

# Advanced Aerospace Engineering Principles

Aerospace Engineering · Answer Key · 10 Questions

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## 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