Engineering Mechanics - Statics 16th edition Hibbeler Solutions Manual

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Answers to Selected Problems

Chapter 1

1-1 a) 3.46 m, b) 45.6 s, c) 5.56 kN, d) 4.52 Mg
1-2 a) GN/s, b) Gg/N, c) GN/(kg · s)
1-3 a) Gg/m, b) kN/s, c) mm · kg
1-5 a) 45.3 MN, b) 56.8 km, c) 5.63 μg
1-6 $\rho_w = 2.42\ \text{Mg/m}^3$
1-7 a) 0.431 g, b) 35.3 kN, c) 5.32 m
1-9 a) km/s, b) mm, c) Gs/kg, d) mm · N
1-10 a) $m = 2.04$ g, b) $m = 15.3$ Mg, c) $m = 6.12$ Gg
1-11 a) 27.5 kN/m^3, b) 0.508 mm/s, c) 1.13 kN · m
1-13 $\rho_{al} = 2.71\ \text{Mg/m}^3$
1-14 a) $44.9(10^{-3})\ \text{N}^2$, b) $2.79(10^3)\ \text{s}^2$, c) 23.4 s
1-15 a) $m_e = 3.65$ Gg, b) $W_e = 35.8$ MN, c) $W_m = 5.89$ MN, d) $m_m = 3.65$ Gg
1-17 $v = 88.5$ km/h, $v = 24.6$ m/s
1-18 a) 8.53 km/kg^2, b) 135 m^2 · kg^3
1-19 a) 4.66 m, b) 55.6 s, c) 4.56 kN, d) 2.77 Mg
1-21 $F = 10.0$ nN, $W_1 = 78.5$ N, $W_2 = 118$ N

Chapter 2

2-1 $F_R = 320$ lb, $\theta = 176°$
2-2 $F_R = 474$ lb, $\theta = 75.4°$
2-3 $\theta = 10.9°$, $F_{\min} = 235$ lb
2-5 $\theta = 18.6°$, $F = 319$ N
2-6 $F_R = 8.03$ kN, $\phi = 1.22°$
2-7 $(F_1)_v = 2.93$ kN, $(F_1)_u = 2.07$ kN
2-9 $F_R = 464$ N, $\theta = 78.6°$
2-10 $F_R = 222$ N, $\theta = 4.26°$
2-11 $F_a = 30.6$ lb, $F_b = 26.9$ lb
2-13 $F_{AB} = 186$ lb, $F_{AC} = 239$ lb
2-14 $F = 616$ lb, $\theta = 46.9°$
2-15 $F_{1u} = 205$ N, $F_{1v} = 160$ N
2-17 $F_R = 19.2$ N $\measuredangle$ 2.37°
2-18 $F_R = 19.2$ N $\measuredangle$ 2.37°
2-19 $F_A = 439$ N, $F_B = 311$ N
2-21 $\theta = 53.5°$, $F_{AB} = 621$ lb
2-22 $F_{AC} = 323$ lb, $\phi = 38.3°$
2-23 $F_C = 4.51$ kN, $F_B = 5.96$ kN
2-25 $F_{AB} = 485$ lb
2-26 $\theta = 54.3°$, $F_A = 686$ N
2-27 $F_R = 1.23$ kN, $\theta = 6.08°$
2-29 $T = 744$ lb, $\theta = 23.8°$
2-30 $T = 54.7$ lb, $P = 42.6$ lb
2-31 $\theta = 60°$, $P = 40$ lb, $T = 69.3$ lb
2-33 $F_R = 747$ N $\measuredangle$ 85.5°
2-34 $\mathbf{F}_1 = \{20\mathbf{i} + 34.6\mathbf{j}\}$ lb, $\mathbf{F}_2 = \{47.0\mathbf{i} - 17.1\mathbf{j}\}$ lb
2-35 $F_R = 69.2$ lb $\measuredangle$ 14.7°
2-37 $F_R = 391$ lb $\measuredangle$ 4.12°
2-38 $1.22\ \text{kN} \le P \le 3.17\ \text{kN}$
2-39 $F_{1x} = 141$ N, $F_{1y} = 141$ N, $F_{2x} = -130$ N, $F_{2y} = 75$ N
2-41 $F_R = 25.1$ kN, $\theta = 185°$
2-42 $\mathbf{F}_1 = \{680\mathbf{i} - 510\mathbf{j}\}$ N, $\mathbf{F}_2 = \{-312\mathbf{i} - 541\mathbf{j}\}$ N, $\mathbf{F}_3 = \{-530\mathbf{i} + 530\mathbf{j}\}$ N
2-43 $F_R = 546$ N, $\theta = 253°$
2-45 $\mathbf{F}_1 = \{F_1 \cos\theta\mathbf{i} + F_1 \sin\theta\mathbf{j}\}$ N, $\mathbf{F}_2 = \{350\mathbf{i}\}$ N, $\mathbf{F}_3 = \{-100\mathbf{j}\}$ N, $\theta = 67.0°$ $\measuredangle$, $F_1 = 434$ N
2-46 $\theta = 68.6°$, $F_B = 480$ lb
2-47 $F_R = 420$ lb $\nwarrow$ 14.8°
2-49 $F_R = 389$ N, $\psi = 42.7°$
2-50 $\mathbf{F_1} = \{-52.0\mathbf{i} + 30\mathbf{j}\}$ lb, $\mathbf{F_2} = \{-47.0\mathbf{i} - 17.1\mathbf{j}\}$ lb
2-51 $F_R = 99.8$ lb, $\theta = 173°$
2-53 $\theta = 103°$, $F_2 = 88.1$ lb
2-54 $F_R = 161$ lb $\searrow$ 38.3°
2-55 $F_R = 29.3$ lb, $\theta = 347°$
2-57 $F_R = 380$ N, $F_1 = 57.8$ N
2-58 $\theta = 86.0°$, $F = 1.97$ kN
2-59 $F_R = 11.1$ kN $\measuredangle$ 47.7°
2-61 $\beta = 120°$, $\mathbf{F} = \{30\mathbf{i} - 30\mathbf{j} + 42.4\mathbf{k}\}$ N
2-62 $\mathbf{F} = \{289\mathbf{i} + 225\mathbf{j} - 261\mathbf{k}\}$ lb
2-63 $F_R = 114$ lb, $\alpha = 62.1°$, $\beta = 113°$, $\gamma = 142°$
2-65 $\alpha = 46.1°$, $\beta = 114°$, $\gamma = 53.1°$
2-66 $F_R = 799$ N, $\alpha = 58.7°$, $\beta = 84.4°$, $\gamma = 32.0°$
2-67 $F_3 = 166$ N, $\alpha = 97.5°$, $\beta = 63.7°$, $\gamma = 27.5°$
2-69 $F = 50$ N, $\alpha = 74.1°$, $\beta = 41.3°$, $\gamma = 53.1°$
2-70 $F_R = 384$ N, $\alpha = 14.8°$, $\beta = 88.9°$, $\gamma = 105°$
2-71 $F_1 = 429$ lb, $\alpha_1 = 62.2°$, $\beta_1 = 110°$, $\gamma_1 = 145°$
2-73 $\alpha_1 = 45.6°$, $\beta_1 = 53.1°$, $\gamma_1 = 66.4°$
2-74 $\alpha_1 = 90°$, $\beta_1 = 53.1°$, $\gamma_1 = 66.4°$
2-75 $\mathbf{F}_1 = \{14\mathbf{j} - 48\mathbf{k}\}$ lb, $\mathbf{F}_2 = \{90\mathbf{i} - 127\mathbf{j} + 90\mathbf{k}\}$ lb
2-77 $F = 113$ lb, $\alpha = 45°$, $\beta = 69.3°$, $\gamma = 128°$
2-78 $\mathbf{F}_1 = \{-159\mathbf{i} + 276\mathbf{j} + 318\mathbf{k}\}$ N, $\mathbf{F}_2 = \{424\mathbf{i} + 300\mathbf{j} - 300\mathbf{k}\}$ N, $\gamma_2 = 120°$
2-79 $F_R = 634$ N, $\alpha = 65.3°$, $\beta = 24.8°$, $\gamma = 88.4°$
2-81 $F_R = 1.55$ kip, $\alpha = 82.4°$, $\beta = 37.6°$, $\gamma = 53.4°$
2-82 $F_R = 1.60$ kip, $\alpha = 82.6°$, $\beta = 29.4°$, $\gamma = 61.7°$
2-83 $\alpha_3 = 139°$, $\beta_3 = 128°$, $\gamma_3 = 102°$, if $F_R = 387$ lb, $\beta_3 = 60.7°$, $\gamma_3 = 64.4°$, if $F_R = 1.41$ kip
2-85 $F = 2.02$ kN, $F_y = 0.523$ kN
2-86 $r_{AB} = 2.11$ m
2-87 $r_{AB} = 9.06$ in.
2-89 $x = 5.06$ m, $y = 3.61$ m, $z = 6.51$ m
2-90 $z = 6.63$ ft
2-91 $x = y = 4.42$ ft
2-93 $\mathbf{F}_B = \{-400\mathbf{i} - 200\mathbf{j} + 400\mathbf{k}\}$ N, $\mathbf{F}_C = \{-200\mathbf{i} + 200\mathbf{j} + 350\mathbf{k}\}$ N

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2-94 $F_R = 960$ N, $\alpha = 129°$, $\beta = 90°$, $\gamma = 38.7°$
2-95 $\mathbf{F}_A = \{-1.46\mathbf{i} + 5.82\mathbf{k}\}$ kN, $\mathbf{F}_C = \{0.857\mathbf{i} + 0.857\mathbf{j} + 4.85\mathbf{k}\}$ kN, $\mathbf{F}_B = \{0.970\mathbf{i} - 1.68\mathbf{j} + 7.76\mathbf{k}\}$ kN, $F_R = 18.5$ kN, $\alpha = 88.8°$, $\beta = 92.6°$, $\gamma = 2.81°$
2-97 $F_R = 378$ lb, $\alpha = 149°$, $\beta = 90°$, $\gamma = 59.0°$
2-98 $F_R = 1.48$ kN, $\alpha = 86.9°$, $\beta = 77.5°$, $\gamma = 167°$
2-99 $r_{OA} = 7.32$ ft
2-101 $F_R = 1.54$ kN, $\alpha = 84.8°$, $\beta = 171°$, $\gamma = 97.5°$
2-102 $F_C = 442$ N, $F_B = 318$ N, $F_D = 866$ N
2-103 N/A
2-105 $F_{OA} = 31.4$ lb
2-106 $(F_{AB})_z = 600$ lb
2-107 $(F_{AC})_z = 569$ lb
2-109 $F_1 = 333$ N, $F_2 = 373$ N
2-110 $\theta = 74.4°$, $\phi = 55.4°$
2-111 $\theta = 34.2°$
2-113 $F_{||} = 4.07$ N, $F_{\perp} = 23.1$ N
2-114 $\theta = 70.5°$
2-115 $\phi = 65.8°$
2-117 $\theta = 74.2°$
2-118 $r_{BC} = 5.39$ m
2-119 $\theta = 19.2°$
2-121 $F_{CA} = 16.2$ lb
2-122 $\theta = 115°$, $F_{1y} = 300$ N, $F_{2y} = 90$ N
2-123 $(F_2)_{F1} = 71.6$ N
2-125 $F_{AC} = 26.5$ lb, $F_{BA} = 66.4$ lb
2-126 $F_u = 246$ N
2-127 $F_{AC} = 366$ N, $\mathbf{F}_{AC} = \{293\mathbf{j} + 219\mathbf{k}\}$ N
2-129 $F_{AB} = 31.1$ N
2-130 $(\mathbf{F}_{AB})_{AC} = \{116\mathbf{i} - 231\mathbf{j} + 231\mathbf{k}\}$ N

Chapter 3

3-1 $F_{BA} = 3.92$ kN, $F_{BC} = 3.40$ kN
3-2 $F_{BC} = 2.90$ kN, $y = 841$ mm
3-3 $\theta_{\min} = 34.3°$
3-5 $T = 720$ lb, $F = 540$ lb
3-6 $T = 766$ lb, $\theta = 70.1°$
3-7 $T_{BC} = 22.3$ kN, $T_{BD} = 32.6$ kN
3-9 $l'_{AB} = 0.448$ ft, $l'_{AC} = 0.656$ ft
3-10 $F_{CA} = 80.0$ N, $F_{CB} = 90.4$ N
3-11 $\theta = 64.3°$, $F_{CB} = 85.2$ N, $F_{CA} = 42.6$ N
3-13 $F_{AC} = F_{AB} = \{2.45 \csc \theta\}$ kN, $(l_{AC})_{\min} = (l_{AB})_{\min} = 1.73$ m
3-14 $s_{AD} = 0.5$ ft, $s_{AC} = 0.808$ ft, $s_{AB} = 0.476$ ft
3-15 $W = 840$ lb
3-17 $y = 6.59$ m
3-18 $\theta = 35.0°$
3-19 $l' = 2.66$ ft
3-21 $m_{\max} = 2.78$ Mg
3-22 $F = 15.8$ lb
3-23 $d = 1.56$ ft
3-25 $F = 39.3$ lb
3-26 $T_{HA} = 294$ N, $T_{AB} = 340$ N, $T_{AE} = 170$ N, $T_{BD} = 490$ N, $T_{BC} = 562$ N
3-27 $m_{\max} = 26.6$ kg
3-29 $F_{ED} = 30.2$ lb, $F_{EB} = 43.6$ lb, $F_{BC} = 69.8$ lb, $F_{BA} = 86.6$ lb
3-30 $W_{\max} = 57.7$ lb
3-31 $s = 5.33$ ft
3-33 $d = 7.13$ in.
3-34 $k = 6.80$ lb/in.
3-35 $F_{BD} = 171$ N, $F_{BC} = 145$ N
3-37 $\theta_{\min} = 11.6°$
3-38 $\theta = 60°$, $T_{AB} = 34.6$ lb
3-39 $\theta = 60°$, $W_{\max} = 46.1$ lb
3-41 $T_B = 34.6$ mN, $T_A = 52.9$ mN, $\theta = 19.1°$, $m = 4.08$ g
3-42 $\theta = 78.7°$, $F_{CD} = 127$ lb
3-43 $\alpha_3 = 77.2°$, $\beta_3 = 148°$, $\gamma_3 = 119°$, $P = 639$ lb
3-45 $T_B = 109$ lb, $T_C = 47.4$ lb, $T_D = 87.9$ lb
3-46 $s_{OB} = 327$ mm, $s_{OA} = 218$ mm
3-47 $F_{AB} = 2.52$ kN, $F_{CB} = 2.52$ kN, $F_{BD} = 3.64$ kN
3-49 $F_{AB} = 1.31$ kN, $F_{AC} = 763$ N, $F_{AD} = 708$ N
3-50 $F_{AC} = F_{AD} = 312$ N, $F_{AB} = 580$ N
3-51 $F_{AB} = 520$ N, $F_{AC} = F_{AD} = 260$ N, $d = 3.61$ m
3-53 $m_{\max} = 90.2$ kg
3-54 $F_B = F_D = 858$ N, $F_C = 0$
3-55 $m_{\max} = 2.62$ Mg
3-57 $W_{\max} = 55.7$ lb
3-58 $F_{AB} = 469$ lb, $F_{AC} = F_{AD} = 331$ lb
3-59 $F_{AC} = 574$ lb, $F_{AB} = 500$ lb, $F_{CD} = 1.22$ kip, $F_{CE} = F_{CF} = 416$ lb
3-61 $F_{AB} = F_{AC} = F_{AD} = 375$ lb
3-62 $\theta = 0°$, $F_{OA} = 149$ lb (C), $F_{OB} = F_{OC} = 74.5$ lb (T)
3-63 $s = 333$ mm
3-65 $F_{AE} = 2.91$ kip (C), $(T_{AD})_{\max} = 1.60$ kip
3-66 $F_{AB} = F_{AC} = 16.6$ kN, $F_{AD} = 55.2$ kN
3-67 $h = 1.64$ ft

Chapter 4

4-1 $(M_{F1})_A = 3$ kip·ft ↻, $(M_{F2})_A = 5.6$ kip·ft ↻, $(M_{F3})_A = 2.59$ kip·ft ↻
4-2 $(M_{F1})_B = 4.12$ kip·ft ↺, $(M_{F2})_B = 2$ kip·ft ↺, $(M_{F3})_B = 40$ lb·ft ↺
4-3 $(M_P)_A = 123$ lb·in. ↻, $F = 23.7$ lb
4-5 $M_A = (1.2 \sin \theta + 0.8 \cos \theta)$ kN·m

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4-6 $(M_A)_{\min} = 0$ at $\theta = 146°$
4-7 $(M_O)_{\text{Case 1}} = 120\ \text{N}\cdot\text{m}\circlearrowleft$, $(M_O)_{\text{Case 2}} = 520\ \text{N}\cdot\text{m}\circlearrowleft$
4-9 $(M_R)_B = 1.23\ \text{kN}\cdot\text{m}\circlearrowleft$
4-10 $M_O = 7.11\ \text{N}\cdot\text{m}\circlearrowright$
4-11 $M_A = 7.71\ \text{N}\cdot\text{m}\circlearrowleft$
4-13 $(M_A)_{\max} = 79.8\ \text{N}\cdot\text{m}\circlearrowright$ at $\theta = 37.9°$, $(M_A)_{\min} = 0$ at $\theta = 128°$
4-14 $\theta = 28.6°$
4-15 $(M_{FA})_C = 162\ \text{lb}\cdot\text{ft}\circlearrowright$, $(M_{FB})_C = 260\ \text{lb}\cdot\text{ft}\circlearrowleft$, ***Counterclockwise***
4-17 $(M_O)_{\max} = 80\ \text{kN}\cdot\text{m}\circlearrowright$, $x = 24.0\ \text{m}$
4-18 $(M_O)_{\max} = 80\ \text{kN}\cdot\text{m}\circlearrowright$ at $\theta = 33.6°$
4-19 $M_C = 13.0\ \text{N}\cdot\text{m}\circlearrowright$, $F = 35.2\ \text{N}$
4-21 $F_t = 618\ \text{N}$
4-22 N/A
4-23 N/A
4-25 $\mathbf{M}_O = \{260\mathbf{i} + 180\mathbf{j} + 510\mathbf{k}\}\ \text{N}\cdot\text{m}$
4-26 $\mathbf{M}_P = \{440\mathbf{i} + 220\mathbf{j} + 990\mathbf{k}\}\ \text{N}\cdot\text{m}$
4-27 $(\mathbf{M}_{FB})_O = \{-1.8\mathbf{i}\}\ \text{kN}\cdot\text{m}$
4-29 $(\mathbf{M}_R)_O = \{-720\mathbf{i} + 720\mathbf{j}\}\ \text{N}\cdot\text{m}$
4-30 $\mathbf{M}_O = \{-84\mathbf{i} - 8\mathbf{j} - 39\mathbf{k}\}\ \text{kN}\cdot\text{m}$
4-31 $\mathbf{M}_P = \{-116\mathbf{i} + 16\mathbf{j} - 135\mathbf{k}\}\ \text{kN}\cdot\text{m}$
4-33 $\alpha = 77.8°$, $\beta = 29.6°$, $\gamma = 63.4°$
4-34 $\mathbf{M}_O = \{-128\mathbf{i} + 128\mathbf{j} - 257\mathbf{k}\}\ \text{N}\cdot\text{m}$
4-35 $\mathbf{M}_B = \{-37.6\mathbf{i} + 90.7\mathbf{j} - 155\mathbf{k}\}\ \text{N}\cdot\text{m}$
4-37 $\text{M}_O = \{32.6\mathbf{i} - 69.3\mathbf{j} - 72\mathbf{k}\}\ \text{lb}\cdot\text{ft}$
4-38 $(\mathbf{M}_{F1})_O = \{110\mathbf{i} - 50\mathbf{j} + 90\mathbf{k}\}\ \text{lb}\cdot\text{ft}$
4-39 $(\mathbf{M}_{F2})_O = \{90\mathbf{i} - 130\mathbf{j} - 60\mathbf{k}\}\ \text{lb}\cdot\text{ft}$
4-41 $y = 2\ \text{m}$, $z = 1\ \text{m}$
4-42 $y = 1\ \text{m}$, $z = 3\ \text{m}$, $d = 1.15\ \text{m}$
4-43 $\mathbf{M}_A = \{-5.39\mathbf{i} + 13.1\mathbf{j} + 11.4\mathbf{k}\}\ \text{N}\cdot\text{m}$
4-45 $\mathbf{M}_A = \{1.56\mathbf{i} - 0.750\mathbf{j} - 1.00\mathbf{k}\}\ \text{kN}\cdot\text{m}$
4-46 $\mathbf{M}_B = \{1.00\mathbf{i} + 0.750\mathbf{j} - 1.56\mathbf{k}\}\ \text{kN}\cdot\text{m}$
4-47 $(\mathbf{M}_{FA})_O = \{-18\mathbf{i} + 9\mathbf{j} - 3\mathbf{k}\}\ \text{N}\cdot\text{m}$, $(\mathbf{M}_{FB})_O = \{18\mathbf{i} + 7.5\mathbf{j} + 30\mathbf{k}\}\ \text{N}\cdot\text{m}$
4-49 $(\mathbf{M}_{F1})_A = \{-36\mathbf{i} - 36\mathbf{k}\}\ \text{lb}\cdot\text{ft}$, $(\mathbf{M}_{F2})_A = \{-42\mathbf{i} - 14\mathbf{j} - 68\mathbf{k}\}\ \text{lb}\cdot\text{ft}$, $(M_R)_A = 131\ \text{lb}\cdot\text{ft}$, $\alpha = 127°$, $\beta = 96.1°$, $\gamma = 143°$
4-50 $M = (10\sqrt{127\sin^2\theta + 225})\ \text{N}\cdot\text{m}$, $M_{\max}$ at $\theta = 90°$, $M_{\min}$ at $\theta = 0°, 180°$
4-51 $\mathbf{M}_O = \{-1.77\,\mathbf{i} - 1.10\,\mathbf{j}\}\ \text{kN}\cdot\text{m}$
4-53 $F_{\max} = 770\ \text{N}$
4-54 $\mathbf{M}_y = \{277\mathbf{j}\}\ \text{N}\cdot\text{m}$
4-55 $\mathbf{M}_x = \{77.1\mathbf{i}\}\ \text{N}\cdot\text{m}$, $\mathbf{M}_z = \{-91.9\mathbf{k}\}\ \text{N}\cdot\text{m}$
4-57 $P = 8.50\ \text{lb}$
4-58 $M_x = 21.7\ \text{N}\cdot\text{m}$
4-59 $F = 139\ \text{N}$
4-61 $M_{AB} = 136\ \text{N}\cdot\text{m}$
4-62 $M_{BC} = 165\ \text{N}\cdot\text{m}$
4-63 $M_{CA} = 226\ \text{N}\cdot\text{m}$
4-65 $(M_{F1})_z = 38.2\ \text{lb}\cdot\text{in.}$, $(M_{F2})_z = 14.1\ \text{lb}\cdot\text{in.}$
4-66 $M_{AB} = 0$
4-67 $(\mathbf{M}_R)_{Oa} = \{26.1\mathbf{i} - 15.1\mathbf{j}\}\ \text{lb}\cdot\text{ft}$
4-69 $F = 162\ \text{lb}$
4-70 $M_y = 0.828\ \text{N}\cdot\text{m}$
4-71 $M_{y'} = 464\ \text{lb}\cdot\text{ft}$
4-73 $R = 28.9\ \text{N}$
4-74 $F = 67.5\ \text{lb}$
4-75 $F = 830\ \text{N}$
4-77 $\theta = 56.1°$
4-78 $(M_c)_R = 9.69\ \text{kN}\cdot\text{m}\circlearrowright$
4-79 $N = 26.0\ \text{N}$
4-81 $\theta = 45°$, $P = 49.5\ \text{N}$
4-82 $M_c = 900\ \text{lb}\cdot\text{ft}$, $R_B = 500\ \text{lb}$
4-83 $(M_c)_R = 5.20\ \text{kN}\cdot\text{m}\circlearrowright$
4-85 $d = 5.54\ \text{ft}$
4-86 $(M_c)_R = 53.4\ \text{lb}\cdot\text{ft}\circlearrowright$
4-87 $(M_c)_R = 53.4\ \text{lb}\cdot\text{ft}\circlearrowright$
4-89 $(M_c)_R = 96.0\ \text{lb}\cdot\text{ft}$, $\alpha = 47.4°$, $\beta = 74.9°$, $\gamma = 133°$
4-90 $M_3 = 318\ \text{lb}\cdot\text{ft}$, $M_1 = M_2 = 287\ \text{lb}\cdot\text{ft}$
4-91 $(\mathbf{M}_c)_R = \{11.0\mathbf{i} - 49.0\mathbf{j} - 40\mathbf{k}\}\ \text{lb}\cdot\text{ft}$, $(M_c)_R = 64.2\ \text{lb}\cdot\text{ft}$, $\alpha = 80.1°$, $\beta = 140°$, $\gamma = 129°$
4-93 $F = 992\ \text{N}$
4-94 $\mathbf{M}_c = \{-65.0\mathbf{i} - 37.5\mathbf{k}\}\ \text{N}\cdot\text{m}$, $M_c = 75\ \text{N}\cdot\text{m}$
4-95 $F = 15.4\ \text{N}$
4-97 $F = 832\ \text{N}$
4-98 $(\mathbf{M}_c)_R = \{-12.1\mathbf{i} - 10\mathbf{j} - 17.3\mathbf{k}\}\ \text{N}\cdot\text{m}$
4-99 $d = 342\ \text{mm}$
4-101 $\mathbf{M}_c = \{7.01\mathbf{i} + 42.1\mathbf{j}\}\ \text{N}\cdot\text{m}$
4-102 $F = 35.1\ \text{N}$
4-103 $F_R = 365\ \text{N}\ \angle 70.8°$, $(M_R)_O = 2.36\ \text{kN}\cdot\text{m}\circlearrowleft$
4-105 $F_R = 464\ \text{lb}\ \angle 45.1°$, $(M_R)_B = 1.60\ \text{kip}\cdot\text{ft}\circlearrowright$
4-106 $F_R = 464\ \text{lb}\ \angle 45.1°$, $(M_R)_A = 832\ \text{lb}\cdot\text{ft}\circlearrowright$
4-107 $F_R = 461\ \text{N}\ \angle 49.4°$, $(M_R)_O = 438\ \text{N}\cdot\text{m}\circlearrowright$
4-109 $F_R = 342\ \text{N}\ \angle 43.0°$, $(M_R)_O = 99.5\ \text{N}\cdot\text{m}\circlearrowright$
4-110 $F_R = 73.8\ \text{lb}\ \angle 59.0°$, $(M_R)_O = 359\ \text{lb}\cdot\text{ft}\circlearrowright$
4-111 $\theta = 26.6°$, $F = 8.94\ \text{kN}$, $d = 4.5\ \text{m}$
4-113 $F_R = 29.9\ \text{lb}\ \angle 78.4°$, $(M_R)_O = 214\ \text{lb}\cdot\text{in.}\circlearrowleft$
4-114 $F_R = 26.4\ \text{lb}\ \angle 85.7°$, $(M_R)_O = 205\ \text{lb}\cdot\text{in.}\circlearrowleft$
4-115 $F_R = 219\ \text{lb}\ \angle 79.5°$, $(M_R)_A = 1.19\ \text{kip}\cdot\text{ft}\circlearrowleft$
4-117 $F_R = 416\ \text{lb}\ \angle 35.2°$, $(M_R)_O = 1.48\ \text{kip}\cdot\text{ft}\circlearrowright$
4-118 $F_2 = 41.1\ \text{lb}$, $\theta = 44.9°$, $F_1 = 36.8\ \text{lb}$
4-119 $\mathbf{F}_R = \{-5\mathbf{i} - 35\mathbf{j} - 70\mathbf{k}\}\ \text{N}$, $(\mathbf{M}_R)_O = \{-8.45\mathbf{i} + 4.9\mathbf{j} - 5.12\mathbf{k}\}\ \text{N}\cdot\text{m}$
4-121 $\mathbf{F}_R = \{-0.7\mathbf{j} - 2.2\mathbf{k}\}\ \text{kip}$, $(\mathbf{M}_R)_A = \{19.6\mathbf{i} - 21.6\mathbf{j} + 8.4\mathbf{k}\}\ \text{kip}\cdot\text{ft}$
4-122 $\mathbf{F}_R = \{-30\mathbf{i} + 15\mathbf{j} + 45\mathbf{k}\}\ \text{lb}$, $(\mathbf{M}_R)_O = \{80\mathbf{i} - 87.5\mathbf{j} + 102\mathbf{k}\}\ \text{lb}\cdot\text{ft}$

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4-123 $\mathbf{F}_R = \{506\mathbf{i} - 23.2\mathbf{j} + 1.24(10^3)\mathbf{k}\}$ N, $(\mathbf{M}_R)_O = \{-17.7\mathbf{i} - 600\mathbf{j} + 26.5\mathbf{k}\}$ N·m
4-125 $\mathbf{F}_R = \{-70\mathbf{i} + 140\mathbf{j} - 408\mathbf{k}\}$ N, $(\mathbf{M}_R)_P = \{-26\mathbf{i} + 357\mathbf{j} + 127\mathbf{k}\}$ N·m
4-126 $F_R = 10.8$ kip ↓, $d = 13.7$ ft →
4-127 $F_R = 10.8$ kip ↓, $d = 9.26$ ft ←
4-129 $F_R = 58.3$ lb ⟋ 31.0°, $y = -3$ ft
4-130 $F_R = 67.1$ lb ⟋ 26.6°, $d = 8.25$ in. ↑
4-131 $F_R = 1.30$ kN ⟋ 84.5°, $x = 7.36$ m →
4-133 $F_R = 78.1$ lb ⟍ 87.1°, $y = -25$ ft
4-134 $F_R = 78.1$ lb ⟍ 87.1°, $d = 31$ ft
4-135 $F_R = 991$ N ⟋ 63.0°, $y = 1.78$ m ↑
4-137 $F_R = 65.9$ lb ⟍ 49.8°, $d = 2.10$ ft →
4-138 $F_R = 65.9$ lb ⟍ 49.8°, $d = 4.62$ ft ↓
4-139 $F_R = 98.5$ lb ∠ 24.0°, $d = 4.33$ ft ↑
4-141 $F_R = 197$ lb ∠ 42.6°, $d = 5.24$ ft ↓
4-142 $F_R = 197$ lb ∠ 42.6°, $d = 0.824$ ft ←
4-143 $F_R = 26$ kN, $y = 82.7$ mm, $x = 3.85$ mm
4-145 $F_C = 600$ N, $F_D = 500$ N
4-146 $F_R = 700$ lb, $z = 0.447$ ft, $x = -0.117$ ft
4-147 $F_B = 163$ lb, $F_C = 223$ lb
4-149 $z = 0.586$ ft, $\mathbf{F}_R = \{-10\mathbf{j}\}$ lb, $\mathbf{M}_R = \{-14.1\mathbf{j}\}$ lb·ft
4-150 $F_R = 108$ lb, $M_R = -624$ lb·ft, $x = 8.69$ ft, $y = 0.414$ ft
4-151 $F_R = 495$ N, $M_R = 1.54$ kN·m, $z = 1.16$ m, $y = 2.06$ m
4-153 $F_R = 30$ kN ↓, $\bar{x} = 3.4$ m →
4-154 $F_R = 21$ kN ↓, $d = 3.43$ m →
4-155 $a = 1.26$ m, $b = 2.53$ m
4-157 $F_R = 0.525$ kN ↑, $d = 0.171$ m →
4-158 $F_R = 3.9$ kip ↑, $d = 11.3$ ft →
4-159 $F_R = 13.2$ lb ↓, $d = 0.340$ ft →
4-161 $w_1 = 190$ lb/ft, $w_2 = 282$ lb/ft
4-162 $w_2 = 17.2$ kN/m, $w_1 = 30.3$ kN/m
4-163 $F_R = 3.25$ kip ⟋ 67.2°, $d = 3.86$ ft ↑
4-165 $F_R = 3.1$ kN ↓, $d = 2.06$ m →
4-166 $F_R = 1.8$ kip ↓, $(M_R)_A = 4.2$ kip·ft ↻
4-167 $F_R = 1.8$ kip ↓, $d = 2.33$ ft →
4-169 $F_R = 1.35$ kN ⟋ 42.0°, $d = 0.556$ m ←
4-170 $b = 5.62$ m, $a = 1.54$ m
4-171 $F_R = 1.25$ kN ↓, $\bar{x} = 8$ m →
4-173 $F_R = 774$ lb ↖, $\bar{x} = 2.25$ ft ↗
4-174 $F_R = 10.7$ kN ↓, $\bar{x} = 1$ m →
4-175 $F_R = 53.3$ lb ↓, $\bar{x} = 1.6$ ft →

Chapter 5

5-1 N/A
5-2 N/A
5-3 N/A
5-5 N/A
5-6 N/A
5-7 N/A
5-9 N/A
5-10 $B_y = 586$ N, $F_A = 413$ N
5-11 $N_A = 750$ N, $B_y = 600$ N, $B_x = 450$ N
5-13 $N_A = 2.175$ kN, $B_y = 1.875$ kN, $B_x = 0$
5-14 $N_A = 3.33$ kN, $B_x = 2.4$ kN, $B_y = 133$ N
5-15 $A_x = 0$, $A_y = 6.75$ kN, $M_A = 46.2$ kN·m
5-17 $F_A = 30$ lb, $F_B = 36.2$ lb, $F_C = 9.38$ lb
5-18 $N_B = 1.04$ kN, $A_x = 0$, $A_y = 600$ N
5-19 $T = 34.6$ kN, $A_x = 20.8$ kN, $A_y = 87.7$ kN
5-21 $F_{CD} = 131$ N, $B_x = 34.0$ N, $B_y = 95.4$ N
5-22 $F_{AB} = 38.3$ kN (T), $C_x = 30.7$ kN, $C_y = 3.37$ kN
5-23 $x_{max} = 5.21$ m, $C_x = 32$ kN, $C_y = 4.38$ kN
5-25 $N_C = 15$ kip, $N_A = 15$ kip, $N_B = 12$ kip
5-26 $F_A = 432$ lb, $F_B = 0$, $F_C = 432$ lb
5-27 $N_B = 150$ lb, $A_y = 300$ lb, $A_x = 150$ lb
5-29 $P = 27.7$ lb
5-30 $\theta = 33.6°$, $P_{min} = 27.6$ lb
5-31 N/A
5-33 $A_x = 25.4$ kN, $B_y = 22.8$ kN, $B_x = 25.4$ kN
5-34 $F_{max} = 14.0$ kN
5-35 $N_B = 2.11$ N, $F_A = 2.81$ N
5-37 $A_y = 50$ lb, $N_B = 1.6$ kip, $A_x = 1.51$ kip
5-38 $F = 93.8$ lb, $A_x = 1.42$ kip, $A_y = 46.9$ lb
5-39 $\theta = 8.63°$
5-41 $F_{BC} = 410$ lb (C), $A_x = 71.2$ lb, $A_y = 396$ lb
5-42 $F_{CB} = 782$ N, $A_x = 625$ N, $A_y = 681$ N
5-43 $(F_2)_{max} = 724$ N, $(F_1)_{max} = 1.45$ kN, $(F_A)_{max} = 1.75$ kN
5-45 $d = 6$ ft, $w = 267$ lb/ft
5-46 $B_x = 989$ N, $A_x = 989$ N, $B_y = 186$ N
5-47 $F_{max} = 800$ lb, $A_x = 540$ lb, $A_y = 160$ lb
5-49 $N_A = N_B = 180$ lb, $h = 0.3$ ft
5-50 $p = 662$ psi
5-51 $N_C = 214$ N, $N_A = N_B = 571$ N
5-53 $T = \dfrac{W\cos\theta}{2\sin(\phi - \theta)}$, $A_x = \dfrac{W\cos\phi\cos\theta}{2\sin(\phi - \theta)}$, $A_y = \dfrac{W(\sin\phi\cos\theta - 2\cos\phi\sin\theta)}{2\sin(\phi - \theta)}$
5-54 $l_0 = 70.3$ mm
5-55 $k = 11.2$ lb/ft
5-57 $F_{BC} = 6.02$ kip (C), $A_x = 4.26$ kip, $A_y = 3.66$ kip
5-58 $P = \left\{\dfrac{490\cos\theta}{\sin(\theta/2 + 45°)}\right\}$ N
5-59 $T = 9.08$ lb
5-61 $R_C = 63.9$ lb, $R_B = 11.9$ lb, $R_A = 26.0$ lb
5-62 $d = \dfrac{a}{\cos^3\theta}$
5-63 $\theta = \tan^{-1}\left(\dfrac{l}{6\sqrt{a^2 - l^2/4}}\right)$

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5-65 $A_x = -360$ N, $A_y = -240$ N, $A_z = 720$ N, $M_{Ax} = 7.20$ kN·m, $M_{Ay} = -10.8$ kN·m, $M_{Az} = 0$

5-66 $F_A = 663$ lb, $F_C = 569$ lb, $F_B = 449$ lb

5-67 $F = 368$ N, $B_z = 401$ N, $A_z = 334$ N, $A_y = 0$, $B_x = -435$ N, $A_x = 66.9$ N

5-69 $A_x = -8$ kN, $A_y = 0$, $A_z = -24.4$ kN, $M_y = 20.0$ kN·m, $M_x = -572$ kN·m, $M_z = 64.0$ kN·m

5-70 $C_y = -318$ N, $C_z = 500$ N, $B_z = -273$ N, $B_x = 239$ N, $A_x = -239$ N, $A_z = 90.9$ N

5-71 $N_C = 0$, $W_{max} = 451$ lb, $N_A = N_B = 376$ lb

5-73 $F_{BD} = F_{CD} = 62.4$ lb, $A_z = 50.0$ lb, $A_x = 33.3$ lb, $A_y = 0$

5-74 $C_y = -800$ N, $B_z = -107$ N, $B_y = 600$ N, $C_x = 53.6$ N, $A_x = -400$ N, $A_z = 800$ N

5-75 $F_{DC} = 375$ lb (C), $E_x = 0$, $E_z = 562$ lb, $A_x = 0$, $A_y = 0$, $A_z = 62.5$ lb

5-77 $T_{BC} = 1.40$ kN, $A_y = -800$ N, $A_x = 1.20$ kN, $(M_A)_x = -600$ N·m, $(M_A)_y = 1.20$ kN·m, $(M_A)_z = 2.40$ kN·m

5-78 $F_{CB} = 1.37$ kN, $(M_A)_x = -785$ N·m, $(M_A)_z = 589$ N·m, $A_x = 1.18$ kN, $A_y = 589$ N, $A_z = 0$

5-79 $F_{CD} = 0$, $F_{EF} = 100$ lb, $F_{BD} = 150$ lb, $A_x = 0$, $A_y = 0$, $A_z = -50$ lb

5-81 $F_{BC} = 175$ lb, $A_x = 130$ lb, $A_y = -10$ lb, $M_{Ax} = -300$ lb·ft, $M_{Ay} = 0$, $M_{Az} = -720$ lb·ft

5-82 $F_{BC} = 105$ lb

5-83 $B_y = -50$ lb, $M_{Bz} = 0$, $M_{Bx} = -300$ lb·ft, $B_x = -16.7$ lb, $A_x = 16.7$ lb, $M_{By} = -900$ lb·ft, $B_z = 200$ lb, $A_z = -200$ lb

5-85 $F_{BD} = 294$ N, $F_{BC} = 589$ N, $A_x = 0$, $A_y = 589$ N, $A_z = 490$ N

5-86 $T_{DE} = 32.1$ lb, $T_{BC} = 42.9$ lb, $A_x = 3.57$ lb, $A_y = 50$ lb, $(M_A)_x = 0$, $(M_A)_y = -17.9$ lb·ft

5-87 $T = 58$ N, $C_z = 77.6$ N, $C_y = -24.9$ N, $D_x = 0$, $D_y = -68.5$ N, $D_z = 32.1$ N

Chapter 6

6-1 $F_{AD} = 849$ lb (C), $F_{AB} = 600$ lb (T), $F_{BD} = 400$ lb (C), $F_{BC} = 600$ lb (T), $F_{DC} = 1.41$ kip (T), $F_{DE} = 1.60$ kip (C)

6-2 $F_{AD} = 1.13$ kip (C), $F_{AB} = 800$ lb (T), $F_{BD} = 0$, $F_{BC} = 800$ lb (T), $F_{DC} = 1.13$ kip (T), $F_{DE} = 1.60$ kip (C)

6-3 $F_{BA} = 214$ lb (T), $F_{BC} = 525$ lb (C), $F_{CA} = 371$ lb (T)

6-5 $F_{AE} = 8.94$ kN (C), $F_{AB} = 8$ kN (T), $F_{BC} = 8$ kN (T), $F_{BE} = 8$ kN (C), $F_{EC} = 8.94$ kN (T), $F_{ED} = 17.9$ kN (C), $F_{DC} = 8$ kN (T)

6-6 $F_{AE} = 372$ N (C), $F_{AB} = 332$ N (T), $F_{BC} = 332$ N (T), $F_{BE} = 196$ N (C), $F_{EC} = 558$ N (T), $F_{ED} = 929$ N (C), $F_{DC} = 582$ N (T)

6-7 $F_{GB} = 27.5$ kN (T), $F_{AF} = 15$ kN (C), $F_{AB} = 28.0$ kN (C), $F_{BF} = 25$ kN (T), $F_{BC} = 15$ kN (T), $F_{FC} = 21.2$ kN (C), $F_{FE} = 0$, $F_{ED} = 0$, $F_{EC} = 15$ kN (T), $F_{DC} = 0$

6-9 $F_{DF} = F_{BG} = 0$, $F_{CF} = F_{CG} = 0$, $F_{EF} = F_{AG} = 0$, $F_{BA} = F_{DE} = 667$ lb (C), $F_{BC} = F_{CD} = 667$ lb (C)

6-10 $F_{BG} = 0$, $F_{GC} = 0$, $F_{GA} = 0$, $F_{DF} = 400$ lb (C), $F_{FC} = F_{FE} = 333$ lb (T), $F_{BC} = F_{BA} = 708$ lb (C), $F_{DC} = F_{DE} = 825$ lb (C)

6-11 $F_{EF} = 0.667P$ (T), $F_{FD} = 1.67P$ (T), $F_{BA} = 0.471P$ (C), $F_{AE} = 1.67P$ (T), $F_{CA} = 1.49P$ (C), $F_{FB} = 1.41P$ (T), $F_{BD} = 1.49P$ (C), $F_{EC} = 1.41P$ (T), $F_{CD} = 0.471P$ (C)

6-13 $F_{CD} = F_{AD} = 0.687P$ (T), $F_{CB} = F_{AB} = 0.943P$ (C), $F_{DB} = 1.33P$ (T)

6-14 $P_{max} = 848$ lb

6-15 $P_{max} = 848$ lb

6-17 $P_{max} = 5.19$ kN

6-18 $F_{CB} = 3$ kN (T), $F_{CD} = 2.60$ kN (C), $F_{DE} = 2.60$ kN (C), $F_{DB} = 2$ kN (T), $F_{BE} = 2$ kN (C), $F_{BA} = 5$ kN (T)

6-19 $F_{CB} = 8$ kN (T), $F_{CD} = 6.93$ kN (C), $F_{DE} = 6.93$ kN (C), $F_{DB} = 4$ kN (T), $F_{BE} = 4$ kN (C), $F_{BA} = 12$ kN (T)

6-21 $F_{AB} = 43.8$ kN (C), $F_{AG} = 26.2$ kN (T), $F_{BC} = 26.2$ kN (C), $F_{BG} = 35$ kN (T)

6-22 $F_{AB} = 7.5$ kN (T), $F_{AE} = 4.5$ kN (C), $F_{ED} = 4.5$ kN (C), $F_{EB} = 8$ kN (T), $F_{BD} = 19.8$ kN (C), $F_{BC} = 18.5$ kN (T)

6-23 $F_{AB} = 3.75$ kip (C), $F_{AH} = 3$ kip (T), $F_{BC} = 3.75$ kip (C), $F_{BH} = 1$ kip (C), $F_{HC} = 1$ kip (T), $F_{GH} = 2$ kip (T), $F_{EF} = 3$ kip (T), $F_{ED} = 3.75$ kip (C), $F_{DC} = 3.75$ kip (C), $F_{DF} = 1$ kip (C), $F_{CF} = 1$ kip (T), $F_{CG} = 2$ kip (C), $F_{FG} = 2$ kip (T)

6-25 $F_{BD} = 260$ lb (C), $F_{CD} = 480$ lb (T), $F_{AC} = 0$, $F_{AB} = 0$, $F_{BC} = 100$ lb (T)

6-26 $(P_2)_{max} = 134$ lb

6-27 $F_{HI} = 42.5$ kN (T), $F_{HC} = 100$ kN (T), $F_{DC} = 125$ kN (C)

6-29 $F_{GF} = 8.08$ kN (T), $F_{BC} = 7.70$ kN (C), $F_{CG} = 0.770$ kN (C)

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6-30 $F_{FG} = 8.08$ kN (T), $F_{CD} = 8.47$ kN (C), $F_{CF} = 0.770$ kN (T)
6-31 $F_{CD} = 50$ kN (T), $F_{HD} = 7.07$ kN (C), $F_{GD} = 5$ kN (C)
6-33 $F_{HG} = 29.0$ kN (C), $F_{BC} = 20.5$ kN (T), $F_{HC} = 12.0$ kN (T)
6-34 $F_{FE} = 1.80$ kip (C), $F_{EC} = 693$ lb (C)
6-35 $F_{CB} = 3.60$ kN (T), $F_{GC} = 1.80$ kN (C), $F_{FG} = 4.02$ kN (C)
6-37 $F_{LK} = 10$ kip (C), $F_{LC} = 2.5$ kip (C), $F_{BC} = 10$ kip (T)
6-38 $F_{JI} = 7.33$ kip (C), $F_{DE} = 9$ kip (T), $F_{JE} = 3.00$ kip (C)
6-39 $F_{FE} = 8.49$ kN (T), $F_{BC} = 8.49$ kN (C), $F_{FC} = 0$
6-41 $F_{JI} = 7.50$ kip (T), $F_{EI} = 2.50$ kip (C)
6-42 $F_{KJ} = 3.07$ kip (C), $F_{CD} = 3.07$ kip (T), $F_{NJ} = 0.167$ kip (C)
6-43 $F_{JI} = 2.13$ kip (C), $F_{DE} = 2.13$ kip (T)
6-45 $F_{BF} = 0$, $F_{BG} = 35.4$ kN (C), $F_{AB} = 45$ kN (T)
6-46 $F_{BG} = (200\sqrt{L^2 + 9})$ N (C), $F_{BC} = (200L)$ N (C), $F_{HG} = (400L)$ N (T)
6-47 $F_{GF} = 1.78$ kN (T), $F_{CD} = 2.23$ kN (C), $F_{CF} = 0$
6-49 BN, NC, DO, OC, HJ, LE, and JG, $F_{EF} = 7.88$ kN (T), $F_{LK} = 9.25$ kN (C), $F_{EP} = 1.94$ kN (T)
6-50 $F_{AD} = 300$ lb (C), $F_{BD} = 450$ lb (C), $F_{CD} = 568$ lb (C)
6-51 $F_{AB} = 6.46$ kN (T), $F_{AC} = F_{AD} = 1.50$ kN (C), $F_{BC} = F_{BD} = 3.70$ kN (C), $F_{BE} = 4.80$ kN (T)
6-53 $F_{AE} = F_{AC} = 220$ N (T), $F_{AB} = 583$ N (C), $F_{BD} = 707$ N (C), $F_{BE} = F_{BC} = 141$ N (T)
6-54 $F_{max} = 169$ N
6-55 $F_{BC} = 1.15$ kN (C), $F_{DF} = 4.16$ kN (C), $F_{BE} = 4.16$ kN (T)
6-57 $F_{CD} = 650$ lb (C), $F_{CF} = 0$, $F_{DF} = 1.23$ kip (T), $F_{EF} = 525$ lb (C)
6-58 $F_{AE} = 450$ lb (T), $F_{AB} = 300$ lb (T), $F_{BC} = 0$, $F_{BF} = 225$ lb (T), $F_{BE} = 515$ lb (T), $F_{BD} = 721$ lb (C)
6-59 $F_{AD} = 686$ N (T), $F_{BD} = 0$, $F_{CD} = 615$ N (C), $F_{BC} = 229$ N (T), $F_{AC} = 343$ N (T), $F_{EC} = 457$ N (C)
6-61 $P = 300$ lb, $F_B = 580$ lb
6-62 $P = 25$ lb, $R_A = 25$ lb, $R_B = 60$ lb
6-63 Wmax $= 980$ lb
6-65 $A_x = 300$ N, $A_y = 300$ N, $C_x = 300$ N, $C_y = 300$ N
6-66 $A_x = 80$ lb, $A_y = 80$ lb, $B_y = 133$ lb, $B_x = 333$ lb, $C_x = 413$ lb, $C_y = 53.3$ lb
6-67 $P_{max} = 742$
6-69 $D_x = 0$, $D_y = 5$ kN, $A_x = 0$, $A_y = 17$ kN, $M_A = 32$ kN·m
6-70 $C_x = D_x = 160$ lb, $C_y = D_y = 107$ lb, $B_y = 26.7$ lb, $B_x = 80$ lb, $E_x = 0$, $E_y = 26.7$ lb, $A_x = 160$ lb
6-71 $M = 2.43$ kN·m
6-73 $F_{AC} = 2.51$ kip (C), $F_{AB} = 3.08$ kip (C), $F_{AD} = 3.43$ kip (T)
6-74 $A_y = 245$ N, $D_y = 245$ N, $D_x = 695$ N, $A_x = 695$ N
6-75 $F_{CD} = 1.01$ kN, $F_{ABC} = 319$ N
6-77 $A_x = 300$ lb, $A_y = 400$ lb, $C_y = 1.2$ kip, $D_x = 300$ lb, $D_y = 800$ lb
6-78 $N_A = 8$ kip, $N_C = 5.14$ kip, $N_B = 14.9$ kip
6-79 $C_y = 1.33$ kN, $B_y = 549$ N, $C_x = 2.98$ kN, $A_y = 235$ N, $A_x = 2.98$ kN, $B_x = 2.98$ kN
6-81 $F_{IJ} = 9.06$ kN (T), $F_{BC} = 15.4$ kN (C)
6-82 $C_y = 5$ kN, $B_y = 15$ kN, $M_A = 30$ kN·m, $A_y = 5$ kN, $A_x = 0$
6-83 $D_x = 50$ lb, $D_y = 50$ lb, $B_x = 112$ lb, $A_x = 62.5$ lb, $B_y = 117$ lb, $A_y = 167$ lb
6-85 $P = 107$ N
6-86 $W_S = 3.35$ lb, No
6-87 $C_x = 75$ lb, $C_y = 100$ lb
6-89 $A_x = 4.20$ kN, $B_x = 4.20$ kN, $A_y = 4.00$ kN, $B_y = 3.20$ kN, $C_x = 3.40$ kN, $C_y = 4.00$ kN
6-90 $P = 2$ lb
6-91 $F = 120$ lb
6-93 $T = 5.10$ kN, $\theta = 30°$, $A_x = 4.33$ kN, $A_y = 5.15$ kN
6-94 $\theta = 33.7°$, $s = 177$ mm
6-95 $F_N = 5.25$ lb
6-97 $P = 40$ N, $x = 240$ mm
6-98 $N_E = 5$ kN, $N_C = 16.7$ kN, $A_x = 0$, $A_y = 2.67$ kN, $M_A = 21.5$ kN·m
6-99 $N_C = 12.7$ kN, $A_x = 12.7$ kN, $A_y = 2.94$ kN $N_D = 1.05$ kN
6-101 $F_{AB} = 8.60$ MN (C), $F_C = 9.78$ MN
6-102 $A_y = 34.0$ N, $A_x = 0$, $C_y = 6.54$ N, $C_x = 0$, $x = 292$ mm, $B_y = 1.06$ N, $B_x = 0$
6-103 $F = 562$ N
6-105 $F = 6.93$ kN
6-106 $F_s = 286$ N
6-107 $d_{min} = 0.638$ ft
6-109 $F_E = 3.64F$
6-110 $\theta = 6.22°$
6-111 $W = 25.5$ lb
6-113 $m_S = 1.71$ kg
6-114 $m_L = 106$ kg
6-115 $P_{max} = 282$ N, $B_x = D_x = 70.7$ N, $B_y = D_y = 283$ N, $B_z = D_z = 283$ N

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6-117 $F_{AB} = 1.56$ kN, $E_x = 0$, $E_y = 0$, $M_{Ex} = 0.5$ kN · m, $M_{Ey} = 0$

6-118 $M_{Cx} = 0$, $C_x = 0$, $C_z = 0.18$ kip, $C_y = 1.17$ kip, $M_{Cz} = 4.14$ kip · ft, $A_x = 0$, $A_y = 1.44$ kip, $A_z = 0.540$ kip

Chapter 7

7-1 $N_C = 0$, $V_C = -1$ kip, $M_C = 56$ kip · ft, $N_D = 0$, $V_D = -1$ kip, $M_D = 48$ kip · ft

7-2 $N_B = 0$, $V_B = -100$ lb, $M_B = 750$ lb · in., $N_D = 0$, $V_D = 75$ lb, $M_D = -750$ lb · in.

7-3 $N_A = -39$ kN, $V_A = 0$, $M_A = -2.42$ kN · m

7-5 $N_C = 21.7$ kN, $V_C = 62.5$ kN, $M_C = -225$ kN · m

7-6 $N_D = 0$, $V_D = 8$ kN, $M_D = -9.75$ kN · m, $N_E = 0$, $V_E = 5$ kN, $M_E = 7.5$ kN · m

7-7 $N_C = 0$, $V_C = 2.88$ kN, $M_C = 6.56$ kN · m, $N_D = 0$, $V_D = 1.75$ kN, $M_D = 9.75$ kN · m

7-9 $N_E = 470$ N , $V_E = 215$ N, $M_E = 660$ N · m, $N_F = 0$, $V_F = -215$ N, $M_F = 660$ N · m

7-10 $N_C = 0$, $V_C = 0.5$ kip, $M_C = 3.6$ kip · ft

7-11 $N_C = 0$, $V_C = 0$, $M_C = 1.5$ kN · m

7-13 $N_C = 0$, $V_C = \dfrac{3w_0L}{8}$, $M_C = -\dfrac{5}{48}w_0L^2$

7-14 $N_C = -1.80$ kip, $V_C = -125$ lb, $M_C = 9.75$ kip · ft

7-15 $M_C = -15$ kip · ft, $N_C = 0$, $V_C = 2.01$ kip, $M_D = 3.77$ kip · ft, $N_D = 0$, $V_D = 1.11$ kip

7-17 $N_A = 86.6$ lb, $V_A = 150$ lb, $M_A = 1.8$ kip · in.

7-18 $N_C = -4$ kip, $V_C = -1$ kip, $M_C = -14$ kip · ft, $N_D = -4$ kip, $V_D = 1.75$ kip, $M_D = -5$ kip · ft

7-19 $N_E = -1.92$ kN, $V_E = 800$ N, $M_E = 2.4$ kN · m

7-21 $N_C = -4.32$ kip, $V_C = 1.35$ kip, $M_C = 4.72$ kip · ft

7-22 $N_D = 0$, $V_D = 5$ kip, $M_D = 46$ kip · ft

7-23 $N_C = -\dfrac{wL}{2}\csc\theta$, $V_C = 0$, $M_C = \dfrac{wL^2}{8}\cos\theta$

7-25 $N_C = -265$ lb, $V_C = -649$ lb, $M_C = -4.23$ kip · ft, $N_D = -265$ lb, $V_D = 637$ lb, $M_D = -3.18$ kip · ft

7-26 $a = \dfrac{L}{3}$

7-27 $N_C = -1.91$ kN, $V_C = 0$, $M_C = 382$ N · m

7-29 $N_C = -406$ lb, $V_C = 903$ lb, $M_C = 1.35$ kip · ft

7-30 $N_D = -464$ lb, $V_D = -203$ lb, $M_D = 2.61$ kip · ft

7-31 $V_D = 0$, $N_D = 200$ lb, $M_D = 900$ lb · ft, $V_E = 120$ lb, $N_E = 360$ lb, $M_E = 1.14$ kip · ft

7-33 $N_D = -450$ lb, $V_D = 250$ lb, $M_D = -750$ lb · ft

7-34 $N_E = 250$ lb, $V_E = 0$, $M_E = 675$ lb · ft

7-35 $V_{Ax} = 0$, $N_{Ay} = 0$, $V_{Az} = 250$ lb, $M_{Ax} = 188$ lb · ft, $M_{Ay} = 188$ lb · ft, $M_{Az} = 0$, $V_{Bx} = 0$, $V_{By} = 0$, $N_{Bz} = 250$ lb, $M_{Bx} = 438$ lb · ft, $M_{By} = 188$ lb · ft, $M_{Bz} = 0$

7-37 $V = -0.293rw_0$, $N = -0.707rw_0$, $M = 0.0783\, r^2w_0$

7-38 $N = -0.866rw_0$, $V = -1.5rw_0$, $M = 1.23r^2w_0$

7-39 $V = 0.278rw_0$, $N = 0.0759rw_0$, $M = 0.0759r^2w_0$

7-41 $V_D = 135$ N, $N_D = 180$ N, $M_D = 270$ N · m

7-42 $(V_C)_x = 450$ N, $(N_C)_y = 0$, $(V_C)_z = -550$ N, $(M_C)_x = -825$ N · m, $(M_C)_y = 30$ N · m, $(M_C)_z = 675$ N · m

7-43 $(V_D)_x = 116$ kN, $(N_D)_y = -65.6$ kN, $(V_D)_z = 0$, $(M_D)_x = 49.2$ kN · m, $(M_D)_y = 87$ kN · m, $(M_D)_z = 26.2$ kN · m

7-45 a) $0 \le x < a$: $V = \left(1 - \dfrac{a}{L}\right)P$

$M = \left(1 - \dfrac{a}{L}\right)Px$

$a < x \le L$: $V = -\left(\dfrac{a}{L}\right)P$

$M = P\left(a - \dfrac{a}{L}x\right)$,

b) $0 \le x < 2$ m: $V = 6$ kN, $M = \{6x\}$ kN · m

2 m $< x \le 6$ m: $V = -3$ kN

$M = \{18 - 3x\}$ kN · m

7-46 a) For $0 \le x < a$, $V = P$, $M = Px$

For $a < x < L - a$, $V = 0$, $M = Pa$

For $L - a < x \le L$, $V = -P$, $M = P(L - x)$, b) For $0 \le x < 5$ ft, $V = 800$ lb $M = \{800x\}$ lb · ft

For 5 ft $< x < 7$ ft, $V = 0$ $M = 4$ kip · ft

For 7 ft $< x \le 12$ ft, $V = -800$ lb

$M = \{9.6 - 0.8x\}$ kip · ft

7-47 a) For $0 \le x < a$, $V = \dfrac{Pb}{a + b}$, $M = \dfrac{Pb}{a + b}x$

For $a < x \le a + b$, $V = -\dfrac{Pa}{a + b}$

$M = Pa - \dfrac{Pa}{a + b}x$,

b) For $0 \le x < 5$ ft, $V = 350$ lb

$M = \{350x\}$ lb · ft

For 5 ft $< x \le 12$ ft, $V = -250$ lb

$M = \{3 - 0.25x\}$ kip · ft

7-49 For $0 \le x < b$, $V = -Pa/b$, $M = -Pax/b$, For $b < x \le a + b$, $V = P$, $M = -P(a + b - x)$

7-50 $V = \{4 - 2x\}$ kN, $M = \{-x^2 + 4x - 10\}$ kN · m

7-51 $V = \{28 - 3x\}$ kN, $M = \{28x - 1.5x^2 - 114\}$ kN · m

7-53 For $0 \le x < 8$ m, $V = \{134 - 40x\}$ kN, $M = \{134x - 20x^2\}$ kN · m, For 8 m $< x \le 11$ m, $V = 20$ kN, $M = \{20x - 370\}$ kN · m

7-54 $(w_0)_{max} = 8.52$ kN/m

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7-55 For $0 \le x < L$, $V = \frac{w}{18}(7L - 18x)$,
$M = \frac{w}{18}(7Lx - 9x^2)$, For $L < x < 2L$,
$V = \frac{w}{2}(3L - 2x)$, $M = \frac{w}{18}(27Lx - 20L^2 - 9x^2)$,
For $2L < x \le 3L$, $V = \frac{w}{18}(47L - 18x)$,
$M = \frac{w}{18}(47Lx - 9x^2 - 60L^2)$

7-57 a) $V = \frac{w}{8}(7L - 8x)$
$M = -\frac{w}{8}(4x^2 - 7Lx + 3L^2)$,
b) $V = \{5(10.5 - x)\}$ kN
$M = \{-2.5(x^2 - 21x + 108)\}$ kN · m

7-58 $V = \frac{w}{4}(3L - 4x)$, $M = \frac{w}{4}(3Lx - 2x^2 - L^2)$

7-59 For $0 \le x < 3$ m, $V = \{-2x^2/3 - 4\}$ kN,
$M = \{-2x^3/9 - 4x\}$ kN · m,
For $3\text{ m} < x \le 6$ m, $V = \{4(6 - x)\}$ kN,
$M = \{-2(6 - x)^2\}$ kN · m

7-61 For $0 \le x < 15$ ft, $V = -20$ kip,
$M = \{-20x\}$ kip · ft,
For $15\text{ ft} < x < 45$ ft, $V = \{120 - 4x\}$ kip,
$M = \{-1.65(10^3) + 120x - 2x^2\}$ kip · ft,
For $45\text{ ft} < x \le 60$ ft, $V = 20$ kip,
$M = \{-1.2(10^3) + 20x\}$ kip · ft

7-62 $a = \frac{L}{\sqrt{2}}$

7-63 $(w_0)_{max} = 21.7$ lb/ft

7-65 $V = \{3 - 0.5x\}$ kip,
$M = \{3x - 0.25x^2 - 6.75\}$ kip · ft

7-66 $V_x = 0$, $V_z = \{24 - 4y\}$ lb,
$M_x = \{2y^2 - 24y + 64\}$ lb · ft, $M_y = 8$ lb · ft,
$M_z = 0$

7-67 $V = \frac{\pi\gamma {r_0}^2}{3L^2}[(L + x)^3 - L^3]$,
$M = -\frac{\pi\gamma {r_0}^2}{12L^2}[(L + x)^4 - L^3(4x + L)]$

7-69 $V = \{16 - 4y\}$ lb, $M = \{-2y^2 + 16y - 40\}$ lb · ft

7-70 $V_{max} = 675$ lb, $M_{max} = 1.9$ kip · ft

7-71 $V_{max} = -14.5$ kN, $M_{max} = -22$ kN · m

7-73 $V_{max} = \pm 5$ kN, $M_{max} = -10$ kN · m

7-74 $V_{max} = -225$ lb, $M_{max} = -300$ lb · ft

7-75 $V_{max} = 625$ N, $M_{max} = 750$ N · m

7-77 $V_{max} = -14$ kN, $M_{max} = 18$ kN · m

7-78 $V_{max} = 45$ kN, $M_{max} = -67.5$ kN · m

7-79 $V_{max} = -2P$, $M_{max} = PL$

7-81 $V_{max} = 800$ lb, $M_{max} = -1.2$ kip · ft

7-82 $V_{max} = 28$ kN, $M_{max} = -114$ kN · m

7-83 $V_{max} = -10.5$ kN, $M_{max} = 22.6$ kN · m

7-85 $V_{max} = -110$ lb, $M_{max} = -180$ lb · ft

7-86 $V_{max} = \pm 3$ kN, $M_{max} = 3$ kN · m

7-87 $V_{max} = -15.8$ kN, $M_{max} = 20.5$ kN · m

7-89 $V_{max} = \pm 20$ kN, $M_{max} = 45$ kN · m

7-90 $V_{max} = \pm 11.5$ kN, $M_{max} = -21$ kN · m

7-91 $V_{max} = -172$ lb, $M_{max} = -200$ lb · ft

7-93 $V_{max} = 3.75$ kip, $M_{max} = 37.5$ kip · ft

7-94 $x_B = 4.36$ ft

7-95 $P = 71.4$ lb

7-97 $x_B = 3.98$ ft

7-98 $P = 84$ lb

7-99 $y_B = 8.67$ ft, $y_D = 7.04$ ft

7-101 $h = 2.68$ ft, $\mathscr{L} = 13.4$ ft

7-102 $w_{max} = 51.9$ lb/ft

7-103 $T_{max} = 14.4$ kip, $T_{min} = 13.0$ kip

7-105 $T_B = 48.7$ MN, $T_A = 51.4$ MN

7-106 $(w_0)_{max} = 77.8$ kN/m

7-107 $y = \{46.0(10^{-6})x^3 + 0.176x\}$ ft, $T_{max} = 48.7$ kip

7-109 $T_{max} = 594$ kN

7-110 $T_{min} = 552$ kN

7-111 $h_{min} = 7.09$ m

7-113 $y = \{137[\cosh 7.32(10^{-3})x - 1]\}$ ft, $\mathscr{L} = 158$ ft

7-114 $T_{max} = 5.36$ kN, $\mathscr{L} = 51.3$ m

7-115 $y = \{23.5[\cosh 0.0425x - 1]\}$ m, $T_{max} = 1.60$ kN

7-117 $d_{AC} = 8.07$ m

7-118 N/A

7-119 $F_{Rx} = 292$ lb

7-121 $s = 5.14$ ft

7-122 $T_{max} = 4.52$ kip, $\mathscr{L} = 331$ ft

Chapter 8

8-1 $P_{max} = 12.8$ kN

8-2 $P = 76.0$ lb

8-3 $N_A = 16.5$ kN, $N_B = 42.3$ kN, No

8-5 $P = 140$ N, $d = 500$ mm

8-6 $F_C = 30.5$ N, $N_C = 152$ N, $x = 0.794$ m

8-7 $b = 2a \sin\theta$

8-9 N/A

8-10 $\phi = \theta_k$, $P_{min} = W \sin(\alpha + \theta_k)$

8-11 $P = 0.990$ lb

8-13 $F_A = 604$ N, No

8-14 $\theta_{max} = 21.8°$

8-15 $l = 26.7$ ft

8-17 $(\mu_A)_{min} = (\mu_B)_{min} = 0.268$

8-18 $\theta_{max} = 15.9°$

8-19 $(\mu_s)_{min} = 0.578$

8-21 $n_{max} = 8$

8-22 $s = 5$ in.

8-23 $P_{min} = 1.18$ kN

8-25 Yes., It slips.

8-26 It will slip.

8-27 It will slip.

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8-29 $\mu_s = 0.306$
8-30 $P_{min} = 1.03$ kN
8-31 $P_{min} = 845$ N
8-33 No
8-34 At $P = \frac{W}{2}\mu_s = 0.333$,
For $0 < P < \frac{W}{2}$ and $\frac{W}{2} < P \le W$,
$$\mu_s = \frac{(P + W) - \sqrt{(W + 7P)(W - P)}}{2(2P - W)}$$
8-35 $P_{max} = 8.18$ lb
8-37 $M_{max} = 77.2$ N·m
8-38 $F_A = 71.4$ N
8-39 No
8-41 $n_{max} = 7$
8-42 $F_B = 200$ N
8-43 $\mu_{min} = 0.177$
8-45 $d_{max} = 2.7$ in.
8-46 $P_{min} = 613$ N
8-47 $P_{min} = 13.4$ lb
8-49 $P_{min} = 589$ N
8-50 $(\mu_A)_{max} = 0.152$, $(\mu_B)_{max} = 0.254$
8-51 $P_{min} = 49.1$ N
8-53 $P_{min} = 83.4$ lb
8-54 $P_{min} = 100$ lb
8-55 $d_{max} = \frac{2\mu_s l}{1\sqrt{1 + 4\mu_s^2}}$
8-57 $P_{min} = \frac{1}{2}\mu_s W$
8-58 $\theta_{max} = 33.3°$
8-59 $\theta_{max} = 22.6°$
8-61 $P_{min} = 858$ N
8-62 $P_{max} = 0.0328W$
8-63 $P_{min} = 1.38W$
8-65 $P_{min} = 304$ N
8-66 $s_{min} = 32.9$ mm
8-67 $F = 66.7$ N
8-69 $P_{min} = 575$ N
8-70 $\theta_{max} = 33.3°$
8-71 $F = 71.4$ N
8-73 N/A
8-74 $M = 40.6$ N·m
8-75 $\mu_s = 0.0637$
8-77 $P = 51.2$ N
8-78 $P = 880$ N, $M_{max} = 351$ N·m
8-79 $P = 617$ lb
8-81 $F = 4.91$ N
8-82 $P = 2.85$ kN
8-83 $(W_D)_{max} = 12.7$ lb
8-85 $n_{min} = 2$
8-86 $P = 1.54$ kN
8-87 $\mu_s = 0.0583$
8-89 $(T_A)_{min} = 1.95$ kN, $(T_B)_{min} = 759$ N
8-90 $P_{min} = 736$ N
8-91 $\theta = 40.1°$
8-93 $M_{max} = 458$ N·m
8-94 $(m_D)_{max} = 25.5$ kg
8-95 $F_A = 16.2$ N, No
8-97 $n_{max} = 30$, $M = 150$ lb·ft
8-98 N/A
8-99 $P_{min} = 53.6$ N
8-101 $W_{max} = 39.5$ lb
8-102 $T_1 = 1.85$ N, $T_2 = 1.59$ N
8-103 $n_{min} = 2$
8-105 $\theta_{max} = 38.7°$
8-106 $d = 4.07$ m, $(\mu_s)_{min} = 0.190$
8-107 $M = 304$ lb·in.
8-109 $M = 97.5$ lb·ft
8-110 $F_s = 1.62$ kip
8-111 $M_{min} = 238$ N·m
8-113 $M = \frac{\mu_s P}{3\cos\theta}\left(\frac{d_2^3 - d_1^3}{d_2^2 - d_1^2}\right)$
8-114 $p_0 = 0.442$ psi, $F_{min} = 573$ lb
8-115 $P_{min} = 2.00$ N
8-117 $P = 814$ N
8-118 $P_{min} = 0.590$ lb, $P_{min} \approx 0.597$ lb
8-119 $M = \frac{\mu_k P r}{\sqrt{1 + \mu_k^2}}$
8-121 $m_B = 13.2$ kg
8-122 $(r_f)_A \approx 0.2$ in., $(r_f)_B \approx 0.075$ in.
8-123 $(r_f)_A \approx 7.5$ mm, $(r_f)_B \approx 3$ mm
8-125 $P = 1.88$ lb, $P \approx 1.89$ lb
8-126 $P_{min} = 216$ N
8-127 $P_{max} = 178$ N
8-129 $P_{max} = 266$ N
8-130 N/A
8-131 $P_{min} = 33.4$ lb

Chapter 9

9-1 $\bar{x} = 0.546$ m, $O_x = 0$, $O_y = 7.06$ N, $M_O = 3.85$ N·m
9-2 $\bar{x} = 0$, $\bar{y} = 1.82$ ft
9-3 $\bar{x} = 0.574$ m, $B_x = 0$, $B_y = 84.8$ N, $A_y = 63.1$ N
9-5 $m = 13.9$ kg, $\bar{x} = 1.24$ m, $\bar{y} = 2.18$ m
9-6 $A = 2.25\text{ft}^2$, $\bar{x} = 2.4$ft, $\bar{y} = 0.857$ft
9-7 $A = \frac{2}{3}ah$, $\bar{x} = \frac{3}{8}a$, $\bar{y} = \frac{3}{5}h$
9-9 $\bar{x} = 0.649$ ft
9-10 $\bar{y} = 2.04$ ft

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9-11 $\bar{x} = \frac{3}{4}b$

9-13 $\bar{x} = \left(\frac{\pi - 2}{2\pi}\right)a$

9-14 $\bar{y} = \frac{\pi}{8}a$

9-15 $\bar{x} = 1.08$ in.

9-17 $\bar{y} = \frac{a\pi}{8}, \bar{x} = \frac{L}{2}$

9-18 $\bar{x} = 0.398$ m

9-19 $\bar{y} = 1.00$ m

9-21 $\bar{x} = 1.6$ ft

9-22 $\bar{y} = 4.15$ ft

9-23 $\bar{x} = 0.4$ft

9-25 $\bar{x} = 3.20$ ft, $\bar{y} = 3.20$ ft, $\bar{z} = -0.125$ ft, $T_A = 384$ lb, $T_C = 384$ lb, $T_B = 1.15$ kip

9-26 $\bar{y} = \frac{4b}{3\pi}, \bar{x} = \frac{4a}{3\pi}$

9-27 $\bar{y} = 2.80$ m , $\bar{x} = 6.00$ m

9-29 $\bar{y} = 1.33$ in.

9-30 $\bar{x} = 1$ m

9-31 $\bar{y} = 0.4$ m

9-33 $\bar{y} = \frac{\pi a}{8}$

9-34 $\bar{x} = -3$ m, $\bar{y} = 0.25$ m, $\bar{z} = -0.3$ m, $A_z = 52.3$ kN, $M_{Ay} = 52.3$ kN · m, $A_z - 52.3 = 0$, $A_z = 52.3$ kN, $M_A = 52.3$ kN · m

9-35 $\bar{x} = 0.446$ m

9-37 $\bar{y} = \frac{3}{4}h$

9-38 $\bar{y} = \frac{4}{5}$

9-39 $\bar{y} = \frac{2}{5}h$

9-41 $\bar{x} = \bar{y} = 0, \bar{z} = \frac{2}{3}a$

9-42 $\bar{z} = \frac{R^2 + 3r^2 + 2rR}{4(R^2 + r^2 + rR)}h$

9-43 $\bar{z} = 2.50$ ft

9-45 $\bar{y} = 0.833$ ft

9-46 $\bar{y} = \frac{3}{8}a$

9-47 $\bar{y} = 16.9$ in.

9-49 $m = 0.917\pi\rho_0 a^3, \bar{y} = 0.418a$

9-50 $\bar{z} = \frac{c}{4}$

9-51 $\bar{x} = 34.4$ mm, $\bar{y} = 85.8$ mm

9-53 $\bar{x} = -0.590$ in., $\bar{y} = 1.07$ in., $\bar{z} = 2.14$ in.

9-54 $\bar{x} = -50$ mm, $\bar{y} = 86.6$ mm, $\phi = 19.1°$

9-55 $\bar{x} = 2.43$ m, $\bar{y} = 1.31$ m

9-57 $\bar{x} = 121$ mm, $\bar{y} = 44.1$ mm, $\bar{z} = 124$ mm

9-58 $\bar{x} = 1.60$ ft, $\bar{y} = 7.04$ ft, $A_x = 0$, $A_y = 149$ lb, $M_A = 502$ lb · ft

9-59 $\bar{y} = \frac{h}{3}\left(\frac{2b_1 + b_2}{b_1 + b_2}\right)$

9-61 $\bar{x} = 2.64$ in., $\bar{y} = 12$ in.

9-62 $\bar{x} = 4.83$ in., $\bar{y} = 2.56$ in.

9-63 $\bar{y} = 11.9$ in.

9-65 $\bar{x} = 0, \bar{y} \approx 545$ mm

9-66 $\bar{y} = 272$ mm

9-67 $\bar{y} = 324$ mm

9-69 $\bar{x} = 105$ mm

9-70 $\bar{y} = 5.12$ in.

9-71 $\bar{x} = 2.11$ ft, $\bar{y} = 1.34$ ft

9-73 $\bar{x} = 2.5$ in., $\bar{y} = 4$ in.

9-74 $\bar{x} = 7.18$ ft, $A_y = 667$ lb, $B_y = 2.63$ kip

9-75 $\bar{y} = 58.1$ mm

9-77 $\theta = 53.1°$

9-78 $\bar{y} = 154$ mm

9-79 $\bar{x} = 2.19$ in., $\bar{y} = 2.79$ in., $\bar{z} = 1.67$ in.

9-81 $\bar{x} = \frac{L + (n - 1)d}{2}$

9-82 N/A

9-83 $d = 3$ m

9-85 $\bar{x} = 13.1$ mm, $\bar{z} = 22.5$ mm, $\theta_{max} = 30.1°$

9-86 $\bar{z} = 111$ mm

9-87 $\bar{x} = 4.56$ m, $\bar{y} = 3.07$ m, $B_y = 4.66$ kN, $A_y = 5.99$ kN

9-89 $\bar{y} = 2.57$ in.

9-90 $V = 101$ ft^3

9-91 $A = 141$ in^2

9-93 $W = 3.01$ lb

9-94 $A = 70.0$ in^2

9-95 $R = 29.3$ kip

9-97 $A = 302$ m^2

9-98 $V = 536$ m^3

9-99 $A = 88.0$ m^2

9-101 $A = 141$ in^2

9-102 $V = 49.1$ in^3

9-103 $V = 25.5$ m^3

9-105 $V = 0.0486$ m^3

9-106 $V = 3.49$ m^3

9-107 $A = 1.36(10^3)$

9-109 $h = 29.9$ mm

9-110 $V = 207$ m^3, $A = 188$ m^2

9-111 $W = 3.12(10^6)$ lb

9-113 $V = 1.40(10^3)$ in^3

9-114 $A = 119(10^3)$ mm^2

9-115 $F_R = 7.62$ kN, $\bar{x} = 2.74$ m, $\bar{y} = 3$ m

9-117 $F_R = 678$ lb, $\bar{x} = 0.948$ ft, $\bar{y} = 1.50$ ft

9-118 $F_R = 4.00$ kip, $\bar{y} = -6.49$ ft

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9-119 $F_{Rx} = 628$ kN, $F_{Ry} = 538$ kN
9-121 $F_{RA} = 157$ kN, $F_{RB} = 235$ kN, $d_o = 4.22$ m
9-122 $F_{CDEF} = 750$lb, $F_{ABDC} = 1.8$ kip
9-123 $F_R = 83.4$ kN
9-125 $F_R = 117$ lb, $d = 13.1$ in.
9-126 $d_{\min} = 2.69$ m
9-127 $F_{R1} = 13.8$ kip on $ABDC$,
$F_{R2} = 61.4$ kip on $BDFE$
9-129 $h = 6.67$ m
9-130 $h = 7.73$ m

Chapter 10

10-1 $I_x = 2.13\ \text{m}^4$
10-2 $I_y = 4.57\ \text{m}^4$
10-3 $I_x = 0.533\ \text{m}^4$
10-5 $I_x = \frac{2}{7}bh^3$
10-6 $I_y = \frac{2}{15}hb^3$
10-7 $I_x = \frac{\pi r_0^4}{8}$
10-9 $I_x = 10.7\ \text{in}^4$
10-10 $I_x = 3.20\ \text{m}^4$
10-11 $I_x = 1.54\ \text{in}^4$
10-13 $I_x = 0.0606\ \text{m}^4$
10-14 $I_y = 0.222\ \text{m}^4$
10-15 $I_x = 19.5\ \text{in}^4$
10-17 $I_x = \frac{\pi r^4}{16}$
10-18 $I_y = \frac{b^3h}{6}$
10-19 $I_x = 39.0\ \text{m}^4$
10-21 $I_x = 0.533\ \text{m}^4$
10-22 $I_y = 2.44\ \text{m}^4$
10-23 $I_x = \frac{3ab^3}{35}$
10-25 $\bar{y} = 1.83$ in., $I_{x'} = 33.5\ \text{in}^4$
10-26 $I_y = 74\ \text{in}^4$
10-27 $\bar{y} = 2$ in., $I_{x'} = 128\ \text{in}^4$
10-29 $I_x = \frac{1}{12}a^4$
10-30 $I_x = 548(10^6)\ \text{mm}^4$
10-31 $I_y = 548(10^6)\ \text{mm}^4$
10-33 $I_y = 388\ \text{in}^4$
10-34 $I_x = 115(10^6)\ \text{mm}^4$
10-35 $I_y = 153(10^6)\ \text{mm}^4$
10-37 $I_y = 10.3(10^9)\ \text{mm}^4$
10-38 $I_y = 914(10^6)\ \text{mm}^4$
10-39 $\bar{y} = 334$ mm, $I_{x'} = 3.83(10^9)\ \text{mm}^4$
10-41 $I_y = 29.8(10^6)\ \text{mm}^4$
10-42 $I_x = 154(10^6)\ \text{mm}^4$
10-43 $I_y = 91.3(10^6)\ \text{mm}^4$
10-45 $\bar{x} = 61.6$ mm, $I_{y'} = 41.2(10^6)\ \text{mm}^4$
10-46 $I_x = 52.7(10^6)\ \text{mm}^4$
10-47 $I_y = 2.51(10^6)\ \text{mm}^4$
10-49 $J_O = \frac{1}{32}\pi d^4 - \frac{1}{6}a^4$
10-50 $\bar{y} = 0.181$ m, $I_{x'} = 4.23(10^{-3})\ \text{m}^4$
10-51 $I_{x'} = 520(10^6)\ \text{mm}^4$
10-53 $I_y = 45.5(10^6)\ \text{mm}^4$
10-54 $I_{xy} = \frac{1}{6}l^3t\sin 2\theta$
10-55 $I_{xy} = 48\ \text{in}^4$
10-57 $I_{xy} = \frac{3}{16}b^2h^2$
10-58 $I_{xy} = \frac{3}{16}b^2h^2$
10-59 $I_{xy} = 10.7\ \text{in}^4$
10-61 $I_{xy} = 0.667\ \text{in}^4$
10-62 $I_{xy} = -28.1(10^3)\ \text{mm}^4$
10-63 $I_u = 15.8\ \text{in}^4$, $I_v = 25.8\ \text{in}^4$
10-65 $I_{xy} = \frac{a^2c\sin^2\theta}{12}(4a\cos\theta + 3c)$
10-66 $I_{xy} = 98.4(10^6)\ \text{mm}^4$
10-67 $I_{xy} = -110\ \text{in}^4$
10-69 $\bar{y} = 4.67$ in., $I_x = 1.47(10^3)\ \text{in}^4$, $I_y = 2.50(10^3)\ \text{in}^4$
10-70 $\bar{x} = 1.68$ in., $\bar{y} = 1.68$ in., $I_{\max} = 31.7\ \text{in}^4$,
$I_{\min} = 8.07\ \text{in}^4$, $\theta_{p1} = 45°$, $\theta_{p2} = -45°$
10-71 $\bar{x} = 1.68$ in., $\bar{y} = 1.68$ in., $I_{\max} = 31.7\ \text{in}^4$,
$I_{\min} = 8.07\ \text{in}^4$, $\theta_{p1} = 45°$, $\theta_{p2} = -45°$
10-73 $\bar{x} = 48.2$ mm, $I_u = 112(10^6)\ \text{mm}^4$,
$I_v = 258(10^6)\ \text{mm}^4$, $I_{uv} = -126(10^6)\ \text{mm}^4$
10-74 $I_{\max} = 117(10^6)\ \text{mm}^4$, $I_{\min} = 28.8(10^6)\ \text{mm}^4$
10-75 $I_{\max} = 117(10^6)\ \text{mm}^4$, $I_{\min} = 28.8(10^6)\ \text{mm}^4$
10-77 $I_u = 43.9\ \text{in}^4$, $I_v = 23.6\ \text{in}^4$, $I_{uv} = 17.5\ \text{in}^4$
10-78 $I_u = 909(10^6)\ \text{mm}^4$, $I_v = 703(10^6)\ \text{mm}^4$,
$I_{uv} = 179(10^6)\ \text{mm}^4$
10-79 $I_u = 909(10^6)\ \text{mm}^4$, $I_v = 703(10^6)\ \text{mm}^4$,
$I_{uv} = 179(10^6)\ \text{mm}^4$
10-81 $\theta_{p1} = -27.3°$, $I_{\max} = 24.6(10^6)\ \text{mm}^4$,
$I_{\min} = 2.56(10^6)\ \text{mm}^4$
10-82 $\theta_{p1} = -22.5°$, $I_{\max} = 250\ \text{in}^4$, $I_{\min} = 20.4\ \text{in}^4$
10-83 $\theta_{p1} = -22.5°$, $I_{\max} = 250\ \text{in}^4$, $I_{\min} = 20.4\ \text{in}^4$
10-85 $I_x = \frac{2}{5}mb^2$
10-86 $k_x = 1.20$ in.
10-87 $k_y = 1.56$ in.
10-89 $k_x = 57.7$ mm

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10-90 $I_x = \frac{3}{10}mr^2$
10-91 $I_y = 2.25\ \text{slug}\cdot\text{ft}^2$
10-93 $I_y = \frac{5}{18}m$
10-94 $I_z = \frac{7}{18}ma^2$
10-95 $I_O = 0.450\ \text{g}\cdot\text{m}^2$, $\bar{y} = 57.7\ \text{mm}$, $I_G = 0.150\ \text{g}\cdot\text{m}^2$
10-97 $I_z = 1.53\ \text{kg}\cdot\text{m}^2$
10-98 $I_A = 2.17\ \text{slug}\cdot\text{ft}^2$
10-99 $I_O = 5.27\text{kg}\cdot\text{m}^2$
10-101 $I_O = 0.276\ \text{kg}\cdot\text{m}^2$
10-102 $\bar{y} = 203\ \text{mm}$, $I_G = 0.230\ \text{kg}\cdot\text{m}^2$
10-103 $I_O = \frac{1}{2}ma^2$
10-105 $I_z = 0.113\ \text{kg}\cdot\text{m}^2$
10-106 $I_G = 118\ \text{slug}\cdot\text{ft}^2$
10-107 $I_O = 293\ \text{slug}\cdot\text{ft}^2$
10-109 $I_z = 34.2\ \text{kg}\cdot\text{m}^2$

Chapter 11

11-1 $F_{AD} = 3.92\ \text{kN (C)}$
11-2 $P = 2W\cot\theta$
11-3 $F_s = 10.0\ \text{lb}$
11-5 $\theta = 27.4°$, or $72.7°$
11-6 $k = 1.05\ \text{kN/m}$
11-7 $F_E = 177\ \text{N}$
11-9 $k = 10.8\ \text{lb/ft}$
11-10 $\theta = \cos^{-1}\left(\frac{a}{2L}\right)^{\frac{1}{3}}$
11-11 $P = \frac{ka(a\sin\theta - l_0)}{l}$
11-13 $F = 13.9\ \text{N}$
11-14 $M = 43.3\ \text{N}\cdot\text{m}$
11-15 $\theta = 24.9°$
11-17 $F_C = 427\ \text{N}$
11-18 $P = 2k\tan\theta\,(2l\cos\theta - l_0)$
11-19 $P = 2k(2l\cos\theta - l_0)$
11-21 $\theta = 90°$, or $33.4°$
11-22 $F = 259\ \text{lb}$
11-23 $W_G = 2.5\ \text{lb}$
11-25 $\theta = \sin^{-1}\left(\frac{4W}{ka}\right)$, or $90°$
11-26 Unstable at $x = -0.5$ ft, Stable at $x = 0.833$ ft
11-27 Unstable at $\theta = 38.7°$, Stable at $\theta = 90°$, Unstable at $\theta = 141°$
11-29 Unstable at $x = -0.424$ ft, Stable at $x = 0.590$ ft
11-30 Unstable at $\theta = 34.6°$, Stable at $\theta = 145°$
11-31 Unstable at $\theta = 17.5°$, Stable at $\theta = 70.9°$
11-33 $W_D = 275\ \text{lb}$
11-34 $\theta = \sin^{-1}\left(\frac{W}{2kL}\right)$
11-35 Stable at $h = 8.71$ in.
11-37 Unstable at $\theta = 0°$, Stable at $\theta = 71.5°$
11-38 N/A
11-39 $W = \frac{8k}{3L}$
11-41 Unstable at $\theta = 23.9°$
11-42 $b < 2r$
11-43 Unstable at $\theta = 12.1°$
11-45 Stable at $\theta = 76.8°$
11-46 Unstable at $\theta = 0°$
11-47 $h = 1.35$ in.
11-49 $h = 0$

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