سری هفتم

1) $V_C = \omega_C r_C = 0.01$

$\omega_S = \frac{V_C}{r_S} = 0.2 \qquad V_A = V_E = \omega_S r_A = 4/0 \ \frac{mm}{sec}$

$V_w = V_C \cos\theta = 34.6 \ \frac{mm}{sec}$

2) $\omega_A = A(t^3 + Bt) \qquad \omega_B = \frac{r_A}{r_B}\omega_A$

$\alpha_A = A(3t^2 + B) \qquad \alpha_B = \frac{r_A}{r_B}\alpha_A$

$V = \omega_B r_E = 3$

$a_t = \alpha_B r_E = 2.7$

$a_n = \omega_B^2 r_E = 600 \ m/s^2$

3) $x = 2r\cos\theta = 0.3$

$\dot{x} = -2r\sin\theta\,\dot{\theta} \qquad \ddot{x} = -2r\cos\theta\,\dot{\theta}^2 - 2r\sin\theta\,\ddot{\theta}$

$\omega = \frac{-V}{2r\sin\theta} = -19.2 \qquad \alpha = \frac{a - 2r\cos\theta\,\omega^2}{2r\sin\theta} = -183$

4) $\dot{x} = V_B \qquad \ddot{x} = 0 \qquad x = h\tan\theta \qquad \dot{x} = h\dot{\theta}\sec^2\theta$

$\ddot{x} = h\dot{\theta}\sec^2\theta + 2h\dot{\theta}^2\sec^2\theta\tan\theta$

$\sec\theta = \frac{\sqrt{h^2 + x^2}}{h} \qquad \tan\theta = \frac{x}{h}$

$\Rightarrow \omega = \frac{h V_B}{h^2 + x^2}, \qquad \alpha = \frac{-2h x V_B^2}{(h^2 + x^2)^2}$

5) $\begin{bmatrix} 0 \\ 0 \\ -\omega \end{bmatrix} \times \begin{bmatrix} -r_B\cos\theta \\ r_B\sin\theta \\ \cdot \end{bmatrix} + \begin{bmatrix} \cdot \\ \cdot \\ \omega_{AB} \end{bmatrix} \times \begin{bmatrix} r_A\cos\phi \\ r_A\sin\phi \\ 0 \end{bmatrix} = \begin{bmatrix} V_A \\ 0 \\ 0 \end{bmatrix}$

$\Rightarrow \omega_{AB} = -4.16, \qquad V_A = 2.4$

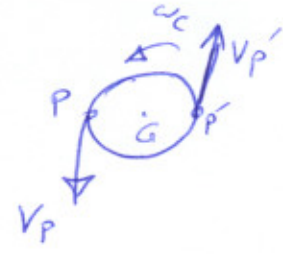
4- $\omega_{BC} = 2 \qquad V_C = 4$

$$\begin{bmatrix} 0 \\ 0 \\ \omega_{AB} \end{bmatrix} \times \begin{bmatrix} r_{AB}\cos\theta \\ r_{AB}\sin\theta \\ 0 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ \omega_{BC} \end{bmatrix} \times \begin{bmatrix} r_{BC}\cos\phi \\ -r_{BC}\sin\phi \\ 0 \end{bmatrix} = \begin{bmatrix} V_C \\ 0 \\ 0 \end{bmatrix} \qquad \omega_{BC} = -1.96 \quad V_C = -1.34$$

5- $V_G = V_t + V_{G/B} \Rightarrow V_G = V_t - \omega r \Rightarrow \omega = \dfrac{V_t - V_G}{r} = 6 \dfrac{rad}{sec}$

6- $V_P = \omega r_A \qquad V_{P'} = \omega r_B \qquad \omega_C = \dfrac{V_P + V_{P'}}{2 r_C} = 4$

$V_D = -V_{P'} + \omega_C r_C =$



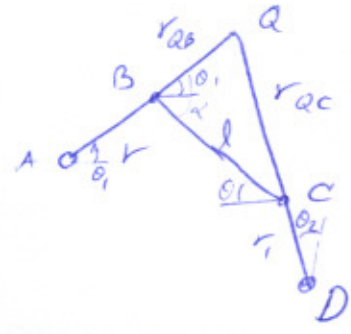
9- $\alpha = \theta_1 + \theta \qquad \beta = \dfrac{\pi}{2} - \theta - \theta_2 \qquad \gamma = \pi - \alpha - \beta$

$r_{QB} = l \dfrac{\sin\beta}{\sin\gamma} = 0$

$r_{QC} = l \dfrac{\sin\alpha}{\sin\gamma} = 0.61\ m$

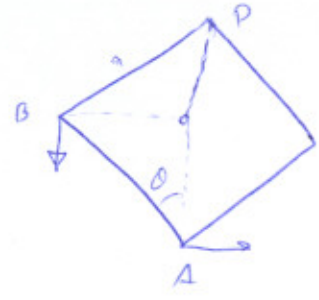
$V_C = \omega_D r_1 \qquad \omega_{BC} = \dfrac{V_C}{r_{QC}} \qquad V_B = \omega_{BC} r_{QB}$

$\omega_A = \dfrac{V_B}{r} \Rightarrow \omega_A = 0$



10- $\omega = \dfrac{V_A}{a\cos\theta} = 30.79$

$V_P = \omega \sqrt{(-a\sin\theta + a\cos\theta)^2 + (a\sin\theta)^2} = 5.72\ m/s$



11- $r_{AB}\sin(\theta - \phi) = r_{CB}\sin\theta$

$$\begin{pmatrix} V_B \\ 0 \\ 0 \end{pmatrix} + \begin{pmatrix} 0 \\ 0 \\ \omega \end{pmatrix} \times \begin{pmatrix} -r_{AB}\cos\phi \\ r_{AB}\sin\phi \\ 0 \end{pmatrix} = \begin{pmatrix} V_A\cos\theta \\ -V_A\sin\theta \\ 0 \end{pmatrix}$$

$$\begin{pmatrix} a_B \\ \cdot \\ \cdot \end{pmatrix} + \begin{bmatrix} \cdot \\ \cdot \\ \alpha \end{bmatrix} \times \begin{pmatrix} -r_{AB}\cos\phi \\ r_{AB}\sin\phi \\ 0 \end{pmatrix} + \begin{pmatrix} 0 \\ 0 \\ \omega \end{pmatrix} \times \left[\begin{pmatrix} 0 \\ 0 \\ \omega \end{pmatrix} \times \begin{pmatrix} -r_{AB}\cos\phi \\ r_{AB}\sin\phi \\ 0 \end{pmatrix} \right] = \begin{pmatrix} a_A\cos\theta \\ -a_A\sin\theta \\ 0 \end{pmatrix}$$

$\rightarrow \phi = 39.73\ deg \quad \omega = 0.18 \dfrac{rad}{sec} \quad \alpha = 0.1049 \dfrac{rad}{sec^2}, V_A = 1.640 \dfrac{ft}{s}, a_A = 1.18 \dfrac{ft}{s^2}$