Important Properties of Fluid Formulas PDF

Formulas
Examples
with Units

List of 33
Important Properties of Fluid Formulas

1) Absolute Pressure using Equation of State given Specific Weight Formula

Evaluate Formula

Formula

$$P_{ab'} = R \cdot S \cdot T$$

Example with Units

$$310575\,\text{Pa} = 4.1\,\text{J/(kg*K)} \cdot 0.75\,\text{kN/m}^3 \cdot 101\,\text{K}$$

2) Absolute Pressure using Gas Density Formula

Evaluate Formula

Formula

$$P_{ab} = T \cdot \rho_{gas} \cdot R$$

Example with Units

$$0.53\,\text{Pa} = 101\,\text{K} \cdot 0.00128\,\text{g/L} \cdot 4.1\,\text{J/(kg*K)}$$

3) Absolute Temperature of Gas Formula

Evaluate Formula

Formula

$$T = \frac{P_{ab}}{R \cdot \rho_{gas}}$$

Example with Units

$$97.561\,\text{K} = \frac{0.512\,\text{Pa}}{4.1\,\text{J/(kg*K)} \cdot 0.00128\,\text{g/L}}$$

4) Bulk Modulus of Elasticity Formula

Evaluate Formula

Formula

$$K = \left(\frac{\Delta P}{\frac{dV}{V_f}} \right)$$

Example with Units

$$2000\,\text{N/m}^2 = \left(\frac{100\,\text{Pa}}{\frac{5\,\text{m}^3}{100\,\text{m}^3}} \right)$$

5) Capillary Rise or Depression of Fluid Formula

Evaluate Formula

Formula

$$h_c = \frac{2 \cdot \sigma \cdot \cos(\theta)}{G_f \cdot r_t \cdot W \cdot 1000}$$

Example with Units

$$0.0002\,\text{m} = \frac{2 \cdot 72.75\,\text{N/m} \cdot \cos(10°)}{14 \cdot 5.1\,\text{m} \cdot 9.81\,\text{kN/m}^3 \cdot 1000}$$

6) Capillary Rise or Depression when Tube is inserted in two Liquids Formula

Evaluate Formula

Formula

$$h_c = \frac{2 \cdot \sigma \cdot \cos(\theta)}{r_t \cdot W \cdot (S_1 - S_2) \cdot 1000}$$

Example with Units

$$0.0029\,\text{m} = \frac{2 \cdot 72.75\,\text{N/m} \cdot \cos(10°)}{5.1\,\text{m} \cdot 9.81\,\text{kN/m}^3 \cdot (5 - 4) \cdot 1000}$$

7) Capillary Rise or Depression when two Vertical Parallel Plates are Partially Immersed in Liquid Formula

Evaluate Formula

Formula

$$h_c = \frac{2 \cdot \sigma \cdot (\cos(\theta))}{W \cdot G_f \cdot t}$$

Example with Units

$$0.0002\,\text{m} = \frac{2 \cdot 72.75\,\text{N/m} \cdot (\cos(10°))}{9.81\,\text{kN/m}^3 \cdot 14 \cdot 5\,\text{m}}$$

8) Capillary Rise when Contact is between Water and Glass Formula

Evaluate Formula

Formula

$$h_c = \frac{2 \cdot \sigma}{r_t \cdot W \cdot 1000}$$

Example with Units

$$0.0029\,\text{m} = \frac{2 \cdot 72.75\,\text{N/m}}{5.1\,\text{m} \cdot 9.81\,\text{kN/m}^3 \cdot 1000}$$

9) Compressibility of Fluid Formula

Evaluate Formula

Formula

$$C = \left(\frac{\frac{dV}{V_f}}{\Delta P} \right)$$

Example with Units

$$0.0005\,\text{m}^2\text{/N} = \left(\frac{\frac{5\,\text{m}^3}{100\,\text{m}^3}}{100\,\text{Pa}} \right)$$

10) Compressibility of Fluid given Bulk Modulus of Elasticity Formula

Evaluate Formula

Formula

$$C = \frac{1}{K}$$

Example with Units

$$0.0005\,\text{m}^2\text{/N} = \frac{1}{2000\,\text{N/m}^2}$$

11) Dynamic Viscosity given Shear Stress Formula

Evaluate Formula

Formula

$$\mu = \frac{\tau}{dvdy}$$

Example with Units

$$80\,\text{N*s/m}^2 = \frac{800\,\text{N/m}^2}{10\,\text{cycle/s}}$$

12) Dynamic Viscosity using Kinematic Viscosity Formula

Evaluate Formula

Formula

$$\mu = \rho_f \cdot \nu$$

Example with Units

$$80.08\,\text{N*s/m}^2 = 77\,\text{kg/m}^3 \cdot 1.04\,\text{m}^2\text{/s}$$

13) Gas Constant using Equation of State Formula

Evaluate Formula

Formula

$$R = \frac{P_{ab}}{\rho_{gas} \cdot T}$$

Example with Units

$$3.9604\,\text{J/(kg*K)} = \frac{0.512\,\text{Pa}}{0.00128\,\text{g/L} \cdot 101\,\text{K}}$$

14) Mass Density given Specific Weight Formula

Evaluate Formula

Formula

$$\rho_f = \frac{S}{g}$$

Example with Units

$$76.5306\,\text{kg/m}^3 = \frac{0.75\,\text{kN/m}^3}{9.8\,\text{m/s}^2}$$

15) Mass Density given Viscosity Formula

Evaluate Formula

Formula

$$\rho_f = \frac{\mu}{\nu}$$

Example with Units

$$76.9231\,\text{kg/m}^3 = \frac{80\,\text{N*s/m}^2}{1.04\,\text{m}^2/\text{s}}$$

16) Pressure Intensity inside Droplet Formula

Evaluate Formula

Formula

$$p_i = \frac{2 \cdot \sigma}{r_t}$$

Example with Units

$$28.5294\,\text{N/m}^2 = \frac{2 \cdot 72.75\,\text{N/m}}{5.1\,\text{m}}$$

17) Pressure Intensity inside Liquid Jet Formula

Evaluate Formula

Formula

$$p_i = \frac{\sigma}{r_t}$$

Example with Units

$$14.2647\,\text{N/m}^2 = \frac{72.75\,\text{N/m}}{5.1\,\text{m}}$$

18) Pressure Intensity inside Soap Bubble Formula

Evaluate Formula

Formula

$$p_i = \frac{4 \cdot \sigma}{r_t}$$

Example with Units

$$57.0588\,\text{N/m}^2 = \frac{4 \cdot 72.75\,\text{N/m}}{5.1\,\text{m}}$$

19) Shear Stress between any two thin sheets of Fluid Formula

Evaluate Formula

Formula

$$\tau = dvdy \cdot \mu$$

Example with Units

$$800\,\text{N/m}^2 = 10\,\text{cycle/s} \cdot 80\,\text{N*s/m}^2$$

20) Specific Gravity of Fluid Formula

Evaluate Formula

Formula

$$G_f = \frac{S}{\Upsilon_s}$$

Example with Units

$$10.7143 = \frac{0.75\,\text{kN/m}^3}{70\,\text{N/m}^3}$$

21) Specific Volume of Fluid Formula

Evaluate Formula

Formula

$$v = \frac{1}{\rho_f}$$

Example with Units

$$0.013\,\text{m}^3/\text{kg} = \frac{1}{77\,\text{kg/m}^3}$$

22) Velocity Gradient Formula

Evaluate Formula

Formula

$$dvdy = \frac{dv}{dy}$$

Example with Units

$$10.1\,\text{cycle/s} = \frac{10.1\,\text{m/s}}{1000\,\text{mm}}$$

23) Velocity Gradient given Shear Stress Formula

Evaluate Formula

Formula

$$dvdy = \frac{\tau}{\mu}$$

Example with Units

$$10\,\text{cycle/s} = \frac{800\,\text{N/m}^2}{80\,\text{N*s/m}^2}$$

24) Velocity of Fluid given Shear Stress Formula

Evaluate Formula

Formula

$$V = \frac{Y \cdot \tau}{\mu}$$

Example with Units

$$810\,\text{m/s} = \frac{81\,\text{m} \cdot 800\,\text{N/m}^2}{80\,\text{N*s/m}^2}$$

25) Volume of Fluid given Specific Weight Formula

Evaluate Formula

Formula

$$V_T = \frac{w_l}{S}$$

Example with Units

$$0.6471\,\text{m}^3 = \frac{485.36\,\text{N}}{0.75\,\text{kN/m}^3}$$

26) Specific Weight Formulas

26.1) Specific Weight given Mass Density Formula

Evaluate Formula

Formula

$$S = \rho_f \cdot g$$

Example with Units

$$0.7546\,\text{kN/m}^3 = 77\,\text{kg/m}^3 \cdot 9.8\,\text{m/s}^2$$

26.2) Specific Weight of Fluid Formula

Evaluate Formula

Formula

$$S = \frac{w_l}{V_T}$$

Example with Units

$$0.7704\,\text{kN/m}^3 = \frac{485.36\,\text{N}}{0.63\,\text{m}^3}$$

26.3) Specific Weight of Fluid given Specific Gravity Formula

Evaluate Formula

Formula

$$S = G_f \cdot \Upsilon_s$$

Example with Units

$$0.98\,\text{kN/m}^3 = 14 \cdot 70\,\text{N/m}^3$$

26.4) Specific Weight using Equation of State given Absolute Pressure Formula

Evaluate Formula

Formula

$$S = \frac{P_{ab'}}{R \cdot T}$$

Example with Units

$$0.7245\,\text{kN/m}^3 = \frac{300000\,\text{Pa}}{4.1\,\text{J/(kg*K)} \cdot 101\,\text{K}}$$

27) Surface Tension Formulas

27.1) Surface Tension given Capillary Rise or Depression Formula

Evaluate Formula

Formula

$$\sigma = \frac{h_c \cdot W \cdot G_f \cdot r_t \cdot 1000}{2 \cdot (\cos(\theta))}$$

Example with Units

$$106.6859\,\text{N/m} = \frac{0.0003\,\text{m} \cdot 9.81\,\text{kN/m}^3 \cdot 14 \cdot 5.1\,\text{m} \cdot 1000}{2 \cdot (\cos(10^\circ))}$$

27.2) Surface Tension given Pressure Intensity inside Droplet Formula

Evaluate Formula

Formula

$$\sigma = p_i \cdot \frac{r_t}{2}$$

Example with Units

$$77.01\,\text{N/m} = 30.2\,\text{N/m}^2 \cdot \frac{5.1\,\text{m}}{2}$$

27.3) Surface Tension given Pressure Intensity inside Liquid Jet Formula

Evaluate Formula

Formula

$$\sigma = p_i \cdot r_t$$

Example with Units

$$154.02\,\text{N/m} = 30.2\,\text{N/m}^2 \cdot 5.1\,\text{m}$$

27.4) Surface Tension given Pressure Intensity inside Soap Bubble Formula

Evaluate Formula

Formula

$$\sigma = p_i \cdot \frac{r_t}{4}$$

Example with Units

$$38.505\,\text{N/m} = 30.2\,\text{N/m}^2 \cdot \frac{5.1\,\text{m}}{4}$$

Variables used in list of Properties of Fluid Formulas above

- **C** Compressibility of Fluid *(Square Meter per Newton)*
- **dv** Change in Velocity *(Meter per Second)*
- **dV** Change in Volume *(Cubic Meter)*
- **dvdy** Velocity Gradient *(Cycle per Second)*
- **dy** Change in Distance *(Millimeter)*
- **g** Acceleration due to Gravity *(Meter per Square Second)*
- G_f Specific Gravity of Fluid
- h_c Capillary Rise (or Depression) *(Meter)*
- **K** Bulk Modulus of Elasticity *(Newton per Square Meter)*
- P_{ab} Absolute Pressure by Gas Density *(Pascal)*
- $P_{ab'}$ Absolute Pressure by Specific Weight *(Pascal)*
- p_i Internal Pressure Intensity *(Newton per Square Meter)*
- **R** Gas Constant *(Joule per Kilogram per K)*
- r_t Radius of Tube *(Meter)*
- **S** Specific Weight of Liquid in Piezometer *(Kilonewton per Cubic Meter)*
- S_1 Specific Gravity of Liquid 1
- S_2 Specific Gravity of Liquid 2
- **t** Distance between Vertical Plates *(Meter)*
- **T** Absolute Temperature of Gas *(Kelvin)*
- **v** Specific Volume *(Cubic Meter per Kilogram)*
- **V** Fluid Velocity *(Meter per Second)*
- V_f Fluid Volume *(Cubic Meter)*
- V_T Volume *(Cubic Meter)*
- **W** Specific Weight of Water in KN per cubic meter *(Kilonewton per Cubic Meter)*
- w_l Weight of Liquid *(Newton)*
- **Y** Distance between Fluid Layers *(Meter)*
- **ΔP** Change in Pressure *(Pascal)*
- **θ** Contact Angle *(Degree)*

Constants, Functions, Measurements used in list of Properties of Fluid Formulas above

- Functions: **cos**, cos(Angle)
  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- Measurement: **Length** in Meter (m), Millimeter (mm)
  Length Unit Conversion
- Measurement: **Temperature** in Kelvin (K)
  Temperature Unit Conversion
- Measurement: **Volume** in Cubic Meter (m^3)
  Volume Unit Conversion
- Measurement: **Pressure** in Pascal (Pa), Newton per Square Meter (N/m^2)
  Pressure Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Acceleration** in Meter per Square Second (m/s^2)
  Acceleration Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Frequency** in Cycle per Second (cycle/s)
  Frequency Unit Conversion
- Measurement: **Specific Heat Capacity** in Joule per Kilogram per K (J/(kg*K))
  Specific Heat Capacity Unit Conversion
- Measurement: **Surface Tension** in Newton per Meter (N/m)
  Surface Tension Unit Conversion
- Measurement: **Dynamic Viscosity** in Newton Second per Square Meter ($N*s/m^2$)
  Dynamic Viscosity Unit Conversion
- Measurement: **Kinematic Viscosity** in Square Meter per Second (m^2/s)
  Kinematic Viscosity Unit Conversion
- Measurement: **Density** in Gram per Liter (g/L), Kilogram per Cubic Meter (kg/m^3)
  Density Unit Conversion

- **μ** Dynamic Viscosity *(Newton Second per Square Meter)*
- **ν** Kinematic Viscosity *(Square Meter per Second)*
- **ρ_f** Mass Density of Fluid *(Kilogram per Cubic Meter)*
- **ρ_{gas}** Density of Gas *(Gram per Liter)*
- **σ** Surface Tension *(Newton per Meter)*
- **τ** Shear Stress *(Newton per Square Meter)*
- **Υ_s** Specific Weight of Standard Fluid *(Newton per Cubic Meter)*

- Measurement: **Specific Volume** in Cubic Meter per Kilogram (m³/kg)
  Specific Volume Unit Conversion
- Measurement: **Specific Weight** in Kilonewton per Cubic Meter (kN/m³), Newton per Cubic Meter (N/m³)
  Specific Weight Unit Conversion
- Measurement: **Compressibility** in Square Meter per Newton (m²/N)
  Compressibility Unit Conversion

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