Solution: (See Figure 7-5, p. 359, for nomenclature.)

1 Example 4-1 (p. 190) found the link angles for the open circuit of this linkage in this position to be $\theta_3 = 20.298°$ and $\theta_4 = 57.325°$. Example 6-7 (p. 317) found the angular velocities at this position to be $\omega_3 = -4.121$ and $\omega_4 = 6.998$ rad/sec.

2 Use these angles, angular velocities, and equations 7.12 to find α_3 and α_4 for the open circuit. First find the parameters in equation 7.12c.

$$
\begin{aligned}
A &= c\sin\theta_4 = 80\sin 57.325° = 67.340\\
B &= b\sin\theta_3 = 120\sin 20.298° = 41.628\\
C &= a\alpha_2\sin\theta_2 + a\omega_2^2\cos\theta_2 + b\omega_3^2\cos\theta_3 - c\omega_4^2\cos\theta_4\\
&= 40(15)\sin 40° + 40(25)^2\cos 40° + 120(-4.121)^2\cos 20.298° - 80(6.998)^2\cos 57.325°\\
&= 19\,332.98\\
D &= c\cos\theta_4 = 80\cos 57.325° = 43.190 \qquad (a)\\
E &= b\cos\theta_3 = 120\cos 20.298° = 112.548\\
F &= a\alpha_2\cos\theta_2 - a\omega_2^2\sin\theta_2 - b\omega_3^2\sin\theta_3 + c\omega_4^2\sin\theta_4\\
&= 40(15)\cos 40° - 40(25)^2\sin 40° - 120(-4.121)^2\sin 20.298° + 80(6.998)^2\sin 57.325°\\
&= -13\,019.25
\end{aligned}
$$

3 Then find α_3 and α_4 with equations 7.12a and b.

$$\alpha_3 = \frac{CD - AF}{AE - BD} = \frac{19332.98(43.190) - 67.340(-13\,019.25)}{67.340(112.548) - 41.628(43.190)} = 296.089 \text{ rad/sec}^2 \qquad (b)$$

$$\alpha_4 = \frac{CE - BF}{AE - BD} = \frac{19332.98(112.548) - 41.628(-13\,019.25)}{67.340(112.548) - 41.628(43.190)} = 470.134 \text{ rad/sec}^2 \qquad (c)$$

4 Use equations 7.13 to find the linear accelerations of points A and B.

$$
\begin{aligned}
\mathbf{A}_{A_x} &= -a\alpha_2\sin\theta_2 - a\omega_2^2\cos\theta_2 = -40(15)\sin 40° - 40(25)^2\cos 40° = -19.537 \text{ m/sec}^2\\
\mathbf{A}_{A_y} &= a\alpha_2\cos\theta_2 - a\omega_2^2\sin\theta_2 = 40(15)\cos 40° - 40(25)^2\sin 40° = -15.617 \text{ m/sec}^2
\end{aligned}
\qquad (d)
$$

$$
\begin{aligned}
\mathbf{A}_{BA_x} &= -b\alpha_3\sin\theta_3 - b\omega_3^2\cos\theta_3\\
&= -120(269.089)\sin 20.298° - 120(-4.121)^2\cos 20.298° = -14{,}237 \text{ m/sec}^2\\
\mathbf{A}_{BA_y} &= b\alpha_3\cos\theta_3 - b\omega_3^2\sin\theta_3\\
&= 120(269.089)\cos 20.298° - 120\,(-4.121)^2\sin 20.298° = 32.617 \text{ m/sec}^2
\end{aligned}
\qquad (e)
$$

$$
\begin{aligned}
\mathbf{A}_{B_x} &= -c\alpha_4\sin\theta_4 - c\omega_4^2\cos\theta_4\\
&= -80(470.134)\sin 57.325° - 80(6.998)^2\cos 57.325° = -33.774 \text{ m/sec}^2\\
\mathbf{A}_{B_y} &= c\alpha_4\cos\theta_4 - c\omega_4^2\sin\theta_4\\
&= 80(470.134)\cos 57.325° - 80(6.998)^2\sin 57.325° = 17.007 \text{ m/sec}^2
\end{aligned}
\qquad (f)
$$