direct intercellular communication between adjacent cells
140. **What is the result of the hydrolysis of GTP in the G-protein activation process?**
A) It activates downstream signaling pathways immediately.
B) It deactivates the G-protein, reverting it to its inactive GDP-bound state.
C) It increases the concentration of cyclic AMP in the cell.
D) It initiates the synthesis of new proteins in the nucleus.

Answers

131. B
132. B
133. C
134. B

135. B
136. A
137. B
138. B
139. D
140. B
141. **What is the primary purpose of compartmentalization in metabolic pathways?**
- A) To ensure all reactions occur at the same time
 - B) To increase the efficiency of opposing processes by separating them
 - C) To facilitate direct communication between all cellular components
 - D) To eliminate the need for enzymes in metabolic reactions
142. **Which molecule acts as the main energy currency produced during glycolysis?**
- A) NADH
 - B) FADH₂
 - C) ATP
 - D) GTP
143. **In glycolysis, what is the net yield of NADH produced from one molecule of glucose?**
- A) 1
 - B) 2
 - C) 4
 - D) 0
144. **During which step of glycolysis is ATP hydrolyzed to provide energy for phosphorylation?**
- A) First step (glucose to glucose-6-phosphate)
 - B) Third step (fructose-6-phosphate to fructose-1,6-bisphosphate)
 - C) Seventh step (1,3-bisphosphoglycerate to 3-phosphoglycerate)
 - D) Tenth step (phosphoenolpyruvate to pyruvate)
145. **Which of the following statements about the glycolytic pathway is true?**
- A) It is completely dependent on oxygen availability.
 - B) It includes both reversible and irreversible reactions.
 - C) It occurs exclusively in muscle cells.
 - D) It generates glucose from pyruvate.
146. **What is the role of adenyl cyclase in signal transduction via GPCRs?**
- A) It catalyzes the conversion of ATP to cAMP.
 - B) It hydrolyzes cAMP to AMP, terminating the signal.
 - C) It binds directly to the ligand for receptor activation.
 - D) It transfers phosphate groups to proteins in the signaling pathway.

147. **What would be the effect of a mutation that keeps GPCRs in an active state?**
A) Increased sensitivity to external signals
B) Continuous activation of downstream signaling pathways, potentially leading to diseases like cancer
C) Enhanced regulatory control over metabolic pathways
D) Reduced cellular communication
148. **Which enzyme catalyzes the conversion of glyceraldehyde 3-phosphate (GAP) to 1,3-bisphosphoglycerate?**
A) Aldolase
B) Glyceraldehyde 3-phosphate dehydrogenase
C) Phosphoglycerate mutase
D) Pyruvate kinase
149. **How does the Krebs cycle indirectly depend on glycolysis?**
A) It produces ATP that is used in glycolysis.
B) It requires glucose as a substrate.
C) It uses Acetyl-CoA, a product of glycolysis, as a starting material.
D) It generates NADH, which is converted back to NAD⁺ in glycolysis.
150. **Which type of signaling involves the release of hormones into the bloodstream to target distant cells?**
A) Autocrine
B) Paracrine
C) Endocrine
D) Juxtacrine

Answers

141. B
142. C
143. B
144. B
145. B
146. A
147. B
148. B
149. C
150. C

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