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Rayleigh and Reynolds Number Formulas

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List of 16 Rayleigh and Reynolds Number Formulas

Rayleigh and Reynolds Number

1) Bingham Number

Open Calculator

$$B_n = \frac{S_{sy} \cdot L_c}{\mu_a \cdot v}$$

$$7.0125 = \frac{4.25\text{N/m}^2 \cdot 9.9\text{m}}{0.1\text{Pa*s} \cdot 60\text{m/s}}$$

2) Bingham Number of Plastic Fluids from Isothermal Semi-circular Cylinder

Open Calculator

$$B_n = \left(\frac{\zeta_o}{\mu_B}\right) \cdot \left(\left(\frac{D_1}{g \cdot \beta \cdot \Delta T}\right)\right)^{0.5}$$

$$7.010206 = \left(\frac{1202\text{Pa}}{10\text{Pa*s}}\right) \cdot \left(\left(\frac{5\text{m}}{9.8\text{m/s}^2 \cdot 3.0\text{K}^{-1} \cdot 50.0\text{K}}\right)\right)^{0.5}$$

3) Diameter of rotating cylinder in fluid given Reynolds number

Open Calculator

$$D = \left(\frac{Rew \cdot v_k}{\pi \cdot w}\right)^{\frac{1}{2}}$$

$$3.90882\text{m} = \left(\frac{0.6 \cdot 4\text{MSt}}{\pi \cdot 5.0\text{rad/s}}\right)^{\frac{1}{2}}$$

4) Inertia force given Reynolds number

Open Calculator

$$F_i = Re \cdot \mu$$

$$500000\text{N} = 5000 \cdot 100\text{N}$$

5) Kinematic viscosity given Reynolds number based on rotational speed

Open Calculator

$$v_k = w \cdot \pi \cdot \frac{D^2}{Rew}$$

$$3.981969\text{MSt} = 5.0\text{rad/s} \cdot \pi \cdot \frac{(3.9\text{m})^2}{0.6}$$

6) Modified Rayleigh number given Bingham number

Open Calculator

$$Ra' = \frac{Ra_c}{1 + B_n}$$

$$0.009363 = \frac{0.075}{1 + 7.01}$$

7) Rayleigh Number

Open Calculator

$$Ra_c = G \cdot Pr$$

$$0.609 = 0.87 \cdot 0.7$$

8) Rayleigh number based on length for annular space between concentric cylinders

Open Calculator

$$Ra_l = \frac{Ra_c}{\frac{\left(\left(\ln\left(\frac{d_o}{d_i}\right)\right)^4\right)}{(L^3)\cdot\left(\left(d_i^{-0.6}\right)+\left(d_o^{-0.6}\right)\right)^5}}$$

$$0.25797 = \frac{0.075}{\frac{\left(\left(\ln\left(\frac{0.26\text{m}}{35\text{m}}\right)\right)^4\right)}{\left((3\text{m})^3\right)\cdot\left(\left((35\text{m})^{-0.6}\right)+\left((0.26\text{m})^{-0.6}\right)\right)^5}}$$

9) Rayleigh number based on turbulence for annular space between concentric cylinders

Open Calculator

fx $$\mathrm{Ra_c} = \left(\frac{\left(\left(\ln\left(\frac{\mathrm{d_o}}{\mathrm{d_i}}\right)\right)^4\right) \cdot (\mathrm{Ra_l})}{(\mathrm{L}^3) \cdot \left(\left(\mathrm{d_i}^{-0.6}\right) + \left(\mathrm{d_o}^{-0.6}\right)\right)^5} \right)$$

ex $$0.072683 = \left(\frac{\left(\left(\ln\left(\frac{0.26\mathrm{m}}{35\mathrm{m}}\right)\right)^4\right) \cdot (0.25)}{\left((3\mathrm{m})^3\right) \cdot \left(\left((35\mathrm{m})^{-0.6}\right) + \left((0.26\mathrm{m})^{-0.6}\right)\right)^5} \right)$$

10) Rayleigh number based on turbulence for concentric spheres

Open Calculator

fx $$\mathrm{Ra_c} = \left(\frac{\mathrm{L} \cdot \mathrm{Ra_l}}{\left((\mathrm{D_i} \cdot \mathrm{D_o})^4\right) \cdot \left(\left(\left(\mathrm{D_i}^{-1.4}\right) + \left(\mathrm{D_o}^{-1.4}\right)\right)^5\right)} \right)^{0.25}$$

ex $$0.333296 = \left(\frac{3\mathrm{m} \cdot 0.25}{\left((0.005\mathrm{m} \cdot 0.05\mathrm{m})^4\right) \cdot \left(\left(\left((0.005\mathrm{m})^{-1.4}\right) + \left((0.05\mathrm{m})^{-1.4}\right)\right)^5\right)} \right)^{0.25}$$

11) Reynolds Number given Graetz Number

Open Calculator

fx $$\mathrm{Re_L} = \mathrm{Gr} \cdot \frac{\mathrm{L}}{\mathrm{Pr} \cdot \mathrm{D}}$$

ex $$879.1209 = 800 \cdot \frac{3\mathrm{m}}{0.7 \cdot 3.9\mathrm{m}}$$

12) Reynolds number given Inertia and Viscous Force

Open Calculator

$$\mathrm{Re} = \frac{\mathrm{F_i}}{\mu}$$

$$5000 = \frac{500000\mathrm{N}}{100\mathrm{N}}$$

13) Reynolds number given Peclet number

Open Calculator

$$\mathrm{Re} = \frac{\mathrm{Pe}}{\mathrm{Pr}}$$

$$5000 = \frac{3500}{0.7}$$

14) Reynolds Number given Rotational Speed

Open Calculator

$$\mathrm{Rew} = \mathrm{w} \cdot \pi \cdot \frac{\mathrm{D}^2}{\mathrm{v_k}}$$

$$0.597295 = 5.0\mathrm{rad/s} \cdot \pi \cdot \frac{(3.9\mathrm{m})^2}{4\mathrm{MSt}}$$

15) Rotational speed given Reynolds number

Open Calculator

$$\mathrm{w} = \frac{\mathrm{Rew} \cdot \mathrm{v_k}}{\pi \cdot \mathrm{D}^2}$$

$$5.022641\mathrm{rad/s} = \frac{0.6 \cdot 4\mathrm{MSt}}{\pi \cdot (3.9\mathrm{m})^2}$$

16) Viscous force given Reynolds number

Open Calculator

fx $$\mu = \frac{F_i}{Re}$$

ex $$100\text{N} = \frac{500000\text{N}}{5000}$$

Variables Used

- ΔT Change in Temperature *(Kelvin)*
- B_n Bingham Number
- D Diameter *(Meter)*
- D_1 Diameter of Cylinder 1 *(Meter)*
- d_i Inner Diameter *(Meter)*
- D_i Inside Diameter *(Meter)*
- d_o Outer Diameter *(Meter)*
- D_o Outside Diameter *(Meter)*
- F_i Inertia Force *(Newton)*
- g Acceleration due to Gravity *(Meter per Square Second)*
- G Grashof Number
- Gr Graetz Number
- L Length *(Meter)*
- L_c Characteristic Length *(Meter)*
- Pe Peclet Number
- Pr Prandtl Number
- Ra' Modified Rayleigh Number
- Ra_c Rayleigh Number(t)
- Ra_l Rayleigh Number
- Re Reynolds Number
- Re_L Reynolds Number Based on Length
- Rew Reynolds Number(w)
- S_{sy} Shear Yield Strength *(Newton per Square Meter)*
- v Velocity *(Meter per Second)*
- v_k Kinematic Viscosity *(Megastokes)*
- w Rotational Speed *(Radian per Second)*

- β Coefficient of Volumetric Expansion *(Per Kelvin)*
- ζ_o Fluid Yield Stress *(Pascal)*
- μ Viscous Force *(Newton)*
- μ_a Absolute Viscosity *(Pascal Second)*
- μ_B Plastic Viscosity *(Pascal Second)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **ln**, ln(Number)
  The natural logarithm, also known as the logarithm to the base e, is the inverse function of the natural exponential function.
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Pressure** in Newton per Square Meter (N/m²), 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: **Temperature Difference** in Kelvin (K)
  Temperature Difference Unit Conversion
- Measurement: **Dynamic Viscosity** in Pascal Second (Pa*s)
  Dynamic Viscosity Unit Conversion
- Measurement: **Kinematic Viscosity** in Megastokes (MSt)
  Kinematic Viscosity Unit Conversion
- Measurement: **Angular Velocity** in Radian per Second (rad/s)
  Angular Velocity Unit Conversion
- Measurement: **Coefficient of Linear Expansion** in Per Kelvin (K^{-1})
  Coefficient of Linear Expansion Unit Conversion

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- **Effective Thermal Conductivity and Heat Transfer Formulas**
- **Nusselt Number Formulas**
- **Rayleigh and Reynolds Number Formulas**

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