Automotive Ergonomics and Human Physiology

Automotive Technology And Human Health · Answer Key · 25 Questions

1. What is the typical physiological threshold for human tolerance to sustained lateral acceleration during high-performance cornering before blood flow to the brain is compromised?

A) 2.0g to 3.0g
B) 4.0g to 5.0g
C) 6.0g to 8.0g
D) 10.0g to 12.0g

2. Which anatomical structure is most susceptible to 'whiplash' injury during a rear-end collision due to the decoupling of head and torso acceleration?

A) Cervical vertebrae C4-C6
B) Thoracic spine T1-T3
C) Lumbar vertebrae L1-L2
D) Sacral promontory

3. What is the primary physiological mechanism by which high-frequency whole-body vibration (WBV) from heavy vehicle driving leads to lower back pathology?

A) Hypertrophy of the spinal erectors
B) Degeneration of the intervertebral disc gelatinous nucleus
C) Calcification of the synovial fluid
D) Ossification of the transverse process

4. In crash test dummy calibration, what is the 'HIC' score primarily used to measure, and what does it relate to in human biology?

A) Heart Injury Criteria: Myocardial rupture
B) Head Injury Criterion: Intracranial pressure and brain acceleration
C) Hip Impact Coefficient: Femoral neck fractures
D) Hand Index Calibration: Median nerve damage

5. Which part of the human eye is most affected by the blue-light spectrum emitted from modern high-intensity discharge (HID) and LED automotive headlamps?

A) The fovea centralis
B) The crystalline lens
C) The retinal pigment epithelium
D) The aqueous humor

6. During a frontal impact, what is the maximum recommended chest deflection (in millimeters) allowed by the Euro NCAP standards to maintain a 50% probability of survival?

A) 22mm
B) 42mm
C) 62mm
D) 82mm

7. What is the primary cause of 'driver fatigue' as defined by circadian rhythm disruption in long-haul heavy vehicle transport?

A) Reduced atmospheric pressure
B) Suppression of melatonin secretion
C) Hyperventilation of CO2
D) Increased glucose metabolism

8. Which component of the human vestibular system is most responsible for motion sickness induced by low-frequency oscillations in autonomous vehicles?

A) The cochlea
B) The semicircular canals
C) The organ of Corti
D) The tectorial membrane

9. What physiological effect is specifically mitigated by the use of an automotive airbag's tether system?

A) Excessive forward excursion of the head causing neck hyperextension
B) Thoracic compression beyond 50mm
C) Pelvic rotation leading to sub-marining
D) Cranial contact with the A-pillar

10. What is the primary biological hazard associated with exposure to brake pad dust containing antimony or barium?

A) Dermal sensitization
B) Pulmonary fibrosis and systemic toxicity
C) Ocular cataracts
D) Peripheral neuropathy

11. Which specific spinal region exhibits the highest resonance frequency, making it most vulnerable to localized vibration-induced trauma in truck drivers?

A) Cervical region (4-6 Hz)
B) Thoracic region (8-12 Hz)
C) Lumbar region (4-8 Hz)
D) Sacral region (15-20 Hz)

12. What is the physiological role of the 'submarining' phenomenon during a vehicle crash regarding the human pelvis?

A) The pelvis slides under the lap belt, risking abdominal organ trauma
B) The pelvis fractures due to force applied by the steering column
C) The femur is driven through the acetabulum
D) The pelvic floor muscles undergo involuntary contraction

13. What effect does prolonged exposure to high levels of cabin noise (above 85 dB) have on the human auditory pathway in a vehicle?

A) Temporary threshold shift through hair cell fatigue
B) Permanent displacement of the stapes
C) Enlargement of the tympanic membrane
D) Reduced serotonin production in the cochlea

14. How does the human body's sympathetic nervous system react to 'near-miss' traffic events while driving?

A) Decreased cortisol and increased insulin
B) Increased heart rate variability
C) Increased release of epinephrine and vasodilation of muscles
D) Decreased blood pressure via vagal tone

15. What is the standard measurement unit used for human biomechanical tolerance to impact force in automotive safety testing?

A) Newtons
B) Pascals
C) Joules
D) g-force

16. What is the medical implication of 'Soot' or Diesel Particulate Matter (DPM) inhalation for the human cardiovascular system?

A) Immediate bradycardia
B) Systemic inflammatory response and oxidative stress
C) Dilated cardiomyopathy
D) Hypertrophy of the aortic valve

17. Which human reflex is the primary target for 'Active Brake Assist' systems to reduce reaction time?

A) Myotatic reflex
B) Withdrawal reflex
C) Startle reflex
D) Vestibulo-ocular reflex

18. In ergonomic design, what is the 'Popliteal Height' critical for determining in vehicle seat design?

A) The clearance between the head and the roof liner
B) The optimal angle of the seat back for lumbar support
C) The vertical adjustment range of the seat for proper lower leg circulation
D) The reach distance to the steering wheel

19. Which factor contributes most to the development of deep vein thrombosis (DVT) in drivers performing long-duration travel?

A) Peripheral vasoconstriction
B) Venous stasis in the lower extremities
C) Increased blood viscosity due to hypoxia
D) Over-production of erythrocytes

20. What is the primary physiological risk of an incorrectly deployed steering wheel airbag to an individual's upper extremities?

A) Ulnar nerve compression
B) Fracture of the humerus
C) Dislocation of the shoulder joint
D) Hyperextension of the elbow

21. Which specific biological marker is most commonly monitored in human clinical studies assessing the stress levels of test drivers during high-stress maneuvers?

A) Plasma cortisol levels
B) Serum bilirubin
C) Creatine kinase
D) Aspartate aminotransferase

22. What physiological function does the 'Seatbelt Pretensioner' help preserve by limiting the displacement of the human thoracic cage?

A) Diaphragmatic breathing capacity
B) Cardiac rhythm stability
C) Pulmonary surfactant production
D) Cerebral spinal fluid circulation

23. What is the primary risk to the human femur during a high-speed frontal collision if the dashboard 'knee bolster' fails to deploy correctly?

A) Femoral shaft fracture via axial loading
B) Patellar tendon rupture
C) Avulsion of the quadriceps
D) Displacement of the knee joint capsule

24. How does modern vehicle 'Active Suspension' systems contribute to the reduction of motion-induced vertigo?

A) By stabilizing the horizon-line perception for the ocular system

B) By reducing the frequency of head-neck oscillations

C) By neutralizing centrifugal force acting on the semicircular canals

D) By cooling the inner ear via ventilation

25. What biomechanical limit is defined as the 'HIII' (Hybrid III) dummy thoracic compression limit for a 50th percentile male?

A) 25 mm

B) 45 mm

C) 63 mm

D) 85 mm