

# Important Kinematics of Flow Formulas PDF



**Formulas**  
**Examples**  
**with Units**

**List of 17**  
**Important Kinematics of Flow Formulas**

## 1) Actual Discharge in Venturimeter Formula

Formula

$$Q_a = C'_d \cdot \left( \frac{A_1 \cdot A_2}{\sqrt{(A_1^2) - (A_2^2)}} \cdot \sqrt{2 \cdot [g] \cdot h_v} \right)$$

Evaluate Formula 

Example with Units

$$57376.7744 \text{ cm}^3/\text{s} = 0.94 \cdot \left( \frac{314 \text{ cm}^2 \cdot 78.5 \text{ cm}^2}{\sqrt{(314 \text{ cm}^2)^2 - (78.5 \text{ cm}^2)^2}} \cdot \sqrt{2 \cdot 9.8066 \text{ m/s}^2 \cdot 289 \text{ cm}} \right)$$

## 2) Air Resistance Force Formula

Formula

$$F_a = c \cdot v'^2$$

Example with Units

$$720 \text{ N} = 0.2 \cdot 60 \text{ m/s}^2$$

Evaluate Formula 

## 3) Angular Velocity of Vortex using Depth of Parabola Formula

Formula

$$\omega = \sqrt{\frac{Z \cdot 2 \cdot 9.81}{r_1^2}}$$

Example with Units

$$1.9998 \text{ rad/s} = \sqrt{\frac{3185 \text{ cm} \cdot 2 \cdot 9.81}{1250 \text{ cm}^2}}$$

Evaluate Formula 

## 4) Coefficient of pitot-tube for velocity at any point Formula

Formula

$$C_v = \frac{V_p}{\sqrt{2 \cdot 9.81 \cdot h_p}}$$

Example with Units

$$0.9803 = \frac{6.3 \text{ m/s}}{\sqrt{2 \cdot 9.81 \cdot 210.5 \text{ cm}}}$$

Evaluate Formula 



## 5) Depth of Parabola formed at Free Surface of Water Formula

Formula

$$Z = \frac{(\omega^2) \cdot (r_1^2)}{2 \cdot 9.81}$$

Example with Units

$$3185.525 \text{ cm} = \frac{(2 \text{ rad/s}^2) \cdot (1250 \text{ cm}^2)}{2 \cdot 9.81}$$

Evaluate Formula 

## 6) Difference in Pressure Head for heavier Liquid in Manometer Formula

Formula

$$h = z' \cdot \left( \frac{S_h}{S_o} - 1 \right)$$

Example with Units

$$246.8139 \text{ cm} = 19.8 \text{ cm} \cdot \left( \frac{13.6}{1.01} - 1 \right)$$

Evaluate Formula 

## 7) Difference in pressure head for light liquid in manometer Formula

Formula

$$h_1 = z' \cdot \left( 1 - \left( \frac{S_1}{S_o} \right) \right)$$

Example with Units

$$6.0772 \text{ cm} = 19.8 \text{ cm} \cdot \left( 1 - \left( \frac{0.7}{1.01} \right) \right)$$

Evaluate Formula 

## 8) Drag coefficient given Drag force Formula

Formula

$$C_d = \frac{F_{dD} \cdot 2}{A_p \cdot \rho_{mf} \cdot V_r^2}$$

Example with Units

$$0.002 = \frac{368 \text{ N} \cdot 2}{18800 \text{ cm}^2 \cdot 998 \text{ kg/m}^3 \cdot 14 \text{ m/s}^2}$$

Evaluate Formula 

## 9) Height or depth of paraboloid for volume of air Formula

Formula

$$h_c = \left( \frac{D^2}{2 \cdot (r_1^2)} \right) \cdot (L - H_i)$$

Example with Units

$$172.872 \text{ cm} = \left( \frac{1050 \text{ cm}^2}{2 \cdot (1250 \text{ cm}^2)} \right) \cdot (2500 \text{ cm} - 2010 \text{ cm})$$

Evaluate Formula 

## 10) Rate of flow or discharge Formula

Formula

$$Q = A_{cs} \cdot v_{avg}$$

Example with Units

$$994500 \text{ cm}^3/\text{s} = 130 \text{ cm}^2 \cdot 76.5 \text{ m/s}$$

Evaluate Formula 



## 11) Relative velocity of fluid with respect to body given drag force Formula

Formula

$$V_r = \sqrt{\frac{F_{dD} \cdot 2}{A_p \cdot \rho_{mf} \cdot C_d}}$$

Example with Units

$$14.0049 \text{ m/s} = \sqrt{\frac{368 \text{ N} \cdot 2}{18800 \text{ cm}^2 \cdot 998 \text{ kg/m}^3 \cdot 0.002}}$$

Evaluate Formula 

## 12) Resultant bend force along x and y direction Formula

Formula

$$F_R = \sqrt{(F_x^2) + (F_y^2)}$$

Example with Units

$$52392.7476 \text{ N} = \sqrt{(48000 \text{ N}^2) + (21000 \text{ N}^2)}$$

Evaluate Formula 

## 13) Resultant velocity for two velocity components Formula

Formula

$$V = \sqrt{(u^2) + (v^2)}$$

Example with Units

$$10 \text{ m/s} = \sqrt{(6 \text{ m/s}^2) + (8 \text{ m/s}^2)}$$

Evaluate Formula 

## 14) Total Pressure Force at Bottom of Cylinder Formula

Formula

$$F_b = \rho \cdot 9.81 \cdot \pi \cdot (r_1^2) \cdot H + F_t$$

Example with Units

$$436306.2868 \text{ N} = 997 \text{ kg/m}^3 \cdot 9.81 \cdot 3.1416 \cdot (1250 \text{ cm}^2) \cdot 1.1 \text{ cm} + 383495 \text{ N}$$

Evaluate Formula 

## 15) Total pressure force on top of cylinder Formula

Formula

$$F_t = \left(\frac{LD}{4}\right) \cdot (\omega^2) \cdot \pi \cdot (r_1^4)$$

Example with Units

$$383495.197 \text{ N} = \left(\frac{5 \text{ kg/m}^3}{4}\right) \cdot (2 \text{ rad/s}^2) \cdot 3.1416 \cdot (1250 \text{ cm}^4)$$

Evaluate Formula 

## 16) Velocity at any point for coefficient of pitot-tube Formula

Formula

$$V_p = C_v \cdot \sqrt{2 \cdot 9.81 \cdot h_p}$$

Example with Units

$$6.298 \text{ m/s} = 0.98 \cdot \sqrt{2 \cdot 9.81 \cdot 210.5 \text{ cm}}$$

Evaluate Formula 



## 17) Velocity of Fluid Particle Formula

Formula

$$v_f = \frac{d}{t_a}$$

Example with Units

$$1.25 \text{ m/s} = \frac{10000 \text{ cm}}{80 \text{ s}}$$









Evaluate Formula 



## Variables used in list of Kinematics of Flow Formulas above

- **A<sub>1</sub>** Cross Section Area of Venturimeter Inlet (Square Centimeter)
- **A<sub>2</sub>** Cross Section Area of Venturimeter Throat (Square Centimeter)
- **A<sub>CS</sub>** Cross-Sectional Area (Square Centimeter)
- **A<sub>p</sub>** Projected Area of Body (Square Centimeter)
- **c** Air Constant
- **C<sub>d</sub>** Drag Coefficient for Fluid Flow
- **C'<sub>d</sub>** Coefficient of Discharge of Venturimeter
- **C<sub>v</sub>** Coefficient of Pitot Tube
- **d** Displacement (Centimeter)
- **D** Diameter (Centimeter)
- **F<sub>a</sub>** Air Resistance (Newton)
- **F<sub>b</sub>** Pressure Force on Bottom (Newton)
- **F<sub>dD</sub>** Drag Force by Fluid on Body (Newton)
- **F<sub>R</sub>** Resultant Force on Pipe Bend (Newton)
- **F<sub>t</sub>** Pressure Force on Top (Newton)
- **F<sub>x</sub>** Force along X-Direction on Pipe Bend (Newton)
- **F<sub>y</sub>** Force along Y-Direction on Pipe Bend (Newton)
- **h** Difference in Pressure Head in Manometer (Centimeter)
- **H** Cylinder Height (Centimeter)
- **h<sub>c</sub>** Height of Crack (Centimeter)
- **H<sub>i</sub>** Initial Height of Liquid (Centimeter)
- **h<sub>l</sub>** Difference in Pressure Head for Light Liquid (Centimeter)
- **h<sub>p</sub>** Rise of Liquid in Pitot Tube (Centimeter)
- **h<sub>v</sub>** Net Head of Liquid in Venturimeter (Centimeter)
- **L** Length (Centimeter)
- **LD** Liquid Density (Kilogram per Cubic Meter)
- **Q** Rate of Flow (Cubic Centimeter per Second)

## Constants, Functions, Measurements used in list of Kinematics of Flow Formulas above

- **constant(s):**  $\pi$ , 3.14159265358979323846264338327950288  
*Archimedes' constant*
- **constant(s):** **[g]**, 9.80665  
*Gravitational acceleration on Earth*
- **Functions:** **sqrt**, sqrt(Number)  
*A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.*
- **Measurement:** **Length** in Centimeter (cm)  
*Length Unit Conversion* 
- **Measurement:** **Time** in Second (s)  
*Time Unit Conversion* 
- **Measurement:** **Area** in Square Centimeter (cm<sup>2</sup>)  
*Area Unit Conversion* 
- **Measurement:** **Speed** in Meter per Second (m/s)  
*Speed Unit Conversion* 
- **Measurement:** **Force** in Newton (N)  
*Force Unit Conversion* 
- **Measurement:** **Volumetric Flow Rate** in Cubic Centimeter per Second (cm<sup>3</sup>/s)  
*Volumetric Flow Rate Unit Conversion* 
- **Measurement:** **Angular Velocity** in Radian per Second (rad/s)  
*Angular Velocity Unit Conversion* 
- **Measurement:** **Density** in Kilogram per Cubic Meter (kg/m<sup>3</sup>)  
*Density Unit Conversion* 









- $Q_a$  Actual Discharge through Venturimeter (Cubic Centimeter per Second)
- $r_1$  Radius (Centimeter)
- $S_h$  Specific Gravity of Heavier Liquid
- $S_l$  Specific Gravity of Lighter Liquid
- $S_o$  Specific Gravity of Flowing Liquid
- $t_a$  Total Time Taken (Second)
- $u$  Velocity Component at U (Meter per Second)
- $v$  Velocity Component at V (Meter per Second)
- $v'$  Velocity (Meter per Second)
- $V$  Resultant Velocity (Meter per Second)
- $v_{avg}$  Average Velocity (Meter per Second)
- $v_f$  Velocity of Fluid Particle (Meter per Second)
- $V_p$  Velocity at Any Point for Pitot Tube (Meter per Second)
- $V_r$  Relative Velocity of Fluid Past Body (Meter per Second)
- $z'$  Difference in Liquid Level in Manometer (Centimeter)
- $Z$  Depth of Parabola (Centimeter)
- $\rho$  Density (Kilogram per Cubic Meter)
- $\rho_{mf}$  Density of Moving Fluid (Kilogram per Cubic Meter)
- $\omega$  Angular Velocity (Radian per Second)



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