Important Buoyancy Formulas PDF

Formulas
Examples
with Units

List of 11
Important Buoyancy Formulas

1) Angle of heel for metacentric height in experimental method Formula

Evaluate Formula

Formula

$$\theta = atan\left(\frac{w_1 \cdot D}{W_{fv} \cdot GM}\right)$$

Example with Units

$$8.2421° = atan\left(\frac{343\,N \cdot 5.8\,m}{19620\,N \cdot 0.7\,m}\right)$$

2) Archimedes Principle Formula

Evaluate Formula

Formula

$$A_{bouy} = \rho \cdot g \cdot v$$

Example with Units

$$3239.88\,N = 5.51\,kg/m^3 \cdot 9.8\,m/s^2 \cdot 60\,m/s$$

3) Buoyant Force Formula

Evaluate Formula

Formula

$$F_{buoy} = p \cdot A$$

Example with Units

$$40000\,N = 800\,Pa \cdot 50\,m^2$$

4) Centre of Buoyancy Formula

Evaluate Formula

Formula

$$B_c = \frac{d}{2}$$

Example with Units

$$0.525\,m = \frac{1.05\,m}{2}$$

5) Meta-centric height for time period of oscillation and radius of gyration Formula

Evaluate Formula

Formula

$$GM = \frac{4 \cdot \left(\pi^2\right) \cdot \left(k_G^{\,2}\right)}{\left(T^2\right) \cdot [g]}$$

Example with Units

$$0.7004\,m = \frac{4 \cdot \left(3.1416^2\right) \cdot \left(8\,m^2\right)}{\left(19.18\,s^2\right) \cdot 9.8066\,m/s^2}$$

6) Meta-centric height in experimental method Formula

Evaluate Formula

Formula

$$GM = \left(\frac{w_1 \cdot D}{W_{fv} \cdot \tan\left(\theta\right)}\right)$$

Example with Units

$$0.7002\,m = \left(\frac{343\,N \cdot 5.8\,m}{19620\,N \cdot \tan\left(8.24°\right)}\right)$$

7) Movable weight for metacentric height in experimental method Formula

Evaluate Formula

Formula

$$w_1 = \frac{GM \cdot W_{fv} \cdot \tan(\theta)}{D}$$

Example with Units

$$342.9117\,\text{N} = \frac{0.7\,\text{m} \cdot 19620\,\text{N} \cdot \tan(8.24°)}{5.8\,\text{m}}$$

8) Radius of gyration for metacentric height and time period of oscillation Formula

Evaluate Formula

Formula

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

Example with Units

$$7.9979\,\text{m} = \frac{(19.18\,\text{s}) \cdot \sqrt{0.7\,\text{m} \cdot 9.8066\,\text{m/s}^2}}{2 \cdot 3.1416}$$

9) Time Period of Oscillation of Ship Formula

Evaluate Formula

Formula

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

Example with Units

$$19.1849\,\text{s} = (2 \cdot 3.1416) \cdot \left(\sqrt{\frac{8\,\text{m}^2}{0.7\,\text{m} \cdot 9.8066\,\text{m/s}^2}}\right)$$

10) Volume of body in fluid for metacentric height and BG Formula

Evaluate Formula

Formula

$$V_T = \frac{I}{GM + BG}$$

Example with Units

$$12.5\,\text{m}^3 = \frac{11.25\,\text{m}^4}{0.7\,\text{m} + 0.2\,\text{m}}$$

11) Volume of fluid displaced Formula

Evaluate Formula

Formula

$$V = \frac{W}{\rho_{df}}$$

Example with Units

$$0.0326\,\text{m}^3 = \frac{32.5\,\text{kg}}{997\,\text{kg/m}^3}$$

Variables used in list of Buoyancy Formulas above

- **A** Area *(Square Meter)*
- A_{bouy} Archimedes Principle *(Newton)*
- B_c Centre of Buoyancy for Floating Body *(Meter)*
- **BG** Distance of CG from Center of Buoyancy *(Meter)*
- **d** Depth of Immersed Object in Water *(Meter)*
- **D** Distance Travelled by Weight on Vessel *(Meter)*
- F_{buoy} Buoyant Force *(Newton)*
- **g** Acceleration Due to Gravity *(Meter per Square Second)*
- **GM** Metacentric Height of Floating Body *(Meter)*
- **I** Moment of Inertia of Plain Floating Body *(Meter^4)*
- k_G Radius of Gyration of Floating Body *(Meter)*
- **p** Pressure *(Pascal)*
- **T** Time Period of Oscillation of Floating Body *(Second)*
- **v** Velocity *(Meter per Second)*
- **V** Volume of Fluid Displaced by Body *(Cubic Meter)*
- V_T Volume of Body Submerged in Water *(Cubic Meter)*
- **W** Weight of Displaced Fluid *(Kilogram)*
- w_1 Movable Weight on Floating Vessel *(Newton)*
- W_{fv} Weight of Floating Vessel *(Newton)*
- **θ** Angle of Heel *(Degree)*
- **ρ** Density *(Kilogram per Cubic Meter)*
- ρ_{df} Density of Displaced Fluid *(Kilogram per Cubic Meter)*

Constants, Functions, Measurements used in list of Buoyancy 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: **Weight** in Kilogram (kg)
  Weight Unit Conversion
- Measurement: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Volume** in Cubic Meter (m³)
  Volume 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: **Acceleration** in Meter per Square Second (m/s²)
  Acceleration Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion

- Measurement: **Density** in Kilogram per Cubic Meter (kg/m³)
  Density Unit Conversion
- Measurement: **Second Moment of Area** in Meter⁴ (m⁴)
  Second Moment of Area Unit Conversion

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