Important Approximate Methods of Hypersonic Inviscid Flowfields Formulas PDF

Formulas
Examples
with Units

List of 11
Important Approximate Methods of Hypersonic Inviscid Flowfields Formulas

1) Non-Dimensional Density Formula

Evaluate Formula

Formula

$$\rho_{-} = \frac{\rho}{\rho_{liq}}$$

Example with Units

$$4.3003 = \frac{663.1\,\text{kg/m}^3}{154.2\,\text{kg/m}^3}$$

2) Non-Dimensional Density for High Mach Number Formula

Evaluate Formula

Formula

$$\rho_{-} = \frac{\gamma + 1}{\gamma - 1}$$

Example

$$4.3333 = \frac{1.6 + 1}{1.6 - 1}$$

3) Non-Dimensional Parallel Velocity Component for High Mach Number Formula

Evaluate Formula

Formula

$$u_{-} = 1 - \frac{2 \cdot \left(\sin\left(\beta\right)\right)^2}{\gamma - 1}$$

Example with Units

$$0.7347 = 1 - \frac{2 \cdot \left(\sin\left(0.286\,\text{rad}\right)\right)^2}{1.6 - 1}$$

4) Non-Dimensional Perpendicular Velocity Component for High Mach Number Formula

Evaluate Formula

Formula

$$v_{-} = \frac{\sin\left(2 \cdot \beta\right)}{\gamma - 1}$$

Example with Units

$$0.9022 = \frac{\sin\left(2 \cdot 0.286\,\text{rad}\right)}{1.6 - 1}$$

5) Non-Dimensional Pressure Formula

Evaluate Formula

Formula

$$p_{-} = \frac{P}{\rho \cdot V_{\infty}^2}$$

Example with Units

$$0.8 = \frac{800\,\text{Pa}}{663.1\,\text{kg/m}^3 \cdot 1.228\,\text{m/s}^2}$$

6) Non-Dimensional Pressure for High Mach Number Formula

Evaluate Formula

Formula

$$p_{mech} = 2 \cdot \frac{\left(\sin\left(\beta\right)\right)^2}{\gamma + 1}$$

Example with Units

$$0.0612 = 2 \cdot \frac{\left(\sin\left(0.286\,\text{rad}\right)\right)^2}{1.6 + 1}$$

7) Non-Dimensional Radius for Hypersonic Vehicles Formula

Evaluate Formula

Formula

$$r_{-} = \frac{R}{\lambda \cdot H}$$

Example with Units

$$1.9048 = \frac{8\,\text{m}}{0.5 \cdot 8.4\,\text{m}}$$

8) Slenderness Ratio with Cone Radius for Hypersonic Vehicle Formula

Evaluate Formula

Formula

$$\lambda_{hyp} = \frac{R}{H}$$

Example with Units

$$0.9524 = \frac{8\,\text{m}}{8.4\,\text{m}}$$

9) Transformed Conical Variable Formula

Evaluate Formula

Formula

$$\theta_{-} = \frac{R}{\lambda \cdot H}$$

Example with Units

$$1.9048 = \frac{8\,\text{m}}{0.5 \cdot 8.4\,\text{m}}$$

10) Transformed Conical Variable with Cone Angle in Hypersonic Flow Formula

Evaluate Formula

Formula

$$\theta_{-} = \frac{\beta \cdot \left(\frac{180}{\pi}\right)}{\alpha}$$

Example with Units

$$1.9001 = \frac{0.286\,\text{rad} \cdot \left(\frac{180}{3.1416}\right)}{8.624\,\text{rad}}$$

11) Transformed Conical Variable with Wave Angle Formula

Evaluate Formula

Formula

$$\theta_{w} = \frac{\beta \cdot \left(\frac{180}{\pi}\right)}{\lambda}$$

Example with Units

$$32.7732 = \frac{0.286\,\text{rad} \cdot \left(\frac{180}{3.1416}\right)}{0.5}$$

Variables used in list of Approximate Methods of Hypersonic Inviscid Flowfields Formulas above

- **H** Height of Cone *(Meter)*
- **P** Pressure *(Pascal)*
- **p_** Non Dimensionalized Pressure
- **p_{mech}** Non Dimensionalized Pressure For High Mech Number
- **R** Radius of Cone *(Meter)*
- **r_** Non Dimensionalized Radius
- **u_** Non Dimensionalized Upstream Parallel Velocity
- **v_** Non Dimensionalized Velocity
- **V_∞** Freestream Velocity *(Meter per Second)*
- **α** Semi Angle of Cone *(Radian)*
- **β** Wave Angle *(Radian)*
- **γ** Specific Heat Ratio
- **θ_** Transformed Conical Variable
- **θ_w** Transformed Conical Variable With Wave Angle
- **λ** Slenderness Ratio
- **λ_{hyp}** Slenderness Ratio For Hypersonic Vehicles
- **ρ** Density *(Kilogram per Cubic Meter)*
- **ρ_** Non Dimensionalized Density
- **ρ_{liq}** Liquid Density *(Kilogram per Cubic Meter)*

Constants, Functions, Measurements used in list of Approximate Methods of Hypersonic Inviscid Flowfields Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Functions: **sin**, sin(Angle) *Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.*
- Measurement: **Length** in Meter (m) *Length Unit Conversion*
- Measurement: **Pressure** in Pascal (Pa) *Pressure Unit Conversion*
- Measurement: **Speed** in Meter per Second (m/s) *Speed Unit Conversion*
- Measurement: **Angle** in Radian (rad) *Angle Unit Conversion*
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m^3) *Density Unit Conversion*

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