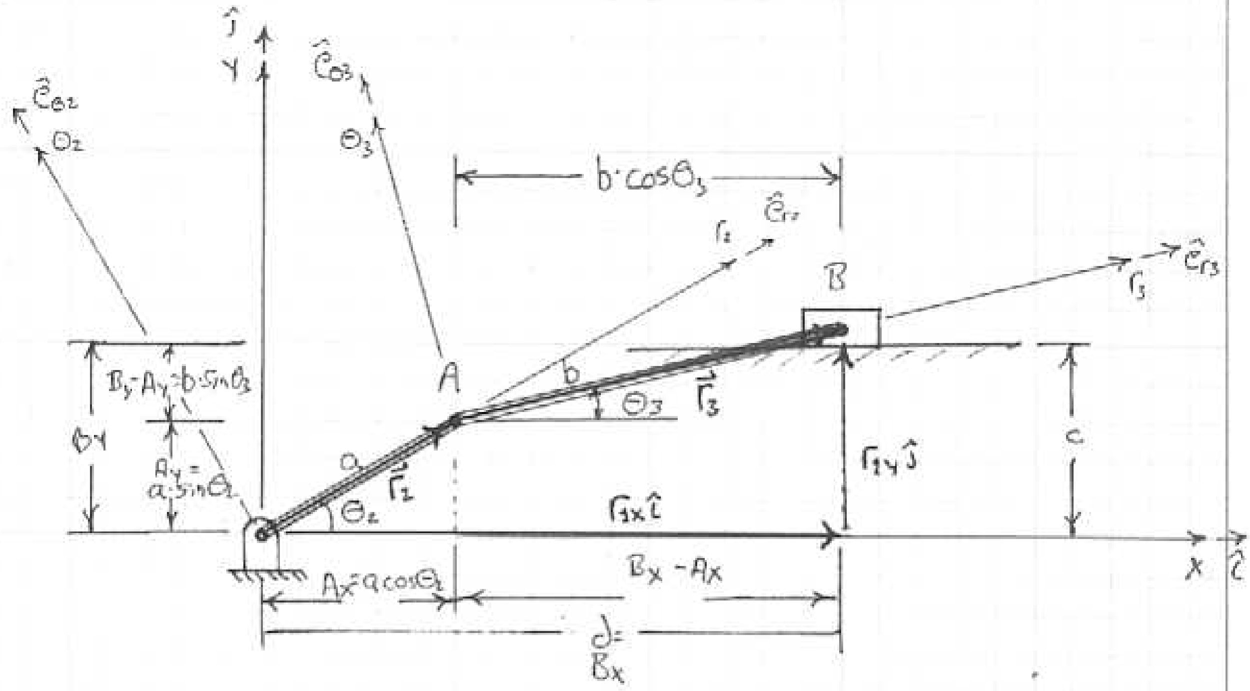

IF a, b, c, & d ARE GIVEN ALONG WITH θ_2, THE POSITION OF POINT B REMAINS TO BE DETERMINED.

$$b^2 = (B_x - A_x)^2 + (B_y - A_y)^2$$

FROM THE PROBLEM $\boxed{B_y = c}$ (1)

$$b^2 = (B_x - A_x)^2 + (c - A_y)^2$$

$$b^2 = B_x^2 - 2 \cdot B_x \cdot A_x + A_x^2 + (c - A_y)^2$$

$$B_x^2 - 2 \cdot B_x \cdot A_x + A_x^2 + (c - A_y)^2 - b^2 = 0$$

$$\underbrace{B_x^2 - 2 \cdot B_x \cdot A_x + (-A_x)^2} - \cancel{(-A_x)^2} + \cancel{A_x^2} + (c - A_y)^2 - b^2 = 0$$

$$(B_x - A_x)^2 = b^2 - (c - A_y)^2$$

$$\boxed{B_x = A_x \pm \sqrt{b^2 - (c - A_y)^2}}$$

~~B_y = A_y ±~~.

FOR THE SLIDER CRANK, THE VECTOR LOOP EQUATION CAN BE WRITTEN

$$\vec{r}_2 + \vec{r}_3 = r_{1x}\cdot\hat{i} + r_{1y}\cdot\hat{j} \qquad (1)$$

WHERE

$$\vec{r}_2 = r_2\cdot\hat{e}_{r2} \qquad (2)$$

$$\vec{r}_3 = r_3\cdot\hat{e}_{r3} \qquad (3)$$

$$\vec{r}_1 = r_{1x}\hat{i} + r_{1y}\hat{j} \qquad (4)$$

THE UNIT VECTORS FOR THIS PROBLEM ARE DEFINED AS FOLLOWS

$$\hat{e}_{r2} = \cos\theta_2\,\hat{i} + \sin\theta_2\,\hat{j} \qquad (5)$$

$$\hat{e}_{\theta 2} = -\sin\theta_2\,\hat{i} + \cos\theta_2\,\hat{j} \qquad (6)$$

$$\hat{e}_{r3} = \cos\theta_3\,\hat{i} + \sin\theta_3\,\hat{j} \qquad (7)$$

$$\hat{e}_{\theta 3} = -\sin\theta_3\,\hat{i} + \cos\theta_3\,\hat{j} \qquad (8)$$

SUBSTITUTING (2)→(4) INTO (1)

$$r_2\cdot\hat{e}_{r2} + r_3\cdot\hat{e}_{r3} = r_{1x}\cdot\hat{i} + r_{1y}\cdot\hat{j} \qquad (9)$$

TAKING THE DERIVATIVE OF (9) WITH RESPECT TO TIME YIELDS AN EXPRESSION THAT RELATES THE VELOCITY COMPONENTS IN THIS LINKAGE.

$$\cancel{\dot{r}_2}^{\,0}\cdot\hat{e}_{r2} + r_2\cdot\underbrace{\dot{\hat{e}}_{r2}}_{\dot{\theta}_2\hat{k}\times\hat{e}_{r2}} + \cancel{\dot{r}_3}^{\,0}\cdot\hat{e}_{r3} + r_3\cdot\underbrace{\dot{\hat{e}}_{r3}}_{\dot{\theta}_3\hat{k}\times\hat{e}_{r3}} = \dot{r}_{1x}\cdot\hat{i} + \cancel{\dot{r}_{1y}}^{\,0}\cdot\hat{j}$$

$$r_2\cdot\dot{\theta}_2\cdot\hat{e}_{\theta 2} + r_3\cdot\dot{\theta}_3\cdot\hat{e}_{\theta 3} = \dot{r}_{1x}\cdot\hat{i} \qquad (10)$$

(10) IS A SINGLE VECTOR EQUATION WHICH REPRESENTS TWO SCALAR EQUATIONS. FOR THIS TYPE OF PROBLEM $\dot{\theta}_2$ IS GIVEN LEAVING TWO UNKNOWNS $\dot{\theta}_3$ AND $\dot{r}_{1x}$. SOLVING FOR THE UNKNOWNS STARTS BY SUBSTITUTING (6) AND (7) INTO (10)

$$r_2\cdot\dot{\theta}_2\cdot(-\sin\theta_2\,\hat{i} + \cos\theta_2\,\hat{j}) + r_3\cdot\dot{\theta}_3\cdot(-\sin\theta_3\,\hat{i} + \cos\theta_3\,\hat{j}) = \dot{r}_{1x}\,\hat{i} \qquad (11)$$

DOTTING (11) WITH $\hat{i}$

$$-r_2\cdot\dot{\theta}_2\cdot\sin\theta_2 - r_3\cdot\dot{\theta}_3\cdot\sin\theta_3 = \dot{r}_{1x} \qquad (12)$$

DOTTING (12) WITH $\hat{j}$

$$r_2\cdot\dot{\theta}_2\cdot\cos\theta_2 + r_3\cdot\dot{\theta}_3\cdot\cos\theta_3 = 0$$

$$\boxed{\dot{\theta}_3 = -\frac{r_2\cdot\dot{\theta}_2\cdot\cos\theta_2}{r_3\cdot\cos\theta_3}} \qquad (13)$$

SUBSTITUTING 13 INTO 12

$$\dot{r}_{1x} = -\cancel{r_3} \cdot \sin\theta_3 \cdot \left[-\frac{r_2 \cdot \dot{\theta}_2 \cdot \cos\theta_2}{\cancel{r_3} \cdot \cos\theta_3} \right] - r_2 \cdot \dot{\theta}_2 \cdot \sin\theta_2$$

$$\boxed{\dot{r}_{1x} = r_2 \cdot \dot{\theta}_2 \left[\tan\theta_3 \cdot \cos\theta_2 - \sin\theta_2 \right]} \quad (14)$$