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Three Dimensional Incompressible Flow Formulas

Calculators! Examples! Conversions!

List of 29 Three Dimensional Incompressible Flow Formulas

Three Dimensional Incompressible Flow

1) Doublet Strength for 3D Incompressible Flow

Open Calculator

fx $$\mu = -\frac{4 \cdot \pi \cdot \phi \cdot r^2}{\cos(\theta)}$$

ex $$-999.807844\mathrm{m^3/s} = -\frac{4 \cdot \pi \cdot 8\mathrm{m^2/s} \cdot (2.758\mathrm{m})^2}{\cos(0.7\mathrm{rad})}$$

2) Radial Coordinate for 3D Doublet Flow given Velocity Potential

Open Calculator

fx $$r = \sqrt{\frac{\mu \cdot \cos(\theta)}{4 \cdot \pi \cdot \phi}}$$

ex $$8.7224\mathrm{m} = \sqrt{\frac{10000\mathrm{m^3/s} \cdot \cos(0.7\mathrm{rad})}{4 \cdot \pi \cdot 8\mathrm{m^2/s}}}$$

3) Radial Coordinate for 3D Source Flow given Radial Velocity

Open Calculator

fx $$r = \sqrt{\frac{\Lambda}{4 \cdot \pi \cdot V_r}}$$

ex $$1.174454\text{m} = \sqrt{\frac{104\text{m}^2/\text{s}}{4 \cdot \pi \cdot 6\text{m/s}}}$$

4) Radial Coordinate for 3D Source Flow given Velocity Potential

Open Calculator

fx $$r = -\frac{\Lambda}{4 \cdot \pi \cdot \phi}$$

ex $$-1.034507\text{m} = -\frac{104\text{m}^2/\text{s}}{4 \cdot \pi \cdot 8\text{m}^2/\text{s}}$$

5) Radial Velocity for 3D Incompressible Source Flow

Open Calculator

fx $$V_r = \frac{\Lambda}{4 \cdot \pi \cdot r^2}$$

ex $$1.088015\text{m/s} = \frac{104\text{m}^2/\text{s}}{4 \cdot \pi \cdot (2.758\text{m})^2}$$

6) Source Strength for 3D Incompressible Source Flow given Radial Velocity

Open Calculator

fx $$\Lambda = 4 \cdot \pi \cdot V_r \cdot r^2$$

ex $$573.5214\text{m}^2/\text{s} = 4 \cdot \pi \cdot 6\text{m/s} \cdot (2.758\text{m})^2$$

7) Source Strength for 3D Incompressible Source Flow given Velocity Potential

Open Calculator

fx $\Lambda = -4 \cdot \pi \cdot \phi \cdot r$

ex $-277.264401 \mathrm{m^2/s} = -4 \cdot \pi \cdot 8 \mathrm{m^2/s} \cdot 2.758 \mathrm{m}$

8) Velocity Potential for 3D Incompressible Doublet Flow

Open Calculator

fx $\phi = -\frac{\mu \cdot \cos(\theta)}{4 \cdot \pi \cdot r^2}$

ex $-80.015375 \mathrm{m^2/s} = -\frac{10000 \mathrm{m^3/s} \cdot \cos(0.7 \mathrm{rad})}{4 \cdot \pi \cdot (2.758 \mathrm{m})^2}$

9) Velocity Potential for 3D Incompressible Source Flow

Open Calculator

fx $\phi = -\frac{\Lambda}{4 \cdot \pi \cdot r}$

ex $-3.000746 \mathrm{m^2/s} = -\frac{104 \mathrm{m^2/s}}{4 \cdot \pi \cdot 2.758 \mathrm{m}}$

Flow Over Sphere

Pressure Coefficient

10) Polar Coordinate given Surface Pressure Coefficient

Open Calculator

fx $$\theta = a\sin\left(\sqrt{\frac{4}{9} \cdot (1 - C_p)}\right)$$

ex $$0.302746\text{rad} = a\sin\left(\sqrt{\frac{4}{9} \cdot (1 - 0.8)}\right)$$

11) Surface Pressure Coefficient for Flow over Sphere

Open Calculator

fx $$C_p = 1 - \frac{9}{4} \cdot (\sin(\theta))^2$$

ex $$0.066213 = 1 - \frac{9}{4} \cdot (\sin(0.7\text{rad}))^2$$

Radial Velocity

12) Doublet Strength given Radial Velocity

Open Calculator

fx $$\mu = 2 \cdot \pi \cdot r^3 \cdot \left(V_\infty + \frac{V_r}{\cos(\theta)}\right)$$

ex $$9997.426\text{m}^3/\text{s} = 2 \cdot \pi \cdot (2.758\text{m})^3 \cdot \left(68\text{m/s} + \frac{6\text{m/s}}{\cos(0.7\text{rad})}\right)$$

13) Freestream Velocity given Radial Velocity

Open Calculator

fx
$$V_\infty = \frac{\mu}{2 \cdot \pi \cdot r^3} - \frac{V_r}{\cos(\theta)}$$

ex
$$68.01953\mathrm{m/s} = \frac{10000\mathrm{m^3/s}}{2 \cdot \pi \cdot (2.758\mathrm{m})^3} - \frac{6\mathrm{m/s}}{\cos(0.7\mathrm{rad})}$$

14) Polar Coordinate given Radial Velocity

Open Calculator

fx
$$\theta = a\cos\left(\frac{V_r}{\frac{\mu}{2 \cdot \pi \cdot r^3} - V_\infty}\right)$$

ex
$$0.702943\mathrm{rad} = a\cos\left(\frac{6\mathrm{m/s}}{\frac{10000\mathrm{m^3/s}}{2 \cdot \pi \cdot (2.758\mathrm{m})^3} - 68\mathrm{m/s}}\right)$$

15) Radial Coordinate given Radial Velocity

Open Calculator

fx
$$r = \left(\frac{\mu}{2 \cdot \pi \cdot \left(V_\infty + \frac{V_r}{\cos(\theta)}\right)}\right)^{\frac{1}{3}}$$

ex
$$2.758237\mathrm{m} = \left(\frac{10000\mathrm{m^3/s}}{2 \cdot \pi \cdot \left(68\mathrm{m/s} + \frac{6\mathrm{m/s}}{\cos(0.7\mathrm{rad})}\right)}\right)^{\frac{1}{3}}$$

16) Radial Velocity for Flow over Sphere

Open Calculator

fx $$V_r = -\left(V_\infty - \frac{\mu}{2 \cdot \pi \cdot r^3}\right) \cdot \cos(\theta)$$

ex $$6.014934\mathrm{m/s} = -\left(68\mathrm{m/s} - \frac{10000\mathrm{m^3/s}}{2 \cdot \pi \cdot (2.758\mathrm{m})^3}\right) \cdot \cos(0.7\mathrm{rad})$$

Stagnation Point

17) Doublet Strength given Radial Coordinate of Stagnation Point

Open Calculator

fx $$\mu = 2 \cdot \pi \cdot V_\infty \cdot R_s^3$$

ex $$738.2994\mathrm{m^3/s} = 2 \cdot \pi \cdot 68\mathrm{m/s} \cdot (1.2\mathrm{m})^3$$

18) Freestream Velocity at Stagnation Point for Flow over Sphere

Open Calculator

fx $$V_\infty = \frac{\mu}{2 \cdot \pi \cdot R_s^3}$$

ex $$921.0356\mathrm{m/s} = \frac{10000\mathrm{m^3/s}}{2 \cdot \pi \cdot (1.2\mathrm{m})^3}$$

19) Radial Coordinate of Stagnation Point for Flow over Sphere

Open Calculator

fx $$r = \left(\frac{\mu}{2 \cdot \pi \cdot V_{\infty}} \right)^{\frac{1}{3}}$$

ex $$2.860468\text{m} = \left(\frac{10000\text{m}^3/\text{s}}{2 \cdot \pi \cdot 68\text{m/s}} \right)^{\frac{1}{3}}$$

Surface Velocity over Sphere

20) Freestream Velocity given Maximum Surface Velocity

Open Calculator

fx $$V_{\infty} = \frac{2}{3} \cdot V_{s,max}$$

ex $$16.66667\text{m/s} = \frac{2}{3} \cdot 25\text{m/s}$$

21) Freestream Velocity given Surface Velocity for Flow over Sphere

Open Calculator

fx $$V_{\infty} = \frac{2}{3} \cdot \frac{V_{\theta}}{\sin(\theta)}$$

ex $$60.02112\text{m/s} = \frac{2}{3} \cdot \frac{58\text{m/s}}{\sin(0.7\text{rad})}$$

22) Maximum Surface Velocity for Flow over Sphere

Open Calculator

fx $$V_{s,max} = \frac{3}{2} \cdot V_{\infty}$$

ex $$102\mathrm{m/s} = \frac{3}{2} \cdot 68\mathrm{m/s}$$

23) Polar Coordinate given Surface Velocity for Flow over Sphere

Open Calculator

fx $$\theta = a\sin\left(\frac{2}{3} \cdot \frac{V_{\theta}}{V_{\infty}}\right)$$

ex $$0.604836\mathrm{rad} = a\sin\left(\frac{2}{3} \cdot \frac{58\mathrm{m/s}}{68\mathrm{m/s}}\right)$$

24) Surface Velocity for Incompressible Flow over Sphere

Open Calculator

fx $$V_{\theta} = \frac{3}{2} \cdot V_{\infty} \cdot \sin(\theta)$$

ex $$65.7102\mathrm{m/s} = \frac{3}{2} \cdot 68\mathrm{m/s} \cdot \sin(0.7\mathrm{rad})$$

Tangential Velocity

25) Doublet Strength given Tangential Velocity

Open Calculator

fx $$\mu = 4 \cdot \pi \cdot r^3 \cdot \left(\frac{V_\theta}{\sin(\theta)} - V_\infty \right)$$

ex $$5808.182\text{m}^3/\text{s} = 4 \cdot \pi \cdot (2.758\text{m})^3 \cdot \left(\frac{58\text{m/s}}{\sin(0.7\text{rad})} - 68\text{m/s} \right)$$

26) Freestream Velocity given Tangential Velocity

Open Calculator

fx $$V_\infty = \frac{V_\theta}{\sin(\theta)} - \frac{\mu}{4 \cdot \pi \cdot r^3}$$

ex $$52.09954\text{m/s} = \frac{58\text{m/s}}{\sin(0.7\text{rad})} - \frac{10000\text{m}^3/\text{s}}{4 \cdot \pi \cdot (2.758\text{m})^3}$$

27) Polar Coordinate given Tangential Velocity

Open Calculator

fx $$\theta = a\sin\left(\frac{V_\theta}{V_\infty + \frac{\mu}{4 \cdot \pi \cdot r^3}} \right)$$

ex $$0.579398\text{rad} = a\sin\left(\frac{58\text{m/s}}{68\text{m/s} + \frac{10000\text{m}^3/\text{s}}{4 \cdot \pi \cdot (2.758\text{m})^3}} \right)$$

28) Radial Coordinate given Tangential Velocity

Open Calculator

fx $$r = \left(\frac{\mu}{4 \cdot \pi \cdot \left(\frac{V_\theta}{\sin(\theta)} - V_\infty \right)} \right)^{\frac{1}{3}}$$

ex $$3.305579\text{m} = \left(\frac{10000\text{m}^3/\text{s}}{4 \cdot \pi \cdot \left(\frac{58\text{m/s}}{\sin(0.7\text{rad})} - 68\text{m/s} \right)} \right)^{\frac{1}{3}}$$

29) Tangential Velocity for Flow over Sphere

Open Calculator

fx $$V_\theta = \left(V_\infty + \frac{\mu}{4 \cdot \pi \cdot r^3} \right) \cdot \sin(\theta)$$

ex $$68.24336\text{m/s} = \left(68\text{m/s} + \frac{10000\text{m}^3/\text{s}}{4 \cdot \pi \cdot (2.758\text{m})^3} \right) \cdot \sin(0.7\text{rad})$$

Variables Used

- C_p Pressure Coefficient
- r Radial Coordinate *(Meter)*
- R_s Radius of Sphere *(Meter)*
- V_∞ Freestream Velocity *(Meter per Second)*
- V_r Radial Velocity *(Meter per Second)*
- $V_{s,max}$ Maximum Surface Velocity *(Meter per Second)*
- V_θ Tangential Velocity *(Meter per Second)*
- θ Polar Angle *(Radian)*
- Λ Source Strength *(Square Meter per Second)*
- μ Doublet Strength *(Cubic Meter per Second)*
- ϕ Velocity Potential *(Square Meter per Second)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **acos**, acos(Number)
  Inverse trigonometric cosine function
- Function: **asin**, asin(Number)
  Inverse trigonometric sine function
- Function: **cos**, cos(Angle)
  Trigonometric cosine function
- Function: **sin**, sin(Angle)
  Trigonometric sine function
- Function: **sqrt**, sqrt(Number)
  Square root function
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Angle** in Radian (rad)
  Angle Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m^3/s)
  Volumetric Flow Rate Unit Conversion
- Measurement: **Velocity Potential** in Square Meter per Second (m^2/s)
  Velocity Potential Unit Conversion

Check other formula lists

- **Incompressible flow over airfoil Formulas**
- **Incompressible Flow over Finite Wings Formulas**
- **Three Dimensional Incompressible Flow Formulas**

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