

# Advanced Glycolysis MCQs (30 Questions - FULL EXACT VERSION)

1. Which of the following is INCORRECT regarding glycolysis as a metabolic pathway?
  - A. Glycolysis is a cytosolic metabolic pathway that occurs in virtually all cell types regardless of mitochondrial presence.
  - B. Glycolysis converts one molecule of glucose into two molecules of pyruvate through a sequence of enzymatic reactions.
  - C. Glycolysis requires functional mitochondria for initiation of glucose phosphorylation and ATP investment steps.
  - D. Glycolysis can proceed under both aerobic and anaerobic conditions depending on oxygen availability.
  
2. Which of the following is INCORRECT regarding anaerobic glycolysis?
  - A. In the absence of oxygen, pyruvate is reduced to lactate to regenerate NAD<sup>+</sup> required for glycolysis continuation.
  - B. Red blood cells rely exclusively on anaerobic glycolysis due to absence of mitochondria.
  - C. Lactate production requires oxidative phosphorylation within mitochondria to regenerate NAD<sup>+</sup>.
  - D. Anaerobic glycolysis becomes predominant in skeletal muscle during intense exercise.
  
3. Which of the following is INCORRECT regarding glucose transport into cells?
  - A. Glucose is transported across the plasma membrane primarily via facilitated diffusion using specific transporter proteins.
  - B. Transport of glucose through GLUT proteins follows the concentration gradient without direct ATP consumption.
  - C. GLUT-mediated transport of glucose requires ATP hydrolysis to move glucose against its concentration gradient.
  - D. Different tissues express distinct GLUT isoforms adapted to their metabolic needs.
  
4. Which of the following is INCORRECT regarding GLUT transporters?
  - A. GLUT-3 is highly expressed in neurons and has a high affinity for glucose.
  - B. GLUT-4 is insulin-dependent and primarily expressed in skeletal muscle and adipose tissue.
  - C. GLUT-1 is mainly responsible for glucose uptake in adult skeletal muscle during exercise.
  - D. GLUT-2 is found in liver and pancreatic $\beta$ -cells and has a relatively low affinity for glucose.

5. Which of the following BEST describes the physiological role of glucokinase?

- A. It is a high-affinity enzyme present in all tissues that is strongly inhibited by glucose-6-phosphate accumulation.
- B. It functions in liver and pancreatic  $\beta$ -cells as a glucose sensor by phosphorylating glucose when its concentration is high.
- C. It catalyzes reversible phosphorylation of glucose and operates efficiently at low glucose concentrations.
- D. It is structurally identical to hexokinase and shares identical regulatory properties.

6. Which of the following is INCORRECT regarding hexokinase?

- A. Hexokinase has a low  $K_m$ , allowing it to function efficiently at low intracellular glucose concentrations.
- B. Hexokinase is inhibited by its product glucose-6-phosphate, preventing excessive glucose phosphorylation.
- C. Hexokinase is primarily found in liver and acts as a major glucose sensor for systemic glucose regulation.
- D. Hexokinase can phosphorylate multiple hexoses in addition to glucose.

7. Which of the following is INCORRECT regarding the first step of glycolysis?

- A. Glucose is phosphorylated to glucose-6-phosphate using ATP as a phosphate donor.
- B. This reaction is essentially irreversible under physiological conditions.
- C. The enzyme responsible for this step is phosphofructokinase-1.
- D. The reaction traps glucose inside the cell by adding a negatively charged phosphate group.

8. Which of the following is INCORRECT regarding phosphofructokinase-1 (PFK-1)?

- A. It catalyzes the phosphorylation of fructose-6-phosphate to fructose-1,6-bisphosphate.
- B. It is considered the rate-limiting and most important regulatory step in glycolysis.
- C. The reaction catalyzed by PFK-1 is readily reversible under normal cellular conditions.
- D. It is highly regulated by cellular energy status and metabolic signals.

9. Which of the following is INCORRECT regarding the aldolase reaction?

- A. Fructose-1,6-bisphosphate is cleaved into two triose phosphate molecules.
- B. The products include dihydroxyacetone phosphate (DHAP) and glyceraldehyde-3-phosphate.

- C. This step directly generates ATP through substrate-level phosphorylation.
- D. This reaction marks the transition between the energy investment and cleavage phase.

10. Which of the following BEST describes the energy investment phase of glycolysis?

- A. It involves generation of ATP and NADH through oxidative reactions.
- B. It consumes ATP to phosphorylate intermediates and prepare glucose for cleavage.
- C. It occurs within mitochondria where oxidative phosphorylation takes place.
- D. It involves only reversible reactions with no energy input required.

11. Which of the following is INCORRECT regarding glyceraldehyde-3-phosphate dehydrogenase?

- A. It catalyzes oxidation of glyceraldehyde-3-phosphate producing NADH.
- B. It forms a high-energy intermediate, 1,3-bisphosphoglycerate.
- C. It directly produces ATP during this reaction step.
- D. It is part of the energy generation phase of glycolysis.

12. Which of the following is INCORRECT regarding ATP generation in glycolysis?

- A. ATP is generated at the phosphoglycerate kinase step through substrate-level phosphorylation.
- B. ATP is also generated at the pyruvate kinase step during conversion of PEP to pyruvate.
- C. ATP is generated during the hexokinase step as glucose is phosphorylated.
- D. Substrate-level phosphorylation is a key mechanism for ATP generation in glycolysis.

13. Which of the following is INCORRECT regarding enolase?

- A. Enolase catalyzes conversion of 2-phosphoglycerate to phosphoenolpyruvate (PEP).
- B. The reaction involves removal of water (dehydration).
- C. Enolase activity is inhibited by fluoride ions.
- D. The enzyme produces NADH as part of its catalytic mechanism.

14. Which of the following is INCORRECT regarding pyruvate kinase?

- A. It catalyzes conversion of phosphoenolpyruvate to pyruvate.
- B. The reaction is coupled with ATP generation via substrate-level phosphorylation.
- C. The reaction is reversible under physiological conditions.
- D. It is one of the key regulatory steps in glycolysis.

15. Which of the following BEST describes the total ATP yield of aerobic glycolysis?

- A. Glycolysis yields a net gain of 2 ATP molecules per glucose regardless of oxygen availability.
- B. Glycolysis produces ATP directly and indirectly via NADH that can be oxidized in mitochondria.
- C. Glycolysis produces no ATP but only NADH for oxidative phosphorylation.
- D. Glycolysis yields the same ATP as the TCA cycle under aerobic conditions.

16. Which of the following is INCORRECT regarding anaerobic ATP yield in glycolysis?

- A. Under anaerobic conditions, glycolysis results in a net gain of 2 ATP molecules per molecule of glucose metabolized.
- B. NADH produced during glycolysis is reoxidized via the electron transport chain to generate additional ATP under anaerobic conditions.
- C. Lactate formation is essential to regenerate NAD<sup>+</sup>, allowing glycolysis to continue in the absence of oxygen.
- D. Anaerobic glycolysis provides energy without requiring mitochondrial oxidative phosphorylation.

17. Which of the following is INCORRECT regarding hormonal regulation of glycolysis?

- A. Insulin promotes glycolysis by increasing the synthesis and activity of key glycolytic enzymes in the liver.
- B. Glucagon suppresses glycolysis in the liver by decreasing the activity of key regulatory enzymes.
- C. Insulin decreases glycolytic enzyme expression, thereby reducing glycolytic flux in hepatocytes.
- D. Hormonal regulation of glycolysis is closely linked to blood glucose levels and metabolic state.

18. Which of the following BEST describes regulation of phosphofructokinase-1 (PFK-1)?

- A. PFK-1 is inhibited by AMP and activated by high ATP concentrations, reflecting high energy demand.
- B. PFK-1 is activated by fructose-2,6-bisphosphate, which enhances glycolytic flux under fed conditions.
- C. PFK-1 is not subject to allosteric regulation and functions at a constant rate in all tissues.
- D. PFK-1 activity is independent of hormonal signals and cellular energy status.

19. Which of the following is INCORRECT regarding the metabolic fate of pyruvate?

- A. Pyruvate can be converted into acetyl-CoA via pyruvate dehydrogenase under aerobic conditions.

B. Pyruvate can be carboxylated to oxaloacetate as part of gluconeogenesis or anaplerotic reactions.

C. Pyruvate can be reduced to lactate under anaerobic conditions in the cytosol.

D. Pyruvate is unable to enter mitochondria and therefore cannot participate in oxidative metabolism.

20. Which of the following is INCORRECT regarding pyruvate dehydrogenase complex?

A. The pyruvate dehydrogenase complex is located in the mitochondrial matrix.

B. It catalyzes conversion of pyruvate into acetyl-CoA linking glycolysis to the TCA cycle.

C. The reaction catalyzed by this complex is reversible under physiological conditions.

D. The complex requires multiple coenzymes including NAD<sup>+</sup>, FAD, and CoA.

21. Which of the following is INCORRECT regarding the tricarboxylic acid (TCA) cycle?

A. The TCA cycle takes place in the mitochondrial matrix and is central to energy metabolism.

B. The cycle is absent in red blood cells due to lack of mitochondria.

C. The TCA cycle represents the final common pathway for oxidation of carbohydrates.

D. The TCA cycle occurs in the cytosol and directly produces glucose.

22. Which of the following is INCORRECT regarding NADH production in metabolism?

A. NADH is generated during glycolysis through oxidation of glyceraldehyde-3-phosphate.

B. NADH is produced in multiple steps of the TCA cycle contributing to ATP generation.

C. NADH is directly produced during the hexokinase reaction in glycolysis.

D. NADH serves as an electron carrier that can be oxidized to produce ATP.

23. Which of the following is INCORRECT regarding gluconeogenesis?

A. Gluconeogenesis occurs primarily in the liver during fasting conditions.

B. It utilizes intermediates of glycolysis in reverse with some bypass reactions.

C. Gluconeogenesis is an energy-consuming process requiring ATP and GTP.

D. Gluconeogenesis occurs exclusively in skeletal muscle and supplies glucose to blood.

24. Which of the following is INCORRECT regarding pyruvate carboxylase?

A. Pyruvate carboxylase catalyzes conversion of pyruvate into oxaloacetate.

- B. The enzyme requires biotin as a cofactor for its activity.
- C. The reaction occurs in the cytosol and does not involve mitochondria.
- D. The reaction requires ATP and is important in gluconeogenesis.

25. Which of the following BEST describes transport of oxaloacetate from mitochondria to cytosol?

- A. Oxaloacetate diffuses freely across mitochondrial membranes due to its small size.
- B. Oxaloacetate is converted to malate, which can cross the mitochondrial membrane and then be reconverted.
- C. Oxaloacetate is transported via GLUT transporters similar to glucose transport.
- D. Oxaloacetate is exported using ATP-driven pumps located in the inner mitochondrial membrane.

26. Which of the following is INCORRECT regarding phosphoenolpyruvate carboxykinase (PEPCK)?

- A. PEPCK catalyzes conversion of oxaloacetate to phosphoenolpyruvate.
- B. The reaction uses GTP as a source of energy.
- C. The enzyme is located exclusively in mitochondria in all tissues.
- D. It is an essential enzyme in gluconeogenesis.

27. Which of the following is INCORRECT regarding glucose-6-phosphatase?

- A. It catalyzes conversion of glucose-6-phosphate into free glucose.
- B. It is present in liver and kidney tissues.
- C. It is present in skeletal muscle allowing glucose release into blood.
- D. It is essential for maintaining blood glucose levels during fasting.

28. Which of the following is INCORRECT regarding regulation of gluconeogenesis?

- A. Glucagon stimulates gluconeogenesis during fasting states.
- B. AMP acts as an inhibitor of gluconeogenesis reflecting low energy state.
- C. High ATP levels stimulate gluconeogenesis by providing required energy.
- D. Acetyl-CoA inhibits pyruvate carboxylase and reduces gluconeogenic flux.

29. Which of the following BEST describes the Cori cycle?

- A. Lactate produced in muscle is transported to the liver where it is converted back into glucose.

- B. Glucose is directly converted into ATP in the liver and transported to muscle.
- C. Pyruvate is stored in skeletal muscle and used only during rest conditions.
- D. NADH generated in muscle is transported to liver for ATP production.

30. Which of the following is INCORRECT regarding glycolysis-related metabolic defects?

- A. Pyruvate dehydrogenase deficiency can lead to accumulation of lactate causing lactic acidosis.
- B. The brain is particularly affected due to reliance on oxidative metabolism for energy production.
- C. Pyruvate accumulates and is primarily converted into acetyl-CoA in all pathological conditions.
- D. Increased lactate levels in blood are a common consequence of impaired pyruvate metabolism.

## Model Answers

1. C

2. C

3. C

4. C

5. B

6. C

7. C

8. C

9. C

10. B

11. C

12. C

13. D

14. C

15. B

16. B

17. C

18. B

19. D

20. C

21. D

22. C

23. D

24. C

25. B

26. C

27. C

28. D

29. A

30. C