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Elementary Flows Formulas

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List of 16 Elementary Flows Formulas

Elementary Flows

Doublet Flow

1) Stream Function for 2-D Doublet Flow

Open Calculator

fx $$\psi = \frac{\kappa \cdot \sin(\theta)}{2 \cdot \pi \cdot r}$$

ex $$38.73372\text{m}^2/\text{s} = \frac{3400\text{m}^3/\text{s} \cdot \sin(0.7\text{rad})}{2 \cdot \pi \cdot 9\text{m}}$$

2) Velocity Potential for 2-D Doublet Flow

Open Calculator

fx $$\phi = \frac{\kappa}{2 \cdot \pi \cdot r} \cdot \cos(\theta)$$

ex $$45.98629\text{m}^2/\text{s} = \frac{3400\text{m}^3/\text{s}}{2 \cdot \pi \cdot 9\text{m}} \cdot \cos(0.7\text{rad})$$

Source Flow

3) Radial Velocity for 2-D Incompressible Source Flow

Open Calculator

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

ex $$2.36964\text{m/s} = \frac{134\text{m}^2/\text{s}}{2 \cdot \pi \cdot 9\text{m}}$$

4) Source Strength for 2-D Incompressible Source Flow

Open Calculator

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

ex $133.4549\text{m}^2/\text{s} = 2 \cdot \pi \cdot 9\text{m} \cdot 2.36\text{m/s}$

5) Stagnation Streamline Equation for Flow over Semi-Infinite Body

Open Calculator

fx $\psi = 0.5 \cdot \Lambda$

ex $67\text{m}^2/\text{s} = 0.5 \cdot 134\text{m}^2/\text{s}$

6) Stream Function for 2-D Incompressible Source Flow

Open Calculator

fx $\psi_{source} = \frac{\Lambda}{2 \cdot \pi} \cdot \theta$

ex $14.92873\text{m}^2/\text{s} = \frac{134\text{m}^2/\text{s}}{2 \cdot \pi} \cdot 0.7\text{rad}$

7) Stream Function for Flow over Rankine Oval

Open Calculator

fx $\psi_r = V_\infty \cdot r \cdot \sin(\theta) + \left(\frac{\Lambda}{2 \cdot \pi}\right) \cdot (\theta_1 - \theta_2)$

ex

$-48.200111\text{m}^2/\text{s} = 6.4\text{m/s} \cdot 9\text{m} \cdot \sin(0.7\text{rad}) + \left(\frac{134\text{m}^2/\text{s}}{2 \cdot \pi}\right) \cdot (10\text{rad} - 14\text{rad})$

8) Stream Function for Semi-Infinite Body

Open Calculator

fx $$\psi = V_\infty \cdot r \cdot \sin(\theta) + \frac{\Lambda}{2 \cdot \pi} \cdot \theta$$

ex $$52.03567\text{m}^2/\text{s} = 6.4\text{m/s} \cdot 9\text{m} \cdot \sin(0.7\text{rad}) + \frac{134\text{m}^2/\text{s}}{2 \cdot \pi} \cdot 0.7\text{rad}$$

9) Velocity Potential for 2-D Source Flow

Open Calculator

fx $$\phi = \frac{\Lambda}{2 \cdot \pi} \cdot \ln(r)$$

ex $$46.85969\text{m}^2/\text{s} = \frac{134\text{m}^2/\text{s}}{2 \cdot \pi} \cdot \ln(9\text{m})$$

Uniform Flow

10) Stream Function for Uniform Incompressible Flow

Open Calculator

fx $$\psi = V_\infty \cdot y$$

ex $$37.12\text{m}^2/\text{s} = 6.4\text{m/s} \cdot 5.8\text{m}$$

11) Stream Function for Uniform Incompressible Flow in Polar Coordinates

Open Calculator

fx $$\psi = V_\infty \cdot r \cdot \sin(\theta)$$

ex $$37.10694\text{m}^2/\text{s} = 6.4\text{m/s} \cdot 9\text{m} \cdot \sin(0.7\text{rad})$$

12) Velocity Potential for Uniform Incompressible Flow

Open Calculator

fx $$\phi = V_\infty \cdot x$$

ex $$37.248\text{m}^2/\text{s} = 6.4\text{m/s} \cdot 5.82\text{m}$$

13) Velocity Potential for Uniform Incompressible Flow in Polar Coordinates

Open Calculator

fx $\phi = V_\infty \cdot r \cdot \cos(\theta)$

ex $44.05491 m^2/s = 6.4 m/s \cdot 9 m \cdot \cos(0.7 rad)$

Vortex Flow

14) Stream Function for 2-D Vortex Flow

Open Calculator

fx $\psi_{vortex} = \frac{\gamma}{2 \cdot \pi} \cdot \ln(r)$

ex $-146.873644 m^2/s = \frac{-420 m^2/s}{2 \cdot \pi} \cdot \ln(9 m)$

15) Tangential Velocity for 2-D Vortex Flow

Open Calculator

fx $V_\theta = -\frac{\gamma}{2 \cdot \pi \cdot r}$

ex $7.427231 m/s = -\frac{-420 m^2/s}{2 \cdot \pi \cdot 9 m}$

16) Velocity Potential for 2-D Vortex Flow

Open Calculator

fx $\phi = -\left(\frac{\gamma}{2 \cdot \pi}\right) \cdot \theta$

ex $46.79155 m^2/s = -\left(\frac{-420 m^2/s}{2 \cdot \pi}\right) \cdot 0.7 rad$

Variables Used

- **r** Radial Coordinate *(Meter)*
- V_∞ Freestream Velocity *(Meter per Second)*
- V_r Radial Velocity *(Meter per Second)*
- V_θ Tangential Velocity *(Meter per Second)*
- **x** Distance on X-Axis *(Meter)*
- **y** Distance on Y-Axis *(Meter)*
- **γ** Vortex Strength *(Square Meter per Second)*
- **θ** Polar Angle *(Radian)*
- θ_1 Polar Angle from Source *(Radian)*
- θ_2 Polar Angle from Sink *(Radian)*
- **κ** Doublet Strength *(Cubic Meter per Second)*
- **Λ** Source Strength *(Square Meter per Second)*
- **ϕ** Velocity Potential *(Square Meter per Second)*
- **ψ** Stream Function *(Square Meter per Second)*
- ψ_r Rankine Oval Stream Function *(Square Meter per Second)*
- ψ_{source} Source Stream Function *(Square Meter per Second)*
- ψ_{vortex} Vortex Stream Function *(Square Meter per Second)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **cos**, cos(Angle)
  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- Function: **ln**, ln(Number)
  The natural logarithm, also known as the logarithm to the base e, is the inverse function of the natural exponential function.
- Function: **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: **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

- **Elementary Flows Formulas**
- **Flow and Lift Distribution Formulas**
- **Flow over Airfoils and Wings Formulas**
- **Lift Distribution Formulas**

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