

Lecture 1 final Questions

- The most important controlled step in the glycolytic pathway is:**
 - the formation of fructose 1, 6 bisphosphate
 - formation of glucose - 6 - phosphate
 - Formation of glyceraldehyde - 3 - phosphate
 - formation of fructose - 6 - phosphate
 - formation of Phosphoenolpyruvate
- Activators of the enzyme pyruvate kinase include:**
 - Insulin
 - Fructose1, 6 bisphosphate
 - Fructose 2, 6 bisphosphate
 - A + B
 - None of the above
- Glucagon controls the entry of glycolysis by altering the enzymatic action of PFK2, these results in the inhibition of:**
 - Fructose-6-phosphate into fructose-1,6-bisphosphate
 - Glucose-6-phosphate into fructose-6-Phosphate
 - Fructose 1, 6-bisphosphate into fructose 2, 6-bisphosphate
 - Fructose1, 6-bisphosphate into fructose-6-Phosphate
- Rate of Glycolysis is increased by**
 - Increased Insulin / glucagon ratio
 - ATP
 - Citrate
 - Increased cAMP level
- Which of the following enzymes are regulated?**
 - Glucokinase / hexokinase
 - Aldolase
 - Pyruvate Kinase
 - A + C
 - none of the above

6. rate limiting enzyme of glycolysis:

- A. hexokinase
- B. phosphatase1
- C. Phosphofructokinase1
- D. Aldolase
- E. glucokinase

7. the enzyme having low km and low Vmax for glucose is:

- A. hexokinase
- B. phosphatase1
- C. Phosphofructokinase1
- D. Aldolase
- E. glucokinase

8. Which is inhibited by glucose - 6 - phosphate:

- A. hexokinase
- B. glucokinase
- C. A + B
- D. None

9. Which one of the following statements concerning glycolysis is correct?

- A. The conversion of glucose to lactate requires the presence of oxygen.
- B. Hexokinase I is important in hepatic glucose metabolism only in the absorptive period following consumption of a carbohydrate-containing meal.
- C. Fructose 2,6-bisphosphate is a potent inhibitor of phosphofructokinase.
- D. The regulated reactions are also the irreversible reactions.
- E. The conversion of glucose to lactate yields two ATP and two NADH.

10. The reaction catalyzed by phosphofructokinase-1:

- A. is activated by high concentrations of ATP and citrate.
- B. uses fructose 1-phosphate as substrate.
- C. is the rate-limiting reaction of the glycolytic pathway.
- D. is near equilibrium in most tissues.
- E. is inhibited by fructose 2,6-bisphosphate.

11. Compared with the resting state, vigorously contracting skeletal muscle shows:

- A. an increased conversion of pyruvate to lactate.
- B. decreased oxidation of pyruvate to CO₂ and water.
- C. decreased NADH/NAD⁺ ratio.
- D. a decreased concentration of AMP.
- E. decreased levels of fructose 2,6-bisphosphate.

12. Glycolysis

- A. does not require O_2 to generate energy.
- B. requires O_2 to generate energy.
- C. is inhibited by O_2 .
- D. rate is increased in the presence of O_2 .

13. The fate of pyruvate produced during glycolysis depends primarily on the availability of

- A. NAD^+ to keep the pathway going.
- B. molecular oxygen.
- C. ADP for conversion to ATP.
- D. coenzyme A for further metabolism of pyruvate.
- E. phosphoric acid for the synthesis of ATP.

14. In aerobic metabolism, what is the fate of pyruvate produced by glycolysis?

- A. Pyruvate loses carbon dioxide, and the remaining two carbon atoms become linked to coenzyme A.
- B. Pyruvate loses carbon dioxide, producing acetaldehyde, which, in turn, is reduced to ethanol.
- C. Pyruvate is reduced to lactate.
- D. None of these

15. In humans, pyruvate can be converted to

- A. acetyl-CoA only.
- B. lactate only.
- C. ethanol only.
- D. acetyl-CoA and lactate.

16. Which of the following is not an end product of glucose metabolism via either aerobic or anaerobic means?

- A. ethanol
- B. carbon dioxide
- C. lactate
- D. fructose
- E. all of these are end products of glucose metabolism

17. What is the net ATP yield per glucose during glycolysis?

- A. 1
- B. 2
- C. 3
- D. 4
- E. 6

18. Starting from Glucose-6-P to 2 Lactate, the net ATP produced is:

- A. 1
- B. 2
- C. 3
- D. 4

19. In the conversion of glucose to pyruvate, how many of the actual steps involve electron transfer?

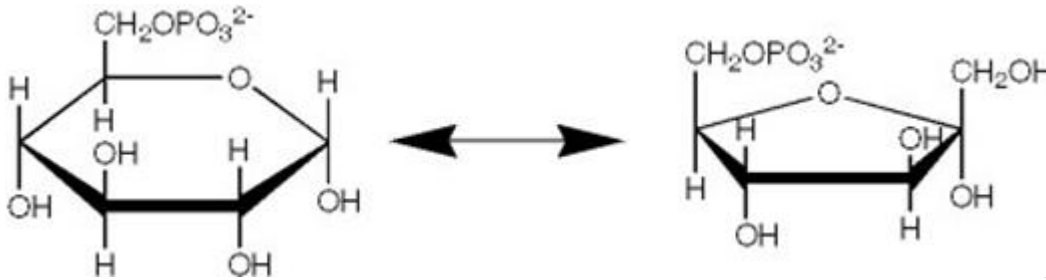
- A. none
- B. 1
- C. 2
- D. 3
- E. 4

20. The order of compounds in the conversion of glucose to pyruvic acid is as follows:

(PEP = phosphoenolpyruvate)

- A. Fructose-bisphosphate, fructose-6-phosphate, 1,3-phosphoglyceric acid, 3-phosphoglyceric acid, PEP.
- B. Fructose-6-phosphate, fructose-bisphosphate, PEP, 1,3-phosphoglyceric acid, 3-phosphoglyceric acid.
- C. Fructose-6-phosphate, fructose-bisphosphate, 1,3-phosphoglyceric acid, 3-phosphoglyceric acid, PEP.
- D. Fructose-6-phosphate, fructose-bisphosphate, 3-phosphoglyceric acid, 1,3-phosphoglyceric acid, PEP.

21. Which enzyme catalyzes the reaction shown?



- A. an epimerase
- B. an isomerase
- C. a mutase
- D. a dehydrogenase

22. which of the following glycolytic intermediates is high energy compound?

- A. Glucose-6-P
- B. Fructose 1,6 bisphosphate
- C. 1,3 bisphosphoglycerate
- D. Phosphoenolpyruvate
- E. c + d

23. The phosphorylation of fructose 6-phosphate to fructose-1,6-bisphosphate is the committed step in glycolysis because

- A. it is the rate-limiting step.
- B. it is the most strongly exergonic step in the pathway.
- C. fructose 1,6-bisphosphate can undergo no other reactions than those of glycolysis.
- D. two phosphate groups are involved.

24. Which of the following enzymes interconverts an aldose and a ketose?

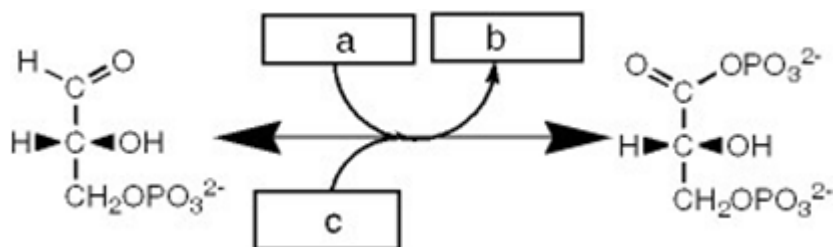
- A. kinase
- B. isomerase
- C. mutase
- D. dehydrogenase
- E. phosphorylase

25. Which enzyme is the key regulatory enzyme in glycolysis?

- A. Glyceraldehyde-3-phosphate dehydrogenase
- B. Enolase
- C. Phosphofructokinase
- D. Aldolase

26. Which of the following exercise(s) allosteric control in the reaction of phosphofructokinase?
- ATP
 - fructose 1,6-bisphosphate
 - both of these
 - neither of these
27. The reaction of fructose 1,6-bisphosphate to give glyceraldehyde-3-phosphate and dihydroxyacetone phosphate is an example of
- a reverse aldol condensation.
 - hydrolysis.
 - oxidation.
 - dehydration.
28. The isomerization of dihydroxyacetone phosphate to give glyceraldehyde 3-phosphate
- is catalyzed by the enzyme triose phosphate isomerase.
 - requires several enzymes.
 - requires coenzyme A.
 - requires thiamine pyrophosphate.
29. The step that commits the cell to metabolize glucose is catalyzed by
- hexokinase.
 - phosphoglucomutase.
 - aldolase.
 - phosphofructokinase.
30. Which of the following enzymes catalyzes the cleavage of fructose bisphosphate into two 3-carbon units?
- Aldolase
 - Enolase
 - An isomerase
 - A mutase
 - None of these enzymes carries out that reaction.
31. In glycolysis Steps, ATP is synthesized by
- substrate-level phosphorylation.
 - oxidative phosphorylation.
 - photophosphorylation.
 - both substrate-level and oxidative phosphorylation.
 - all three of the above methods.

32. Which group of small molecules best fit the boxes associated with the reaction shown?



	a	b	c
I.	ATP	ADP	H ₂ O
II.	NADH	NAD ⁺	Pi
III.	NAD ⁺	NADH	H ₂ O
IV	NAD ⁺	NADH	Pi

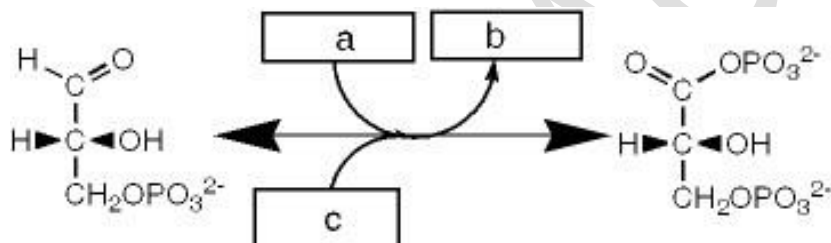
A) I

B) II

C) III

D) IV

33. What kind of enzyme catalyzes the reaction shown?

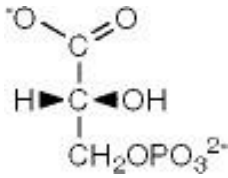


- A. an epimerase
- B. an isomerase
- C. a mutase
- D. a dehydrogenase

34. Enolase catalyzes

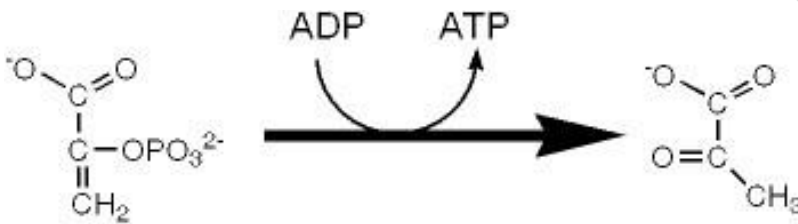
- A. the cleavage of fructose bisphosphate into two 3-carbon units.
- B. the dehydration of 2-phosphoglycerate.
- C. the conversion of phosphoenolpyruvate to pyruvate.
- D. the conversion of glucose-6-phosphate to fructose-6-phosphate.

35. What is the name of the pictured glycolytic intermediate?



- A. 1-phosphoglycerate
- B. glyceraldehyde-3-phosphate
- C. dihydroxyacetone phosphate
- D. 3-phosphoglycerate

36. Which enzyme catalyzes reaction the reaction shown?



- A. enolase
- B. pyruvate dehydrogenase
- C. pyruvate kinase
- D. phosphoglycerate mutase

37. Which of the following enzymes of glycolysis is not involved in regulation of the pathway?

- A. Hexokinase
- B. Phosphofruktokinase
- C. Aldolase
- D. Pyruvate kinase
- E. All of these proteins regulate glycolysis.

38. How many enzymes of glycolysis are control points for the pathway?

- A. 1
- B. 2
- C. 3
- D. 4
- E. All the enzymes serve as control points.

39. Which of the following enzymes catalyzes a dehydration reaction?

- A. Glyceraldehyde-3-phosphate dehydrogenase
- B. Enolase
- C. Phosphofructokinase
- D. Aldolase

40. In the conversion of glyceraldehyde 3-phosphate to 1,3-bisphosphoglycerate

- A. an alcohol group is phosphorylated.
- B. an alcohol is oxidized to an aldehyde.
- C. an alcohol is oxidized to a carboxylic acid.
- D. an aldehyde is oxidized to a carboxylic acid.

41. An enzyme not involved in the control of glycolysis is

- A. hexokinase.
- B. triose phosphate isomerase.
- C. pyruvate kinase.
- D. phosphofructokinase.

42. During anaerobic metabolism in red blood cells, the carbons of glucose end up in

- A. CO₂.
- B. ethanol.
- C. lactic acid.
- D. both CO₂ and ethanol.
- E. all of the above.

43. The fate of NADH from glycolysis depends on whether conditions are anaerobic or aerobic.

- A. True
- B. False

44. The cells that is primarily affect by genetic deficiency of glycolytic enzymes are?

- A. Hepatocytes
- B. Adipocytes
- C. Erythrocytes
- D. Muscles

45. The product of this enzyme has high energy bond that can be used to produce ATP by substrate level phosphorylation

- A. Aldolase
- B. Enolase
- C. Pyruvate kinase
- D. Phosphoglycerate kinase

46. Toothpastes and Fluoridated water inhibit dental caries and mouth bacterial growth by inhibiting.....:

- A. Aldolase
- B. Hexokinase
- C. PFK I
- D. Enolase

47. Which of the following will occur during Fasting?

- A. Secretion of Insulin
- B. Increased level of Fructose 2,6 Bisphosphate
- C. Increase Glycolysis rate
- D. Phosphorylation of PFK II

48. High Insulin/Glucagon ratio

- A. Increase Glycolysis rate
- B. Phosphorylate PFK II
- C. Phosphorylate PFK I
- D. Increase level of cAMP

**49. Which of the following best describe the activity level and phosphorylation state in the listed hepatic enzymes in an individual who consumed a carbohydrate rich meal about an hour ago?
PFK1= phosphofructokinase 1, PFK2=phosphofructokinase 2, P=phosphorylated**

Choices	PFK1		PFK2		Pyruvate kinase	
	Activity	P	Activity	P	Activity	P
A)	Low	No	Low	No	Low	No
B)	High	Yes	Low	Yes	Low	Yes
C)	High	No	High	No	High	No
D)	High	Yes	High	Yes	High	Yes

50. Glucose uptake by:

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

51. Given that the km of glucokinase for glucose is 10mM, whereas that of hexokinase is 0.1 mM, which isozyme will be closely approach Vmax at the normal blood glucose concentration of 5 mM?

- A. Glucokinase
- B. Hexokinase
- C. Both
- D. None

Lecture 2 final Questions

52. Which of the following slows down TCA?

- A. increased concentration of AMP and pyruvate
- B. NAD^+ and ADP
- C. calcium ions
- D. ATP and NADH
- E. fumarate

53. All of the following co-factors are required in the pyruvate dehydrogenase complex except:

- A. lipoic acid
- B. NAD^+
- C. FAD
- D. All are required

54. NADH is produced in all TCA reactions except:

- A. Isocitrate dehydrogenase
- B. Malate dehydrogenase
- C. succinate dehydrogenase
- D. α -keto-glutarate dehydrogenase
- E. it is produced in all of them

55. Substrate level phosphorylation occurs from which of the following enzymes?

- A. lactate dehydrogenase
- B. Succinate dehydrogenase.
- C. succinate thiokinase (succinyl-CoA synthetase)
- D. fumarase
- E. hexokinase

56. When having thiamine deficiency, which enzymatic activity do you expect to be decreased?

- A. pyruvate carboxylase
- B. malate dehydrogenase
- C. fumarase
- D. α - ketoglutarate dehydrogenase
- E. lactate dehydrogenase

57. inhibitors of succinate dehydrogenase will cause a decrease in the concentration of?

- A. Citrate
- B. Pyruvate
- C. isocitrate
- D. fumarate
- E. Acetyl-CoA

58. Complete oxidation of 5 Acetyl-CoA yield:

- A. 50 ATP
- B. 60 ATP
- C. 10 ATP
- D. 5 ATP

59. Succinate Dehydrogenase deficiency will increase the level of:

- A. $FADH_2$
- B. NAD^+
- C. Succinate
- D. NADH

60. Arsenic is an inhibitor that can bind to Lipoate which on the following will be affected:

- A. α -ketoglutarate dehydrogenase
- B. Pyruvate dehydrogenase
- C. Glyceraldehyde - 3 - P dehydrogenase
- D. All
- E. Only A + B

61. Which coenzyme listed below is NOT associated with α -ketoglutarate complex?

- A. TPP
- B. Lipoic acid
- C. Biotin
- D. NAD^+

62. When oxaloacetate react with acetyl-CoA to form citrate?

- A. A new c-c bond is formed
- B. An oxidative decarboxylation take place
- C. A dehydration reaction take place
- D. A rearrangement take place

63. Release of succinate from succinyl-CoA can be coupled with GTP synthesis because: -

- A. The amide bond between succinate and CoA has large $-\Delta G$
- B. The thioester bond between succinate and CoA has large $-\Delta G$
- C. The link between succinate and CoA involves an acid anhydride
- D. CoA is a high energy compound, just like GTP
- E. None of these.

64. All reaction of citric acid cycle take place in mitochondrial matrix EXCEPT:

- A. Citrate to isocitrate
- B. Isocitrate to alpha ketoglutarate
- C. Succinyl - CoA to succinate
- D. Succinate to fumarate

65. Formation of oxaloacetate from malate in citric acid cycle is followed by:

- A. Formation of isocitrate from citrate
- B. Formation of citrate from oxaloacetate and acetyl - CoA
- C. Formation of succinate from succinyl - CoA
- D. Formation of fumarate from Succinate

66. The conversion of Pyruvate to Acetyl-CoA and carbon dioxide:

- A. Involve the participation of lipoic acid
- B. Is activated when pyruvate dehydrogenase complex is phosphorylated
- C. Is reversible
- D. Occurs in the cytosol
- E. Requires the coenzyme biotin

67. Which of the following conditions decrease oxidation of acetyl-CoA by the citric acid cycle?

- A. A high availability of Calcium
- B. High Acetyl-CoA/CoA ratio
- C. Low ATP/ADP ratio
- D. Low $NAD^+/NADH$ ratio

68. Which of the following substances is a direct precursor of succinyl - CoA in Krebs' cycle?

- A. Malic acid
- B. Succinic acid
- C. Oxaloacetic acid
- D. Citric acid
- E. α - ketoglutaric acid

69. which of the following steps in citric acid cycle represent substrate level phosphorylation?

- A. Oxaloacetate + acetyl-CoA → citrate
- B. Alpha - ketoglutarate → Succinyl – CoA
- C. Succinyl - CoA → succinate
- D. Fumarate → malate

70. when we describe citric acid cycle as amphibolic, we mean that:

- A. It produces and consume GTP
- B. It plays role in both catabolism and anabolism
- C. It produces both NADH and FADH₂
- D. it links glycolysis pathway with oxidative phosphorylation pathway in

71. Which of the following statements concerns the citric acid cycle as the central metabolic pathway is true?

- A. It is involved in the metabolism of sugars and amino acids.
- B. It is involved in the metabolism of amino acids and lipids.
- C. It links anaerobic metabolism to aerobic metabolism.
- D. Many of its intermediaries are starting points for synthesis of a variety of compounds.
- E. All of these are reasons why the citric acid cycle is considered to be the central pathway.

72. The reaction of the citric acid cycle that does not take place in the mitochondrial matrix is the one catalyzed by:

- A. fumarase
- B. citrate synthase
- C. isocitrate dehydrogenase
- D. succinate dehydrogenase
- E. All of these reactions take place in the matrix

73. Which of the following vitamins and enzyme cofactors are used by the pyruvate dehydrogenase complex during oxidative decarboxylation?

- A. Lipoic Acid
- B. Niacin (NAD⁺)
- C. Pantothenic Acid (CoA)
- D. Thiamine
- E. All of these

74. in the conversion of succinyl-CoA to succinate GTP is produced from GDP, What is the source of phosphate added is?

- A. ATP
- B. ADP
- C. Phosphoenolpyruvate
- D. inorganic phosphate

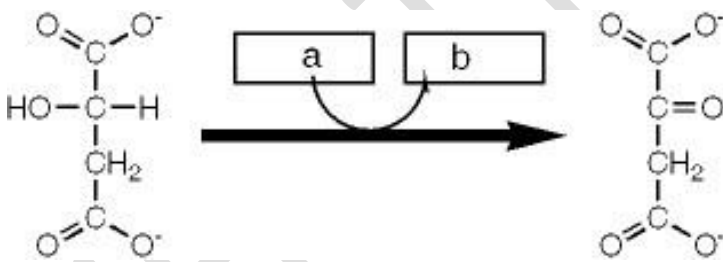
75. Which one of the following conditions decreases the oxidation of acetyl CoA by the citric acid cycle?

- A. A low ATP/ADP ratio
- B. A low NADH concentration due to rapid oxidation to NAD⁺ through the respiratory chain
- C. A low NAD⁺/NADH ratio
- D. A high concentration of AMP
- E. A low GTP/GDP ratio

76. The following is the sum of three steps in the citric acid cycle. $A + B + FAD + H_2O \rightarrow C + FADH_2 + NADH$ Choose the lettered answer that corresponds to the missing "A", "B", and "C" in the equation. Reactant A, Reactant B, Product C

- A. Succinyl CoA, GDP, Succinate
- B. Succinate, NAD⁺, Oxaloacetate
- C. Fumarate, NAD⁺, Oxaloacetate
- D. Succinate, NAD⁺, Malate

77. Which group of small molecules best fit the boxes associated with the reaction shown?



	A	B
I.	GDP + Pi	GTP
II.	NAD ⁺	NADH
III.	NADP ⁺	NADPH
IV	FAD	FADH ₂

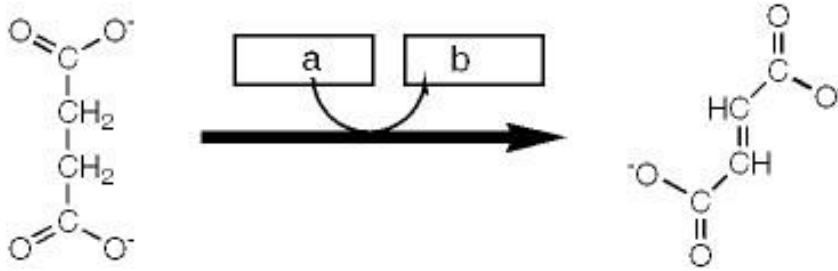
A) I

B) II

C) III

D) IV

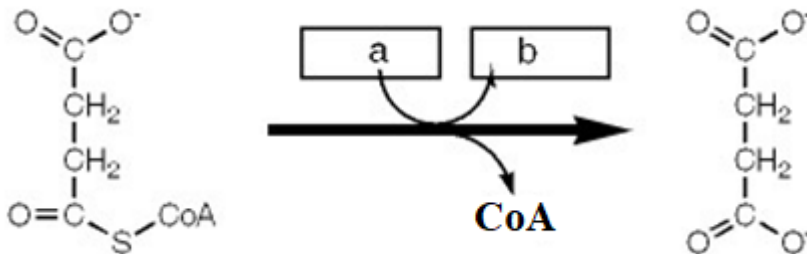
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	A	B
I.	GDP + Pi	GTP
II.	NAD ⁺	NADH
III.	NADP ⁺	NADPH
IV	FAD	FADH ₂

A.I B. II C. III D. IV

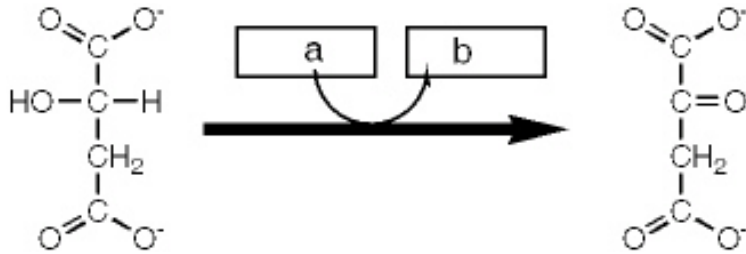
79. Which group of small molecules best fit the boxes associated with the reaction shown?



	A	B
I.	GDP + Pi	GTP
II.	NAD ⁺	NADH
III.	NADP ⁺	NADPH
IV	FAD	FADH ₂

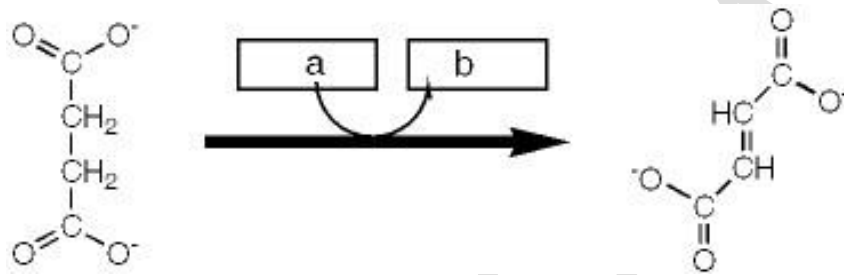
A.I B. II C. III D. IV

80. Which enzyme catalyzes the reaction shown?



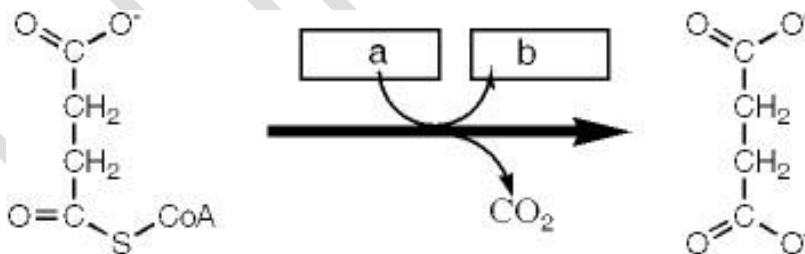
- A. isocitrate dehydrogenase
- B. malate dehydrogenase
- C. fumarase
- D. succinate dehydrogenase

81. Which enzyme catalyzes the reaction shown?



- A. isocitrate dehydrogenase
- B. malate dehydrogenase
- C. fumarase
- D. succinate dehydrogenase

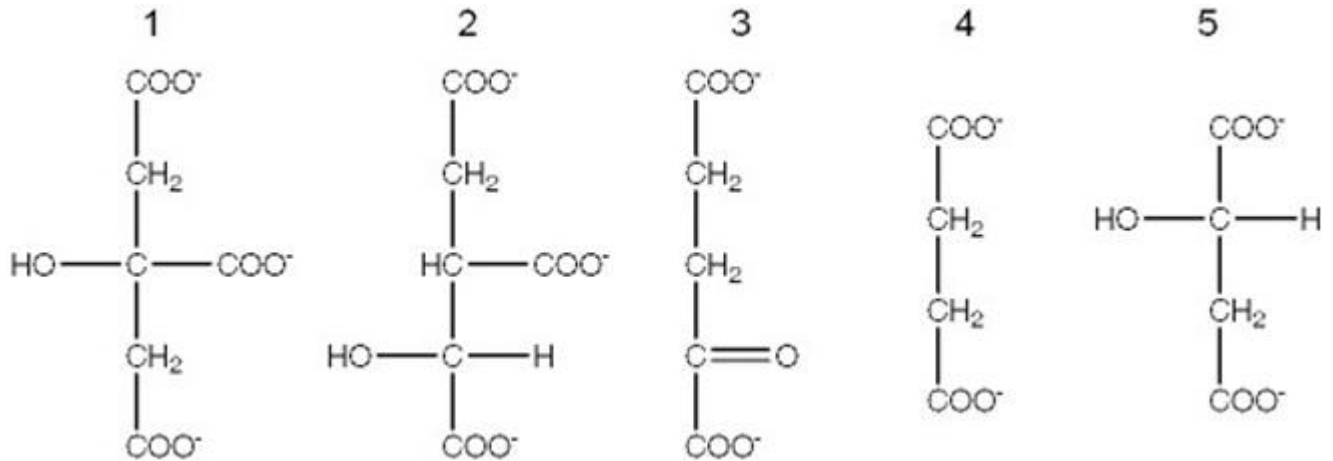
82. Which enzyme catalyzes the reaction shown?



- A. Succinate thiokinase
- B. succinate dehydrogenase
- C. pyruvate dehydrogenase
- D. a-ketoglutarate dehydrogenase

Refer to this figure then answer Question (84 - 88)

The following compounds are all intermediates in the citric acid cycle.



83. Which intermediate releases CO_2 concurrent with oxidation?

- A. 1
- B. 2
- C. 3
- D. Both 1 and 3
- E. Both 2 and 3

84. Which intermediate is formed from acetyl-CoA and oxaloacetate?

- A. 1
- B. 2
- C. 3
- D. 4
- E. 5

85. Which intermediate does FAD oxidize?

- A. 2
- B. 3
- C. 4
- D. 5
- E. More than one of these is oxidized by FAD.

86. Which intermediate is formed from fumarate?

- A. 1
- B. 2
- C. 3
- D. 4
- E. 5

87. Which intermediate is decarboxylated and becomes bonded to Coenzyme A during the cycle?

- A. 1
- B. 2
- C. 3
- D. 4
- E. 5

88. Which of the following catalyze an Irreversible step in TCA cycle?

- A. Citrate Synthase
- B. Isocitrate Dehydrogenase
- C. A-ketoglutarate Dehydrogenase
- D. None of the above
- E. All of the above

89. The direct connection between TCA cycle and ETC is:

- A. Succinyl-CoA to Succinate
- B. Succinate to Fumarate
- C. Fumarate to Malate
- D. Malate to Oxaloacetate

90. A 1-month-old male show neurologic problems and lactic acidosis. Enzyme assay for pyruvate dehydrogenase complex (PDHC) activity on extract of cultured skin fibroblast showed 5% of normal activity with a low concentration of thiamine pyrophosphate (TPP) but 80% of normal activity when the assay contained thousand-fold higher concentration of TPP. Which one of the following concerning the patient is correct?

- A. administration of thiamine is expected to reduce his serum lactate level and improve his clinical symptoms
- B. a high carbohydrate diet would be expected to be beneficial for this patient
- C. citrate production from aerobic glycolysis is expected to be increased
- D. PDH kinase, a regulatory enzyme of the PDHC, is expected to be active

Lecture 3 final Questions

- 91. The only reaction which actually uses molecular oxygen is**
- A. Cytochrome c oxidase.
 - B. NADH Dehydrogenase
 - C. Succinate Dehydrogenase
 - D. Cytochrome bc1 complex.
- 92. How do uncoupling agents affect the electron transport chain and oxidative phosphorylation?**
- A. They block the flow of electrons, so protons are not pumped, and ATP synthesis ceases.
 - B. They remove electrons from the chain, so less protons are pumped, and ATP synthesis decreases
 - C. They block the flow of protons through the ATP synthase, so ATP synthesis ceases. Electron flow and proton pumping are also halted as a result
 - D. They provide an alternative path for protons to re-enter the mitochondrial matrix thus ATP synthesis decreases. Electron flow and proton pumping are not affected
- 93. The F1F0 complex is actually a transmembrane complex.**
- A. True
 - B. False
- 94. In the conformational coupling mechanism for oxidative phosphorylation, the effect of the proton gradient is**
- A. to inhibit conformational changes in the ATP synthase
 - B. to create more sites for ATP synthesis
 - C. the release of ATP from the synthase
 - D. all of these
 - E. none of these
- 95. Which of the following is not true of the process of oxidative phosphorylation?**
- A. protons flow into the mitochondrial matrix through ion channels in the ATP synthase.
 - B. the F0 part of the ATP synthase serves as a proton channel
 - C. the F1 part of the ATP synthase is the site of ATP formation
 - D. iron - sulfur proteins bind to the ATP synthase

96. A poison that prevents the transfer of electrons from the last iron - sulfur cluster of Complex I to Coenzyme Q is added to a suspension of actively respiring mitochondria, which statement best describes the effect seen?
- ATP production would be impaired as this would uncouple oxidative phosphorylation from electron transport.
 - ATP production would be reduced as few protons would be pumped into mitochondrial matrix
 - ATP production would be severely impaired as this would completely block electron transport through the electron transport chain.
 - This compound would have little to no effect on ATP production.
97. An alternative mode of entry into the electron transport chain is the oxidation of
- malate to Oxaloacetate.
 - succinate to fumarate.
 - isocitrate to α - ketoglutarate.
 - α - ketoglutarate to succinyl - CoA.
98. The complex in the electron transport chain that does not have a direct link to coenzyme Q in some form is
- the succinate dehydrogenase complex.
 - Complex I.
 - cytochrome c oxidase.
 - Complex III
99. Iron deficiency in a cell can adversely affect electron transport at which of the following sites?
- coenzyme Q and FADH₂
 - NADH and FADH₂
 - cytochrome b and cytochrome c
 - coenzyme Q and NADH
100. Complex II of the electron transport chain oxidizes____, reduces____,and____protons in the process.
- | | | |
|---------------|-------------|---------------|
| A. succinate; | coenzyme Q; | does not pump |
| B. succinate; | coenzyme Q; | pumps |
| C. NADH; | coenzyme Q; | does not pump |
| D. NADH; | coenzyme Q; | pumps |

101. The final reduced species in the electron transport chain is
- O₂
 - H₂O
 - cytochrome c
 - coenzyme Q
102. Which complex of the electron transport chain does NOT contain an iron-sulfur cluster?
- Complex I
 - Complex II
 - Complex III
 - Complex IV
103. Which of the following is not true?
- The synthesis of ATP in mitochondria is driven by a proton or pH gradient.
 - The synthesis of ATP is coupled to the oxidation of NADH
 - The reoxidation of NADH and FADH₂ indirectly creates a proton gradient that is involved in ATP synthesis
 - All of these are true.
104. How many electrons are required for the complete reduction of one molecule of oxygen gas?
- one
 - two
 - four
 - eight
105. The final electron acceptor of complex III is:
- Oxygen
 - Ubiquinone
 - cytochrome c .
 - Non - Heme iron protein
106. Which of the following compounds inhibit the phosphorylation of ADP without affecting electron transport?
- Antimycin A
 - Amytal
 - Rotenone
 - Dinitrophenole

107. **The only complex in electron transport chain which actually uses molecular oxygen is:**
- A. Complex I
 - B. complex II
 - C. complex III
 - D. complex IV
108. **The reactions of electron transport chain take place in the mitochondria occurs in:**
- A. The outer membrane
 - B. The inner membrane
 - C. The mitochondrial matrix
 - D. The intermembrane space
109. **Cyanide ion is poisonous because it:**
- A. Interfere with fatty acid transport
 - B. Activate fatty acid desaturation
 - C. Inhibit gluconeogenesis
 - D. Inhibit mitochondrial oxidation
110. **When mitochondria are actively carrying out aerobic respiration:**
- A. the pH of the matrix is greater than the pH of the intermembrane space
 - B. The pH of the matrix is less than the pH of the intermembrane space
 - C. The pH of the matrix is about the same as the pH of the Intermembrane Space
 - D. The pH of the matrix versus the intermembrane space has nothing to do with either or not aerobic respiration is occur
111. **Which of the following components of ETC is hydrophobic lipid?**
- A. FMN
 - B. Cyt c
 - C. Ubiquinone
 - D. Fe-S cluster
 - E. None of the above
112. **High level ofmake you lose weight?**
- A. CoQ
 - B. ATP-synthase
 - C. UCP1
 - D. Cyt c

113. Which of the following component of ETC plays a role in apoptosis?
- CoQ
 - Cyt c1
 - Cyt a
 - Cyt c
114. Which of the following will not accumulate when mitochondria exposed to Antimycin A?
- NADH
 - CoQ
 - ADP
 - O₂
 - Cytc (Fe⁺³)
115. Porphyrias are group of genetic diseases that affect Heme biosynthesis, which of the following sites of ETC will be affected in these disorders?
- NADH dehydrogenase
 - Succinate Dehydrogenase
 - Cytc Oxidase
 - F0F1 complex
116. Which of the following called Respiratory control that most affect the rate of oxidative phosphorylation?
- H⁺
 - ADP
 - NADH
 - FADH₂
117. 2,4 Dinitrophenol (DNP), an uncoupler of oxidative phosphorylation, was used as weight-loss agent in 1930s. Reports of fatal overdose led to its discontinuation in 1939. Which of the following is most likely be true concerning individuals taking 2,4DNP?
- ATP in the mitochondria are greater than normal
 - Body temperature is elevated as result of hypermetabolism
 - Cyanide has no effect on electron flow
 - The proton gradient across the inner mitochondrial membrane is greater than normal
 - The rate of electron transport is abnormally low
118. Which of the following has the greatest tendency to gain electrons?
- Coenzyme Q
 - Cytochrome C
 - Flavin adenine dinucleotide
 - Oxygen

Lecture 4 final Questions

119. Which of the following enzymes is found in the liver but not in the muscle?
- Hexokinase
 - Glucose-6-phosphatase
 - Glycogen phosphorylase
 - Lactate dehydrogenase
120. In the cori cycle, carbon in the form of lactate carried by blood to liver then back to the muscle in form of?
- glucose
 - pyruvate
 - ethanol
 - Acetyl CoA
 - ATP
121. Which of the following is INCORRECT about gluconeogenesis?
- It occurs in liver cells
 - It refers to the synthesis of glucose from small non-carbohydrate precursors
 - Its stimulated by high concentration of fructose - 2, 6 – bisphosphate
 - It occurs in three cellular locations (cytosol, mitochondria, and ER)
122. Biotin is important in gluconeogenesis for all of these reasons EXCEPT:
- Its necessary to add CO_2 to certain intermediates in this pathway
 - CO_2 becomes one or more of the 6 carbons in the glucose products.
 - Biotin is capable of binding covalently to CO_2
 - Biotin helps synthesize an important precursor of phosphoenolpyruvate
123. Conversion of pyruvate to phosphoenolpyruvate require:
- One ATP
 - One ATP and One NADH
 - One ATP and one GTP
 - One GTP and One NADH
124. Which of the following substances can't contribute in Gluconeogenesis?
- Alanine
 - Glutamate
 - Palmitate
 - Pyruvate
 - Glycerol

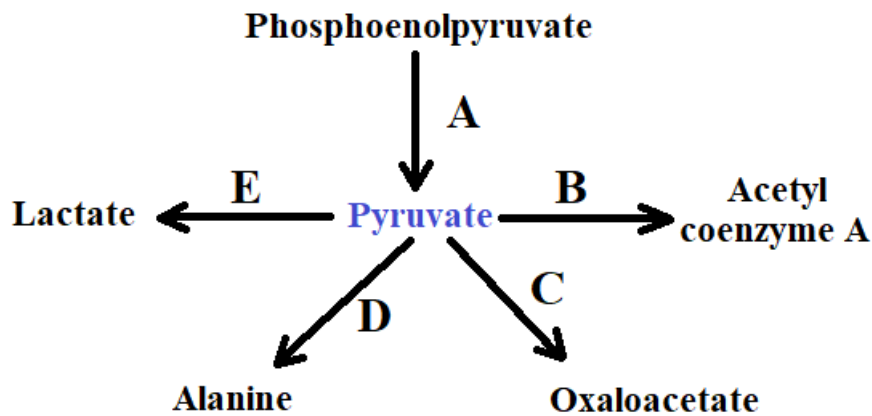
125. which of the following will be a common intermediate when using Pyruvate and glycerol for gluconeogenesis?
- A. Dihydroxyacetone phosphate
 - B. glyceraldehyde 3 - P
 - C. oxaloacetate
 - D. 1, 3 bisphosphoglycerate
126. Which of the following enzymes catalyzes a reversible reaction in glycolysis?
- A. Hexokinase
 - B. Phosphofructokinase
 - C. Enolase
 - D. Pyruvate kinase
127. Which of the following enzymes found in the mitochondria?
- A. Hexokinase
 - B. Pyruvate kinase
 - C. Glucose - 6 - phosphatase
 - D. Pyruvate carboxylase
128. Pyruvate carboxylase is used to directly synthesize which of the following molecules?
- A. Pyruvate
 - B. Oxaloacetate
 - C. malate
 - D. Acetyl-coA
 - E. α -ketoglutarate.
129. The reaction; fructose -1,6-bisphosphate \rightarrow fructose - 6 - P is catalyzed by the enzyme:
- A. Phosphofructokinase
 - B. Fructose- 1,6 - bisphosphatase
 - C. Triose phosphate isomerase
 - D. fructose 2,6 bisphosphatase
130. How many ATP and GTP are required for synthesis of one molecule of glucose via gluconeogenesis?
- A. 4GTP + 2ATP
 - B. 2GTP + 2ATP
 - C. 4GTP +4 ATP
 - D. 2GTP + 4ATP

131. **In the Cori cycle:**
- A. Lactic acid is transported from the liver to muscle by the blood
 - B. Lactic acid is transported from the liver to the kidneys by the blood
 - C. Glycolysis takes place in muscles and gluconeogenesis in the liver
 - D. Glycolysis takes place in liver and gluconeogenesis in the muscles
132. **An enzyme used in both glycolysis and Gluconeogenesis?**
- A. Phosphoglycerate Kinase
 - B. Glucose-6-Phosphatase
 - C. Hexokinase
 - D. Pyruvate kinase
 - E. PFK I
133. **Which of the following about gluconeogenesis is false?**
- A. It can use carbon skeleton of certain amino-acid
 - B. It consists entirely of the reactions of glycolysis operating in the reverse direction
 - C. It employs the enzyme glucose-6- phosphatase
 - D. It requires metabolic Energy ATP or GTP
134. **The enzyme fructose - 2, 6 - bisphosphatase and phosphofructokinase – 2 are present as a protein dimer, then:**
- A. They are activated together
 - B. They are inhibited together
 - C. The first is activated by phosphorylation and the other is inactivated
 - D. The first is inactivated by phosphorylation and the other is activated
135. **The synthesis of glucose from pyruvate by gluconeogenesis:**
- A. occurs exclusively in the cytosol.
 - B. is inhibited by an elevated level of glucagon.
 - C. requires the participation of biotin.
 - D. involves lactate as an intermediate.
 - E. requires the oxidation/reduction of FAD.
136. **Increased production of lactate in muscle cells:**
- A. Stimulate gluconeogenesis in muscle cells
 - B. Stimulate gluconeogenesis in liver cells
 - C. Stimulate glycolysis in muscle cells
 - D. Stimulate glycolysis in liver cells

137. Which of the following pathways occurs partly in the endoplasmic reticulum?
- Glycolysis
 - Gluconeogenesis
 - The pentose phosphate pathway
 - The citric acid cycle
138. Which of the following statements is CORRECT?
- Increased concentration of fructose - 2, 6 - bisphosphate stimulate glycolysis
 - Increased concentration of fructose - 2, 6 - bisphosphate stimulate gluconeogenesis
 - Increased activity of fructose - 2, 6 - bisphosphatase stimulate glycolysis
 - Increased activity of fructose - 2, 6 - bisphosphatase inhibit gluconeogenesis
139. Given that acetyl CoA cannot be a substrate for gluconeogenesis, why is its production in fatty acid oxidation essential for gluconeogenesis?
- provide the FADH₂ required for gluconeogenesis
 - provide ATP required for gluconeogenesis
 - it inhibits pyruvate dehydrogenase and activate pyruvate carboxylase
 - B+ C
 - none of the above since fatty acid oxidation has nothing to do in gluconeogenesis
140. What effect does AMP have on gluconeogenesis and glycolysis?
- AMP activate PFK II consequently Glycolysis
 - AMP activate Fructose bisphosphatase II consequently Gluconeogenesis
 - AMP activate PFK I consequently Glycolysis
 - AMP activate Fructose 1,6 Bisphosphatase I consequently Gluconeogenesis
141. Which of the following statements concerning fructose - 2, 6 - bisphosphate is NOT CORRECT
- It inhibits phosphofructokinase I
 - It inhibits fructose - 1, 6 - bisphosphatase
 - It's a keto sugar
 - Its increased level activate glycolysis
142. Which one of the following statements concerning gluconeogenesis is correct?
- It occurs in muscle.
 - It is stimulated by fructose 2,6-bisphosphate.
 - It is inhibited by elevated levels of acetyl CoA.
 - It is important in maintaining blood glucose during the normal overnight fast.
 - It uses carbon skeletons provided by degradation of fatty acids.

143. All of the following Enzymes important to convert lactate back to Glucose Except?
- A. 3-phosphoglycerate kinase
 - B. Aldolase
 - C. Enolase
 - D. PFK1
144. one of the following can't be used as a substrate for gluconeogenesis
- A. Glycerol
 - B. alanine
 - C. lactic acid
 - D. Acetyl - CoA
145. the conversion of pyruvate to PEP requires:
- A. lactate dehydrogenase
 - B. PFK1
 - C. pyruvate kinase
 - D. Glucose - 6 - phosphate dehydrogenase
 - E. None of the above.
146. Which of the following enzyme(s) bypass Pyruvate kinase reaction during gluconeogenesis?
- A. pyruvate decarboxylase
 - B. pyruvate carboxylase
 - C. phosphoenolpyruvate carboxykinase
 - D. b + c
 - E. none of the above since pyruvate kinase catalyze a reversible step
147. which one of the following statements concerning gluconeogenesis is correct?
- A. Its an energy-producing (exergonic) process
 - B. Its important in maintaining blood glucose during a 2-day fast
 - C. Its inhibited by a fall in the insulin/glucagon ratio
 - D. It occurs in the cytosol of the muscle cells
 - E. It uses carbon skeleton provided by fatty acid degradation

148. Which reaction in the diagram below would be inhibited in the presence of large amount of avidin (an egg white protein that bind and sequeceter Biotin and prevent its absorption in the intestine)



149. Which of the following reactions is unique to gluconeogenesis?
- 1,3-Bisphosphoglycerate \rightarrow 3-phosphoglycerate
 - Lactate \rightarrow pyruvate
 - Oxaloacetate \rightarrow phosphoenolpyruvate
 - Phosphoenolpyruvate \rightarrow pyruvate

Lecture 5 final Questions

150. Which of the following when found in less than normal amount results in glycogen storage disease V?
- Hexokinase
 - Glucose - 6 - phosphatase
 - Myophosphorylase
 - Lactate dehydrogenase
151. a substrate for glycogen synthase is:
- Glucose - 6 - phosphate
 - glucose - 1 - phosphate
 - UDP - glucose
 - free glucose
 - none of the above
152. Both glucagon and epinephrine stimulate _____ and inhibit _____ -
- glycogen synthesis / breakdown
 - glycogen breakdown / synthesis
 - glycolysis / gluconeogenesis
 - cAMP breakdown / cAMP formation
 - Glucose uptake / release
153. When glycogen synthase is phosphorylated:
- Its activity declined
 - Its activity increased
 - Its activity unaffected
 - That enzyme does not get phosphorylated
154. Which enzyme activates glycogen phosphorylase?
- Protein Kinase A
 - Debranching enzyme
 - Phosphorylase kinase
 - Phosphoprotein phosphatase

155. A 2-year-old boy was brought into the emergency room, suffering from severe fasting hypoglycemia. On physical examination, he was found to have hepatomegaly. Laboratory tests indicated that he also had hyperlactic acidemia and hyperuricemia. A liver biopsy (خزعة, عينة) indicated that hepatocytes contained greater than normal amounts of glycogen that was of normal structure. Enzyme assay likely confirmed a deficiency in which of the following enzymes?
- Glycogen synthase
 - Glycogen phosphorylase
 - Glucose 6-phosphatase
 - Amylo- $\alpha(1\rightarrow6)$ -glucosidase
 - 4 – 6 Transferase
156. The hormones, epinephrine and glucagon have which one of the following effects on glycogen metabolism in the liver?
- The net synthesis of glycogen is increased.
 - Glycogen phosphorylase is phosphorylated and active, whereas glycogen synthase is phosphorylated and inactive.
 - Both glycogen phosphorylase and glycogen synthase are activated by phosphorylation but at significantly different rates.
 - Glycogen phosphorylase is inactivated by a rise in Ca^{2+} , whereas glycogen synthase is activated.
 - cAMP-dependent protein kinase A is activated, whereas phosphorylase kinase is inactivated.
157. In an individual at rest, who has fasted for 12 hrs which of the following occurs?
- Gluconeogenesis is the major process that maintain blood glucose level
 - Liver glycogen store is depleted
 - Glycogen synthase in liver is activated
 - Adenylate cyclase is inhibited in liver
158. Which of the following enzymes release free glucose residues from glycogen chains?
- glycogen phosphorylase
 - Protein Kinase A
 - Debranching enzyme
 - Phosphorylase kinase
 - Phosphoprotein phosphatase
159. Insulin promotes glycogen synthesis in the liver by
- inhibiting glycogen synthase
 - binding to phosphorylase
 - causing the dephosphorylation of both phosphorylase and glycogen synthase
 - activating Glycogen phosphorylase
 - facilitating the entry of glucose to the cell

160. **High ratio of insulin to glucagon can:**
- A. Promote gluconeogenesis
 - B. Promote glycolysis
 - C. Occurs during fasting
 - D. Decrease fructose 2, 6 Bisphosphate level
161. **30 years old male present with severe muscle cramp with normal lactate level, he mostly has deficiency of:**
- A. Glucose 6- phosphatase
 - B. Myophosphorylase
 - C. Liver glycogen phosphorylase
 - D. Glucose 6-P translocase
162. **15 – years old type 1 diabetic faint after injecting himself with insulin, he is administered Glucagon and rapidly recover consciousness, Glucagon induce the activity of?**
- A. Glycogen synthase
 - B. Glycogen phosphorylase
 - C. Glucokinase
 - D. Hexokinase
 - E. UDP-glucose Pyrophosphorylase
163. **Branching in glycogen is important for:**
- A. increasing solubility
 - B. increasing synthesis rate
 - C. increasing degradation rate
 - D. All of the above
 - E. none of the above
164. **Which enzyme forms α (1 - 6) linkages?**
- A. glycogen phosphorylase
 - B. Protein Kinase A
 - C. Glycogen branching enzyme
 - D. Phosphorylase kinase
 - E. Phosphoprotein phosphatase
165. **During well - feed state, all is true except?**
- A. Glycogen synthase is activated
 - B. Insulin production stimulates glycogen 4-4 transferase
 - C. Glycogenolysis is inhibited
 - D. glycogenin initiates glucose attachment (self glycosylation)
 - E. nothing is false

166. Which of the following about glycogen synthase is true?
- A. the phosphorylated form is less active
 - B. inhibited by glucagon
 - C. activated by high insulin / glucagon ratio
 - D. activated by high level of Glucose-6-P
 - E. all of the above
167. which of the following intermediates is common in both glycogen synthesis and break down?
- A. Glucose - 1 - phosphate
 - B. Fructose 6 - phosphate
 - C. UDP - glucose
 - D. Glycogenin
168. Infant present with enlarged heart and muscle weakness his fasting blood glucose was normal which of following is most likely to be the enzyme deficiency?
- A. Liver glycogen phosphorylase
 - B. Muscle glycogen synthase
 - C. POMP disease
 - D. Muscle glycogen phosphoglase
169. Which of the following statements regarding formation of glucose - 1 - phosphate from glycogen is NOT CORRECT?
- A. It triggered by low blood glucose
 - B. It requires ATP hydrolysis
 - C. It is catalyzed by glycogen phosphorylase enzyme
 - D. It involves the cleavage of an alpha (1- 4) bond
170. The enzyme glycogen phosphorylase catalyzes a reaction in:
- A. the formation of glycogen from glucose
 - B. Glycogen breakdown
 - C. Gluconeogenesis
 - D. The pentose phosphate pathway
171. Muscles can't break down glycogen to maintain normal blood sugar because it?
- A. Lacks Glucose - 6 - phosphatase
 - B. Lacks phsphoglucose mutase
 - C. Lack glucagon receptors
 - D. Lack Glucokinase

172. In contracting skeletal muscle, a sudden elevation of the cytosolic Ca^{2+} concentration will result in:
- A. activation of cAMP-dependent protein kinase A.
 - B. dissociation of cAMP-dependent protein kinase A into catalytic and regulatory subunits.
 - C. inactivation of phosphorylase kinase caused by the action of protein phosphatase-1.
 - D. direct activation of glycogen phosphorylase kinase b.
 - E. conversion of cAMP to AMP by phosphodiesterase.
173. Explain why the hypoglycemia seen with Type Ia glycogen storage disease (glucose 6-phosphatase deficiency) is severe? Whereas that seen with Type VI (liver phosphorylase deficiency) is mild.
- A. Type Ia gluconeogenesis also affected since Glucose 6 phosphate required to release glucose from liver cell.
 - B. Type VI muscles restore the normal glucose level in blood
 - C. Type VI glycogen cannot be degraded but liver retain its ability to restore glucose via gluconeogenesis
 - D. A+C
 - E. all
174. The activity of muscle glycogen synthase is increased by the action of the following?
- A. Epinephrine
 - B. Glucagon
 - C. Insulin
 - D. Phosphorylation
 - E. Fasting and starvation
175. Which of the following generate free glucose during the enzymatic breakdown of glycogen in muscles?
- A. Phosphorylase
 - B. 4-4 transferase
 - C. α 1-6 glucosidase
 - D. glucose -6-phosphatse
176. Glycogen synthase add glucose to the non-reducing end of primer from?
- A. Glucose 1-p
 - B. Glucose 6-p
 - C. UDP – glucose
 - D. ADP –glucose
 - E. UTP

177. The degradation of glycogen normally produce?
- A. More glucose than glucose 1-P
 - B. More glucose 1-P than glucose
 - C. Equal amount of glucose and glucose 1-P
 - D. Glucose 1-P only
 - E. Neither glucose nor glucose 1-P
178. the rate limiting step in the glycogen synthesis pathway:
- A. Glucose - 6 - phosphate first interact with UTP to give UDP - glucose
 - B. Glucose first interact with UTP to give UDP – glucose
 - C. Glucose - 1 - phosphate first interact with UTP to give UDP - glucose
 - D. Glucose first interact with UDP to give UDP – glucose
179. Patient with glycogen storage disease characterized by muscle weakness and normal blood lactate has deficiency in:
- A. muscle Glycogen phosphorylase
 - B. liver Glycogen phosphorylase
 - C. lysosomal 1 - 4 glucosidase
 - D. glucose 6 – phosphatase

Question	Answer	Question	Answer	Question	Answer	Question	Answer	Question	Answer
1	A	41	B	81	C	121	C	161	B
2	D	42	C	82	A	122	B	162	B
3	A	43	A	83	E	123	C	163	D
4	A	44	C	84	A	124	C	164	C
5	D	45	B	85	C	125	A	165	B
6	C	46	D	86	E	126	C	166	E
7	A	47	D	87	C	127	D	167	A
8	A	48	A	88	E	128	B	168	C
9	D	49	C	89	B	129	B	169	B
10	C	50	C	90	A	130	D	170	B
11	A	51	B	91	A	131	C	171	A
12	A	52	D	92	D	132	A	172	D
13	B	53	D	93	A	133	B	173	D
14	A	54	C	94	C	134	C	174	C
15	D	55	C	95	D	135	C	175	C
16	D	56	D	96	B	136	B	176	C
17	B	57	D	97	B	137	B	177	B
18	C	58	B	98	C	138	A	178	C
19	C	59	C	99	C	139	D	179	A
20	C	60	E	100	A	140	C		
21	B	61	C	101	B	141	A		
22	E	62	A	102	D	142	D		
23	C	63	B	103	B	143	D		
24	B	64	D	104	C	144	D		
25	C	65	B	105	C	145	E		
26	A	66	A	106	D	146	D		
27	A	67	D	107	D	147	B		
28	A	68	E	108	B	148	C		
29	A	69	C	109	D	149	C		
30	A	70	B	110	A	150	C		
31	A	71	E	111	C	151	C		
32	D	72	D	112	C	152	B		
33	D	73	E	113	D	153	A		
34	B	74	D	114	B	154	C		
35	D	75	C	115	C	155	C		
36	C	76	B	116	B	156	B		
37	C	77	B	117	B	157	B		
38	C	78	D	118	D	158	C		
39	B	79	A	119	B	159	C		
40	D	80	B	120	A	160	B		