Mechanical Engineering in Nature

Mechanical Engineering · Practice Test · 12 Questions

1. The drag reduction observed in the skin of the shortfin mako shark, which inspires surface engineering for fluid transport, is primarily attributed to which mechanical feature?

A) Superhydrophobic wax coatings
B) Micro-riblets on dermal denticles
C) Active mucus secretion channels
D) Electrostatic repulsion of boundary layer particles

2. In the study of insect flight, which mechanical phenomenon allows the Manduca sexta moth to maintain stable hovering despite turbulent gust conditions?

A) Passive aeroelasticity of the wing membrane
B) Active cavitation of wing tip vortices
C) Hysteresis in thoracic muscle contraction
D) Variable-stiffness hydraulic actuator control

3. What mechanical property of the dactyl club in the peacock mantis shrimp allows it to withstand high-velocity impacts against gastropod shells without fracturing?

A) A ceramic-metal matrix gradient
B) The Bouligand structure of chitin fibers
C) A self-healing polymer resin
D) Piezoelectric crystalline lattice arrays

4. Which mechanical system explains the extreme energy storage efficiency of the flea's jump, involving the deformation of resilin?

A) Hydraulic fluid displacement
B) Pneumatic pressure release
C) Elastic strain energy storage in a protein spring
D) Centrifugal force amplification

5. The attachment mechanism of the gecko foot, used as a model for synthetic adhesives, relies primarily on which physical principle?

A) Capillary adhesion
B) Van der Waals forces
C) Vacuum suction chambers
D) Chemical covalent bonding

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6. Woodpeckers utilize which mechanical strategy to prevent brain injury during repetitive high-deceleration drilling?

A) Cerebrospinal fluid compressibility
B) Asymmetric beak geometry for kinetic energy dissipation
C) High-frequency vibration dampening via the hyoid apparatus
D) Elastic deformation of the cranial cancellous bone

7. What is the primary mechanical function of the 'bulla' bone in the ear of a baleen whale regarding underwater acoustics?

A) Impedance matching for low-frequency vibration transmission
B) Thermal regulation of auditory nerves
C) Elastic recoil for rapid signal processing
D) Pressure compensation at depth

8. The lotus effect, utilized in surface engineering to create self-cleaning materials, is defined by which mechanical surface characteristic?

A) Surface energy reduction through chemical grafting
B) Micro-scale roughness combined with epicuticular waxes
C) High-frequency electrostatic repulsion
D) Hydrophilic pore-based capillary suction

9. How do the wing surfaces of owls suppress the mechanical noise of aeroacoustic turbulence during flight?

A) Comb-like leading-edge serrations
B) Elastic membrane wing trailing edges
C) Porous wing-surface coating
D) Active boundary layer suction

10. In botanical mechanics, the opening of pine cones in response to humidity is driven by which phenomenon?

A) Osmotic pressure fluctuations
B) Differential swelling of bilayered tissue structures
C) Hydraulic capillary action
D) Thermal expansion coefficients

11. The structural integrity of deep-sea glass sponges is attributed to which engineering geometry of their spicule arrays?

A) Triangular space-frame lattices
B) Hexagonal prism hierarchies
C) Concentric cylindrical reinforcements
D) Icosahedral mineral stacking

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12. The rapid tongue projection in chameleons is governed by which mechanical energy conversion process?

A) Pneumatic inflation of the hyoid bone
B) Elastic recoil of pre-loaded collagen tissues
C) Hydraulic pressure amplification
D) Rapid muscle twitch activation

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