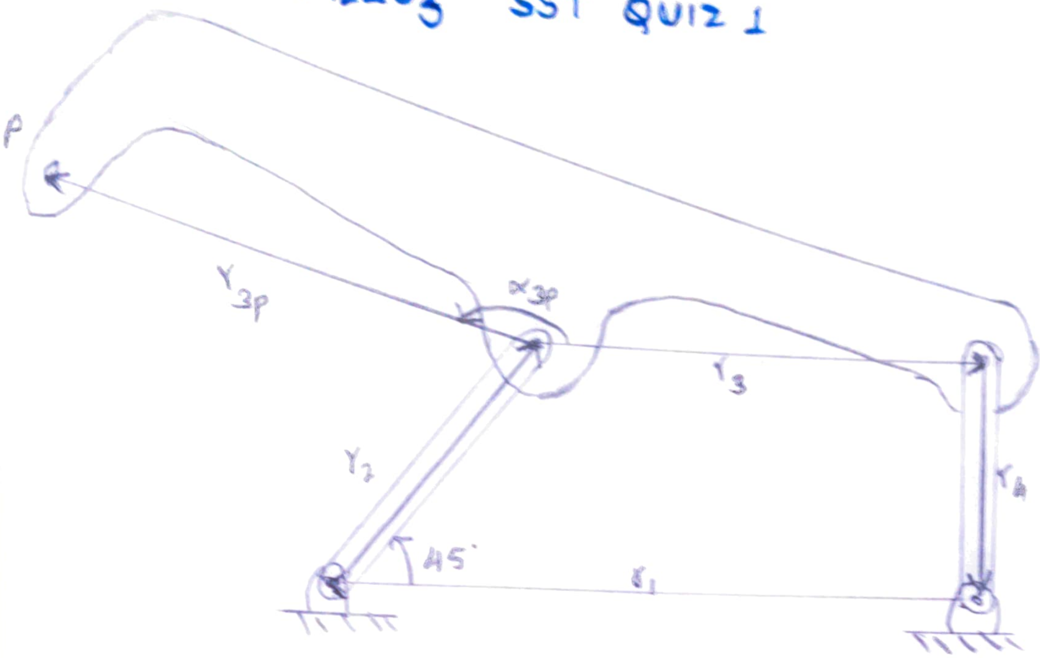
ME203 SST QUIZ 1

SAHANA.V
191ME173



Solution : Given : link 1, 3 are horizontal
link 4 is vertical
link 2 is input link

$r_1 = 161$ cm

$r_2 = 141$ cm

$r_3 = 120$ cm

$r_4 = 100$ cm

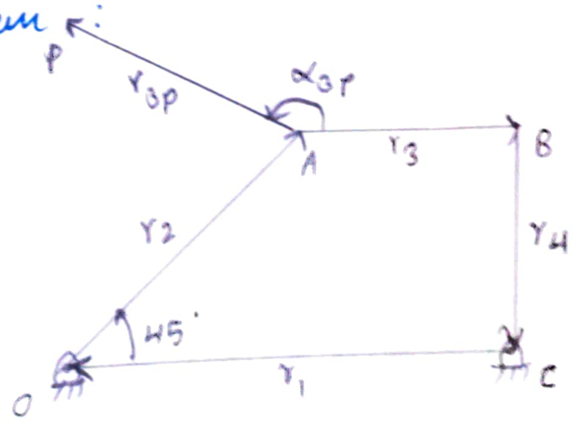
$\theta_2 = 45°$

$\omega_2 = 0.5$ rad/sec

$r_{3p} = 200$ cm

$\alpha_{3p} = 135°$

Kinematic Vector diagram :



Loop OABC, writing equation →

$$\vec{r}_1 + \vec{r}_2 + \vec{r}_3 + \vec{r}_4 = 0 \rightarrow \text{Loop 1 equation}$$

CE : $\theta_{3p} = \theta_3 + \alpha_{3p} \rightarrow$ loop vector equation

differentiating loop 1 eqn wrt time →

$$\frac{d(\text{Loop 1 eqn})}{dt} = r_2 w_2 i e^{i\theta_2} + r_3 w_3 i e^{i\theta_3} + r_4 w_4 i e^{i\theta_4} = 0 \rightarrow (i)$$

(because θ_1 is constant and derivative will be 0)

From loop vector equation

$$\frac{d(CE)}{dt} = \frac{d(\theta_{3p})}{dt} = \frac{d(\theta_3)}{dt}$$

$$\Rightarrow \omega_{3p} = \omega_3 \rightarrow (ii)$$

Now,

$$V_p = \frac{d}{dt}(\vec{OP}) = \frac{d}{dt}(r_2 + r_{3p}) = r_2 w_2 i e^{i\theta_2} + r_{3p} \omega_{3p} i e^{i\theta_{3p}} \rightarrow (iii)$$

Resolving the above equations into scalar form →

$$L1_x = -r_2 w_2 \sin\theta_2 - r_3 \omega_3 \sin\theta_3 - r_4 w_4 \sin\theta_4 = 0$$

$$L1_y = +r_2 w_2 \cos\theta_2 + r_3 w_3 \cos\theta_3 + r_4 w_4 \cos\theta_4 = 0$$

$$w_{3p} = \omega_3$$

$$V_{px} = -r_2 w_2 \sin\theta_2 - r_{3p} w_{3p} \sin\theta_{3p} = 0$$

$$V_{py} = r_2 w_2 \cos\theta_2 + r_{3p} w_{3p} \cos\theta_{3p} = 0.$$

Solving the above 5 equations →

$$V_{px} = -141 \times 0.5 \times \sin(45) - 120 \times \omega_3 \times \sin(0) - 100 \times \omega_4 \times \sin(-90) = 0$$

$$V_{py} = 141 \times 0.5 \times \cos(45) + 120 \times \omega_3 \times \cos(0) + 100 \times \omega_4 \times \cos(90) = 0$$

$$\Rightarrow \quad \omega_3 = -0.4154 \quad (\text{from } L1_y)$$
$$\omega_4 = 0.4985 \quad (\text{from } L1_x)$$

Also,

$$\omega_{3p} = \omega_3 = -0.4154$$

Substituting these values in (iii)

$$V_{px} = -141 \times 0.5 \times \sin(45) - 200 \times (-0.4154) \times \sin 135)$$
$$= \underline{\underline{8.896 \text{ cm/s}}}$$

$$V_{py} = 141 \times 0.5 \times \cos 45 + 200 \times (-0.4154) \times \cos 135$$
$$= \underline{\underline{108.6 \text{ cm/s.}}}$$

$$V_p = \sqrt{(V_{px})^2 + (V_{py})^2} = \underline{\underline{108.96 \text{ cm/s}}}$$

$$\boxed{\text{Therefore absolute velocity of P} = 108.96 \text{ cm/s.}}$$