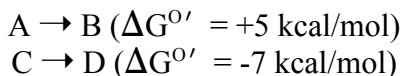


- Why is the function of lactate dehydrogenase important for the continuing function of glycolysis under anaerobic conditions?
 - conversion of pyruvate to lactate produces ATP
 - conversion of pyruvate to lactate produces reducing equivalents needed for glycolysis
 - conversion of lactate to pyruvate is necessary to prevent lactic acidosis
 - pyruvate reduction to lactate converts NADH to NAD^+ , needed for glyceraldehyde-3-P dehydrogenase
- Fructose and lactose are common dietary sugars whose structures and metabolism have all the following features **EXCEPT**:
 - both are initially phosphorylated by hexokinase as the first major step in their metabolism
 - for both there are disease states that can arise due to defects in the enzymes involved in their metabolism.
 - each sugar is processed by a distinct set of enzymes but eventually produces pyruvate through glycolysis
 - both sugars are hexoses
- Which of the following statements about glycolysis is **not** correct? Glycolysis:
 - is the enzyme-catalyzed pathway that converts glucose to pyruvate or lactate.
 - occurs mainly in the mitochondria.
 - occurs in all cells.
 - produces 2ATP/glucose under anaerobic conditions.
 - is necessary for energy production in the brain and red blood cells.
- A patient appears healthy, but exhibits greater than normal fluctuations in blood sugar levels, both high and low, even though his insulin/glucagon levels appear normal. Which of the following enzymes has a special role in controlling blood sugar levels and, thus, could account for the problem, if it were defective.
 - hexokinase
 - glucose-6-P dehydrogenase
 - citrate synthase
 - α -ketoglutarate dehydrogenase
 - glucokinase
- The reaction catalyzed by pyruvate kinase has a high negative $\Delta G^{O'}$ of -7.5 kcal/mol. Its $\Delta G'$ is less negative, -4 kcal/mol. What situation in the cell can best account for this less negative $\Delta G'$? (Hint: Write down the rxn catalyzed before answering).
 - The reactant concentrations are much higher than the product concentrations.
 - The enzyme is a very good catalyst.
 - The level of ATP in the cell is much higher than the level of ADP.
 - Pyruvate is rapidly removed, keeping the product concentration low.
 - All of the above could contribute to this observation.

6. Which of the following enzymes is involved in making or further processing of pyruvate and is allosterically inhibited by high AMP or ADP levels (signalling low cellular energy)?
- pyruvate carboxylase
 - alanine aminotransferase
 - lactate dehydrogenase
 - pyruvate dehydrogenase
 - pyruvate kinase

7. Two reactions are coupled (catalyzed by the same enzyme)



A correct description of the overall reaction is:

- will only occur when A and C are at high levels compared to B and D.
 - will always have a negative $\Delta G'$
 - will proceed in the forward direction as written, regardless of the concentrations of the reactants and products.
 - should result in net formation of B and D if catalyzed under standard conditions (equal concentration of substrate and product).
 - would be predicted to be fast.
8. A patient is suffering from thiamine deficiency. Which of the following symptoms would you **NOT** expect to see?
- high levels of alanine in the blood
 - high levels of pyruvate in the blood
 - lactic acidosis
 - mental disturbance
 - low blood sugar
9. The pyruvate dehydrogenase reaction is central to metabolism of carbohydrates, and therefore highly regulated. The following compounds, enzymes, and hormones all influence the reaction directly or indirectly in a positive (+) or negative (-) way as indicated, **EXCEPT**:
- pyruvate \oplus
 - CoASH \oplus
 - acetyl CoA \ominus
 - insulin \oplus
 - NADH \oplus

10. Synthetic processes that utilize intermediates from the TCA Cycle are correctly matched with the intermediate involved **EXCEPT**:
- A. malate : glucose synthesis
 - B. α -ketoglutarate: cholesterol synthesis
 - C. succinyl CoA : heme synthesis
 - D. citrate : fatty acid synthesis
11. A gas-well worker is suddenly overcome when investigating a leak. He has been exposed to a high concentration of hydrogen sulfide gas. He lost consciousness and suffered cardiopulmonary arrest (his heart stopped). The sudden loss of heart and mental function was due to:
- A. inhibition of cytochrome oxidase (Complex IV)
 - B. inhibition of Complex III, cytochrome bc_1
 - C. uncoupling of his mitochondrial electron transport chain.
 - D. direct inhibition of ATP synthase.
 - E. inhibition of pyruvate dehydrogenase.
12. The reactions of the TCA Cycle are important in energy production because:
- A. they supply intermediates for synthetic reactions.
 - B. TCA Cycle function is always required to allow glycolysis to keep going.
 - C. CO_2 is a high energy product.
 - D. they produce more ATP directly, by substrate level phosphorylation, than glycolysis (per glucose metabolised).
 - E. they produce reducing equivalents that can be further processed to yield considerable energy.
13. ADP, signalling low energy levels, is an effector of one of the reactions of the TCA cycle listed, in the direction indicated:
- A. citrate synthase \ominus
 - B. malate DH \oplus
 - C. α -ketoglutarate DH \ominus
 - D. isocitrate DH \oplus
 - E. succinyl CoA synthase \ominus

14. A mountain climber lost his food supplies in a fall and has been trying to reach base camp for over 24 hours without food. At this time, he is still functional and still able to maintain blood sugar because of:
- A. gluconeogenesis in the brain
 - B. glycogen breakdown in muscle
 - C. mobilization of lipid and amino acids to support gluconeogenesis in the liver
 - D. gluconeogenesis in the muscle to support muscle and brain function
 - E. all of the above
15. Gluconeogenesis and glycolysis are “reciprocally” regulated at several steps. Which of the following pairs of enzymes exhibit this behavior and are correctly listed with one of the allosteric effectors that oppositely affect their activities?
- A. glucose-6-phosphatase/hexokinase/ATP
 - B. pyruvate kinase/pyruvate carboxylase/citrate
 - C. phosphofructokinase/fructose 1,6 biphosphatase/fructose 2,6 biphosphate
 - D. pyruvate kinase/pyruvate carboxylase/phosphate
 - E. glucose-6-phosphatase/hexokinase/citrate
16. A worker in a factory producing TNT is exposed to an intermediate in the process, 2,4 dinitrophenol (DNP); symptoms of high fever, weakness, and loss of weight are observed. This is due to the fact that:
- A. DNP directly inhibits the electron transfer chain.
 - B. DNP ‘uncouples’ electron transfer from ATP synthesis by causing proton leakage across the mitochondrial membranes.
 - C. DNP directly inhibits ATP synthase.
 - D. DNP stimulates rapid electron transfer, resulting in the production of heat but not ATP.
 - E. B and D are correct.
17. The compound, ubiquinone, or Coenzyme Q, has been fed to aging rats by a researcher at the University of Michigan, and was found to increase their exercise performance. From what you know of its function, which would be the most likely explanation of this effect?
- A. increased rates of glycolysis
 - B. increased activity of pyruvate DH
 - C. increased mobilization of fat to supply energy
 - D. increased efficiency of electron and proton transfer by the electron transfer chain, leading to more ATP production
 - E. increased activity of glycogen synthase leading to more stored glycogen.

18. In which of the following situations would the pentose phosphate pathway be **LEAST** likely to need transketolase/transaldolase reactions?
- A. in growing dividing cells
 - B. in adipose cells, synthesizing fat but not dividing
 - C. in red blood cells exposed to reactive oxygen species
 - D. in the brain cells, synthesizing neurotransmitters
19. A patient is admitted in a state of collapse with very low blood sugar levels. A shot of epinephrine is administered. Which of the events described would **NOT** be promoted in the liver:
- A. activation of protein kinase
 - B. phosphorylation of glycogen phosphorylase
 - C. dephosphorylation of glycogen synthase
 - D. inactivation of glycogen synthase
 - E. increased cAMP production
20. During starvation (24 hours without food) fatty acid mobilization and oxidation will be activated. This process has the following features **EXCEPT**:
- A. under these conditions, high insulin levels promote fatty acid oxidation
 - B. the oxidation reactions, yielding reducing equivalents, occur inside mitochondria.
 - C. fatty acids are released from membranes by phospholipases
 - D. fatty acids are mobilized from adipose tissue by hormone sensitive lipase
 - E. activation of fatty acids in the cell involves making fatty acyl CoA
21. Fat, or triglyceride, is the most important storage form of energy because:
- A. it is water-soluble and readily transported as free fatty acids in the blood
 - B. it can be synthesized in the mitochondria when energy levels are high
 - C. it is more rapidly mobilized than glycogen
 - D. it contains more energy (in reducing equivalents) per unit weight than glycogen
22. Glycogen:
- A. is synthesized in a process requiring UDP-glucose as an intermediate.
 - B. is stored only in the liver, not in muscle.
 - C. contains mainly α -1,6 linked glucose units.
 - D. is the major storage form of energy in the body.
 - E. during a normal 24 hour period, is maintained at a constant level in the liver.

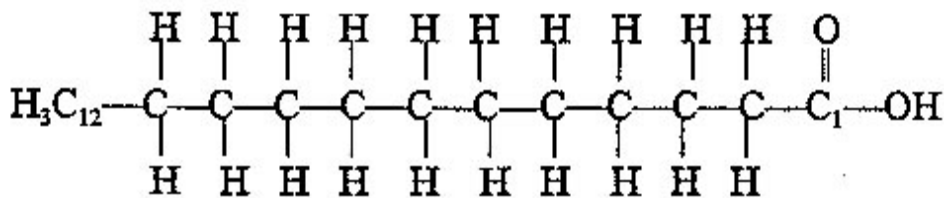
23. Breakdown of glycogen:
- produces glucose-1-P as the initial product of the phosphorolysis reaction.
 - does not occur in muscle.
 - is catalyzed by reversal of the glycogen synthase reaction.
 - is hormonally controlled, being stimulated by insulin.
 - is regulated in the liver cell by ATP and glucose-6-P as positive effectors.
24. Carnitine deficiency can produce disease states that may be mild (e.g., muscle cramping) or severe (e.g., weakness or death). The cause of the problem is that lack of carnitine directly inhibits:
- transport of fatty acids into the cell
 - fatty acid oxidation reactions inside the mitochondria
 - fatty acid transport into mitochondria
 - fatty acyl CoA synthetase
 - β -ketothiolase

Using the reaction scheme below, in which each arrow represents a reaction sequence, answer Questions 25 and 26.



25. Which reaction sequence indicated by an arrow occurs in liver mitochondria (but not muscle) when gluconeogenesis is strongly stimulated (e.g., starvation)?
26. Which reaction sequence involves citrate as an intermediate, assuming the acetylCoA is inside mitochondria?

27. If the 12-carbon fatty acid shown was synthesized by Fatty Acid Synthase, which of the following statements would **CORRECTLY** describe it (carbons 1 and 12 are indicated)?



- A. carbons 1 and 2 were the first added (from the acetyl primer)
 B. carbons 11 and 12 are derived from malonyl CoA
 C. carbons 3 and 4 were added before 1 and 2
 D. this is an unsaturated fatty acid
 E. carbon 1 is the omega (ω) carbon
28. The pathways for synthesis of triglyceride (fat) and many phospholipids have some reactions and intermediates in common. The pathways become separate after:
- A. formation of CDP-diacylglycerol
 B. formation of diacylglycerol-P (phosphatidate)
 C. glycerol-3-phosphate formation
 D. addition of one fatty acid by acyl transferase
29. To synthesize cholesterol, 3 acetyl CoA molecules are used to make a 5-carbon isoprene unit. Which of the following enzymes, substrates, or intermediates is **NOT** involved in this process?
- A. mevalonate
 B. 3 ATP/isoprene unit
 C. β -ketothiolase
 D. HMG-CoA reductase
 E. HMG-CoA lyase
30. Cholesterol controls its own level in cells by:
- A. inhibiting synthesis of receptors that would allow cholesterol uptake from the blood
 B. promoting synthesis of HMG CoA reductase
 C. acting as a direct positive effector of HMG-CoA reductase
 D. inhibiting HMG CoA reductase breakdown

ANSWER GRID

Version of the Exam: 3C

1.		6.		11.		16.		21.		26.	
2.		7.		12.		17.		22.		27.	
3.		8.		13.		18.		23.		28.	
4.		9.		14.		19.		24.		29.	
5.		10.		15.		20.		25.		30.	

BCH 514
Exam II
October 11, 2000

ANSWER KEY

Version of the Exam: 3C

1.	D	6.	A	11.	A	16.	E	21.	D	26.	C
2.	A	7.	D	12.	E	17.	D	22.	A	27.	C
3.	B	8.	E	13.	D	18.	A	23.	A	28.	B
4.	E	9.	E	14.	C	19.	C	24.	C	29.	E
5.	C	10.	B	15.	C	20.	A	25.	D	30.	A