Human Physiology in Extreme Environments

Human Physiology · Answer Key · 25 Questions

1. What is the primary physiological mechanism that causes High Altitude Pulmonary Edema (HAPE) in climbers?

A) Increased production of erythropoietin
B) Pulmonary hypertension caused by hypoxic vasoconstriction
C) Excessive vasodilation of the peripheral arteries
D) Rapid dehydration leading to blood viscosity increase

2. During deep-sea saturation diving, which gas is most commonly used in the breathing mixture to replace nitrogen and prevent nitrogen narcosis?

A) Argon
B) Neon
C) Helium
D) Xenon

3. Which physiological process is responsible for the 'Bohr effect' observed in individuals at high altitudes?

A) Increased binding affinity of oxygen to hemoglobin due to high pH
B) Decreased binding affinity of oxygen to hemoglobin due to increased carbon dioxide
C) Increased absorption of iron in the small intestine
D) Rapid excretion of potassium through the kidneys

4. What is the primary cause of 'Immersion Foot' (trench foot) during prolonged exposure to cold, wet environments?

A) Fungal infection of the dermis
B) Peripheral nerve damage from ischemia
C) Crystallization of intercellular fluid
D) Excessive accumulation of sodium in sweat glands

5. The 'mammalian dive reflex' triggers bradycardia, which is specifically defined as:

A) A rapid increase in blood pressure
B) A decrease in heart rate
C) An increase in cardiac output
D) A shift in blood flow to the extremities

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6. Which hormone secretion is significantly suppressed during prolonged exposure to extreme cold to minimize heat loss through peripheral vasodilation?

A) Cortisol
B) Thyroxine
C) Aldosterone
D) Antidiuretic hormone

7. In the context of polar exploration, what is the 'cold-induced vasodilation' (CIVD) reaction, also known as the Lewis hunting reaction?

A) Permanent capillary constriction to preserve core heat
B) Periodic cycles of vasodilation to prevent frostbite
C) Immediate cessation of blood flow to digits
D) Increased shivering rate to generate thermogenesis

8. What metabolic state occurs during severe hypothermia when the body's shivering mechanism ceases?

A) Hyperglycemia
B) Metabolic alkalosis
C) Paradoxical undressing
D) Metabolic acidosis

9. Which physiological adaptation is most common in the Sherpa population residing at high altitudes?

A) Larger lung capacity due to anatomical structural changes
B) Increased hemoglobin concentration leading to thick blood
C) Higher nitric oxide levels for improved vasodilation
D) Higher baseline blood glucose levels for energy

10. What is the primary health risk associated with rapid ascent to high altitudes resulting in Cheyne-Stokes respiration?

A) Inhibition of the respiratory center by low blood pH
B) Periodic apnea caused by instability in the CO2-ventilatory feedback loop
C) Cardiac arrhythmia induced by low potassium levels
D) Severe pulmonary edema blocking gas exchange

11. During microgravity exposure in space flight, what is the primary cause of the 'fluid shift' that leads to facial puffiness?

A) Increased total blood volume
B) Decreased hydrostatic pressure in the lower extremities
C) Increased heart rate forcing fluid to the head
D) Bone marrow suppression

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12. Which electrolyte imbalance is a major danger during extreme endurance activities like ultra-marathons due to excessive water intake (hyponatremia)?

A) High serum calcium
B) Low serum sodium
C) High serum potassium
D) Low serum magnesium

13. What is the 'Valsalva maneuver' used for in the context of deep-sea diving?

A) Equalizing pressure in the middle ear
B) Preventing nitrogen narcosis
C) Reducing the heart rate before a dive
D) Expelling residual carbon dioxide from the lungs

14. How does the human body compensate for chronic hypoxia during long-term Himalayan exploration?

A) Decreased red blood cell count
B) Increased plasma volume
C) Increased 2,3-bisphosphoglycerate (2,3-BPG) levels
D) Reduced respiratory rate

15. What is the direct cause of 'decompression sickness' (the bends) in divers surfacing too quickly?

A) Oxygen toxicity in the brain
B) Nitrogen bubbles forming in blood and tissues
C) Hyperventilation leading to hypocapnia
D) Excessive production of lactic acid

16. What role does the 'Hering-Breuer reflex' play during extreme physical exertion?

A) It prevents over-inflation of the lungs
B) It regulates the release of adrenaline
C) It shifts blood away from the gut
D) It stabilizes body temperature

17. Why is vitamin D deficiency a common risk factor for researchers in long-term Antarctic research stations?

A) Excessive intake of processed foods
B) Lack of UVB radiation exposure
C) Increased metabolism due to cold exposure
D) High altitude blocking UV rays

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18. Which organ is primarily responsible for the compensatory metabolic response to chronic respiratory alkalosis at high altitudes?

A) Liver
B) Kidneys
C) Spleen
D) Pancreas

19. In high-altitude medicine, what is the 'HACE' condition?

A) High Altitude Cerebral Edema
B) Hypoxia-Associated Cardiac Exhaustion
C) Hyper-Acute Circulatory Equilibrium
D) Hemoglobin-Associated Cellular Expansion

20. During prolonged survival at sea, what is the primary danger of consuming untreated seawater?

A) Acute vitamin toxicity
B) Severe osmotic diarrhea and dehydration
C) Cardiac failure from magnesium toxicity
D) Renal overload from excessive chloride

21. What physiological effect does high-velocity winds have on human 'wind chill' perception?

A) It increases the core temperature
B) It removes the insulating layer of warm air near the skin
C) It causes rapid evaporation of sweat leading to overheating
D) It increases the rate of cellular metabolism

22. Which physiological marker is commonly monitored to assess the degree of muscle damage in long-distance explorers?

A) Serum creatinine
B) Creatine kinase
C) Blood urea nitrogen
D) Serum bilirubin

23. What causes the 'hypoxic ventilatory response' to become blunted in some long-term high-altitude dwellers?

A) Carotid body desensitization
B) Increased sympathetic nervous system activity
C) Lowered sensitivity of the medulla to pH
D) Decreased lung elasticity

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24. What is the primary danger of 're-warming' a severely hypothermic patient too quickly?

A) Cold blood from the extremities returning to the heart causing 'afterdrop'

B) Immediate hyperthermia leading to organ failure

C) Seizure activity due to rapid glucose rise

D) Paradoxical hypertension

25. What effect does extreme heat have on the body's 'plasma volume' during desert exploration?

A) It remains constant

B) It increases to cool the body

C) It decreases due to sweating

D) It fluctuates with heart rhythm

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