8.29 $3{,}46 \le \dfrac{L}{a} \le 13{,}63$.
8.36 $168{,}4\ \text{N} \le P \le 308\ \text{N}$.
8.37 $9{,}38\ \text{N} \cdot \text{m} \le M \le 15{,}01\ \text{N} \cdot \text{m}$.
8.38 $-46{,}8\ \text{N} \le P \le 34{,}3\ \text{N}$.
8.42 (*a*) Sistema desliza; $P = 62{,}8$ N.
(*b*) Sistema de roda sobre B; $P = 73{,}2$ N.
8.43 35,8°.
8.44 20,5°.
8.45 1,225 W.
8.48 $\mathbf{P} = 2.080\ \text{N} \downarrow$.
8.49 $\mathbf{P} = 1.966\ \text{N} \downarrow$.
8.53 9,86 kN ←.
8.54 913 N ←.
8.55 (*a*) 28,1°. (*b*) 728 N ∠ 14,0°.
8.57 67,4 N.
8.60 (*b*) 283 N ←.
8.61 0,442.
8.64 0,1103.
8.65 0,1013.
8.69 1.068 N · m.
8.70 4,18 N · m.
8.76 450 N.
8.77 412 N.
8.78 344 N.
8.79 376 N.
8.80 0,226.
8.88 (*a*) 4,80 kN. (*b*) 1,375°.
8.91 0,1670.
8.96 154,4 N.
8.99 (*a*) 1,288 kN. (*b*) 1,058 kN.
8.100 300 mm.
8.102 (*a*) 22,8 kg. (*b*) 291 N.
8.103 (*a*) 109,7 kg. (*b*) 828 N.
8.107 35,1 N · m
8.108 (*a*) 27,0 N · m. (*b*) 675 N.
8.109 (*a*) 39,0 N · m. (*b*) 844 N.
8.112 44,9 N · m ↰.
8.116 (*a*) 11,66 kg. (*b*) 38,6 kg. (*c*) 34,4 kg.
8.117 (*a*) 9,46 kg. (*b*) 167,2 kg. (*c*) 121,0 kg.
8.122 5,97 N.
8.123 9,56 N.
8.126 0,350.
8.131 (*a*) 51,0 N · m. (*b*) 875 N.
8.132 (*a*) 170,5 N. (*b*) 14,04°.
8.135 $6{,}35 \le L/a \le 10{,}81$.
8.138 0,225.
8.139 (*a*) 620 N ←. (*b*) $\mathbf{B}_x = 1.390\ \text{N} \leftarrow$; $\mathbf{B}_y = 1.050\ \text{N} \downarrow$.
8.142 (*a*) 0,238. (*b*) 218 N ↓.
8.C1 $x = 500$ mm: 63,3 N; $P_{\text{máx}} = 67{,}8$ N em $x = 355$ mm.
8.C3 $\mu_A = 0{,}25$: $M = 0{,}0603$ N · m.
8.C4 $\theta = 30°$: $1{,}336\ \text{N} \cdot \text{m} \le M_A \le 2{,}23\ \text{N} \cdot \text{m}$.
8.C6 $\theta = 20°$: 10,39 N · m.
8.C8 (*a*) $x_0 = 0{,}600\,L$; $x_m = 0{,}604L$; $\theta_1 = 5{,}06°$.
(*b*) $\theta_2 = 55{,}4°$.

CAPÍTULO 9

9.1 $b^3h/12$.
9.2 $3a^4/2$.
9.3 $2a^3b/15$.
9.4 $ha^3/5$
9.6 $a^4/8$.
9.7 $2ab^3/7$.
9.9 $ab^3/15$.
9.10 $0{,}1056\,ab^3$.
9.11 $ab^3/15$.
9.12 $2a^3b/21$.
9.15 $ab^3/10$; $b/\sqrt{5}$.
9.16 $3ab^3/35$; $b\sqrt{9/35}$.
9.17 $a^3b/6$; $a/\sqrt{3}$.
9.18 $3a^3b/35$; $b\sqrt{9/35}$.
9.21 $20a^4$; $1{,}826a$.
9.22 $43a^4/48$; $0{,}773a$
9.23 $(\pi/2)(R_2^4 - R_1^4)$; $(\pi/4)(R_2^4 - R_1^4)$
9.24 (*b*) Para $t/R_m = 1$, −10,56%; para $t/R_m = \frac{1}{2}$, −2,99%, para $t/R_m = \frac{1}{10}$, −0,1250%.
9.25 $64a^4/15$; $1{,}265a$.
9.28 $bh(12h^2 + b^2)/48$; $\sqrt{(12h^2 + b^2)/24}$
9.31 $390 \times 10^3\ \text{mm}^4$; 21,9 mm.
9.33 $64{,}3 \times 10^3\ \text{mm}^4$; 8,87 mm.
9.37 $I = 9{,}50 \cdot 10^6\ \text{mm}^4$; $d_2 = 60{,}0$ mm.
9.38 $A = 6.600\ \text{mm}^2$; $\bar{I} = 3{,}72 \cdot 10^6\ \text{mm}^4$.
9.41 $\bar{I}_x = 1{,}874 \cdot 10^6\ \text{mm}^4$; $\bar{I}_y = 5{,}82 \cdot 10^6\ \text{mm}^4$.
9.42 $\bar{I}_x = 48{,}9 \cdot 10^3\ \text{mm}^4$; $\bar{I}_y = 8{,}35 \cdot 10^3\ \text{mm}^4$.
9.45 (*a*) $80{,}9 \cdot 10^6\ \text{mm}^4$. (*b*) $57{,}4 \cdot 10^6\ \text{mm}^4$.
9.46 (*a*) $12{,}16 \cdot 10^6\ \text{mm}^4$. (*b*) $9{,}73 \cdot 10^6\ \text{mm}^4$.
9.49 $\bar{I}_x = 260 \cdot 10^6\ \text{mm}^4$; $\bar{k}_x = 144{,}6$ mm;
$\bar{I}_y = 17{,}53 \cdot 10^6\ \text{mm}^4$; $\bar{k}_y = 37{,}6$ mm.
9.51 $\bar{I}_x = 255 \cdot 10^6\ \text{mm}^4$; $\bar{k}_x = 134{,}1$ mm;
$\bar{I}_y = 100{,}0 \cdot 10^6\ \text{mm}^4$; $\bar{k}_y = 83{,}9$ mm.
9.53 $\bar{I}_x = 3{,}55 \cdot 10^6\ \text{mm}^4$; $\bar{I}_y = 49{,}8 \cdot 10^6\ \text{mm}^4$.
9.55 $\bar{I}_x = 745 \cdot 10^6\ \text{mm}^4$; $\bar{I}_y = 91{,}3 \cdot 10^6\ \text{mm}^4$.
9.57 $3\pi r/16$.
9.58 $3\pi b/16$.
9.59 $15h/14$.
9.60 $4h/7$.
9.63 $5a/8$.
9.64 80,0 mm.
9.67 $a^4/2$.
9.68 $a^2b^2/12$.
9.69 $-b^2h^2/8$.
9.71 $-1{,}760 \cdot 10^6\ \text{mm}^4$.
9.72 $-21{,}6 \cdot 10^6\ \text{mm}^4$.
9.75 $471 \cdot 10^3\ \text{mm}^4$.
9.78 $1{,}165 \cdot 10^6\ \text{mm}^4$.
9.79 (*a*) $\bar{I}_{x'} = 0{,}482a^4$; $\bar{I}_{y'} = 1{,}482a^4$; $\bar{I}_{x'y'} = -0{,}589a^4$.
(*b*) $\bar{I}_{x'} = 1{,}120a^4$; $\bar{I}_{y'} = 0{,}843a^4$; $\bar{I}_{x'y'} = 0{,}760a^4$.
9.80 $\bar{I}_{x'} = 103{,}5 \times 10^6\ \text{mm}^4$; $\bar{I}_{y'} = 97{,}9 \cdot 10^6\ \text{mm}^4$;
$\bar{I}_{x'y'} = -38{,}3 \cdot 10^6\ \text{mm}^4$.
9.85 20,2°; $1{,}754a^4$, $0{,}209a^4$.
9.86 −17,11°; $139{,}1 \times 10^6\ \text{mm}^4$, $62{,}3 \cdot 10^6\ \text{mm}^4$.

CAPÍTULO 7

7.3 $\mathbf{F} = 4{,}80$ kN $\leftarrow$; $\mathbf{V} = 1{,}400$ kN $\downarrow$; $\mathbf{M} = 1{,}380$ kN · m $\circlearrowleft$.
7.4 $\mathbf{F} = 3{,}00$ kN $\leftarrow$; $\mathbf{V} = 0$; $\mathbf{M} = 0{,}600$ kN · m $\circlearrowleft$.
7.7 (Em AJ) $\mathbf{F} = 103{,}9$ N $\nwarrow$; $\mathbf{V} = 60{,}0$ N $\nearrow$; $\mathbf{M} = 18{,}71$ N · m $\circlearrowleft$.
7.8 (Em BK) $\mathbf{F} = 60{,}0$ N $\swarrow$; $\mathbf{V} = 103{,}9$ N $\searrow$; $\mathbf{M} = 10{,}80$ N · m $\circlearrowright$.
7.13 (Em AJ) $\mathbf{F} = 194{,}6$ N $\measuredangle 60°$; $\mathbf{V} = 257$ N $\measuredangle 30°$; $\mathbf{M} = 24{,}7$ N · m $\circlearrowleft$.
7.14 45,2 N · m para $\theta = 82{,}9°$.
7.15 (*a*) $\mathbf{F} = 500$ N $\leftarrow$; $\mathbf{V} = 500$ N $\uparrow$; $\mathbf{M} = 300$ N · m $\circlearrowleft$. (*b*) $\mathbf{F} = 970$ N $\uparrow$; $\mathbf{V} = 171{,}0$ N $\leftarrow$; $\mathbf{M} = 446$ N · m $\circlearrowleft$.
7.16 (*a*) $\mathbf{F} = 500$ N $\leftarrow$; $\mathbf{V} = 500$ N $\uparrow$; $\mathbf{M} = 300$ N · m $\circlearrowleft$. (*b*) $\mathbf{F} = 933$ N $\uparrow$; $\mathbf{V} = 250$ N $\leftarrow$; $\mathbf{M} = 375$ N · m $\circlearrowleft$.
7.17 (Em BJ) $\mathbf{F} = 200$ N $\searrow$; $\mathbf{V} = 120{,}0$ N $\nearrow$; $\mathbf{M} = 120{,}0$ N · m $\circlearrowright$.
7.18 (Em AK) $\mathbf{F} = 520$ N $\leftarrow$; $\mathbf{V} = 120{,}0$ N $\downarrow$; $\mathbf{M} = 96{,}0$ N · m $\circlearrowleft$.
7.23 (On BJ) 0,289 Wr $\circlearrowright$.
7.24 (On BJ) 0,417 Wr $\circlearrowright$.
7.27 0,1009 Wr para $\theta = 57{,}3°$.
7.28 0,357 Wr para $\theta = 49{,}3°$.
7.29 (*b*) $|V|_{máx} = 2P$; $|M|_{máx} = 3Pa$.
7.30 (*b*) $|V|_{máx} = 2P/3$; $|M|_{máx} = 2PL/9$.
7.31 (*b*) $wL/4$; $3\,wL^2/32$.
7.32 (*b*) $wL/2$; $3\,wL^2/8$.
7.35 (*b*) $|V|_{máx} = 35{,}0$ kN; $|M|_{máx} = 12{,}50$ kN · m.
7.36 (*b*) $|V|_{máx} = 50{,}5$ kN; $|M|_{máx} = 39{,}8$ kN · m.
7.39 (*b*) $|V|_{máx} = 64{,}0$ kN; $|M|_{máx} = 92{,}0$ kN · m.
7.40 (*b*) $|V|_{máx} = 60{,}0$ kN; $|M|_{máx} = 72{,}0$ kN · m.
7.43 (*b*) $|V|_{máx} = 1{,}800$ kN; $|M|_{máx} = 0{,}225$ kN · m.
7.44 (*b*) $|V|_{máx} = 2{,}00$ kN; $|M|_{máx} = 0{,}500$ kN · m.
7.49 (*a*) +400 N; +160,0 N · m. (*b*) −200N; +40,0 N · m.
7.54 $|V|_{máx} = 800$ N; $|M|_{máx} = 180{,}0$ N · m.
7.55 (*a*) 54,5°. (*b*) 675 N · m.
7.56 (*a*) 0,311 m. (*b*) 193,0 N · m.
7.57 (*a*) 1,236. (*b*) 0,1180 wa^2.
7.58 $a = 0{,}207\,L$.
7.62 (*a*) 0,414 wL ; 0,0858 wL^2. (*b*) 0,250 wL; 0,250 wL^2.
7.63 $|V|_{máx} = 2P$; $|M|_{máx} = 3Pa$.
7.69 $|V|_{máx} = 7{,}20$ kN; $|M|_{máx} = 5{,}76$ kN · m.
7.70 $|V|_{máx} = 720$ N; $|M|_{máx} = 164{,}0$ N · m.
7.72 $|V|_{máx} = 60{,}0$ kN; $|M|_{máx} = 72{,}0$ kN · m.
7.77 (*b*) 9,00 kN · m, 1,700 m de A.
7.78 (*b*) 26,4 kN · m, 2,05 m de A.
7.83 (*b*) 40,5 kN · m, 1,800 m de A.
7.84 (*b*) 60,5 kN · m, 2,20 m de A.
7.85 (*a*) $V = (w_0/6L)(3x^2 - 6Lx + 2L^2)$; $\mathbf{M} = (w_0/6L)(x^3 - 3Lx^2 + 2L^2x)$. (*b*) $0{,}0642w_0L^2$, em $x = 0{,}423L$.
7.86 (*a*) $V = (w_0/3L)(2x^2 - 3Lx + L^2)$; $M = (w_0/18L)(4x^3 - 9Lx^2 + 6L^2x - L^3)$. (*b*) $w_0L^2/72$, em $x = L/2$.
7.89 (*a*) $\mathbf{P} = 4{,}00$ kN $\downarrow$; $\mathbf{Q} = 6{,}00$ kN $\downarrow$. (*b*) $M_C = -900$ N · m.
7.90 (*a*) $\mathbf{P} = 2{,}50$ kN $\downarrow$; $\mathbf{Q} = 7{,}50$ kN $\downarrow$. (*b*) $M_C = -900$ N · m.
7.93 (*a*) 2,28 m. (*b*) $\mathbf{D}_x = 13{,}67$ kN $\rightarrow$; $\mathbf{D}_y = 7{,}80$ kN $\uparrow$. (c) 15,94 kN.
7.94 (*a*) 1,959 m. (*b*) 2,48 m.
7.97 (*a*) $d_B = 1{,}733$ m; $d_D = 4{,}20$ m. (*b*) 21,5 kN $\measuredangle 3{,}8°$.
7.98 (*a*) 2,8 m. (*b*) $\mathbf{A} = 32{,}0$ kN $\measuredangle 38{,}7°$; $\mathbf{E} = 25{,}0$ kN $\rightarrow$.
7.103 196,2 N.
7.104 157,0 N.
7.107 (*a*) 138,1 m. (*b*) 602 N.
7.108 (*a*) 6,75 m. (*b*) $T_{AB} = 615$ N; $T_{BC} = 600$ N.
7.117 (*a*) 5.880 N. (*b*) 0,873 m.
7.118 (*a*) 6.860 N. (*b*) 31,0°.
7.125 $y = h[1 - \cos(\pi x/L)]$; $T_0 = w_0L^2/h\pi^2$; $T_{máx} = (w_0L/\pi)\sqrt{(L^2/h^2\pi^2) + 1}$.
7.127 (*a*) 26,7 m. (*b*) 70,3 kg.
7.129 (*a*) 164,8 m. (*b*) 4.290 N.
7.133 (*a*) 5,89 m. (*b*) 10,89 N $\rightarrow$.
7.135 (*a*) 30,2 m. (b) 56,6 kg.
7.139 31,8 N.
7.140 29,8 N.
7.143 119,1 N $\rightarrow$.
7.144 177,6 N $\rightarrow$.
7.151 0,394 m e 10,97 m.
7.152 0,1408.
7.153 (*a*) 0,338. (*b*) 56,5°; 0,755 wL.
7.154 (*a*) 1.500 N. (*b*) (Em ABJ) $\mathbf{F} = 1.324$ N $\uparrow$; $\mathbf{V} = 706$ N $\leftarrow$; $\mathbf{M} = 229$ N · m $\circlearrowright$.
7.155 (Em BJ) $\mathbf{F} = 250$ N $\searrow$; $\mathbf{V} = 120{,}0$ N $\nearrow$; $\mathbf{M} = 120{,}0$ N · m $\circlearrowright$.
7.159 (*b*) 41,4 kN; 35,3 kN · m.
7.164 (*a*) 2.770 N. (*b*) 75,14 m.
7.C3 $a = 1{,}923$ m; $M_{máx} = 37{,}0$ kN · m em 4,64 m de A.
7.C8 $c/L = 0{,}300$: $h/L = 0{,}5225$; $s_{AB}/L = 1{,}532$; $T_0/wL = 0{,}300$; $T_{máx}/wL = 0{,}823$.

CAPÍTULO 8

8.3 Em equilíbrio; $\mathbf{F} = 48{,}3$ N $\nwarrow$.
8.4 Bloco em movimento; $\mathbf{F} = 103{,}5$ N $\nwarrow$.
8.5 225 N $\leq P \leq$ 479 N.
8.6 143,0 N $\leq P \leq$ 483 N.
8.7 (*a*) 105,8 N. (*b*) 46,0°.
8.9 (*a*) 403 N. (*b*) 229 N.
8.11 (*a*) 353 N $\leftarrow$. (*b*) 196,2 N $\leftarrow$.
8.12 (*a*) 275 N $\leftarrow$. (*b*) 196,2 N $\leftarrow$.
8.17 $M = Wr\mu_s(1 + \mu_s)/(1 + \mu_s^2)$.
8.18 (*a*) 0,300 Wr. (*b*) 0,349 Wr.
8.19 151,5 N · m.
8.20 1,473 kN.
8.21 0,208.
8.23 (*a*) 136,4°. (*b*) 0,928 W.
8.26 0,860.
8.28 (*a*) 112,5 N. (*b*) 8,81 mm.