

## ANSWERS OF CLASS PROBLEMS

P.1  $R = 20.07 \text{ kN}$  ; Direction of R with respect to P,  $\theta = 46.22^\circ$

P.2  $P = 2192.85 \text{ N}$  ; Component of P parallel to ABC = 2060.608 N

P.3  $\alpha = 26.83^\circ$  ;  $R = 538.516 \text{ N}$

P.4  $\theta = 63.58^\circ$

P.5  $M_c = 41699.91 \text{ N-mm}$  same for all cases

P.6  $\underline{M}_o = 240\sqrt{2} \left( \frac{i}{\sqrt{2}} - \frac{k}{\sqrt{2}} \right) \text{ N-m}$  ;  $\underline{M}_D = 236.75 \left( \frac{45i - 150j - 120k}{197.29} \right) \text{ N-m}$

P.7  $R = 100 (1.4i - 1.8j) \text{ kN}$  ;  $x = 88 \text{ m}$

P.8  $R = -500j$  ; Point of application of R = (0.64L, 0.4B)

$P = 140 \text{ kN}$  ;  $\eta = 6/7B$  ;  $\zeta = 0$

P.9  $R = 280 \text{ N}$  ;  $\bar{X} = 4.714 \text{ m}$

P.10  $d = 450 \text{ mm}$

P.11  $a = 0.6423 \text{ m}$

P.12  $R = 6.659 \times 10^8 \left( \frac{i-j}{\sqrt{2}} \right) \text{ N}$  ;  $\bar{\theta} = \frac{\pi}{4}$  ;  $\bar{Z} = 26.66 \text{ m}$

P.13  $P = 2.341 \times 10^6 \text{ N}$

P.14  $\underline{M}_A^R = \frac{20000}{\sqrt{6}} \underline{i} + \left( 400 + \frac{4000}{\sqrt{6}} \right) \underline{j} + \frac{8000}{\sqrt{6}} \underline{k}$  ;  $\underline{M}_B^R = \left( 400 + \frac{4000}{\sqrt{6}} \right) \underline{j} - \frac{2000}{\sqrt{6}} \underline{k}$  ;

$\underline{R} = -\frac{500}{\sqrt{6}} \underline{i} + \left( 400 + \frac{500}{\sqrt{6}} \right) \underline{j} + \frac{1000}{\sqrt{6}} \underline{k}$  ;  $x = -2.40633 \text{ m}$  ;  $z = -0.52739 \text{ m}$

P.15  $C_x = 0$  ;  $C_y = 14 \text{ kN}$  ;  $B_y = 26 \text{ kN}$

P.16  $T = 195 \text{ kN}$

P.17  $B_x = 549.36 \text{ N}$  ;  $T = 549.36 \text{ N}$  ;  $A_y = 686.7 \text{ N}$

P.18  $A_y = 550 \text{ N}$  ;  $B_y = 760$  ;  $C_x = -300 \text{ N}$  ;  $C_y = 1000 \text{ N}$  ;  $D_x = 300 \text{ N}$  ;  $D_y = -210 \text{ N}$

P.19  $D_x = 13.6 \text{ kN}$  ;  $D_y = 7.5 \text{ kN}$  ;  $E_x = -13.6 \text{ kN}$  ;  $E_y = -2.7 \text{ kN}$

P.20  $C_x = 277.77 \text{ N}$  ;  $C_y = -166.66 \text{ N}$  ;  $B_x = -277.77 \text{ N}$  ;  $B_y = 416.66 \text{ N}$

P.21  $F_{BD} = 375 \text{ N}$  ;  $C_x = -205 \text{ N}$  ;  $C_y = -360 \text{ N}$

P.22  $V = 2243.94 \text{ N}$  ;  $C_x = 1265.02 \text{ N}$  ;  $C_y = 1897.53 \text{ N}$

P.23  $F_c = 2439.5 \text{ N}$  ;  $E_x = -2413.6 \text{ N}$  ;  $E_y = -3011.98 \text{ N}$

P.24  $D_y = 996.67 \text{ N}$

P.25  $T = 82.07 \text{ N}$  ;  $A_x = 77.12 \text{ N}$  ;  $A_y = 126.17 \text{ N}$

P.26  $E_x = -4320 \text{ N}$  ;  $E_y = 5760 \text{ N}$  ;  $C_x = 11880 \text{ N}$  ;  $C_y = -15840 \text{ N}$

P.27  $\theta > 49.1066^\circ$

P.28  $T = 343.35 \text{ N}$

P.29  $T_{CF} = 3.25 \text{ kN}$  ;  $T_{BE} = 3.25 \text{ kN}$  ;  $T_{BD} = 3.9 \text{ kN}$  ;  $A_x = 9.6 \text{ kN}$  ;  $A_y = 0$  ;  $A_z = -1.5 \text{ kN}$

P.30  $T = 450 \text{ kN}$  ;  $D_y = 0$  ;  $A_y = -335 \text{ kN}$

P.31  $F_{AB} = 0$  ;  $F_{AD} = 5 \text{ kN (C)}$  ;  $F_{CB} = 0$  ;  $F_{CF} = 5 \text{ kN (C)}$  ;  $F_{EB} = 12 \text{ kN (T)}$  ;  $F_{DE} = F_{EF} = 30 \text{ kN (T)}$  ;  $F_{BD} = F_{BF} = 34 \text{ kN (C)}$

$F_{AD} = 17 \text{ (C)}$  ;  $F_{AB} = 15 \text{ (T)}$  ;  $F_{BC} = 15 \text{ (T)}$  ;  $F_{CE} = 8 \text{ (T)}$  ;  $F_{DF} = 17 \text{ (C)}$  ;  $F_{EF} = 8 \text{ (T)}$  ;  $F_{DE} = 0$  ;  $F_{BD} = 0$  ;  $F_{BE} = 0$

P.32  $F_{FG} = F_{GH} = F_{HI} = F_{IJ} = F_{IE} = F_{BE} = 0$

$F_{AF} = F_{CH} = F_{DE} = F_{EJ} = F_{GL} = F_{IN} = 0$

P.33  $F_{CD} = 9 \text{ (C)}$  ;  $F_{DF} = 12 \text{ (T)}$  ;  $F_{CE} = 24 \text{ (C)}$

P.34  $F_{DF} = 91.429 \text{ kN (T)}$  ;  $F_{DE} = 68.57 \text{ (C)}$

P.35  $F_{BD} = 240 \text{ kN (T)}$  ;  $F_{DE} = 300 \text{ kN (T)}$

P.36  $F_{GJ} = 143.19 \text{ (T)}$  ;  $F_{IK} = 143.19 \text{ (C)}$

P.37  $P = 403.2 \text{ kN}$ ;  $P = 228.9 \text{ kN}$

P.38  $P = 1030.05 \text{ N}$ ;  $P = 735.75 \text{ N}$

P.39  $P = 206.01 \text{ N}$ ;  $P = 177.6 \text{ N}$ ;  $P = 72.53 \text{ N}$

P.40  $P = 206.01 \text{ N}$ ;  $h = 714.2 \text{ mm}$

P.41  $s = 62.17 \text{ mm}$

P.42  $x_{\min} = 240 \text{ mm}$

P.43  $\mu_s = 0.1904$

P.44  $F = 2140.84 \text{ N}$

P.45  $M = 244.57 \text{ N}\cdot\text{m}$

P.46  $97.295 \text{ N} \leq P \leq 1644.48 \text{ N}$

P.47  $M = 51.91 \text{ N}\cdot\text{m}$

P.48  $\mu_s = 0.5673$

P.49  $Q = \frac{W_3 \sin \theta - W_2}{2}$

P.50  $m = 3.9 \text{ kg}$

P.51  $p = 2.084 \text{ N/mm}^2$

P.52  $Q = \left( \frac{\cos \theta + \sqrt{4 - \sin^2 \theta}}{-\cos \theta + \sqrt{4 - \sin^2 \theta}} \right) P$

P.53  $\theta = 70.726^\circ$

P.54  $E_x = \frac{3P \cos \theta - 5Q \sin \theta}{6 \sin \theta}$ ;  $E_y = \frac{7P \cos \theta + Q \sin \theta}{6 \cos \theta}$

P.55  $F_{CD} = \frac{W}{2 \sin 60^\circ} \text{ (C)}$

P.56  $P < \frac{kl}{3}$

P.57  $\theta = 15.842^\circ$

P.58  $\cos \theta = \cos \theta_0 + \frac{W}{(k_1 + k_2)a}$

P.59  $P < \frac{ka^2}{2l}$  same for both cases

P.60  $\theta_1 = \frac{\pi}{2}$ ;  $\theta_2 = \frac{\pi}{2}$

P.61  $\frac{m(a^2 + b^2)}{12} \ddot{\theta} + k\theta = 0$ ;  $T_n = 1.689$  sec

P.62  $m = 21.24$  kg;  $k = 608.7$  N/m

P.63  $k_2 = 8.344$  N/mm;  $\omega_n = 19.809$  rad/sec

P.64  $0.2\ddot{\theta} + 4\theta = 0$ ;  $T_n = 1.405$  sec

P.65  $\frac{(m_1 l_1^2 + m_2 l_2^2)}{3} \ddot{\theta} + \left( \frac{m_2 g l_2}{2} + 0.1k \right) \theta = 0$ ;  $T_n = 0.171$  sec

P.66  $m_A \ddot{x}_A + \left( k_1 + k_2 \left( \frac{4k_3}{k_2 + 4k_3} \right) \right) x_A = 0$ ;  $\omega_n = 3.242$  rad/sec

P.67  $\omega_n = 23.52$  rad/sec; Amplitude = 0.042039m; Distance moved by A = 0.019292 m

P.68  $\omega_n = 304.36$  rad/sec;  $\theta = -0.1623$  rad

P.69  $\omega_n = 3.5355$  rad/sec;  $\omega_n = 3.062$  rad/sec

P.70  $1\ddot{\theta} + 2\dot{\theta} + 100\theta = 0$ ;  $\zeta = 0.1$ ;  $\theta = -0.02739^\circ$

P.71  $\frac{130}{3} \ddot{\theta} + 300\dot{\theta} + 8000\theta = 0$