Advanced Aerospace Engineering Principles

Aerospace Engineering · Practice Test · 10 Questions

1. In the context of transonic flow, what is the 'drag divergence Mach number'?

A) The Mach number where the lift coefficient drops to zero
B) The Mach number at which the drag coefficient begins to increase rapidly
C) The Mach number at which the shock wave attaches to the leading edge
D) The Mach number where the boundary layer becomes fully turbulent

2. According to the Kutta condition in thin airfoil theory, what must be true at the trailing edge of an airfoil?

A) The flow velocity must be infinite
B) The pressure must be equal to the stagnation pressure
C) The flow must leave the trailing edge smoothly, resulting in a finite velocity
D) The circulation must equal the square of the chord length

3. What is the physical significance of the 'frozen flow' assumption in chemical rocket nozzle analysis?

A) The chemical composition of the exhaust gas remains constant throughout the expansion
B) The exhaust gas temperature drops to absolute zero at the nozzle exit
C) The combustion chamber pressure remains constant regardless of throttle settings
D) The reaction rate is infinite, maintaining chemical equilibrium throughout expansion

4. In hypersonic flight, which term best describes the 'viscous interaction' phenomenon?

A) The displacement effect of the boundary layer significantly alters the effective aerodynamic shape
B) The reduction of skin friction due to laminar flow transition
C) The coupling of radiative heat transfer and convective cooling
D) The complete detachment of the bow shock from the vehicle nose

5. What defines the 'Hohmann transfer orbit' in orbital mechanics?

A) An elliptical orbit that connects two circular coplanar orbits using two impulsive maneuvers
B) A hyperbolic escape trajectory requiring constant thrust
C) A parabolic trajectory designed for gravity assists
D) A non-coplanar orbit involving a change in orbital inclination only

6. Which dimensionless parameter is defined as the ratio of inertial forces to viscous forces in fluid dynamics?

A) Prandtl number
B) Mach number
C) Reynolds number
D) Knudsen number

7. In jet engine design, what is the primary purpose of the 'diffuser' section in a centrifugal compressor?

A) To accelerate the airflow to supersonic speeds
B) To convert the kinetic energy of the air into static pressure
C) To inject fuel into the airflow
D) To reduce the rotational speed of the turbine blades

8. The 'area rule' is a design technique used primarily to achieve what effect in transonic aircraft?

A) Minimizing the wave drag by smoothing the distribution of the cross-sectional area
B) Maximizing the lift-to-drag ratio at low subsonic speeds
C) Preventing engine flameout during high-G maneuvers
D) Increasing the structural integrity of the wing-root attachment

9. In the context of rarefied gas dynamics, what does a high Knudsen number indicate?

A) The flow can be modeled using the Navier-Stokes equations
B) The flow is dominated by continuum mechanics
C) The flow is highly transitional or free-molecular, where particle collisions are infrequent
D) The flow is strictly incompressible and inviscid

10. What does the 'Busemann biplane' theoretical model aim to demonstrate?

A) An aerodynamic configuration that generates zero wave drag at a specific design Mach number
B) A method to increase the structural weight of an aircraft
C) A technique to optimize turbine blade cooling
D) A way to eliminate the sonic boom entirely