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Flow Over Sphere Formulas

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List of 20 Flow Over Sphere Formulas

Flow Over Sphere

Pressure Coefficient

1) Polar Coordinate given Surface Pressure Coefficient

Open Calculator

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

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

2) 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

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

4) Freestream Velocity given Radial Velocity

Open Calculator

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

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

5) 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 $$0.702943rad = a\cos\left(\frac{6m/s}{\frac{10000 m^3/s}{2 \cdot \pi \cdot (2.758m)^3} - 68m/s} \right)$$

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

7) 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 $$6.014934\text{m/s} = -\left(68\text{m/s} - \frac{10000\text{m}^3/\text{s}}{2 \cdot \pi \cdot (2.758\text{m})^3} \right) \cdot \cos(0.7\text{rad})$$

Stagnation Point

8) Doublet Strength given Radial Coordinate of Stagnation Point

Open Calculator

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

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

9) Freestream Velocity at Stagnation Point for Flow over Sphere

Open Calculator

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

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

10) 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

11) Freestream Velocity given Maximum Surface Velocity

Open Calculator

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

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

12) Freestream Velocity given Surface Velocity for Flow over Sphere

Open Calculator

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

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

13) Maximum Surface Velocity for Flow over Sphere

Open Calculator

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

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

14) 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 $$0.604836\text{rad} = a\sin\left(\frac{2}{3} \cdot \frac{58\text{m/s}}{68\text{m/s}}\right)$$

15) Surface Velocity for Incompressible Flow over Sphere

Open Calculator

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

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

Tangential Velocity

16) 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 $$5808.182 m^3/s = 4 \cdot \pi \cdot (2.758m)^3 \cdot \left(\frac{58m/s}{\sin(0.7rad)} - 68m/s \right)$$

17) Freestream Velocity given Tangential Velocity

Open Calculator

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

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

18) 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 $$0.579398rad = a\sin\left(\frac{58m/s}{68m/s + \frac{10000m^3/s}{4 \cdot \pi \cdot (2.758m)^3}} \right)$$

19) 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 $$3.305579\text{m} = \left(\frac{10000\text{m}^3/\text{s}}{4 \cdot \pi \cdot \left(\frac{58\text{m/s}}{\sin(0.7\text{rad})} - 68\text{m/s} \right)} \right)^{\frac{1}{3}}$$

20) 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)*
- μ Doublet Strength *(Cubic 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

Check other formula lists

- **Flow Over Sphere Formulas**

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