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Rayleigh's Method Formulas

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List of 16 Rayleigh's Method Formulas

Rayleigh's Method

1) Displacement of Body from Mean Position

Open Calculator

fx $s_{body} = x \cdot \sin(\omega_n \cdot t_{total})$

ex $0.85394\text{m} = 1.25\text{m} \cdot \sin(21\text{rad/s} \cdot 80\text{s})$

2) Maximum Displacement from Mean Position given Displacement of Body from Mean Position

Open Calculator

fx $x = \frac{s_{body}}{\sin(\omega_n \cdot t_{total})}$

ex $1.097853\text{m} = \frac{0.75\text{m}}{\sin(21\text{rad/s} \cdot 80\text{s})}$

3) Maximum Displacement from Mean Position given Maximum Kinetic Energy

Open Calculator

fx $x = \sqrt{\frac{2 \cdot KE}{W_{load} \cdot \omega_n^2}}$

ex $2.129589\text{m} = \sqrt{\frac{2 \cdot 5000\text{J}}{5\text{kg} \cdot (21\text{rad/s})^2}}$

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4) Maximum Displacement from Mean Position given Maximum Potential Energy

Open Calculator

fx $$x = \sqrt{\frac{2 \cdot PE_{max}}{s_{constrain}}}$$

ex $$2.480695\text{m} = \sqrt{\frac{2 \cdot 40\text{J}}{13\text{N/m}}}$$

5) Maximum Displacement from Mean Position given Maximum Velocity at Mean Position

Open Calculator

fx $$x = \frac{V_{max}}{\omega_f}$$

ex $$1.666667\text{m} = \frac{75\text{m/s}}{45\text{rad/s}}$$

6) Maximum Displacement from Mean Position given Velocity at Mean Position

Open Calculator

fx $$x = \frac{v}{\omega_f \cdot \cos(\omega_f \cdot t_{total})}$$

ex $$1.381628\text{m} = \frac{60\text{m/s}}{45\text{rad/s} \cdot \cos(45\text{rad/s} \cdot 80\text{s})}$$

7) Maximum Kinetic Energy at Mean Position

Open Calculator

$$KE = \frac{W_{load} \cdot \omega_f^2 \cdot x^2}{2}$$

$$7910.156J = \frac{5kg \cdot (45rad/s)^2 \cdot (1.25m)^2}{2}$$

8) Maximum Potential Energy at Mean Position

Open Calculator

$$PE_{max} = \frac{s_{constrain} \cdot x^2}{2}$$

$$10.15625J = \frac{13N/m \cdot (1.25m)^2}{2}$$

9) Maximum Velocity at Mean Position by Rayleigh Method

Open Calculator

$$V_{max} = \omega_f \cdot x$$

$$56.25m/s = 45rad/s \cdot 1.25m$$

10) Natural Circular Frequency given Displacement of Body

Open Calculator

$$f = \frac{a \sin\left(\frac{s_{body}}{x}\right)}{t_p}$$

$$0.2145Hz = \frac{a \sin\left(\frac{0.75m}{1.25m}\right)}{3s}$$

11) Natural Circular Frequency given Maximum Velocity at Mean Position

Open Calculator

fx $$\omega_n = \frac{V_{max}}{x}$$

ex $$60\text{rad/s} = \frac{75\text{m/s}}{1.25\text{m}}$$

12) Natural Frequency given Natural Circular Frequency

Open Calculator

fx $$f = \frac{\omega_n}{2 \cdot \pi}$$

ex $$3.342254\text{Hz} = \frac{21\text{rad/s}}{2 \cdot \pi}$$

13) Potential Energy given Displacement of Body

Open Calculator

fx $$PE = \frac{s_{constrain} \cdot \left(s_{body}^2\right)}{2}$$

ex $$3.65625\text{J} = \frac{13\text{N/m} \cdot \left((0.75\text{m})^2\right)}{2}$$

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14) Time Period given Natural Circular Frequency

Open Calculator

fx $$t_p = \frac{2 \cdot \pi}{\omega_n}$$

ex $$0.299199\text{s} = \frac{2 \cdot \pi}{21\text{rad/s}}$$

15) Time Period of Free Longitudinal Vibrations

Open Calculator

fx $$t_p = 2 \cdot \pi \cdot \sqrt{\frac{W}{s_{constrain}}}$$

ex $$4.928936\text{s} = 2 \cdot \pi \cdot \sqrt{\frac{8\text{N}}{13\text{N/m}}}$$

16) Velocity at Mean Position

Open Calculator

fx $$v = (\omega_f \cdot x) \cdot \cos(\omega_f \cdot t_{total})$$

ex $$54.28379\text{m/s} = (45\text{rad/s} \cdot 1.25\text{m}) \cdot \cos(45\text{rad/s} \cdot 80\text{s})$$

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Variables Used

- **f** Frequency *(Hertz)*
- **KE** Maximum Kinetic Energy *(Joule)*
- **PE** Potential Energy *(Joule)*
- PE_{max} Maximum Potential Energy *(Joule)*
- s_{body} Displacement of Body *(Meter)*
- $s_{constrain}$ Stiffness of Constraint *(Newton per Meter)*
- t_p Time Period *(Second)*
- t_{total} Total Time Taken *(Second)*
- **v** Velocity *(Meter per Second)*
- V_{max} Maximum Velocity *(Meter per Second)*
- **W** Weight of Body in Newtons *(Newton)*
- W_{load} Load *(Kilogram)*
- **x** Maximum Displacement *(Meter)*
- ω_f Cumulative Frequency *(Radian per Second)*
- ω_n Natural Circular Frequency *(Radian per Second)*

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Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **asin**, asin(Number)
  Inverse trigonometric sine function
- Function: **cos**, cos(Angle)
  Trigonometric cosine function
- Function: **sin**, sin(Angle)
  Trigonometric sine function
- Function: **sqrt**, sqrt(Number)
  Square root function
- 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: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Energy** in Joule (J)
  Energy Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Frequency** in Hertz (Hz)
  Frequency Unit Conversion
- Measurement: **Surface Tension** in Newton per Meter (N/m)
  Surface Tension Unit Conversion

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- Measurement: **Angular Velocity** in Radian per Second (rad/s)
  Angular Velocity Unit Conversion

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Check other formula lists

- **Equilibrium Method Formulas**
- **Rayleigh's Method Formulas**

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