

# Biomechanics Practice Exam (Sample)

## Study Guide



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**SAMPLE**

## **Questions**

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- 1. Which muscle contributes to trunk rotation in the same direction?**
  - A. Right external abdominal oblique**
  - B. Left internal abdominal oblique**
  - C. Left external abdominal oblique**
  - D. Right internal abdominal oblique**
- 2. How do bones typically respond to decreased regular loading due to inactivity?**
  - A. Decreased length**
  - B. Hypertrophy**
  - C. Increased length**
  - D. Atrophy**
- 3. What should be the goal of a rehabilitation program following a muscle strain?**
  - A. Strengthening the muscle**
  - B. Increasing joint flexibility**
  - C. Improving cardiovascular fitness**
  - D. Enhancing proprioception**
- 4. What is the significance of cadaver studies in biomechanics?**
  - A. To assess living muscle strength**
  - B. To explore psychological impacts on performance**
  - C. To understand anatomical structures and their mechanical properties**
  - D. To test physical endurance**
- 5. What are the main forces typically acting on the spine during lifting?**
  - A. Friction, tension, and compression**
  - B. Compressive, tensile, and shear forces**
  - C. Rotational, gravitational, and kinetic forces**
  - D. Lateral, vertical, and horizontal forces**

- 6. Define the term "force" in the context of biomechanics.**
- A. A chemical reaction that changes an object's state**
  - B. An influence that causes a change in speed or direction**
  - C. A biological process that repairs tissue**
  - D. A type of muscular contraction**
- 7. What anatomical structure helps manage torsional loading in the spinal system?**
- A. Intervertebral discs**
  - B. Facet joints**
  - C. Annulus fibrosus**
  - D. Ligaments**
- 8. Is translation synonymous with general motion?**
- A. True**
  - B. False**
  - C. Only in specific cases**
  - D. Yes, always**
- 9. What type of joint is the glenohumeral joint?**
- A. Hinge joint**
  - B. Ball-and-socket joint**
  - C. Pivot joint**
  - D. Fibrous joint**
- 10. What does the term "kinetics" primarily focus on in biomechanics?**
- A. The effects of forces on the state of motion**
  - B. The speed and direction of moving objects**
  - C. The appearance of motion without forces**
  - D. The shape and size of the body in motion**

## **Answers**

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- 1. B**
- 2. D**
- 3. A**
- 4. C**
- 5. B**
- 6. B**
- 7. C**
- 8. B**
- 9. B**
- 10. A**

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## **Explanations**

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**1. Which muscle contributes to trunk rotation in the same direction?**

- A. Right external abdominal oblique**
- B. Left internal abdominal oblique**
- C. Left external abdominal oblique**
- D. Right internal abdominal oblique**

The muscle that contributes to trunk rotation in the same direction is the left internal abdominal oblique. The internal abdominal oblique muscle plays a crucial role in trunk rotation by contracting to rotate the trunk towards the same side as the muscle. When the left internal oblique contracts, it causes the torso to rotate counterclockwise, effectively moving the trunk to the left side. This action is essential in many functional movements, such as twisting during athletic activities, and is vital for maintaining stability and coordination during dynamic movements. The internal obliques work in concert with other muscles, including the external obliques on the opposite side, to facilitate these rotational movements. In contrast, the right external abdominal oblique would contribute to rotation to the left (opposite side), while the left external abdominal oblique would rotate the torso to the right (again opposite). The right internal abdominal oblique, similarly, would rotate the trunk to the right. Thus, the left internal abdominal oblique is pivotal for executing a leftward trunk rotation efficiently.

**2. How do bones typically respond to decreased regular loading due to inactivity?**

- A. Decreased length**
- B. Hypertrophy**
- C. Increased length**
- D. Atrophy**

Bones respond to decreased regular loading due to inactivity through a process known as atrophy, which refers to the loss of bone mass and density. This occurs because bones are adaptive tissues that require mechanical stress to maintain their strength and structure. When loading is reduced, such as during inactivity or prolonged periods of immobility, the rate of bone resorption (breakdown) exceeds the rate of bone formation. Consequently, the overall density of the bone diminishes, leading to weakness and a higher risk of fractures. Atrophy in bones reflects the body's ability to conserve resources and adapt to changes in physical demands. Inactivity causes a signal that leads to decreased osteoblast activity (which builds bone) and increased osteoclast activity (which resorbs bone), resulting in the thinning and weakening of bone structure. Therefore, the concept of bone atrophy is directly tied to the lack of mechanical loading that stimulates bone maintenance and growth, making it the correct answer in this context.

### **3. What should be the goal of a rehabilitation program following a muscle strain?**

- A. Strengthening the muscle**
- B. Increasing joint flexibility**
- C. Improving cardiovascular fitness**
- D. Enhancing proprioception**

The goal of a rehabilitation program following a muscle strain specifically focuses on strengthening the affected muscle as it is crucial for recovery and preventing future injuries. After a muscle strain, the muscle fibers experience damage, and rebuilding their strength is vital for restoring normal function. Strengthening helps to regain the ability to perform activities without pain or restriction and improves overall stability in the muscles surrounding the injured area, which can reduce the risk of re-injury. While increasing joint flexibility, improving cardiovascular fitness, and enhancing proprioception are important aspects of overall physical health and can play supporting roles in rehabilitation, they are not the primary focus immediately following a muscle strain. Flexibility may be addressed later in the recovery process, cardiovascular fitness is generally maintained through alternative activities that do not stress the injured muscle, and proprioception is improved through specific balance training once strength is sufficiently rebuilt. Thus, strengthening the muscle directly addresses the core issue of recovery from a strain, making it the most appropriate goal for the rehabilitation program.

### **4. What is the significance of cadaver studies in biomechanics?**

- A. To assess living muscle strength**
- B. To explore psychological impacts on performance**
- C. To understand anatomical structures and their mechanical properties**
- D. To test physical endurance**

Cadaver studies play a crucial role in biomechanics primarily because they allow researchers to investigate anatomical structures and their mechanical properties in detail. By examining cadaveric specimens, scientists can observe the arrangement and interaction of muscles, bones, tendons, and ligaments, which is essential for understanding how these structures contribute to movement and load-bearing capacity in living organisms. The dissection and analysis of cadaver tissues enable the assessment of mechanical properties such as stiffness, elasticity, and strength, providing insights into how these factors influence overall biomechanics. This understanding is fundamental for applications such as surgical planning, rehabilitation strategies, the development of prosthetics, and the design of sports equipment, contributing significantly to the field of biomechanics. In contrast, exploring living muscle strength, psychological impacts, or physical endurance would not be feasible through cadaver studies, as these aspects require functional living tissues and overall body systems, hence they do not align with the primary significance of cadaver research in biomechanics.

**5. What are the main forces typically acting on the spine during lifting?**

- A. Friction, tension, and compression**
- B. Compressive, tensile, and shear forces**
- C. Rotational, gravitational, and kinetic forces**
- D. Lateral, vertical, and horizontal forces**

The correct answer highlights the main forces acting on the spine during lifting as compressive, tensile, and shear forces. These forces are crucial to understanding how the spine responds when lifting objects. Compressive forces occur when the weight being lifted creates pressure along the vertebral column, pushing the vertebrae together. This is particularly significant in maintaining spinal alignment and stability during lifting tasks. Tensile forces come into play as muscles and ligaments stretch when lifting, helping to support and stabilize the spine. Proper engagement of these muscular and connective tissues is important for preventing injuries during lifting activities. Shear forces are created when there is a sideways push or pull during movement, which can lead to the vertebrae sliding past one another if not properly managed. Understanding shear forces is essential in biomechanics as these can contribute to injury if the spine is not adequately supported during lifting. Together, these three types of forces provide a comprehensive picture of the mechanical loading the spine endures under the stress of lifting, helping to inform safe lifting techniques and rehabilitation practices.

**6. Define the term "force" in the context of biomechanics.**

- A. A chemical reaction that changes an object's state**
- B. An influence that causes a change in speed or direction**
- C. A biological process that repairs tissue**
- D. A type of muscular contraction**

In the context of biomechanics, "force" refers specifically to an influence that causes a change in the motion of an object. This can include changes in speed, direction, or shape, and it is a key concept in understanding how bodies move and interact with their environment. Forces can originate from various sources, including muscle contractions, external weights, gravity, and friction. Forces can be quantified, measured in newtons, and can produce acceleration according to Newton's second law of motion ( $F=ma$ ), where force equals mass times acceleration. This principle is foundational in biomechanics, as it helps explain how and why an object, such as a human limb, moves in a particular way under various conditions. The other options do not accurately capture the essence of force in this context. A chemical reaction does not directly pertain to mechanical motion; biological processes like tissue repair focus more on cellular functions rather than mechanical forces; and muscular contraction is a source of force but does not define the term on its own. Thus, understanding force as an influence that causes changes in motion is crucial in biomechanics.

**7. What anatomical structure helps manage torsional loading in the spinal system?**

- A. Intervertebral discs**
- B. Facet joints**
- C. Annulus fibrosus**
- D. Ligaments**

The annulus fibrosus plays a critical role in managing torsional loading in the spinal system. This structure is part of the intervertebral disc and consists of concentric layers of fibrocartilage that encase the nucleus pulposus, which is the gel-like center of the disc. When torsional forces are applied to the spine during activities such as twisting or rotating, the annulus fibrosus helps to resist these forces by distributing them evenly across the disc. The layered structure of the annulus fibrosus allows it to function effectively under various loading conditions, providing stability and preventing excessive twisting of the vertebrae. This is crucial for maintaining the integrity of the spine and protecting it from injury during dynamic movements. In contrast, while intervertebral discs as a whole provide cushioning and some degree of torsional support, it is specifically the annulus fibrosus that directly manages the stresses associated with torsion. Facet joints help limit movement and provide stability to the vertebrae, while ligaments contribute to overall spinal stability. However, they do not specifically address torsional loads in the same way that the annulus fibrosus does.

**8. Is translation synonymous with general motion?**

- A. True**
- B. False**
- C. Only in specific cases**
- D. Yes, always**

Translation and general motion are not synonymous terms in biomechanics. Translation specifically refers to linear motion where all parts of a body move the same distance in the same direction at the same time. In contrast, general motion combines both translational motion and rotational motion, meaning an object may both translate and rotate simultaneously. For example, when a person runs (a clear translational component), their limbs also rotate around their joints, contributing to a more complex motion scenario. The distinction is significant in biomechanics, as understanding the nuances of motion helps analyze different types of activities and body movements. Recognizing this difference is crucial for applications like sports performance analysis and injury prevention, where both types of motion can influence outcomes. Therefore, stating that translation is synonymous with general motion is not accurate, which validates that the answer is indeed false.

**9. What type of joint is the glenohumeral joint?**

- A. Hinge joint
- B. Ball-and-socket joint**
- C. Pivot joint
- D. Fibrous joint

The glenohumeral joint, commonly known as the shoulder joint, is classified as a ball-and-socket joint. This type of joint allows for a wide range of motion, including flexion, extension, abduction, adduction, and rotation. The structure of a ball-and-socket joint involves a spherical head of one bone fitting into a concave socket of another bone, which in this case consists of the humeral head and the glenoid cavity of the scapula. The design of the glenohumeral joint enables significant mobility, making it one of the most flexible joints in the human body. This increased range of motion is crucial for various activities that involve the upper extremities, like reaching, throwing, and lifting. However, this flexibility also contributes to a greater susceptibility to dislocation and other injuries in the shoulder region. In contrast, the other joint types presented, such as hinge, pivot, and fibrous joints, have more restricted movements tailored for specific functions, emphasizing the unique characteristics and capabilities of the glenohumeral joint within the biomechanics of the upper body.

**10. What does the term "kinetics" primarily focus on in biomechanics?**

- A. The effects of forces on the state of motion**
- B. The speed and direction of moving objects
- C. The appearance of motion without forces
- D. The shape and size of the body in motion

The term "kinetics" in biomechanics primarily focuses on the effects of forces on the state of motion. This area of study analyzes how various forces such as muscular, gravitational, and frictional forces influence bodies in motion. Kinetics looks into how these forces cause changes in motion, including acceleration and deceleration, and helps in understanding the underlying principles of movement. In this context, understanding the role of forces is crucial for assessing performance in sports, designing rehabilitation protocols, and enhancing movement efficiency. By examining how forces interact with a body in motion, biomechanics professionals can derive insights into injury prevention and performance optimization. Additionally, this focus on forces can lead to better designs for equipment and gear that may aid in athletic performance or assistive technologies.