Single-mass oscillator - characteristic values

> **Sample document with complete example values. It shows the report the purchased export produces for YOUR input - it is not itself a report for any part.**

Project: Sample project Part/Position: no real part Prepared by: Sample, not released

Single-mass oscillator (spring-mass-damper, one degree of freedom): characteristic values of the free and forced vibration per linear vibration theory.

Input

Mass m	10 kg
Stiffness c	10,000 N/m
Damping constant d (specified)	40 Ns/m

Free vibration

Natural angular frequency $\omega_0 = \sqrt{c/m}$	31.6228 rad/s
Natural frequency $f_0 = \omega_0/(2\cdot\pi)$	5.0329 Hz
Damping ratio $D = d/(2\cdot\sqrt{c\cdot m})$	0.0632
Critical damping $d_{crit} = 2\cdot\sqrt{c\cdot m}$	632.46 Ns/m
Damping constant d	40 Ns/m
Damping case	underdamped (D < 1, oscillatory case)
Damped angular frequency $\omega_d = \omega_0\cdot\sqrt{1-D^2}$	31.5595 rad/s
Damped natural frequency f_d	5.0228 Hz

Resonance (force excitation)

Resonance frequency ratio $\eta_{res} = \sqrt{1-2\cdot D^2}$	0.996
Resonance excitation frequency $f_{res} = \eta_{res}\cdot f_0$	5.0127 Hz
Maximum magnification $V_{max} = 1/(2\cdot D\cdot\sqrt{1-D^2})$	7.9216

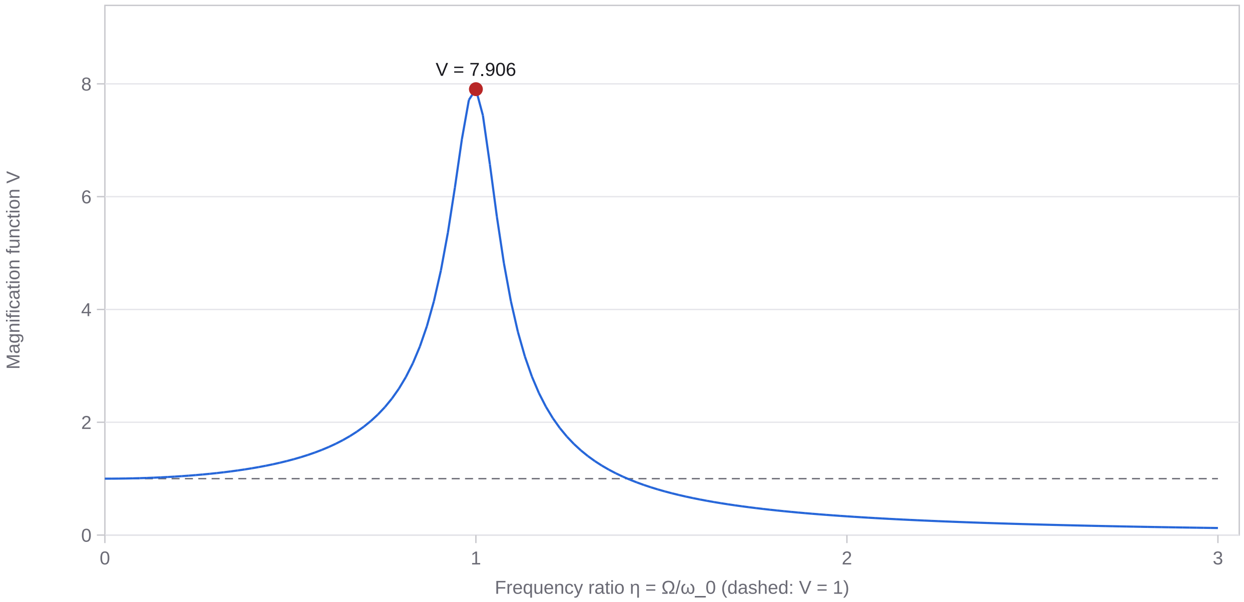
Forced vibration

Excitation frequency	5.0329 Hz
Frequency ratio $\eta = \Omega/\omega_0$	1
Magnification function $V(\eta) = 1/\sqrt{(1-\eta^2)^2+(2\cdot D\cdot\eta)^2}$	7.9057
Phase shift φ	90 deg
Static deflection $x_{stat} = F0/c$	10 mm
Amplitude $x_0 = x_{stat}\cdot V$	79.0569 mm

Assessment criteria

Criterion	Value	Limit	Status
Damping case	underdamped (D < 1, oscillatory case)	Underdamped (D < 1)	● **underdamped (D < 1, oscillatory case)**
Magnification V	7.906	< 1.5	● **outside guideline**

Magnification function V over η



Notes

The excitation is close to resonance ($V \geq 2$): the amplitude is strongly amplified. Move the excitation frequency further from the natural frequency or increase damping.

Calculation basis

Linear single-mass oscillator $m \cdot x'' + d \cdot x' + c \cdot x = F(t)$. Natural angular frequency $\omega_0 = \sqrt{c/m}$, damping ratio $D = d/(2 \cdot \sqrt{c \cdot m})$, damped angular frequency $\omega_d = \omega_0 \cdot \sqrt{1-D^2}$. Under harmonic force excitation $F0 \cdot \cos(\Omega \cdot t)$ the magnification function is $V = 1/\sqrt{(1-\eta^2)^2 + (2 \cdot D \cdot \eta)^2}$ with $\eta = \Omega/\omega_0$; for $D < 1/\sqrt{2}$ the maximum occurs at $\eta_{res} = \sqrt{1-2 \cdot D^2}$ with $V_{max} = 1/(2 \cdot D \cdot \sqrt{1-D^2})$. Formulas per Gross, Hauger, Schröder, Wall: Technische Mechanik 3 (Kinetik), Chapter 5 (Vibrations), Sections 5.2.3 and 5.3.2.

About this sample

All values on these pages come from a freely chosen example calculation and belong to no real part. The purchased export contains the same sections with your input, your header data (project, part, prepared by) and as searchable text. Pricing and scope: maschinenbaurechner.de/en/pricing