Chapter 3 – Study Guide Answers

Name four reasons physical educators, coaches, and exercise scientists should have a basic understanding of energy metabolism.

1. ATP is the source of energy for muscle contraction
2. Producing enough ATP is essential to performance
3. Adaptations to exercise training involve energy metabolism
4. The metabolic demands of training are important in designing training or exercise prescriptions

What are anaerobic and aerobic metabolism?
- Aerobic metabolism is the production of ATP with oxygen.
- Anaerobic metabolism is the production of ATP without oxygen.

What is the respiratory chain?
The Krebs cycle and the electron transport system (ETS), where ATP is produced and oxygen is utilized.

What are the three characteristics of enzymes?
1. An enzyme speeds up or catalyzes a reaction.
2. An enzyme is not changed by the reaction it causes.
3. An enzyme does not change the result of the reaction.

What does it mean when we say that enzymes work by the lock-and-key method?
The enzymes are specific to the reactant to which they bind. The enzyme must fit precisely with the reactant to catalyze the reaction.

1. Temperature and pH of the cellular environment
2. Concentration and activity of reactants and enzymes
3. Allosteric inhibition
4. Availability and concentrations of cofactors and coenzymes

What are the three primary enzymatic reactions that occur in the ATP-PC system?

1. ________ + ________ / ________ + ________ + ________ + ________
2. ________ + ________ + ________ / ________ + ________ + ________
3. ________ + ________ / ________ + ________ + ________
1. ATP + Myosin / ATPase + ADP + inorganic phosphate(PI) + energy
2. PC + ADP + Creatine / Kinase (CK) + ATP + C
3. 2ADP + Adenylate / Kinase (AK) + ATP + AMP

What is anaerobic glycolysis?
- The primary system for ATP production for activities that last from approximately 20–30 seconds to two to three minutes
- The breakdown of glucose to lactate without the use of oxygen

Name the rate-limiting enzyme in glycolysis.
Phosphofructokinase (PFK)

What is its significance in metabolism?
It is the weak link—the rate of conversion of the reactant to product through enzymatic steps can proceed no faster than the rate-limiting enzyme will allow.

What is the electron transport system?
The system where most of the ATP is produced during aerobic metabolism.

What is the final electron acceptor at the end of the ETS?
Oxygen

What is the net chemical reaction of the aerobic metabolism of glucose?
\[ C6H12O6 + 6O2 + 38ADP + 38P \rightarrow 6CO2 + 6H2O + 38ATP \]

Compare the power and capacity of the various energy production systems.
The ATP-PC system
Carbohydrate oxidation
Fatty acid metabolism

- The ATP-PC system has low capacity because there is a limited store of phosphagens available.
- Carbohydrate oxidation is limited by glycogen depletion.
- Fatty acid metabolism has the greatest capacity because, under normal conditions, each person has an inexhaustible supply of energy-rich fats.

What are four main metabolic adaptations that result from endurance training?
1. Increases myoglobin in skeletal muscle, which increases the amount of oxygen available to the mitochondria as the final electron acceptor at the end of ETS.
2. Increases number and size of mitochondria within skeletal muscle, and increases levels of enzymes within the mitochondria and the beta oxidation of long-chain fatty acids.
3. Increases alanine transaminase, so that a greater proportion of pyruvate is converted to alanine than to lactate.
4. An increase in the use of fatty acids compared to carbohydrates for ATP production.

What are the effects of sprint training on anaerobic metabolism?
- Increases the enzymes phosphorylase, HK, PFK, pyruvate kinase, and LDH, which can improve performance by increasing the rate of ATP production.
- Increases phosphocreatine stores within the muscle, which allows high-intensity exercise to be maintained for a longer period of time before fatigue.
What are the metabolic effects of resistance training?

- Increases myosin ATPase and CK as well as the glycolytic enzymes phosphorylase, HK, PFK, and LDH
- Increases ATP and phosphocreatine stores within the muscle
- In general, can improve ATP availability and lead to greater muscle strength and an enhanced ability to perform repeated muscle contractions