

Biomechanical Engineering Systems

Mechanical Engineering · Answer Key · 12 Questions

1. In human joint mechanics, what is the specific function of the synovial fluid within a diarthrodial joint?

- A) To facilitate bone growth
- B) To act as a non-Newtonian lubricant**
- C) To provide electrical insulation for nerves
- D) To transport oxygen to cartilage

2. What is the typical Young's modulus range for healthy human cortical bone?

- A) 1-3 GPa
- B) 15-20 GPa**
- C) 100-150 GPa
- D) 500-600 GPa

3. In cardiac mechanics, what is the primary purpose of the 'Frank-Starling mechanism'?

- A) To regulate blood viscosity
- B) To adjust stroke volume based on end-diastolic volume**
- C) To control heart valve resonance
- D) To calibrate aortic pressure sensors

4. What mechanical property of the human Achilles tendon allows it to function as a spring during locomotion?

- A) High hysteresis
- B) High elastic modulus
- C) Viscoelasticity**
- D) Low tensile strength

5. Which mechanical component of the inner ear functions as a frequency analyzer by varying its stiffness along its length?

- A) Semicircular canals
- B) The basilar membrane**
- C) The malleus
- D) The stapes

6. In prosthetic socket design, what phenomenon describes the mechanical interaction where shear forces cause tissue breakdown?

A) Fretting corrosion

B) Interface strain

C) Cavitation

D) Hysteresis loss

7. The human spine functions as a column under axial load; what is the main mechanical purpose of the nucleus pulposus in the intervertebral disc?

A) To act as a hydrostatic shock absorber

B) To provide structural rigidity for rotation

C) To anchor the spinal cord

D) To conduct nerve impulses

8. What is the primary mode of failure in human hip implants made of cobalt-chromium alloys due to repetitive micro-motion?

A) Fatigue cracking

B) Fretting and crevice corrosion

C) Thermal expansion

D) Brittle fracture

9. In blood flow mechanics, what describes the tendency of red blood cells to migrate toward the center of a vessel?

A) The Fåhræus-Lindqvist effect

B) The Bernoulli principle

C) Reynolds number instability

D) The Venturi effect

10. What is the architectural efficiency of trabecular bone defined by?

A) Anisotropy and apparent density

B) Total volume only

C) Hydrostatic pressure

D) Elastic deformation rate

11. During respiration, the mechanical work of breathing is predominantly expended to overcome what?

A) Airway resistance and elastic recoil of the lungs

B) Blood flow turbulence

C) Alveolar surface tension only

D) Diaphragm muscle mass

12. In orthopedic mechanics, what is the 'Wolff's Law' primarily concerned with?

A) Bone remodeling in response to mechanical stress

B) Ligament elasticity

C) Nerve conduction velocity

D) Muscle fiber recruitment