Human Physiology in Automotive Engineering

Automotive Technology · Answer Key · 25 Questions

1. Which specific physiological threshold is used in automotive crash testing to define the HIC (Head Injury Criterion) for a 50th percentile male?

A) The duration of deceleration pulse in milliseconds
B) The integrated acceleration of the head over a specific time interval
C) The peak force exerted on the zygomatic arch
D) The rate of change in intracranial pressure during impact

2. During high-G maneuvers, what is the primary physiological mechanism that causes 'grey-out' in test drivers?

A) Peripheral vasoconstriction of the retina
B) Reduction in cerebral perfusion pressure
C) Hyperventilation leading to hypocapnia
D) Vagus nerve stimulation via carotid sinus pressure

3. In automotive ergonomics, the 'H-point' refers to which anatomical feature of the vehicle occupant?

A) The pivot point of the hip joint
B) The highest point of the parietal bone
C) The center of gravity of the human torso
D) The height of the cervical spine relative to the headrest

4. What is the typical maximum frequency range for Whole-Body Vibration (WBV) that causes the most significant discomfort to the human lumbar spine in vehicles?

A) 0.5 to 80 Hz
B) 100 to 500 Hz
C) 0.01 to 0.1 Hz
D) 1000 to 5000 Hz

5. Which physiological metric is most commonly measured to assess driver cognitive load during complex automotive HMI interactions?

A) Galvanic Skin Response (GSR)
B) Heart Rate Variability (HRV)
C) Electromyography (EMG) of the masseter muscle
D) Serum cortisol levels

6. What is the primary risk of 'submarining' during a high-speed frontal impact in a vehicle?

A) Compression of the iliac arteries
B) Laceration of the liver by the lap belt
C) Dislocation of the sacroiliac joint
D) Fracture of the femur against the dashboard

7. The TNO-10 dummy was specifically designed to measure which aspect of human health during automotive side-impact collisions?

A) Thoracic rib deflection
B) Pelvic rotation velocity
C) Cervical spine shear force
D) Abdominal organ displacement

8. In long-haul automotive seating, what is the 'ischiatic tuberosity' loading limit, beyond which tissue necrosis begins to pose a risk?

A) 25 mmHg
B) 32 mmHg
C) 45 mmHg
D) 60 mmHg

9. Which sensory system is primarily responsible for the conflict known as 'motion sickness' in autonomous vehicles?

A) The proprioceptive system
B) The vestibular system
C) The somatosensory cortex
D) The olfactory system

10. What is the average acceleration threshold at which the human sternum begins to suffer structural rib fractures in a modern seatbelt-restrained environment?

A) 40 Gs
B) 60 Gs
C) 90 Gs
D) 120 Gs

11. Which physiological state is indicated by a decrease in the Alpha-to-Theta power ratio in EEG data during long-term driving?

A) Heightened sympathetic arousal
B) Onset of cognitive fatigue
C) Maximum alertness
D) REM sleep transition

12. What is the primary function of the 'deformable barrier' in crash testing regarding human occupant safety?

A) To simulate the elasticity of human soft tissue
B) To manage the energy pulse transmitted to the occupant
C) To prevent the vehicle from rotating upon impact
D) To simulate the deformation of an opposing vehicle's frame

13. The 'N-k' criterion in automotive testing is a combined measure of what?

A) Neck force and neck moment
B) Nerve conduction and kinetic energy
C) Nasal bone fracture and kidney stress
D) None of the above

14. Which anatomical structure is most vulnerable to injury during a 'whiplash' event in a rear-end collision?

A) C5-C6 cervical vertebrae
B) C1-C2 atlanto-axial joint
C) Thoracic outlet nerves
D) Sternocleidomastoid muscle insertion

15. Why do automotive manufacturers prioritize minimizing 'transmissibility' in seat design?

A) To prevent the amplification of floor vibration to the human viscera
B) To reduce the amount of heat transfer to the occupant
C) To lower the acoustic resonance within the cabin
D) To stabilize the driver's visual focus during braking

16. What physiological phenomenon describes the delay between a stimulus and the physical application of the brakes by a human driver?

A) Psychomotor latency
B) Synaptic drift
C) Proprioceptive inhibition
D) Reflex arc suppression

17. Which part of the human eye is most affected by high-intensity strobe lighting often used in automotive emergency vehicle alerts?

A) Fovea centralis
B) Rod cells in the periphery
C) The crystalline lens
D) The choroid layer

18. What is the function of the 'chestband' used in biomechanical crash testing?

A) To measure thoracic deformation over time
B) To monitor heart rate during impact
C) To restrain the shoulder girdle
D) To assess lung capacity post-crash

19. In the context of vehicle ergonomics, what is the '95th percentile male' standard based on?

A) Stature and mass distribution
B) Reflex speed and reaction time
C) Bone density and collagen elasticity
D) Maximum reach and visual field

20. Which specific spinal region is most susceptible to injury during vertical loading in a vehicle undergoing an air-borne impact?

A) Thoracolumbar junction (T11-L2)
B) Cervical spine (C3-C5)
C) Sacral spine (S1-S3)
D) Coccygeal region

21. The 'COZ' (Clearance Offset Zone) in interior vehicle design is intended to prevent contact between the driver's head and which component?

A) The B-pillar
B) The steering column
C) The headliner
D) The side curtain airbag housing

22. What biochemical marker in the blood is often studied to determine the physical stress levels of professional rally drivers post-race?

A) Creatine kinase
B) Aspartate aminotransferase
C) Lactate dehydrogenase
D) All of the above

23. Which sensory organ's function is significantly degraded when the 'stapedial reflex' is triggered by loud engine noise?

A) The cochlea
B) The semicircular canals
C) The tympanic membrane
D) The utricle

24. What is the primary cause of 'visceral organ displacement' in high-deceleration automotive accidents?

A) Differential inertia of soft tissues versus the skeletal frame

B) Excessive blood pressure spike

C) Rapid deflation of the lungs

D) Muscular contraction of the diaphragm

25. How does prolonged exposure to low-frequency noise (below 20 Hz) in heavy vehicles affect human physiological health?

A) It induces resonance in the abdominal organs

B) It causes immediate hearing loss

C) It forces rapid fluctuations in blood pH

D) It inhibits the secretion of melatonin