

Intermediate Dynamics

Exercises #2 Answers

1. Reference frame $B : (\underline{e}_1, \underline{e}_2, \underline{k})$ along the (x, y, z) axes.

$$\underline{v}_A = L(\dot{\theta}C_\phi \underline{e}_1 - \dot{\phi}S_\phi \underline{e}_2 + \dot{\phi}C_\phi \underline{k})$$

$$\underline{a}_A = L\left(\left(\ddot{\theta}C_\phi - 2\dot{\theta}\dot{\phi}S_\phi\right)\underline{e}_1 - \left(\ddot{\phi}S_\phi + \dot{\phi}^2C_\phi + \dot{\theta}^2C_\phi\right)\underline{e}_2 + \left(\ddot{\phi}C_\phi - \dot{\phi}^2S_\phi\right)\underline{k}\right)$$

2. Reference frames: R (fixed frame), and $C : (\underline{e}_1, \underline{e}_2, \underline{e}_3)$

(The results given here are calculated for the instant shown in the diagram, not for an arbitrary position.)

$${}^R\underline{v}_A = (-r\omega_3S_\theta)\underline{e}_1 + (r\omega_3C_\theta)\underline{e}_2 + [r\omega_1S_\theta - (L + rC_\theta)\omega_2]\underline{e}_3$$

$${}^R\underline{a}_A = \left[-r\dot{\omega}_3S_\theta - r\omega_3^2C_\theta - (L + rC_\theta)\omega_2^2 + 2r\omega_1\omega_2S_\theta\right]\underline{e}_1 +$$

$$\left[r\dot{\omega}_3C_\theta - r\omega_1^2S_\theta - r\omega_3^2S_\theta\right]\underline{e}_2 +$$

$$\left[r\dot{\omega}_1S_\theta - (L + rC_\theta)\dot{\omega}_2 + 2r\omega_2\omega_3S_\theta + 2r\omega_1\omega_3C_\theta\right]\underline{e}_3$$

3. ${}^R\underline{v}_A = 0.81\underline{i} - 0.72\underline{j} + 0.76\underline{k}$ (m/s) (at the instant shown)

$${}^R\underline{a}_A = 0.64\underline{i} - 1.392\underline{j} - 1.92\underline{k}$$
 (m/s²) (at the instant shown)