

■ Aufgabe 1.5 - exakt

$$u_L = 1 / 2 \, q_n L^2 / (E_0 A_0)$$

$$\frac{L^2 \, q_n}{2 A_0 E_0}$$

$$\text{Streckenlast}_{qn} = \rho A_0 g$$

$$A_0 g \rho$$

Länge in m, Masse in kg,

$$\text{par} = \{A_0 \rightarrow 0.002^2 \cdot \pi / 4, \rho \rightarrow 8930, E_0 \rightarrow 1.2 \cdot 10^{11}, L \rightarrow 12.000, g \rightarrow 9.810\}$$

$$\{A_0 \rightarrow 3.14159 \times 10^{-6}, \rho \rightarrow 8930, E_0 \rightarrow 1.2 \times 10^{11}, L \rightarrow 12., g \rightarrow 9.81\}$$

$$\text{Streckenlast}_{qn} /. \text{par}$$

$$0.275214$$

Auslenkung u_L in mm

$$u_{L\text{exakt}} = u_L \cdot 1000 /. \text{par}$$

$$0.052562$$

■ Berechnung der Dehnung eines Stabes infolge g mit Eigenfunktionen (A1.5)

Daten aus A 1.3

$\ddot{q}_i + \omega_i^2 q_i = Q_i \rho A g$ infolge der Erdbeschleunigung g . $\omega_i^2 = K_i$, $\text{massmy} = \rho A$

$u(L) = \text{Summe} (q_i * W_i(x=L))$

massmy

$$0.0280544$$

ni

$$10$$

Qi

$$\{18.6202, -6.20674, -3.72405, -2.66003, -2.06891, 1.69275, -1.43233, 1.24135, -1.09531, 0.980012\}$$

Ki

$$\{230254., 2.07229 \times 10^6, 5.75635 \times 10^6, 1.12824 \times 10^7, 1.86506 \times 10^7, 2.78607 \times 10^7, 3.89129 \times 10^7, 5.18071 \times 10^7, 6.65434 \times 10^7, 8.31217 \times 10^7\}$$

Wi

$$\{2.43738 \sin[0.1309 x], -2.43738 \sin[0.392699 x], -2.43738 \sin[0.654498 x], -2.43738 \sin[0.916298 x], -2.43738 \sin[1.1781 x], 2.43738 \sin[1.4399 x], -2.43738 \sin[1.7017 x], 2.43738 \sin[1.9635 x], -2.43738 \sin[2.22529 x], 2.43738 \sin[2.48709 x]\}$$

```

qi = Table[0, {ni}]; ui = Table[0, {ni}]; Sumi = Table[0, {ni + 1}];
Print[" i |      qi      ui=Wi*qi      uL      Fehler %"];
Print["-----"];
Do[
  qi[[i1]] = 1/Ki[[i1]] * Qi[[i1]] * massmy * 9.81;
  ui[[i1]] = qi[[i1]] * Wi[[i1]] * 1000 /. x -> len;
  Sumi[[i1 + 1]] = Sumi[[i1]] + ui[[i1]];
  Print[PaddedForm[i1, 2], " | ", PaddedForm[qi[[i1]], {10, 8}],
    PaddedForm[ui[[i1]], {10, 8}], PaddedForm[Sumi[[i1 + 1]], {10, 8}],
    PaddedForm[(Sumi[[i1 + 1]] - uLexakt) / uLexakt * 100, {8, 2}]
  ];, {i1, ni}];

```

i	qi	ui=Wi*qi	uL	Fehler %
1	0.00002226	0.05424654	0.05424654	3.20
2	-8.24298679 × 10 ⁻⁷	-0.00200913	0.05223741	-0.62
3	-1.78048515 × 10 ⁻⁷	0.00043397	0.05267139	0.21
4	-6.48864849 × 10 ⁻⁸	-0.00015815	0.05251323	-0.09
5	-3.05295807 × 10 ⁻⁸	0.00007441	0.05258764	0.05
6	1.67213105 × 10 ⁻⁸	-0.00004076	0.05254689	-0.03
7	-1.01302068 × 10 ⁻⁸	0.00002469	0.05257158	0.02
8	6.59438943 × 10 ⁻⁹	-0.00001607	0.05255551	-0.01
9	-4.53003548 × 10 ⁻⁹	0.00001104	0.05256655	0.01
10	3.24479725 × 10 ⁻⁹	-7.90881240 × 10 ⁻⁶	0.05255864	-0.01

```
ListPlot[Sumi, PlotJoined -> True];
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