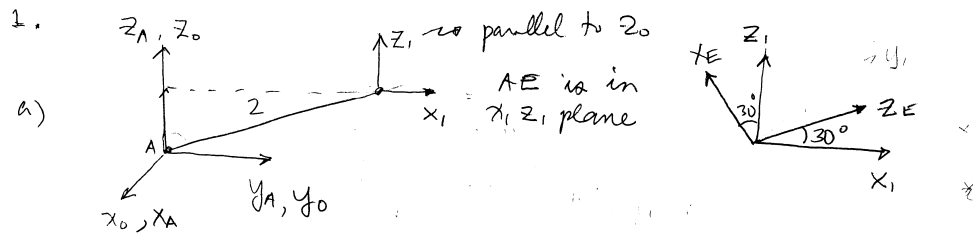


Solutions to Quiz 1, 99/2000



b) $\theta = 90^\circ$, variable

$$r = 2 \sin 30^\circ = 1$$

$$d = 2 \cos 30^\circ = 1.732$$

$$\alpha = 0^\circ$$

c). ${}^0T_1 = \begin{pmatrix} \cos \theta & -\sin \theta & 0 & d \cos \theta \\ \sin \theta & \cos \theta & 0 & d \sin \theta \\ 0 & 0 & 1 & r \\ 0 & 0 & 0 & 1 \end{pmatrix} = {}^AT_1$

${}^AT_E = {}^AT_1 {}^1T_E$ where ${}^1T_E = \begin{pmatrix} -\sin 30^\circ & 0 & \cos 30^\circ & 0 \\ 0 & -1 & 0 & 0 \\ \cos 30^\circ & 0 & \sin 30^\circ & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$

$$\theta_1 = \theta - 90^\circ$$

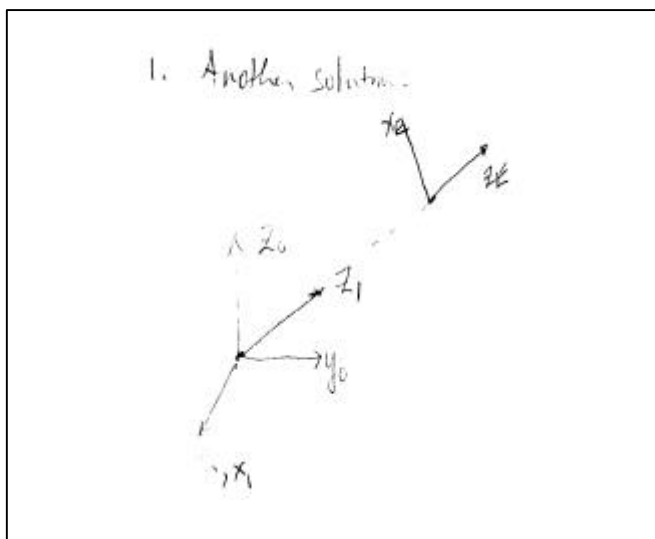
d). $\tau = 0$ by inspection

e). $J = \begin{pmatrix} z_0 \times (P_N - P_0) \\ z_0 \end{pmatrix}$ where $z_0 = \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$

$$P_N = \begin{pmatrix} d \cos(\theta + 90^\circ) \\ d \sin(\theta + 90^\circ) \\ r \end{pmatrix} \quad P_0 = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$

f). No singularities

$$(P_E = P_N)$$



$$2. \quad {}^u \omega_E = {}^u \omega_A + {}^u R_A {}^A \omega_E$$

$$\text{15} \quad {}^A \omega_E = {}^A \dot{z}_A \hat{q}_1 = \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} \hat{q}_1$$

$${}^u u_E = {}^u u_A + {}^u \omega_E \times ({}^u R_A {}^A p_E)$$

$${}^A p_E = {}^A T_E \begin{pmatrix} 0 \\ 0 \\ 0 \\ 1 \end{pmatrix}$$

$$3. \quad {}^A T_{C_0} = \text{initially pos + orient of } C = {}^A T_L \text{ (given)}$$

$${}^A T_{C_1} = \text{Rot}(z, q_1) {}^A T_{C_0}$$

$${}^A T_{C_2} = {}^A T_{C_1} \text{Rot}(y, q_2)$$

$${}^B T_{C_2} = {}^B T_A {}^A T_{C_2} \quad \text{when } {}^B T_A = \overset{\text{given}}{({}^A T_B)^{-1}}$$

$${}^B T_{C_3} = \text{Rot}(x, q_3) {}^B T_{C_2} \quad //$$

$${}^A T_{C_3} = {}^A T_B {}^B T_{C_3}$$

OR

$${}^A T_{C_3} = {}^A T_B \text{Rot}(x, q_3) {}^B T_A \text{Rot}(z, q_1) {}^A T_{C_0} \text{Rot}(y, q_2) //$$