

ME 5550 Intermediate Dynamics
Exercises #3 Answers

1. a) ${}^R\omega_{BC} = 0.204\tilde{i} - 0.612\tilde{j} + 1.36\tilde{k}$ (rad/sec)

$${}^Rv_B = -0.333\tilde{j} \text{ (m/sec)}$$

b) ${}^R\omega_{BC} = 0.769\tilde{i} - 2.31\tilde{j} + 0.513\tilde{k}$ (rad/sec)

$${}^Rv_B = -0.333\tilde{j} \text{ (m/sec)}$$

2. ${}^R\omega_W = \Omega\tilde{j} - (R/r)\Omega\tilde{k}$ (rad/sec)

$${}^R\alpha_W = -(R/r)\Omega^2\tilde{i} \text{ (rad/sec}^2\text{)}$$

$${}^Rv_A = R\Omega\tilde{i} - R\Omega\tilde{j} - r\Omega\tilde{k}$$

$${}^Ra_A = -\left(\frac{R^2 + r^2}{r}\right)\Omega^2\tilde{i} - R\Omega^2\tilde{k}$$

3. \tilde{n}_1 points from C towards A, \tilde{n}_2 points from A towards D, and $\tilde{n}_3 = \tilde{n}_1 \times \tilde{n}_2$.

$${}^{AD}\omega_A = (b/a)\omega_1\tilde{n}_2$$

$${}^R\omega_A = \omega_1\tilde{j} + (b/a)\omega_1\tilde{n}_2 = \omega_1 S_\beta\tilde{n}_1 + \omega_1\left(\frac{b}{a} + C_\beta\right)\tilde{n}_2$$

$${}^R\alpha_A = (b/a)\omega_1^2 S_\beta\tilde{n}_3$$

$${}^Ra_C = \omega_1^2 \left[(b/a)(b + aC_\beta)\tilde{n}_1 - bS_\beta\tilde{n}_2 \right]$$

4. $\omega_B/\omega_A = C_\phi = \cos(\phi)$ (coupling locks when $\phi = 90^\circ$)

5. $\frac{\omega_B}{\omega_A} = \frac{\cos(\phi)}{1 - \sin^2(\theta)\sin^2(\phi)}$