Biomechanical Engineering and Human Physiology

Mechanical Engineering · Answer Key · 15 Questions

1. Which mechanical lever class is most commonly represented by the musculoskeletal system of the human body?

A) First-class lever
B) Second-class lever
C) Third-class lever
D) Fourth-class lever

2. What is the typical Young's modulus range for cortical bone in the longitudinal direction?

A) 1-5 GPa
B) 15-20 GPa
C) 50-60 GPa
D) 100-120 GPa

3. In fluid dynamics as applied to blood flow, what does the Womersley number represent?

A) The ratio of pulsatile inertia forces to viscous forces
B) The ratio of blood density to plasma viscosity
C) The rate of oxygen diffusion through arterial walls
D) The turbulence threshold in venous return

4. What is the primary mechanical function of the meniscus in the human knee joint?

A) Generating synovial fluid
B) Increasing the contact surface area to reduce stress
C) Serving as a rigid pivot point for the femur
D) Converting rotational kinetic energy into heat

5. In the context of bone fracture mechanics, what is the 'stress intensity factor' (K) used to evaluate?

A) Total bone mineral density
B) The resistance of bone to crack propagation
C) The rate of calcium resorption
D) The elastic limit of ligamentous tissue

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6. Which law defines the relationship between the stress on a bone and the bone's subsequent remodeling and structural adaptation?

A) Hooke's Law
B) Wolff's Law
C) Fick's Law
D) Poiseuille's Law

7. What is the typical value of the friction coefficient for a healthy human articular cartilage joint?

A) 0.50 to 0.75
B) 0.20 to 0.40
C) 0.001 to 0.030
D) 0.80 to 1.00

8. Which material property describes the bone's behavior where its strength and stiffness change based on the rate at which a load is applied?

A) Viscoelasticity
B) Isotropy
C) Thixotropy
D) Plasticity

9. In hemodynamics, what does the Reynolds number predict in the context of cardiovascular flow?

A) Blood viscosity changes
B) Onset of turbulent flow
C) Oxygen saturation levels
D) Cardiac output efficiency

10. What is the mechanical definition of 'pre-load' in the context of a cardiac cycle?

A) Pressure in the aorta during systole
B) Tension on the ventricular wall at end-diastole
C) Resistance offered by systemic arterioles
D) The velocity of electrical conduction in the AV node

11. Which engineering material is commonly used in total hip arthroplasty due to its high biocompatibility and resistance to corrosion?

A) Grade 5 Titanium (Ti6Al4V)
B) Low-carbon mild steel
C) Lead-based alloys
D) Raw magnesium

12. In biomechanics, what does the term 'Degrees of Freedom' (DOF) refer to regarding human limb movement?

A) The number of muscles attached to a bone
B) The number of independent parameters required to define a position
C) The amount of force generated during contraction
D) The maximum angle of joint rotation

13. What is the primary mode of failure in the human intervertebral disc during excessive axial loading?

A) Tensile rupture of the annulus fibrosus
B) Buckling of the ligamentum flavum
C) Shear fracture of the vertebral endplate
D) Compression of the spinal cord

14. The 'stress-strain' curve of human tendons primarily displays which characteristic?

A) Perfectly plastic behavior
B) Non-linear elastic behavior
C) Constant modulus of elasticity
D) Brittle fracture mode

15. In fluid-structure interaction, what is 'aneurysm wall tension' calculated by in the Law of Laplace?

A) Pressure multiplied by radius divided by wall thickness
B) Viscosity divided by flow velocity
C) Density multiplied by surface area
D) Radius squared divided by flow rate

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