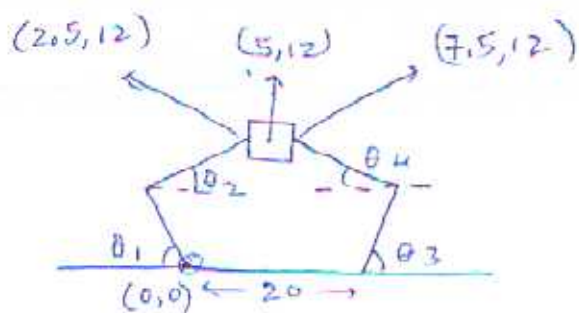


B3



$$-15 \cos \theta_1 + 15 \cos \theta_2 = 2.5$$

$$-\cos \theta_1 + \cos \theta_2 = 1/6 \quad \text{--- (1)}$$

$$15 \sin \theta_1 + 15 \sin \theta_2 = 12$$

$$\sin \theta_1 + \sin \theta_2 = 4/5 \quad \text{--- (2)}$$

Square and add (1) & (2)

$$2 - 2 \cos \theta_1 \cos \theta_2 + 2 \sin \theta_1 \sin \theta_2 = \frac{16}{25} + \frac{1}{36}$$

$$2 - \cos(\theta_1 + \theta_2) - \cos(\theta_1 - \theta_2)$$

$$+ \cos(\theta_1 - \theta_2) - \cos(\theta_1 + \theta_2) = \frac{16}{25} + \frac{1}{36}$$

$$2 \cos(\theta_1 + \theta_2) = 2 - \frac{16}{25} - \frac{1}{36}$$

$$\cos(\theta_1 + \theta_2) = 0.66611$$

$$\theta_1 + \theta_2 = 48.2323^\circ$$

Substitute in (1)

$$-\cos(48.2323 - \theta_2) + \cos \theta_2 = 1/6$$

$$-2 \sin \frac{48.2323}{2} \sin \frac{2\theta_2 - 48.2323}{2} = \frac{1}{6}$$

$$\sin \frac{2\theta_2 - 48.2323}{2} = -0.20395$$

$$\theta_2 - 24.1162 = -11.7683$$

$$\boxed{\begin{matrix} \theta_2 = 12.35^\circ \\ \theta_1 = 35.88^\circ \end{matrix}}$$

$$20 + 15 \cos \theta_3 - 15 \cos \theta_4 = 7.5$$

$$15 \cos \theta_3 - 15 \cos \theta_4 = 12.5$$

$$\cos \theta_3 - \cos \theta_4 = 5/6 \quad \text{--- (3)}$$

$$15 \sin \theta_3 + 15 \sin \theta_4 = 12$$

$$\sin \theta_3 + \sin \theta_4 = 4/5 \quad \text{--- (4)}$$

Square and add (3) and (4).

$$2 - 2 \cos \theta_3 \cos \theta_4 + 2 \sin \theta_3 \sin \theta_4 = \frac{25}{36} + \frac{16}{25}$$

$$2 - \cos(\theta_3 + \theta_4) - \cos(\theta_3 - \theta_4) + \cos(\theta_3 - \theta_4) - \cos(\theta_3 + \theta_4) = \frac{25}{36} + \frac{16}{25}$$

$$2 - \frac{25}{36} - \frac{16}{25} = 2 \cos(\theta_3 + \theta_4)$$

$$\cos(\theta_3 + \theta_4) = 0.33277$$

$$\theta_3 + \theta_4 = 70.563$$

$$\sin(70.563 - \theta_4) + \sin \theta_4 = 4/5$$

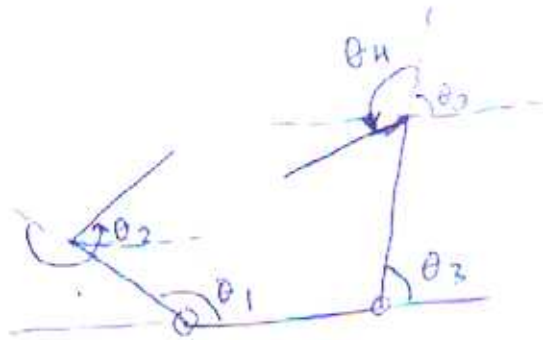
$$2 \sin \frac{70.563}{2} \cos \frac{70.563 - 2\theta_4}{2} = 4/5$$

$$\cos \frac{70.563 - 2\theta_4}{2} = 0.692527$$

$$35.2815 - \theta_4 = 46.1695$$

$$\boxed{\begin{aligned} \theta_4 &= -10.88^\circ \\ \theta_3 &= 81.44^\circ \end{aligned}}$$

convention  $\rightarrow$  If we take  $\theta_1, \theta_2, \theta_3, \theta_4$  — anticlockwise position  
and front arm angles w.r.t base arm angles  
then



then

$$\theta_1 = 144.12^\circ$$

$$\theta_2 = 228.23^\circ$$

$$\theta_3 = 81.44^\circ$$

$$\theta_4 = 109.44^\circ$$