Electrical Engineering in Sub-Saharan Africa: Nature's Influence

Electrical Engineering · Answer Key · 15 Questions

1. The bio-luminescent properties of certain fireflies found in parts of Sub-Saharan Africa rely on a chemical reaction involving luciferin and what enzyme?

A) Amylase
B) Lactase
C) Lipase
D) Luciferase

2. Electric eels, though not native to Sub-Saharan Africa, generate electric fields for navigation and stunning prey. What is the approximate voltage of a strong discharge from a mature electric eel?

A) Up to 50 volts
B) Up to 100 volts
C) Up to 600 volts
D) Up to 1000 volts

3. Some species of termite mounds in Sub-Saharan Africa exhibit remarkable temperature regulation. This is partly achieved through passive ventilation, influenced by the mound's shape and wind currents, demonstrating principles similar to what fundamental electrical engineering concept for heat transfer?

A) Capacitive coupling
B) Inductive reactance
C) Convective heat transfer
D) Resonant frequency

4. The compound eyes of some insects, including certain beetles found in arid regions of Sub-Saharan Africa, have structures that can reduce glare and improve vision. This phenomenon is analogous to the application of which optical coating in electrical engineering for lenses?

A) Anti-reflective coating
B) Polarizing film
C) Diffractive grating
D) Holographic film

5. In the Serengeti, wildebeest migrations are often synchronized with rainfall patterns. This synchronization, influenced by environmental cues, can be conceptually compared to how an electrical system responds to which type of external signal?

A) A DC offset
B) A transient pulse
C) A periodic waveform
D) A static bias

6. The migratory paths of some birds in Sub-Saharan Africa are believed to be influenced by the Earth's magnetic field. This navigation relies on magnetoreception, a biological sensing mechanism that has parallels with sensors used in electrical engineering for detecting what?

A) Light intensity
B) Magnetic fields
C) Sound waves
D) Air pressure

7. Certain types of algae found in African freshwater systems can produce bioelectricity. These organisms use a process similar to photosynthesis to generate small electrical currents, akin to the function of what basic electrical component?

A) A resistor
B) A capacitor
C) A diode
D) A photovoltaic cell

8. The intricate patterns on a zebra's coat in East Africa are thought to serve various functions, including insect repulsion. The contrast and spacing of these stripes might have implications for how light is perceived, similar to how engineers consider pixel density and contrast in display technologies, relating to what fundamental property of light?

A) Refraction
B) Diffraction
C) Polarization
D) Luminance

9. The large ears of the African elephant are adapted for thermoregulation. They radiate heat, helping the animal maintain a stable internal temperature. This process is a natural example of which engineering principle for heat dissipation?

A) Conduction
B) Radiation
C) Insulation
D) Absorption

10. Some fish in African rivers, like the elephantnose fish, use weak electric fields for communication and sensing their environment. These fields are generated by specialized organs that function as biological batteries, converting chemical energy into electrical energy. This process is analogous to the operation of what?

A) An induction coil
B) A transformer
C) A battery
D) A generator

11. The structure of a spider's silk, known for its incredible tensile strength, is a marvel of natural engineering. This strength, achieved at a molecular level, can be conceptually linked to the material science considerations in electrical engineering for designing robust conductors and insulators that can withstand mechanical stress.

A) Dielectric strength
B) Tensile strength
C) Conductivity
D) Thermal resistance

12. The 'humming' sound produced by certain cicadas in Sub-Saharan Africa, used for mating calls, involves rapid vibrations of specialized membranes. The frequency of these vibrations is crucial for species recognition, similar to how engineers use specific frequencies in communication systems, like radio waves, for transmitting information.

A) Amplitude
B) Wavelength
C) Frequency
D) Phase

13. The color vision of many birds in Sub-Saharan Africa is more complex than humans', often including sensitivity to ultraviolet light. This expanded spectrum detection is comparable to how advanced sensors in electrical engineering are designed to capture signals beyond the human visual range, such as in infrared or ultraviolet imaging.

A) Signal-to-noise ratio
B) Bandwidth
C) Spectral sensitivity
D) Resolution

14. The ability of some African dung beetles to orient themselves using the Milky Way for navigation is a remarkable feat of celestial sensing. This celestial navigation is a form of using external reference points, conceptually similar to how GPS receivers in electrical devices use satellite signals for accurate positioning.

A) Inertial navigation
B) Dead reckoning
C) Celestial navigation
D) Triangulation

15. The porous structure of certain types of African soil, which influences water infiltration and retention, can also affect the conductivity of the ground. This variability in ground conductivity is an important consideration in electrical engineering for designing effective grounding systems, ensuring safety and proper operation of electrical equipment.

A) Permittivity
B) Resistivity
C) Inductance
D) Capacitance