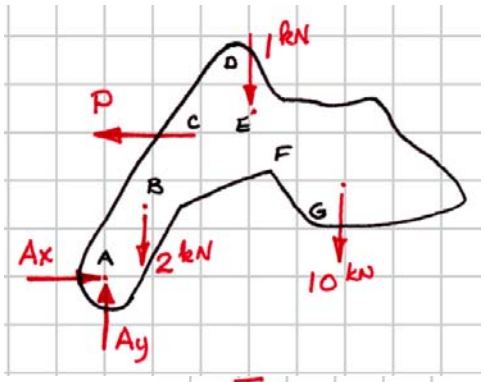
1-40

From an overall free-body diagram, the equations of equilibrium give

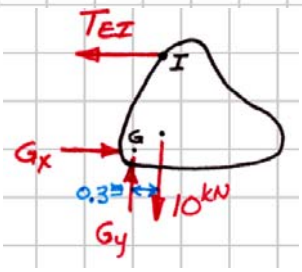


$$\circlearrowleft \Sigma M_A = 0:$$

$$(1.8\cos 30°)P - (0.9\sin 30°)(2) - (2.7\sin 30° + 0.6\sin 30°)(1) - (2.7\sin 30° + 1.8\sin 30° + 0.3)(10) = 0$$

$$P = 17.99 \text{ kN} \quad \text{Ans.}$$

Next, from a free-body diagram of the bucket, the equations of equilibrium give



$$\rightarrow \Sigma F_x = 0: \qquad G_x - T_{EI} = 0$$

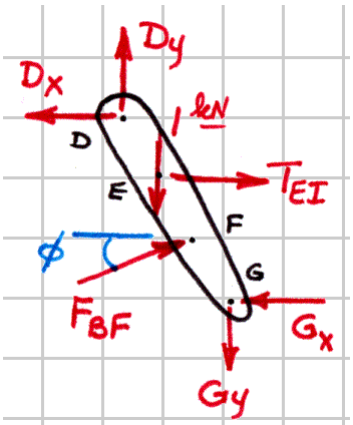
$$\uparrow \Sigma F_y = 0: \qquad G_y - 10 = 0$$

$$\circlearrowleft \Sigma M_G = 0: \quad (1.2\cos 30°)T_{EI} - 0.3(10) = 0$$

$$T_{EI} = 2.88675 \text{ kN} \cong 2.89 \text{ kN (T)} \quad \text{Ans.}$$

$$G_x = 2.88675 \text{ kN} \qquad G_y = 10.00 \text{ kN}$$

Finally, from a free-body diagram of the arm *DEFG*, the equations of equilibrium give



$$\rightarrow \Sigma F_x = 0: \qquad (2.88675) - D_x - (2.88675) + F_{BF}\cos\phi = 0$$

$$\uparrow \Sigma F_y = 0: \qquad D_y - (10) - 1 + F_{BF}\sin\phi = 0$$

$$\circlearrowleft \Sigma M_D = 0: \quad (0.6\cos 30°)(2.88675) - (0.6\sin 30°)(1) + (1.2\cos 30°)(F_{BF}\cos\phi) + (1.2\sin 30°)(F_{BF}\sin\phi) - (1.8\cos 30°)(2.88675) - (1.8\sin 30°)(10) = 0$$

in which

$$\tan\phi = \frac{1.8\cos 30° - 1.2\cos 30°}{1.8\sin 30° + 1.2\sin 30°} \qquad \phi = 19.107°$$

$$F_{BF} = 10.43807 \text{ kN} \cong 10.44 \text{ kN (C)} \quad \text{Ans.}$$

$$D_x = 9.86303 \text{ kN} \qquad D_y = 7.58627 \text{ kN}$$

D = 12.44 kN ◺ 37.6° **Ans.**

G = 10.41 kN ◤ 73.9° **Ans.**