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Fluid in Motion Formulas

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List of 17 Fluid in Motion Formulas

Fluid in Motion

Flow Rate

1) Rate of Flow

Open Calculator

$$Q_f = A \cdot V_{avg}$$

ex $24.102\text{m}^3/\text{s} = 1.3\text{m}^2 \cdot 18.54\text{m/s}$

2) Rate of Flow given Head loss in Laminar Flow

Open Calculator

$$Q_f = h_l \cdot \gamma_f \cdot \pi \cdot \frac{d_p^4}{128 \cdot \mu \cdot L_p}$$

ex $23.09322\text{m}^3/\text{s} = 1.195\text{m} \cdot 108.2\text{N/m}^3 \cdot \pi \cdot \frac{(1.01\text{m})^4}{128 \cdot 1.43\text{N} \cdot 0.10\text{m}}$

3) Rate of Flow given Hydraulic Transmission Power

Open Calculator

$$Q_f = \frac{P}{\gamma_l \cdot (H_e - h_l)}$$

ex $24.19355\text{m}^3/\text{s} = \frac{3000\text{W}}{310\text{N/m}^3 \cdot (1.595\text{m} - 1.195\text{m})}$

4) Volumetric Flow Rate at Vena Contracta

Open Calculator

fx $$V_f = C_d \cdot A_{vc} \cdot \sqrt{2 \cdot [g] \cdot H_w}$$

ex $$30.01237 m^3/s = 0.66 \cdot 6.43 m^2 \cdot \sqrt{2 \cdot [g] \cdot 2.55 m}$$

5) Volumetric Flow Rate of Circular Orifice

Open Calculator

fx $$V_f = 0.62 \cdot a \cdot \sqrt{2 \cdot [g] \cdot H_w}$$

ex $$29.99554 m^3/s = 0.62 \cdot 6.841 m^2 \cdot \sqrt{2 \cdot [g] \cdot 2.55 m}$$

6) Volumetric Flow Rate of Rectangular Notch

Open Calculator

fx $$V_f = 0.62 \cdot b \cdot H \cdot \frac{2}{3} \cdot \sqrt{2 \cdot [g] \cdot H_w}$$

ex $$30.0067 m^3/s = 0.62 \cdot 3.88 m \cdot 2.6457 m \cdot \frac{2}{3} \cdot \sqrt{2 \cdot [g] \cdot 2.55 m}$$

7) Volumetric Flow Rate of Triangular Right Angled Notch

Open Calculator

fx $$V_f = 2.635 \cdot H^{\frac{5}{2}}$$

ex $$30.00075 m^3/s = 2.635 \cdot (2.6457 m)^{\frac{5}{2}}$$

8) Volumetric Flow Rate of Venacontracta given Contraction and Velocity

Open Calculator

fx $$V_f = C_c \cdot C_v \cdot A_{vc} \cdot \sqrt{2 \cdot [g] \cdot H_w}$$

ex $$30.12151 m^3/s = 0.72 \cdot 0.92 \cdot 6.43 m^2 \cdot \sqrt{2 \cdot [g] \cdot 2.55 m}$$

Hydrodynamics Basics

9) Metacentric Height given Time Period of Rolling

Open Calculator

fx $$H_m = \frac{(K_g \cdot \pi)^2}{\left(\frac{T_r}{2}\right)^2 \cdot [g]}$$

ex $$0.730432 m = \frac{(4.43 m \cdot \pi)^2}{\left(\frac{10.4 s}{2}\right)^2 \cdot [g]}$$

10) Moment of Momentum Equation

Open Calculator

fx $$T = \rho_1 \cdot Q \cdot (v_1 \cdot R_1 - v_2 \cdot R_2)$$

ex $$504.2688 N*m = 4 kg/m^3 \cdot 1.072 m^3/s \cdot (20 m/s \cdot 8.1 m - 12 m/s \cdot 3.7 m)$$

11) Poiseuille's Formula

Open Calculator

fx $$Q_v = \Delta p \cdot \frac{\pi}{8} \cdot \frac{r_p^4}{\mu_v \cdot L}$$

ex $$10.00588\text{m}^3/\text{s} = 3.21\text{Pa} \cdot \frac{\pi}{8} \cdot \frac{(2.22\text{m})^4}{1.02\text{Pa*s} \cdot 3\text{m}}$$

12) Power

Open Calculator

fx $$P_w = F_e \cdot \Delta v$$

ex $$900\text{W} = 2.5\text{N} \cdot 360\text{m/s}$$

13) Power Developed by Turbine

Open Calculator

fx $$P_T = \rho_1 \cdot Q \cdot V_{wi} \cdot \nu_t$$

ex $$120.064\text{W} = 4\text{kg/m}^3 \cdot 1.072\text{m}^3/\text{s} \cdot 2\text{m/s} \cdot 14\text{m/s}$$

14) Power Required to Overcome Frictional Resistance in Laminar Flow

Open Calculator

fx $$P_w = \gamma \cdot R_f \cdot h_f$$

ex $$900\text{W} = 31.25\text{N/m}^3 \cdot 24\text{m}^3/\text{s} \cdot 1.2\text{m}$$

15) Reynolds Number

Open Calculator

fx $$\mathrm{Re} = \frac{\rho_1 \cdot v_{fd} \cdot d_p}{\mu_v}$$

ex $$500.0094 = \frac{4\mathrm{kg/m^3} \cdot 126.24\mathrm{m/s} \cdot 1.01\mathrm{m}}{1.02\mathrm{Pa*s}}$$

16) Reynolds Number given Frictional Factor of Laminar Flow

Open Calculator

fx $$\mathrm{Re} = \frac{64}{f}$$

ex $$500 = \frac{64}{0.128}$$

17) Reynolds Number given Length

Open Calculator

fx $$\mathrm{Re} = \rho_1 \cdot v_f \cdot \frac{L}{V_k}$$

ex $$500 = 4\mathrm{kg/m^3} \cdot 60\mathrm{m/s} \cdot \frac{3\mathrm{m}}{14.4\mathrm{kSt}}$$

Variables Used

- **a** Area of Orifice *(Square Meter)*
- **A** Cross Sectional Area *(Square Meter)*
- A_{vc} Area of Jet at Vena Contracta *(Square Meter)*
- **b** Thickness of Dam *(Meter)*
- C_c Coefficient of Contraction
- C_d Coefficient of Discharge
- C_v Coefficient of Velocity
- d_p Diameter of Pipe *(Meter)*
- **f** Friction Factor
- F_e Force on Fluid Element *(Newton)*
- **H** Head of Water Above Sill of Notch *(Meter)*
- H_e Total Head at Entrance *(Meter)*
- h_f Head Loss *(Meter)*
- h_l Head Loss of Fluid *(Meter)*
- H_m Metacentric Height *(Meter)*
- H_w Head *(Meter)*
- K_g Radius of Gyration *(Meter)*
- **L** Length *(Meter)*
- L_p Length of Pipe *(Meter)*
- **P** Power *(Watt)*
- P_T Power Developed by Turbine *(Watt)*

- P_w Power Generated *(Watt)*
- Q Discharge *(Cubic Meter per Second)*
- Q_f Rate of Flow *(Cubic Meter per Second)*
- Q_v Volumetric Flow Rate of Feed to Reactor *(Cubic Meter per Second)*
- R_1 Radius of Curvature at Section 1 *(Meter)*
- R_2 Radius of Curvature at Section 2 *(Meter)*
- R_f Rate of Flow of Fluid *(Cubic Meter per Second)*
- r_p Pipe Radius *(Meter)*
- Re Reynolds Number
- T Torque Exerted on Wheel *(Newton Meter)*
- T_r Time Period of Rolling *(Second)*
- v_1 Velocity at Section 1-1 *(Meter per Second)*
- v_2 Velocity at Section 2-2 *(Meter per Second)*
- V_{avg} Average Velocity *(Meter per Second)*
- v_f Velocity *(Meter per Second)*
- V_f Volumetric Flow Rate *(Cubic Meter per Second)*
- v_{fd} Fluid Velocity *(Meter per Second)*
- V_k Kinematic Viscosity *(Kilostokes)*
- V_{wi} Velocity of Whirl at Inlet *(Meter per Second)*
- γ Specific Weight of Liquid 1 *(Newton per Cubic Meter)*
- γ_f Specific Weight *(Newton per Cubic Meter)*
- γ_l Specific Weight of Liquid *(Newton per Cubic Meter)*
- Δp Pressure Changes *(Pascal)*
- Δv Change in Velocity *(Meter per Second)*

- μ Viscous Force *(Newton)*
- μ_v Dynamic Viscosity *(Pascal Second)*
- v_t Tangential Velocity at Inlet *(Meter per Second)*
- ρ_1 Density of Liquid *(Kilogram per Cubic Meter)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- 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)
  Length Unit Conversion
- Measurement: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Pressure** in Pascal (Pa)
  Pressure Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Power** in Watt (W)
  Power 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: **Dynamic Viscosity** in Pascal Second (Pa*s)
  Dynamic Viscosity Unit Conversion

- Measurement: **Kinematic Viscosity** in Kilostokes (kSt)
  Kinematic Viscosity Unit Conversion
- Measurement: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density Unit Conversion
- Measurement: **Torque** in Newton Meter (N*m)
  Torque Unit Conversion
- Measurement: **Specific Weight** in Newton per Cubic Meter (N/m³)
  Specific Weight Unit Conversion

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- **Fluid in Motion Formulas**
- **Hydrostatic Fluid Formulas**
- **Liquid Jet Formulas**
- **Pipes Formulas**
- **Pressure Relations Formulas**
- **Specific Weight Formulas**

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