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Equations of Motion and Energy Equation Formulas

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List of 22 Equations of Motion and Energy Equation Formulas

Equations of Motion and Energy Equation

Elbow Meter

1) Coefficient of Discharge of Elbow Meter given Discharge

Open Calculator

fx $$C_d = \frac{q}{A \cdot \left(\sqrt{2 \cdot g \cdot h_{elbowmeter}}\right)}$$

ex $$0.631345 = \frac{5m^3/s}{2m^2 \cdot \left(\sqrt{2 \cdot 9.8m/s^2 \cdot 0.8m}\right)}$$

2) Cross-Sectional Area of Elbow Meter given Discharge

Open Calculator

fx $$A = \frac{q}{C_d \cdot \left(\sqrt{2 \cdot g \cdot h_{elbowmeter}}\right)}$$

ex $$1.913168m^2 = \frac{5m^3/s}{0.66 \cdot \left(\sqrt{2 \cdot 9.8m/s^2 \cdot 0.8m}\right)}$$

3) Differential Pressure Head of Elbow Meter

Open Calculator

fx $$H_{Pressurehead} = \frac{\left(\frac{q}{C_d \cdot A}\right)^2}{2 \cdot 9.81}$$

ex $$0.731296m = \frac{\left(\frac{5m^3/s}{0.66 \cdot 2m^2}\right)^2}{2 \cdot 9.81}$$

4) Discharge through Pipe in Elbowmeter

Open Calculator

fx $$q = C_d \cdot A \cdot \left(\sqrt{2 \cdot g \cdot h_{elbowmeter}}\right)$$

ex $$5.226933m^3/s = 0.66 \cdot 2m^2 \cdot \left(\sqrt{2 \cdot 9.8m/s^2 \cdot 0.8m}\right)$$

Euler's Equation of Motion

5) Datum Height at Section 1 from Bernoulli Equation

Open Calculator

fx $$Z_1 = \frac{P_2}{\gamma_f} + 0.5 \cdot \frac{V_{p2}^2}{[g]} + Z_2 - \frac{P_1}{\gamma_f} - 0.5 \cdot \frac{V_1^2}{[g]}$$

ex $$11.47633\text{m} = \frac{10\text{N/mm}^2}{9.81\text{kN/m}^3} + 0.5 \cdot \frac{(34\text{m/s})^2}{[g]} + 12.1\text{m} - \frac{8.9\text{N/mm}^2}{9.81\text{kN/m}^3} - 0.5 \cdot \frac{(58.03\text{m/s})^2}{[g]}$$

6) Datum Height using Piezometric Head for Steady Non-Viscous Flow

Open Calculator

fx $$Z_1 = P - \frac{P_h}{\gamma_f}$$

ex $$11.91845\text{m} = 12\text{m} - \frac{800\text{Pa}}{9.81\text{kN/m}^3}$$

7) Piezometric Head for Steady Non Viscous Flow

Open Calculator

fx $$P = \left(\frac{P_h}{\gamma_f}\right) + h$$

ex $$12.08155\text{m} = \left(\frac{800\text{Pa}}{9.81\text{kN/m}^3}\right) + 12\text{m}$$

8) Pressure at Section 1 from Bernoulli Equation

Open Calculator

fx $$P_1 = \gamma_f \cdot \left(\left(\frac{P_2}{\gamma_f}\right) + \left(0.5 \cdot \left(\frac{V_{p2}^2}{[g]}\right)\right) + Z_2 - Z_1 - \left(0.5 \cdot \left(\frac{V_1^2}{[g]}\right)\right)\right)$$

ex $$8.903692\text{N/mm}^2 = 9.81\text{kN/m}^3 \cdot \left(\left(\frac{10\text{N/mm}^2}{9.81\text{kN/m}^3}\right) + \left(0.5 \cdot \left(\frac{(34\text{m/s})^2}{[g]}\right)\right) + 12.1\text{m} - 11.1\text{m} - \left(0.5 \cdot \left(\frac{(58}{}\right)\right)\right)$$

9) Pressure Head for Steady Non Viscous Flow

Open Calculator

fx $$h_p = \frac{P_h}{\gamma_f}$$

ex $$81.54944\text{mm} = \frac{800\text{Pa}}{9.81\text{kN/m}^3}$$

10) Pressure using Pressure Head for Steady Non Viscous Flow

Open Calculator

fx $P_h = \gamma_f \cdot h_p$

ex $804.42\text{Pa} = 9.81\text{kN/m}^3 \cdot 82\text{mm}$

11) Velocity at Section 1 from Bernoulli Equation

Open Calculator

fx $V_1 = \sqrt{2 \cdot [g] \cdot \left(\left(\frac{P_2}{\gamma_f}\right) + \left(0.5 \cdot \left(\frac{V_{p2}^2}{[g]}\right)\right) + Z_2 - Z_1 - \frac{P_1}{\gamma_f}\right)}$

ex $58.09356\text{m/s} = \sqrt{2 \cdot [g] \cdot \left(\left(\frac{10\text{N/mm}^2}{9.81\text{kN/m}^3}\right) + \left(0.5 \cdot \left(\frac{(34\text{m/s})^2}{[g]}\right)\right) + 12.1\text{m} - 11.1\text{m} - \frac{8.9\text{N/mm}^2}{9.81\text{kN/m}^3}\right)}$

12) Velocity Head for Steady Non Viscous Flow

Open Calculator

fx $V_h = \frac{V^2}{2} \cdot [g]$

ex $8.286619\text{m} = \frac{(1.3\text{m/s})^2}{2} \cdot [g]$

13) Velocity of Flow given Velocity Head for Steady Non Viscous Flow

Open Calculator

fx $V = \sqrt{V_h \cdot 2 \cdot [g]}$

ex $12.68184\text{m/s} = \sqrt{8.2\text{m} \cdot 2 \cdot [g]}$

Forces Acting on Fluid in Motion

14) Acceleration of Fluid given Sum of Total Forces influencing Motion of Fluid

Open Calculator

fx $a_f = \frac{F_g + F_p + F_C + F_s + F_v + F_t}{M_f}$

ex $1.736571\text{m/s}^2 = \frac{10.10\text{N} + 10.12\text{N} + 9.99\text{N} + 10.13\text{N} + 10.14\text{N} + 10.3\text{N}}{35\text{kg}}$

15) Compressibility Force given Sum of Total Forces influencing Motion of Fluid

Open Calculator

fx $F_C = F - (F_g + F_p + F_s + F_v + F_t)$

ex $9.21\text{N} = 60\text{N} - (10.10\text{N} + 10.12\text{N} + 10.13\text{N} + 10.14\text{N} + 10.3\text{N})$

16) Gravity Force given Sum of Total Forces influencing Motion of Fluid

Open Calculator

fx $F_g = F - (F_p + F_C + F_s + F_v + F_t)$

ex $9.32\text{N} = 60\text{N} - (10.12\text{N} + 9.99\text{N} + 10.13\text{N} + 10.14\text{N} + 10.3\text{N})$

17) Mass of Fluid given Sum of Total Forces influencing Motion of Fluid

Open Calculator

fx $M_f = \frac{F_g + F_p + F_C + F_s + F_v + F_t}{a_f}$

ex $35.75294\text{kg} = \frac{10.10\text{N} + 10.12\text{N} + 9.99\text{N} + 10.13\text{N} + 10.14\text{N} + 10.3\text{N}}{1.7\text{m/s}^2}$

18) Pressure Force given Sum of Total Forces influencing Motion of Fluid

Open Calculator

fx $F_p = F - (F_g + F_C + F_s + F_v + F_t)$

ex $9.34\text{N} = 60\text{N} - (10.10\text{N} + 9.99\text{N} + 10.13\text{N} + 10.14\text{N} + 10.3\text{N})$

19) Sum of Total Forces Influencing Motion of Fluid

Open Calculator

fx $F = F_g + F_p + F_C + F_s + F_v + F_t$

ex $60.78\text{N} = 10.10\text{N} + 10.12\text{N} + 9.99\text{N} + 10.13\text{N} + 10.14\text{N} + 10.3\text{N}$

20) Surface Tension Force given Sum of Total Forces influencing Motion of Fluid

Open Calculator

fx $F_s = F - (F_g + F_p + F_C + F_v + F_t)$

ex $9.35\text{N} = 60\text{N} - (10.10\text{N} + 10.12\text{N} + 9.99\text{N} + 10.14\text{N} + 10.3\text{N})$

21) Turbulent Force given Sum of Total Forces influencing Motion of Fluid

Open Calculator

fx $F_t = F - (F_g + F_p + F_C + F_s + F_v)$

ex $9.52\text{N} = 60\text{N} - (10.10\text{N} + 10.12\text{N} + 9.99\text{N} + 10.13\text{N} + 10.14\text{N})$

22) Viscous Force given Sum of Total Forces influencing Motion of Fluid

Open Calculator

fx $F_v = F - (F_g + F_p + F_C + F_s + F_t)$

ex $9.36\text{N} = 60\text{N} - (10.10\text{N} + 10.12\text{N} + 9.99\text{N} + 10.13\text{N} + 10.3\text{N})$

Orifice Meter

Pitot Tube

Venturimeter

Variables Used

- **A** Cross Sectional Area of Pipe *(Square Meter)*
- a_f Acceleration of Fluid *(Meter per Square Second)*
- C_d Coefficient of Discharge
- **F** Force of Fluid *(Newton)*
- F_C Compressibility Force *(Newton)*
- F_g Gravity Force *(Newton)*
- F_p Pressure Force *(Newton)*
- F_s Surface Tension Force *(Newton)*
- F_t Turbulent Force *(Newton)*
- F_v Viscous Force *(Newton)*
- **g** Acceleration due to Gravity *(Meter per Square Second)*
- **h** Height of Section *(Meter)*
- $h_{elbowmeter}$ Elbowmeter Height *(Meter)*
- h_p Pressure Head *(Millimeter)*
- $H_{Pressurehead}$ Difference in Pressure Head *(Meter)*
- M_f Mass of Fluid *(Kilogram)*
- **P** Piezometric Head *(Meter)*
- P_1 Pressure at Section 1 *(Newton per Square Millimeter)*
- P_2 Pressure at Section 2 *(Newton per Square Millimeter)*
- P_h Pressure of Fluid *(Pascal)*
- **q** Discharge of Pipe Through Elbow meter *(Cubic Meter per Second)*
- **V** Velocity of Fluid *(Meter per Second)*
- V_1 Velocity at Point 1 *(Meter per Second)*
- V_h Velocity Head *(Meter)*
- V_{p2} Velocity at Point 2 *(Meter per Second)*
- Z_1 Datum Height at Section 1 *(Meter)*
- Z_2 Datum Height at Section 2 *(Meter)*
- γ_f Specific Weight of Liquid *(Kilonewton per Cubic Meter)*

Constants, Functions, Measurements used

- Constant: **[g]**, 9.80665
  Gravitational acceleration on Earth
- Function: **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 Meter (m), Millimeter (mm)
  Length Unit Conversion
- Measurement: **Weight** in Kilogram (kg)
  Weight Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Pressure** in Newton per Square Millimeter (N/mm²), Pascal (Pa)
  Pressure Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Acceleration** in Meter per Square Second (m/s²)
  Acceleration Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m³/s)
  Volumetric Flow Rate Unit Conversion
- Measurement: **Specific Weight** in Kilonewton per Cubic Meter (kN/m³)
  Specific Weight Unit Conversion

Check other formula lists

- Buoyancy And Floatation Formulas
- Culverts Formulas
- Devices to Measure Flow Rate Formulas
- Equations of Motion and Energy Equation Formulas
- Flow of Compressible Fluids Formulas
- Flow Over Notches and Weirs Formulas
- Fluid Pressure and Its Measurement Formulas
- Fundamentals of Fluid Flow Formulas
- Hydroelectric Power Generation Formulas
- Hydrostatic Forces on Surfaces Formulas
- Impact of Free Jets Formulas
- Impulse Momentum Equation and its Applications Formulas
- Liquids in Relative Equilibrium Formulas
- Most Efficient Section of Channel Formulas
- Non uniform Flow in Channels Formulas
- Properties of Fluid Formulas
- Thermal Expansion of Pipe and Pipe Stresses Formulas
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