THE EVALUATION OF THE ACCELERATION OF THE SLIDER CRANK STARTS WITH TAKING THE DERIVATIVE OF (10) WITH RESPECT TO TIME.

$$\cancel{\dot{r}_2}\cdot\dot{\theta}_2\cdot\hat{e}_{\theta 2} + r_2\cdot\ddot{\theta}_2\cdot\hat{e}_{\theta 2} + r_2\cdot\dot{\theta}_2\cdot\dot{\hat{e}}_{\theta 2}$$
$$+ \cancel{\dot{r}_3}\cdot\dot{\theta}_3\cdot\hat{e}_{\theta 3} + r_3\cdot\ddot{\theta}_3\cdot\hat{e}_{\theta 3} + r_3\cdot\dot{\theta}_3\cdot\dot{\hat{e}}_{\theta 3} = \ddot{r}_{1x}\,\hat{i}$$

$$r_2\cdot\ddot{\theta}_2\cdot\hat{e}_{\theta 2} + r_2\cdot\dot{\theta}_2\cdot\underbrace{\dot{\hat{e}}_{\theta 2}}_{\dot{\theta}_2\hat{k}\times\hat{e}_{\theta 2}} + r_3\cdot\ddot{\theta}_3\cdot\hat{e}_{\theta 3} + r_3\cdot\dot{\theta}_3\cdot\underbrace{\dot{\hat{e}}_{\theta 3}}_{\dot{\theta}_3\hat{k}\times\hat{e}_{\theta 3}} = \ddot{r}_{1x}\,\hat{i}$$

$$r_2\cdot\ddot{\theta}_2\cdot\hat{e}_{\theta 2} - r_2\cdot\dot{\theta}_2^2\cdot\hat{e}_{r2} + r_3\cdot\ddot{\theta}_3\cdot\hat{e}_{\theta 3} - r_3\cdot\dot{\theta}_3^2\cdot\hat{e}_{r3} = \ddot{r}_{1x}\cdot\hat{i} \qquad (15)$$

EQUATION (15) IS ONE VECTOR EQUATION THAT REPRESENTS TWO SCALAR EQUATIONS WITH TWO UNKNOWNS $\ddot{\theta}_3$ AND $\ddot{r}_{1x}$. $\ddot{\theta}_2$ IS GIVEN IN THIS CLASS OF PROBLEMS. SOLVING FOR THE UNKNOWNS STARTS BY SUBSTITUTING (5) - (8) INTO (15)

$$r_2\cdot\ddot{\theta}_2\cdot(-\sin\theta_2\hat{i} + \cos\theta_2\hat{j}) - r_2\cdot\dot{\theta}_2^2\cdot(\cos\theta_2\hat{i} + \sin\theta_2\hat{j})$$
$$+ r_3\cdot\ddot{\theta}_3\cdot(-\sin\theta_3\hat{i} + \cos\theta_3\hat{j}) - r_3\cdot\dot{\theta}_3^2(\cos\theta_3\hat{i} + \sin\theta_3\hat{j}) = \ddot{r}_{1x}\hat{i} \qquad (16)$$

(16) IS NOW DOTTED WITH $\hat{i}$

$$\boxed{-r_2\cdot\ddot{\theta}_2\cdot\sin\theta_2 - r_2\cdot\dot{\theta}_2^2\cdot\cos\theta_2 - r_3\cdot\ddot{\theta}_3\cdot\sin\theta_3 - r_3\cdot\dot{\theta}_3^2\cos\theta_3 = \ddot{r}_{1x}} \qquad (17)$$

DOTTING (16) WITH $\hat{j}$

$$r_2\cdot\ddot{\theta}_2\cos\theta_2 - r_2\cdot\dot{\theta}_2^2\cdot\sin\theta_2 + r_3\cdot\ddot{\theta}_3\cos\theta_3 - r_3\cdot\dot{\theta}_3^2\cdot\sin\theta_3 = 0$$

$$\boxed{\ddot{\theta}_3 = \frac{r_2\cdot\dot{\theta}_2^2\cdot\sin\theta_2 - r_2\cdot\ddot{\theta}_2\cdot\cos\theta_2 + r_3\cdot\dot{\theta}_3^2\cdot\sin\theta_3}{r_3\cdot\cos\theta_3}} \qquad (18)$$