Important Buoyancy And Floatation Formulas PDF

Formulas
Examples
with Units

List of 24
Important Buoyancy And Floatation Formulas

1) Buoyancy Force and Center of Buoyancy Formulas

1.1) Buoyancy Force given Volume of Vertical Prism Formula

Evaluate Formula

Formula

$$F_{Buoyant} = \omega \cdot V$$

Example with Units

$$44566.83\,\text{N} = 75537\,\text{N/m}^3 \cdot 0.59\,\text{m}^3$$

1.2) Buoyant Force on Entire Submerged Body Formula

Evaluate Formula

Formula

$$F_{Buoyant} = \omega \cdot V$$

Example with Units

$$44566.83\,\text{N} = 75537\,\text{N/m}^3 \cdot 0.59\,\text{m}^3$$

1.3) Buoyant Force on Vertical Prism Formula

Evaluate Formula

Formula

$$F_{Buoyant} = \omega \cdot H_{Pressurehead} \cdot A$$

Example with Units

$$44944.515\,\text{N} = 75537\,\text{N/m}^3 \cdot 0.7\,\text{m} \cdot 0.85\,\text{m}^2$$

1.4) Buoyant Force when Body Floats at between two Immiscible Fluids of Specific Weights Formula

Evaluate Formula

Formula

$$F_{Buoyant} = \left(\omega \cdot \nu_1 + \omega_1 \cdot \nu_2\right)$$

Example with Units

$$53523.537\,\text{N} = \left(75537\,\text{N/m}^3 \cdot 0.001\,\text{m}^3\text{/kg} + 65500\,\text{N/m}^3 \cdot 0.816\,\text{m}^3\text{/kg}\right)$$

1.5) Cross Sectional Area of Prism given Buoyancy Force Formula

Evaluate Formula

Formula

$$A = \frac{F_{Buoyant}}{\omega \cdot H_{Pressurehead}}$$

Example with Units

$$0.8374\,\text{m}^2 = \frac{44280\,\text{N}}{75537\,\text{N/m}^3 \cdot 0.7\,\text{m}}$$

1.6) Cross Sectional Area of Prism given Volume of Vertical Prism dV Formula

Evaluate Formula

Formula

$$A = \frac{V}{H_{Pressurehead}}$$

Example with Units

$$0.8429\,\text{m}^2 = \frac{0.59\,\text{m}^3}{0.7\,\text{m}}$$

1.7) Pressure Head Difference given Buoyancy Force Formula

Evaluate Formula

Formula

$$H_{Pressurehead} = \frac{F_{Buoyant}}{\omega \cdot A}$$

Example with Units

$$0.6897\,\text{m} = \frac{44280\,\text{N}}{75537\,\text{N/m}^3 \cdot 0.85\,\text{m}^2}$$

1.8) Pressure Head Difference given Volume of Vertical Prism dV Formula

Evaluate Formula

Formula

$$H_{Pressurehead} = \frac{V}{A}$$

Example with Units

$$0.6941\,\text{m} = \frac{0.59\,\text{m}^3}{0.85\,\text{m}^2}$$

1.9) Specific Weight pf Fluid given Buoyancy Force Formula

Evaluate Formula

Formula

$$\omega = \frac{F_{Buoyant}}{H_{Pressurehead} \cdot A}$$

Example with Units

$$74420.1681\,\text{N/m}^3 = \frac{44280\,\text{N}}{0.7\,\text{m} \cdot 0.85\,\text{m}^2}$$

1.10) Total Buoyant Force given Volumes of Elementary Prism Submerged in Fluids Formula

Evaluate Formula

Formula

$$F_{Buoyant} = \left(\omega \cdot \nu_1 + \omega_1 \cdot \nu_2\right)$$

Example with Units

$$53523.537\,\text{N} = \left(75537\,\text{N/m}^3 \cdot 0.001\,\text{m}^3\text{/kg} + 65500\,\text{N/m}^3 \cdot 0.816\,\text{m}^3\text{/kg}\right)$$

1.11) Volume of Submerged Body given Buoyant Force on Entire Submerged Body Formula

Evaluate Formula

Formula

$$V = \frac{F_{Buoyant}}{\omega}$$

Example with Units

$$0.5862\,\text{m}^3 = \frac{44280\,\text{N}}{75537\,\text{N/m}^3}$$

1.12) Volume of Vertical Prism Formula

Evaluate Formula

Formula

$$V = H_{Pressurehead} \cdot A$$

Example with Units

$$0.595\,\text{m}^3 = 0.7\,\text{m} \cdot 0.85\,\text{m}^2$$

2) Determination of Metacentric Height Formulas

2.1) Angle Made by Pendulum Formula

Evaluate Formula

Formula

$$\theta = atan\left(\frac{d}{l}\right)$$

Example with Units

$$71.5651° = atan\left(\frac{150\,\text{m}}{50\,\text{m}}\right)$$

2.2) Distance Moved by Pendulum on Horizontal scale Formula

Evaluate Formula

Formula

$$d = l \cdot \tan(\theta)$$

Example with Units

$$149.4342\,\text{m} = 50\,\text{m} \cdot \tan(71.5°)$$

2.3) Length of Plumb Line Formula

Evaluate Formula

Formula

$$l = \frac{d}{\tan(\theta)}$$

Example with Units

$$50.1893\,\text{m} = \frac{150\,\text{m}}{\tan(71.5°)}$$

3) Metacentric Height for Floating Bodies Containing liquid Formulas

3.1) Distance between Centre of Gravity of these Wedges Formula

Evaluate Formula

Formula

$$z = \frac{m}{\omega \cdot V}$$

Example with Units

$$1.1219\,\text{m} = \frac{50000\,\text{N*m}}{75537\,\text{N/m}^3 \cdot 0.59\,\text{m}^3}$$

3.2) Moment of Turning Couple due to Movement of Liquid Formula

Evaluate Formula

Formula

$$m = (\omega \cdot V \cdot z)$$

Example with Units

$$46795.1715\,\text{N*m} = (75537\,\text{N/m}^3 \cdot 0.59\,\text{m}^3 \cdot 1.05\,\text{m})$$

3.3) Volume of either Wedge Formula

Evaluate Formula

Formula

$$V = \frac{m}{\omega \cdot z}$$

Example with Units

$$0.6304\,\text{m}^3 = \frac{50000\,\text{N*m}}{75537\,\text{N/m}^3 \cdot 1.05\,\text{m}}$$

4) Stability of Submerged and Floating Bodies Formulas

4.1) Restoring Couple when Floating Body in Stable Equilibrium Formula

Evaluate Formula

Formula

$$R_{\text{Restoring Couple}} = \left(W_{\text{body}} \cdot x \cdot \left(D \cdot \left(\frac{180}{\pi}\right)\right)\right)$$

Example with Units

$$12960\,\text{N*m} = \left(18\,\text{N} \cdot 8\,\text{m} \cdot \left(90° \cdot \left(\frac{180}{3.1416}\right)\right)\right)$$

4.2) Righting Couple when Floating Body in Unstable Equilibrium Formula

Evaluate Formula

Formula

$$R_{Righting\ Couple} = \left(W_{body} \cdot x \cdot \left(D \cdot \left(\frac{180}{\pi} \right) \right) \right)$$

Example with Units

$$12960\,\text{N*m} = \left(18\,\text{N} \cdot 8\,\text{m} \cdot \left(90° \cdot \left(\frac{180}{3.1416} \right) \right) \right)$$

4.3) Weight of Body given Restoring Couple Formula

Evaluate Formula

Formula

$$W_{body} = \frac{R_{Restoring\ Couple}}{x \cdot \left(D \cdot \left(\frac{180}{\pi} \right) \right)}$$

Example with Units

$$18\,\text{N} = \frac{12960\,\text{N*m}}{8\,\text{m} \cdot \left(90° \cdot \left(\frac{180}{3.1416} \right) \right)}$$

4.4) Weight of Body given Righting Couple Formula

Evaluate Formula

Formula

$$W_{body} = \frac{R_{Righting\ Couple}}{x \cdot \left(D \cdot \left(\frac{180}{\pi} \right) \right)}$$

Example with Units

$$18.0014\,\text{N} = \frac{12961\,\text{N*m}}{8\,\text{m} \cdot \left(90° \cdot \left(\frac{180}{3.1416} \right) \right)}$$

5) Time Period of Transverse Oscillation of a Floating Body Formulas

5.1) Radius of Gyration of Body given Time Period Formula

Evaluate Formula

Formula

$$k_G = \sqrt{\left(\left(\frac{T}{2 \cdot \pi} \right)^2 \right) \cdot \left([g] \cdot GM \right)}$$

Example with Units

$$0.1039\,\text{m} = \sqrt{\left(\left(\frac{5.38\,\text{s}}{2 \cdot 3.1416} \right)^2 \right) \cdot \left(9.8066\,\text{m/s}^2 \cdot 0.0015\,\text{m} \right)}$$

5.2) Time Period of One Complete Oscillations Formula

Evaluate Formula

Formula

$$T = 2 \cdot \pi \cdot \left(\frac{{k_G}^2}{[g] \cdot GM} \right)^{\frac{1}{2}}$$

Example with Units

$$5.4396\,\text{s} = 2 \cdot 3.1416 \cdot \left(\frac{0.105\,\text{m}^2}{9.8066\,\text{m/s}^2 \cdot 0.0015\,\text{m}} \right)^{\frac{1}{2}}$$

Variables used in list of Buoyancy And Floatation Formulas above

- **A** Cross-Sectional Area of Body *(Square Meter)*
- **d** Distance Moved *(Meter)*
- **D** Angle Between Bodies *(Degree)*
- $F_{Buoyant}$ Buoyant Force *(Newton)*
- **GM** Metacentric Height *(Meter)*
- $H_{Pressurehead}$ Difference in Pressure Head *(Meter)*
- k_G Radius of Gyration of Body *(Meter)*
- **l** Length of Plumb Line *(Meter)*
- **m** Moment of turning Couple *(Newton Meter)*
- $R_{Restoring\ Couple}$ Restoring Couple *(Newton Meter)*
- $R_{Righting\ Couple}$ Righting Couple *(Newton Meter)*
- **T** Time Period of Rolling *(Second)*
- **V** Volume of Body *(Cubic Meter)*
- W_{body} Weight of Body *(Newton)*
- **x** Distance from submerged to Floating Body *(Meter)*
- **z** Distance between Center of Gravity of these Wedges *(Meter)*
- **θ** Tiltting Angle of Body *(Degree)*
- v_1 Specific Volume at Point 1 *(Cubic Meter per Kilogram)*
- v_2 Specific Volume at Point 2 *(Cubic Meter per Kilogram)*
- **ω** Specific Weight of body *(Newton per Cubic Meter)*
- ω_1 Specific Weight 2 *(Newton per Cubic Meter)*

Constants, Functions, Measurements used in list of Buoyancy And Floatation Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- constant(s): **[g]**, 9.80665 *Gravitational acceleration on Earth*
- Functions: **atan**, atan(Number) *Inverse tan is used to calculate the angle by applying the tangent ratio of the angle, which is the opposite side divided by the adjacent side of the right triangle.*
- 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.*
- Functions: **tan**, tan(Angle) *The tangent of an angle is a trigonometric ratio of the length of the side opposite an angle to the length of the side adjacent to an angle in a right triangle.*
- Measurement: **Length** in Meter (m) *Length Unit Conversion*
- Measurement: **Time** in Second (s) *Time Unit Conversion*
- Measurement: **Volume** in Cubic Meter (m^3) *Volume Unit Conversion*
- Measurement: **Area** in Square Meter (m^2) *Area Unit Conversion*
- Measurement: **Force** in Newton (N) *Force Unit Conversion*
- Measurement: **Angle** in Degree (°) *Angle Unit Conversion*
- Measurement: **Torque** in Newton Meter (N*m) *Torque Unit Conversion*
- Measurement: **Specific Volume** in Cubic Meter per Kilogram (m^3/kg) *Specific Volume Unit Conversion*
- Measurement: **Moment of Force** in Newton Meter (N*m) *Moment of Force Unit Conversion*

- Measurement: **Specific Weight** in Newton per Cubic Meter (N/m³)
  Specific Weight Unit Conversion

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