

Name **Metabolism mid**

Total questions: 44

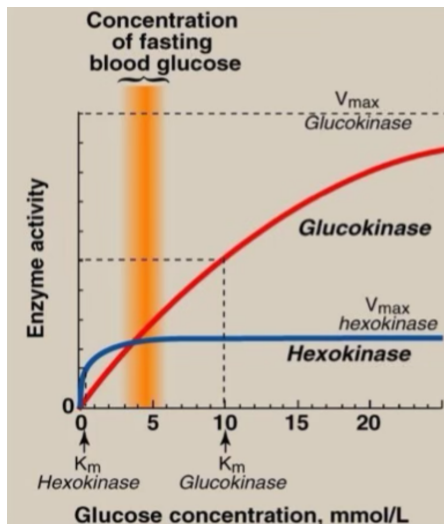
Worksheet time: 3600secs

Instructor name: Hind Shaker

Class Date 

- Why is oxaloacetate (OAA) converted to malate in the mitochondria?
  - Malate is a direct precursor for gluconeogenesis
  - OAA is unstable and must be stored as malate
  - Malate can cross the mitochondrial membrane, whereas OAA cannot
  - OAA must be reduced to NADH before export
- A mutation reduces succinate dehydrogenase activity by 50%. How many ATP would be generated per turn of the TCA cycle in this case?
  - 9.25 ATP
  - 8.5 ATP
  - 9 ATP
  - 7.5 ATP
- Which of the following statements about hexokinase is correct?
  - It has low affinity and high  $K_m$  for glucose
  - It is induced by insulin and glucose
  - It is expressed only in the liver
  - It phosphorylates multiple hexoses, including glucose, galactose, and fructose
- Which of the following is incorrect about Aldolase A?
  - It uses fructose-1-phosphate as a substrate
  - It is found in most tissues, including muscle
  - It is not involved in fructose metabolism
  - It works only in non-specific glycolytic pathways
- Which amino acid is directly converted into pyruvate?
  - Phenylalanine
  - Alanine
  - Methionine
  - Valine

6.



Which of the following statements is correct regarding the enzyme activity shown in the graph?

- a) Both hexokinase and glucokinase have the same  $K_m$  but different  $V_{max}$  values
- b) Glucokinase reaches half of its  $V_{max}$  at fasting glucose concentrations
- c) Glucokinase reaches half of its  $V_{max}$  at fasting glucose concentrations
- d) Hexokinase reaches its  $V_{max}$  at a glucose concentration of 5 mmol/L

7. Which condition would most likely make an unfavorable reaction ( $\Delta G > 0$ ) favorable?

- a) Increasing the reactant concentration relative to the product concentration.
- b) Decreasing the reactant concentration.
- c) Increasing the product concentration.
- d) Decreasing the temperature of the system.

8. A reversible reaction is studied, and the equilibrium constant ( $K$ ) is found to be  $10^{-5}$ . Which of the following conclusions can be drawn about the reaction?

- a) The ratio  $[B]/[A]$  will fluctuate over time but tend to favor products.
- b) The reaction heavily favors the reactants at equilibrium, and only a negligible amount of products will be formed
- c) At equilibrium, the forward and reverse reaction rates are unequal due to the large concentration difference between reactants and products
- d) The forward reaction is spontaneous because  $\Delta G < 0$

9. Which of the following is incorrect about glucagon's action during fasting?

- a) Glucagon stimulates glycolysis by activating the kinase component of PFK-2/FBPase-2
- b) Glucagon reduces fructose-2,6-bisphosphate levels by activating phosphatase activity
- c) Elevated cAMP levels promote gluconeogenesis by reducing PFK-1 activity
- d) Glucagon activates adenylate cyclase, increasing cAMP levels

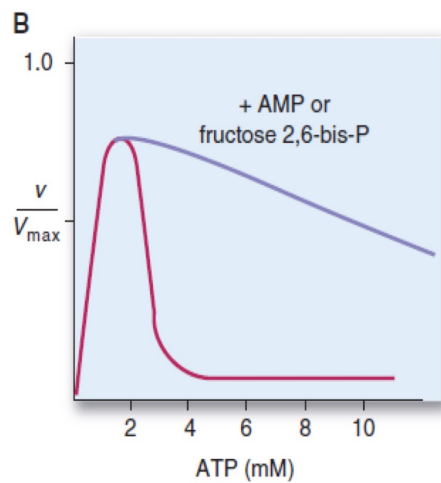
10. What is the primary lipid distinguishing the inner mitochondrial membrane from the outer membrane?
- a) Sphingomyelin
  - b) Cardiolipin
  - c) Phosphatidylserine
  - d) Cholesterol
11. Which of the following complexes has no associated mitochondrial DNA (mtDNA) mutations?
- a) Complex II
  - b) Complex I
  - c) Complex III
  - d) Complex IV
12. One of the following statements about  $\text{FADH}_2$  is WRONG:
- a) It donates electrons to Complex II
  - b) It leads to fewer protons being pumped compared to NADH
  - c) It pumps 4 protons at Complex II
  - d) It bypasses Complex I
13. Leigh Syndrome is caused by mutations in which of the following complexes (nDNA)?
- a) Complex III only
  - b) Complex I and IV
  - c) Complex I, II, and IV
  - d) Complex II and V
14. What feature of the IMM allows it to sustain a proton gradient?
- a) High protein content
  - b) Presence of cardiolipin
  - c) Embedded ATP synthase
  - d) Impermeability to ions like  $\text{H}^+$
15. Which of the following components of the alpha-ketoacid dehydrogenase complex transfers the acyl group to CoA?
- a) E2
  - b) E1
  - c) E3
  - d) All of the above
16. Which step in glycolysis generates NADH?
- a) Phosphoenolpyruvate  $\rightarrow$  Pyruvate
  - b) Glyceraldehyde-3-phosphate  $\rightarrow$  1,3-Bisphosphoglycerate
  - c) Fructose-6-phosphate  $\rightarrow$  Fructose-1,6-bisphosphate
  - d) 1,3-Bisphosphoglycerate  $\rightarrow$  3-Phosphoglycerate
17. What enzyme converts 1,3-bisphosphoglycerate into 2,3-BPG in RBCs?
- a) Pyruvate kinase
  - b) Phosphoglycerate mutase
  - c) 2,3-BPG mutase
  - d) Phosphoglycerate kinase
18. What type of bond does  $\alpha$ -amylase hydrolyze during starch digestion?
- a)  $\alpha$ -1,6 glycosidic bonds
  - b) None of the following
  - c)  $\alpha$ -1,4 glycosidic bonds
  - d)  $\beta$ -1,4 glycosidic bonds

19. What is the role of calcium ions ( $\text{Ca}^{2+}$ ) in regulating isocitrate dehydrogenase?
- a) They have no effect  
b) They convert NADH to  $\text{NAD}^+$   
c) They activate the enzyme  
d) They inhibit the enzyme
20. What does a negative  $E^\circ$  value signify about the reaction?
- a) The reaction cannot occur in the cell.  
b) The reaction is highly exergonic and spontaneous.  
c) The reaction favors the oxidized form in the cell.  
d) The reduced form is more stable than the oxidized form.
21. What is the function of glycogen synthase in glycogen synthesis?
- a) Forms the first glycogen molecule using glycogenin  
b) Adds glucose residues from UDP-glucose to form a linear chain  
c) Converts glucose-6-phosphate to glucose-1-phosphate  
d) Creates  $\alpha$ -1,6 glycosidic bonds for branching
22. Which complex contains the enzymatic activity to hydrolyze  $\alpha$ -1,2 bonds?
- a) Maltase-exoglucosidase complex  
b) Neither  
c) Sucrase-isomaltase complex  
d) Both
23. Which of the following correctly describes the form in which NAD and NADP accept electrons?
- a) In the form of free protons ( $\text{H}^+$ )  
b) In the form of molecular hydrogen  $\text{H}_2$   
c) In the form of hydroxide ions ( $\text{OH}^-$ )  
d) In the form of a hydride ion ( $\text{H}^-$ )
24. Which of the following is correct about the sucrase-isomaltase complex?
- a) The N-terminus of the complex is extracellular  
b) Sucrase cleaves  $\alpha$ -1,2 bonds in sucrose and also has maltase activity  
c) Isomaltase has no maltase activity  
d) It is encoded by two genes and then joined into a single complex
25. Which of the following is wrong about the mechanism of regulated UCPs (uncoupling proteins) ?
- a) UCP1 activity generates heat instead of producing ATP  
b) UCPs allow protons to bypass ATP synthase.  
c) UCPs generate ATP efficiently during thermogenesis.  
d) UCPs create an uncoupling between the ETC and ATP synthase
26. One of the following is WRONG about Antimycin A:
- a) It targets Complex III  
b) It directly inhibits oxygen reduction  
c) It prevents electron transfer from cytochrome b to cytochrome  $c_1$   
d) It blocks both NADH and  $\text{FADH}_2$  pathways

27. Which of the following is incorrect regarding the comparison of MEOS and the main pathway?
- |   |   |
|---|---|
| a) MEOS is more active at low ethanol concentrations compared to the normal pathway | b) The normal pathway generates NADH, contributing to the high NADH/NAD <sup>+</sup> ratio      |
| c) Both pathways ultimately produce acetaldehyde as an intermediate                 | d) MEOS is induced during chronic alcohol consumption, while the normal pathway is constitutive |
28. Why does the citric acid cycle generate only one molecule of GTP per acetyl-CoA, while its indirect energy contribution is much higher?
- |  |   |
|--|---|
| a) NADH and FADH <sub>2</sub> produced in the cycle yield much more ATP in the electron transport chain. | b) The cycle is focused on storing acetyl groups for later use.                                 |
| c) The electron carriers are less significant for energy production than GTP.                            | d) GTP is synthesized in the cytosol, while NADH and FADH <sub>2</sub> are used in the nucleus. |
29. Why are tissues like the lens and retina particularly affected by high glucose levels?
- |   |   |
|---|---|
| a) They produce large amounts of fructose directly from glucose | b) They convert glucose to lactate instead of sorbitol                |
| c) They lack aldose reductase                                   | d) They lack sorbitol dehydrogenase, leading to sorbitol accumulation |
30. What is the effect of fluoroacetate on citrate isomerase (aconitase)?
- |                               |                     |
|-------------------------------|---------------------|
| a) Non-competitive inhibition | b) It has no effect |
| c) Competitive inhibition     | d) Activation       |
31. Which **MAIN** factor drives the activity of the Krebs cycle, the ETC, and oxidative phosphorylation?
- |                                  |   |
|----------------------------------|---|
| a) The cellular demand for ATP   | b) The proton gradient strength                   |
| c) The amount of oxygen consumed | d) The accumulation of NADH and FADH <sub>2</sub> |
32. What is the primary cause of hereditary fructose intolerance (HFI)?
- |                                      |                            |
|--------------------------------------|----------------------------|
| a) Sorbitol dehydrogenase deficiency | b) Hexokinase deficiency   |
| c) Aldolase B deficiency             | d) Fructokinase deficiency |
33. A reaction has a  $\Delta G^\circ$  of +2.0 kcal/mol at 298 K. If the equilibrium constant  $K_{eq}$  is 0.1, which of the following statements is correct?
- |  |   |
|--|---|
| a) The reaction will always proceed in the forward direction regardless of concentrations. | b) The reaction is at equilibrium if $[products]=[reactants]$ |
| c) The reaction can proceed in the forward direction if $[products]<<[reactants]$          | d) The reaction will only proceed in the reverse direction    |

34. All of the following are correct about the role of the  $\beta$  subunits in ATP synthase EXCEPT:
- a) They release ATP in the open (O) state
  - b) They undergo conformational changes (T, L, O) to synthesize and release ATP.
  - c) They rotate with the  $\gamma$  subunit to generate ATP
  - d) They bind ADP and Pi for ATP synthesis in the loose (L) state
35. What is a "limit dextrin"
- a) A segment of glycogen containing four glucose residues near a branch point
  - b) A glucose residue attached to the glycogen core
  - c) A free glucose molecule released by debranching enzymes
  - d) A linear chain of glucose residues created by transferase activity
36. What is the **main** function of Complex IV in the electron transport chain?
- a) Transfer of electrons from ubiquinone to cytochrome c
  - b) Pumping protons into the matrix
  - c) Synthesis of ATP
  - d) Reduction of oxygen to water
37. What happens when a large amount of ethanol is metabolized?
- a) Pyruvate is converted to acetyl-CoA directly
  - b) The NADH/NAD<sup>+</sup> ratio decreases.
  - c) Gluconeogenesis is inhibited
  - d) Fatty acid oxidation is enhanced
38. What distinguishes ATP synthase's  $F_0$  component?
- a) Mobile electron carrier
  - b) Proton channel spanning the IMM
  - c) Catalytic ATP synthesis site
  - d) Contains iron-sulfur clusters
39. The enzyme succinate dehydrogenase in the TCA cycle is unique because:
- a) It is involved in GTP production
  - b) It catalyzes the production of NADH
  - c) It is located in the cytosol
  - d) It is part of the inner mitochondrial membrane
40. Which enzyme's activity is reduced, preventing pyruvate from entering the TCA cycle and contributing to lactic acidosis?
- a) Lactate dehydrogenase
  - b) Phosphofructokinase
  - c) Pyruvate kinase
  - d) Pyruvate dehydrogenase
41. Which of the following diseases is associated with Complex V mutations in mitochondrial DNA?
- a) Sporadic Myopathy
  - b) Paraganglioma
  - c) Leigh Syndrome
  - d) NARP (Neuropathy, Ataxia, and Retinitis Pigmentosa)

42.



What does the initial rise in the curve represent as ATP concentration increases?

- a) ATP acting as an allosteric activator
- b) ATP acting as a negative regulator for PFK-1
- c) ATP acting as a substrate for PFK-1
- d) ATP being inhibited by AMP

43. Which physiological factor activates both isocitrate dehydrogenase and  $\alpha$ -ketoglutarate dehydrogenase?

- a) ATP
- b) Succinyl-CoA
- c) GTP
- d)  $\text{Ca}^{2+}$

44. Which GLUT transporter has a high capacity but low affinity for glucose and may act as a glucose sensor in the pancreas?

- a) GLUT 1
- b) GLUT 2
- c) GLUT 3
- d) GLUT 4

**Answer Keys**

1. c) Malate can cross the mitochondrial membrane, whereas OAA cannot
2. a) 9.25 ATP
3. d) It phosphorylates multiple hexoses, including glucose, galactose, and fructose
4. a) It uses fructose-1-phosphate as a substrate
5. b) Alanine
6. d) Hexokinase reaches its  $V_{max}$  at a glucose concentration of 5 mmol/L
7. a) Increasing the reactant concentration relative to the product concentration.
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12. c) It pumps 4 protons at Complex II
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14. d) Impermeability to ions like  $H^+$
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16. d) 1,3-Bisphosphoglycerate  $\rightarrow$  3-Phosphoglycerate
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21. b) Adds glucose residues from UDP-glucose to form a linear chain
22. c) Sucrase-isomaltase complex
23. d) In the form of a hydride ion ( $H^-$ )
24. b) Sucrase cleaves  $\alpha$ -1,2 bonds in sucrose and also has maltase activity
25. c) UCPs generate ATP efficiently during thermogenesis.
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40. d) Pyruvate dehydrogenase
41. d) NARP (Neuropathy, Ataxia, and Retinitis Pigmentosa)
42. c) ATP acting as a substrate for PFK-1
43. d)  $Ca^{2+}$
44. b) GLUT 2