Name: _____ **Date:** _____

Answer Key: Metabolic Gauntlet: A 10th Grade Exercise Physiology Challenge

Sophomores will synthesize data on bioenergetic pathways and homeostatic disruptions to evaluate athletic performance and cellular adaptation strategies.

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1. A marathon runner hitting 'the wall' at mile 20 is likely experiencing a metabolic shift due to the depletion of which specific substrate?

Answer: B) Liver and muscle glycogen

At high intensities sustained over long durations, the depletion of limited glycogen stores forces the body to rely more heavily on fat oxidation, which is a slower process, resulting in a dramatic performance drop.

2. Concentric cardiac hypertrophy, characterized by thickened ventricular walls, is a common chronic adaptation specifically associated with long-term aerobic endurance training.

Answer: B) False

False. Aerobic training typically leads to eccentric hypertrophy (increased chamber volume), whereas concentric hypertrophy (wall thickening) is more common in response to the high pressure loads of heavy resistance training.

3. During the transition from rest to steady-state exercise, the temporary lag in oxygen uptake is known as _____.

Answer: C) Oxygen deficit

Oxygen deficit occurs because the aerobic system takes time to 'ramp up,' forcing anaerobic pathways to provide the initial energy required at the start of exercise.

4. An elite track cyclist performs a 30-second all-out sprint. Which enzyme is most likely the rate-limiting factor for their primary energy system during this bout?

Answer: B) Phosphofructokinase (PFK)

For a 30-second max effort, the fast glycolytic system is dominant; PFK is the key rate-limiting enzyme that controls the speed of glycolysis.

5. The Frank-Starling Law of the Heart explains that increased venous return leads to a more forceful ventricular contraction by stretching the myocardium.

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Answer: A) True

True. This intrinsic mechanism ensures that the heart can match its output to the amount of blood returning to it (preload) during physical exertion.

6. Type IIx muscle fibers are characterized by high _____ capacity but low fatigue resistance.

Answer: B) Glycolytic

Type IIx (fast-twitch) fibers rely on anaerobic glycolysis for rapid ATP production, making them powerful but quickly exhausted.

7. If an athlete is training at high altitude, their body compensates for lower partial pressure of oxygen by increasing the production of:

Answer: C) Erythropoietin (EPO)

EPO stimulates the production of red blood cells, increasing the blood's oxygen-carrying capacity to offset the hypoxic environment.

8. During incremental exercise, the point where blood lactate begins to accumulate exponentially is identical for both trained and sedentary individuals.

Answer: B) False

False. Trained athletes typically have a higher lactate threshold, meaning they can perform at higher intensities before lactate begins to accumulate in the blood.

9. The respiratory exchange ratio (RER) of 1.0 indicates that the body is primarily metabolizing _____ for fuel.

Answer: C) Carbohydrates

An RER of 1.0 means the volume of CO_2 produced equals the O_2 consumed, which is the chemical signature of pure carbohydrate oxidation.

10. Which of the following best describes the 'Size Principle' of motor unit recruitment during a progressively heavy lift?

Answer: C) Small, slow-twitch units are recruited before large, fast-twitch units

The nervous system recruits smaller, low-threshold motor units first, adding larger, high-threshold units only as the demand for force increases.

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