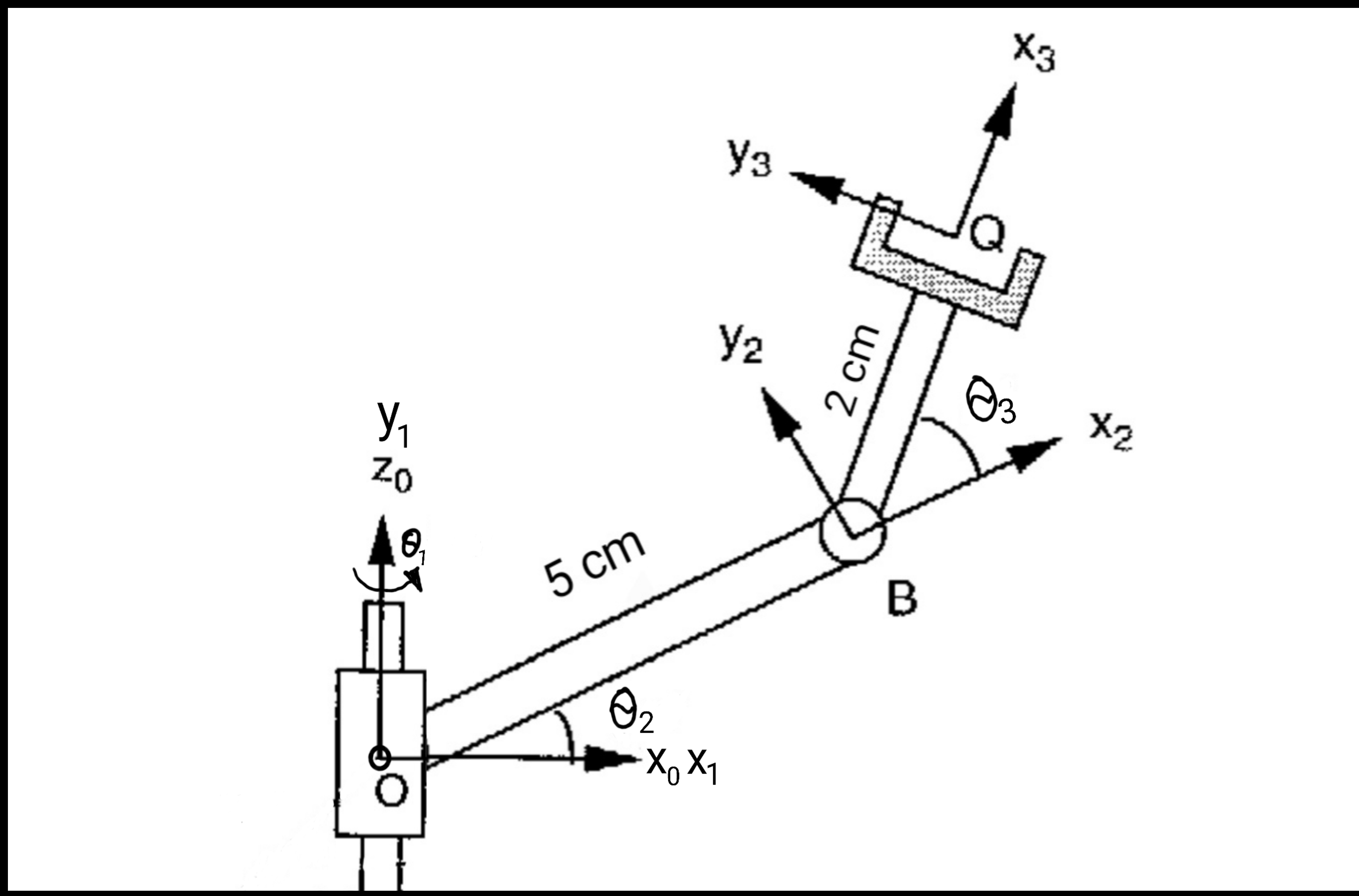


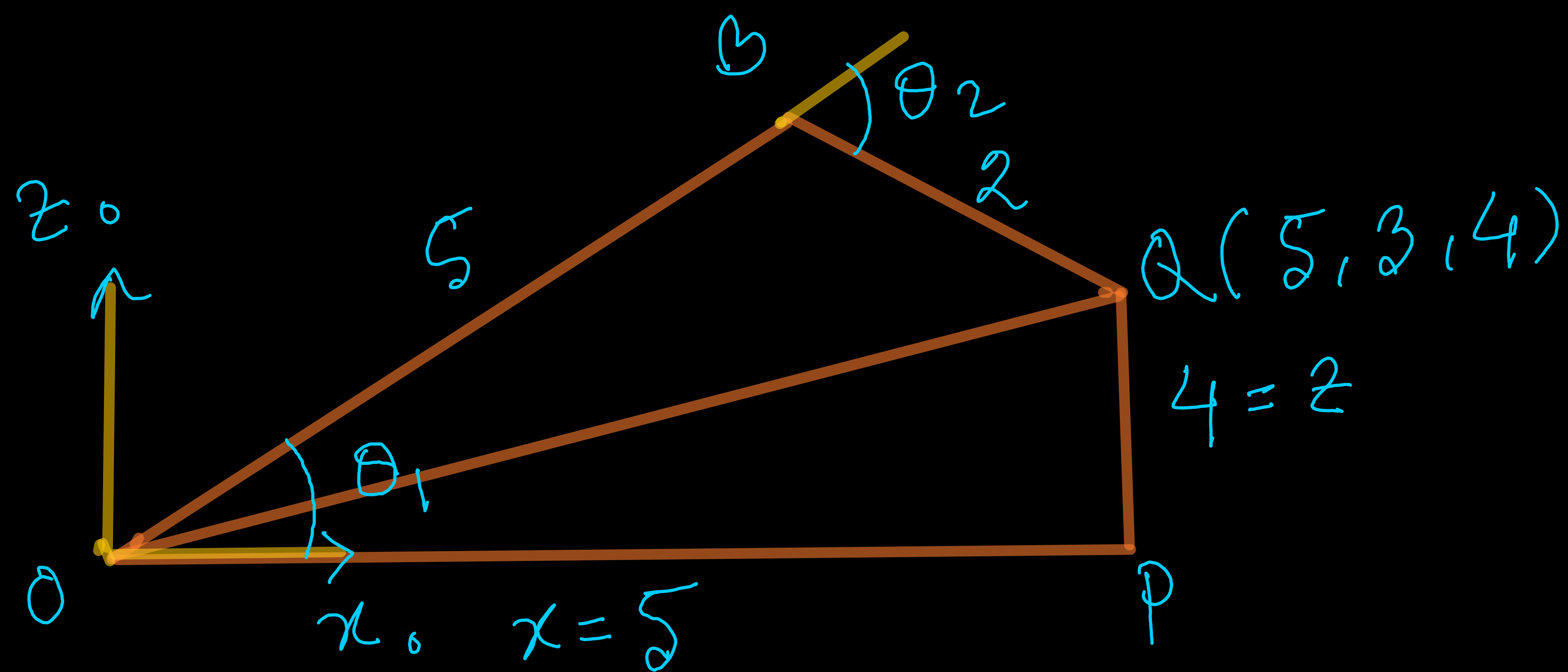
Given that, position of end effector $(x, y, z) = (5, 3, 4)$

length of arm 1 (OB) = 5 cm

" " arm 2 (BQ) = 2 cm

we need to calculate joint angles $\theta_0 = ?$, $\theta_1 = ?$, $\theta_2 = ?$

lets redraw the structure,



$\therefore \triangle OQP \rightarrow OQ^2 = OP^2 + PQ^2$

$$\therefore OQ = \sqrt{OP^2 + PQ^2}$$

$$= \sqrt{5^2 + 4^2}$$

$$= \sqrt{25 + 16}$$

$$= \sqrt{41}$$

Created with Notewise

Now, from ΔOBQ,

according to cosine rule,

$$\cos \angle OBQ = \frac{5^2 + 2^2 - (\sqrt{41})^2}{2 \cdot 5 \cdot 2}$$

$$= \frac{25 + 4 - 41}{20}$$

$$= \frac{-12}{20} = -0.6$$

$$\therefore \angle OBQ = \cos^{-1}(-0.6)$$

$$= 126.87^\circ$$

$$\therefore \theta_2 = 180^\circ - \angle OBQ = 180^\circ - 126.87^\circ$$

$$= 53.13^\circ$$

Again, from ΔOBQ

according to cosine rule,

$$\cos \angle BOQ = \frac{5^2 + (\sqrt{41})^2 - 2^2}{2 \cdot 5 \cdot \sqrt{41}}$$

$$= \frac{25 + 41 - 4}{10 \cdot \sqrt{41}} = 0.968$$

$$\therefore \angle BOQ = \cos^{-1}(0.968) = 14.53^\circ$$

And again from ΔOQP,

$$\therefore \tan \angle QOP = \frac{PQ}{OP}$$

$$= \frac{4}{5}$$

$$\therefore \angle QOP = \tan^{-1}\left(\frac{4}{5}\right)$$

$$= 38.66^\circ$$

$$\therefore \theta_1 = \angle QOP + \angle BOQ = 38.66 + 14.33$$

$$= 52.99^\circ$$

Lastly, from the figure,

we can see,

$$\tan \theta_0 = \frac{y}{x}$$

$$\therefore \theta_0 = \tan^{-1}\left(\frac{y}{x}\right) = \tan^{-1}\left(\frac{3}{5}\right)$$

$$\therefore \theta_0 = 30.96^\circ$$