Dynamics of Machinery

Credits: 3

Lecturer: Abbasi

Instantaneous centre

Definition

Number of IC in a Mechanisim with (n) links:

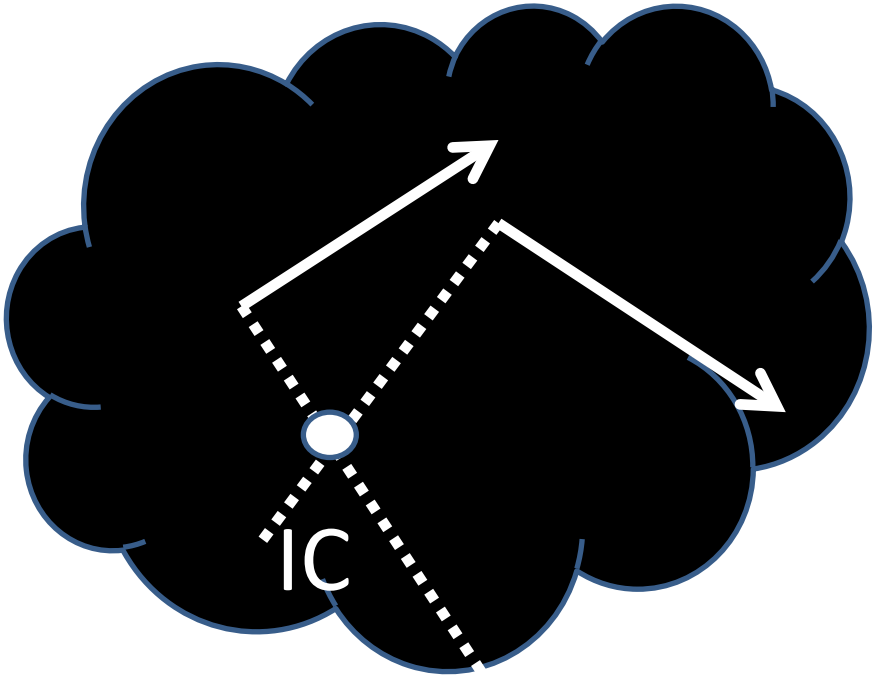
$$= \frac{n(n-1)}{2}$$

Primary IC
- Fixed IC
- Permanent IC

Secodary IC Neither fixed nor permanent

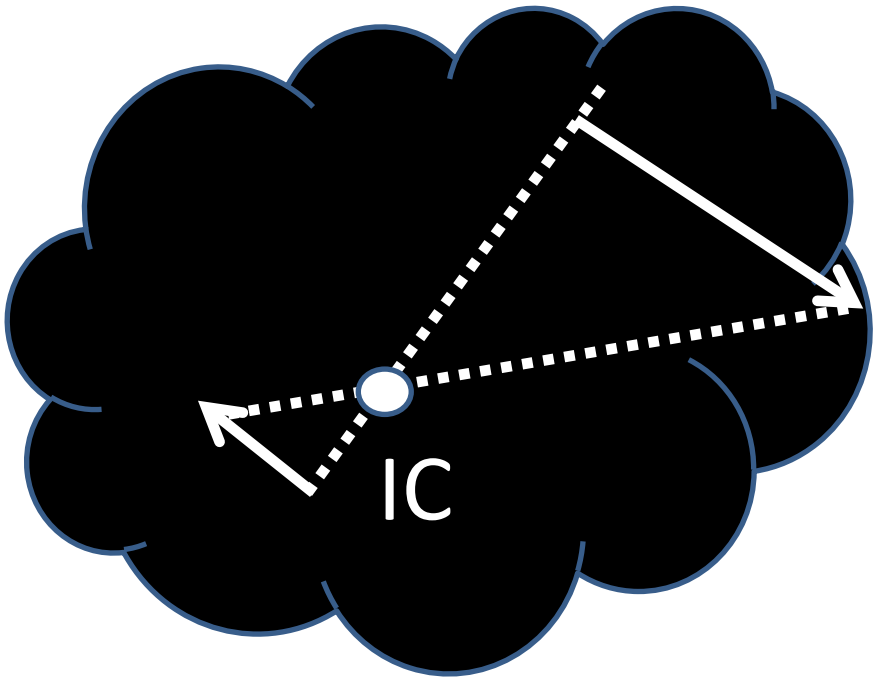
How to find IC

a) With two known velocity vectors (not parallel)

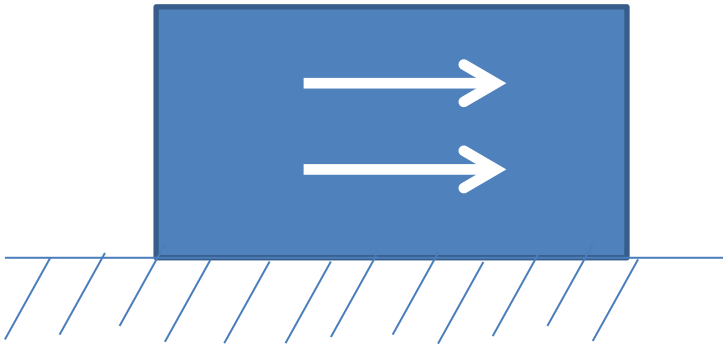


How to find IC

b) With two known velocity vectors (Parallel)

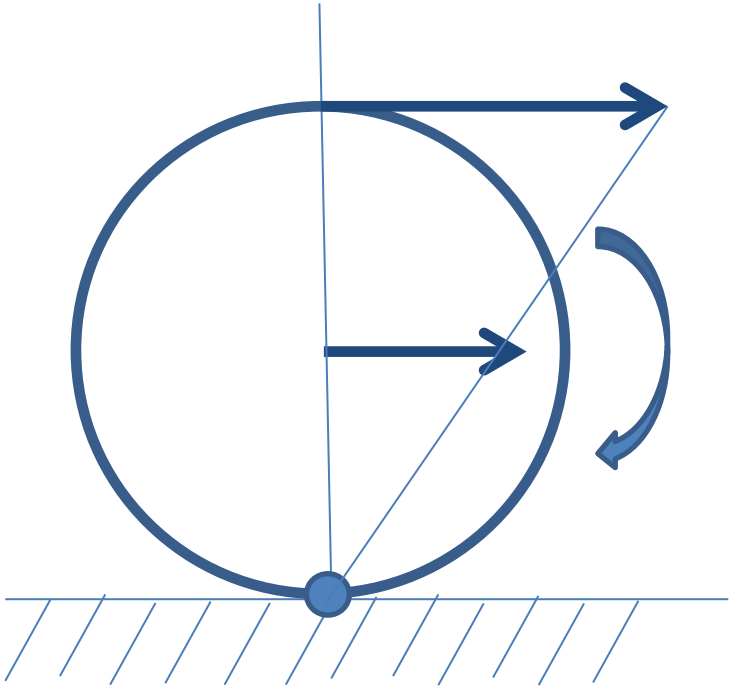


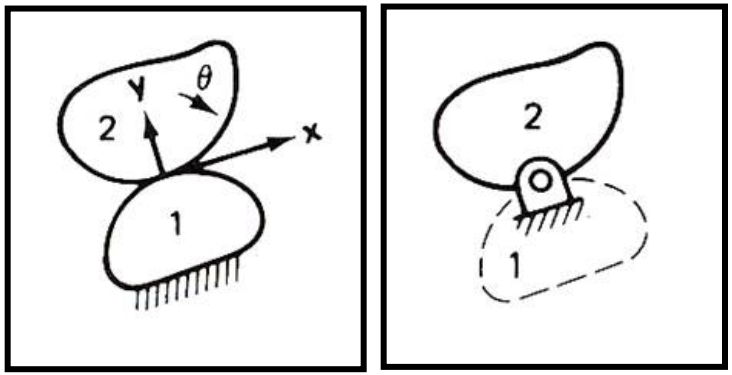
Please, Find IC.



How to find IC

C) Pure rolling



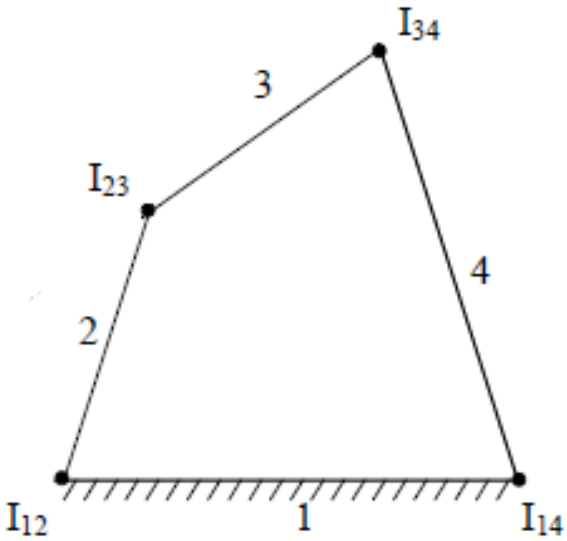


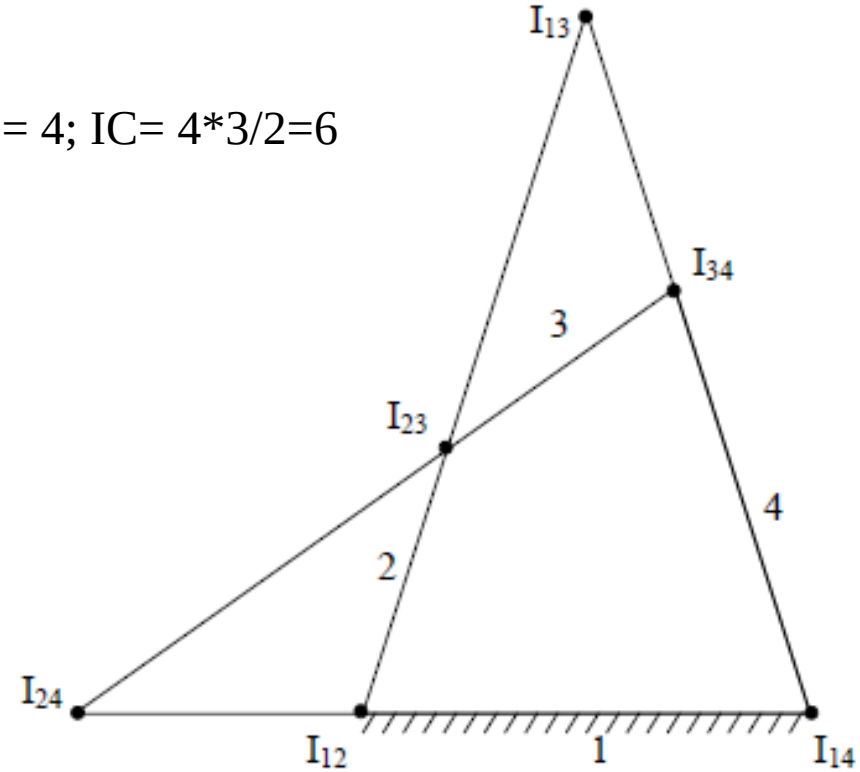
Arnold Kennedy theorem of three centers

If three bodies have motion relative to each other, their instantaneous centers should lie in a straight line.

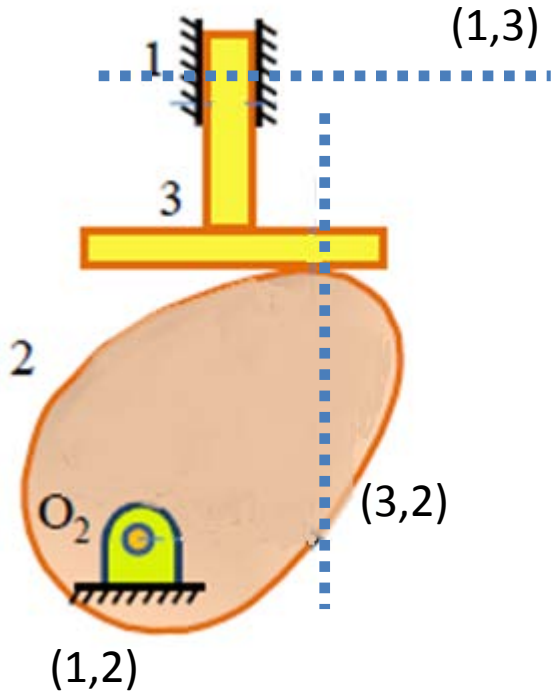
Example

Four bar mechanism. n = 4; IC= 4*3/2=6

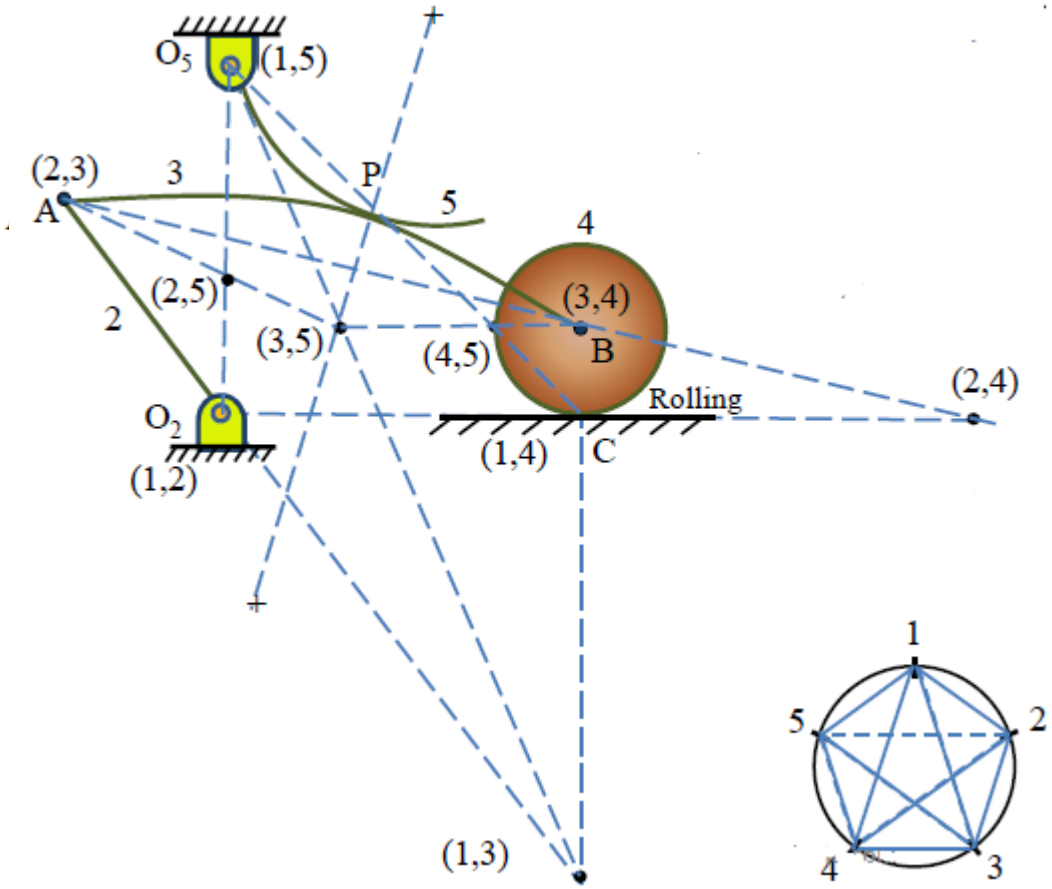




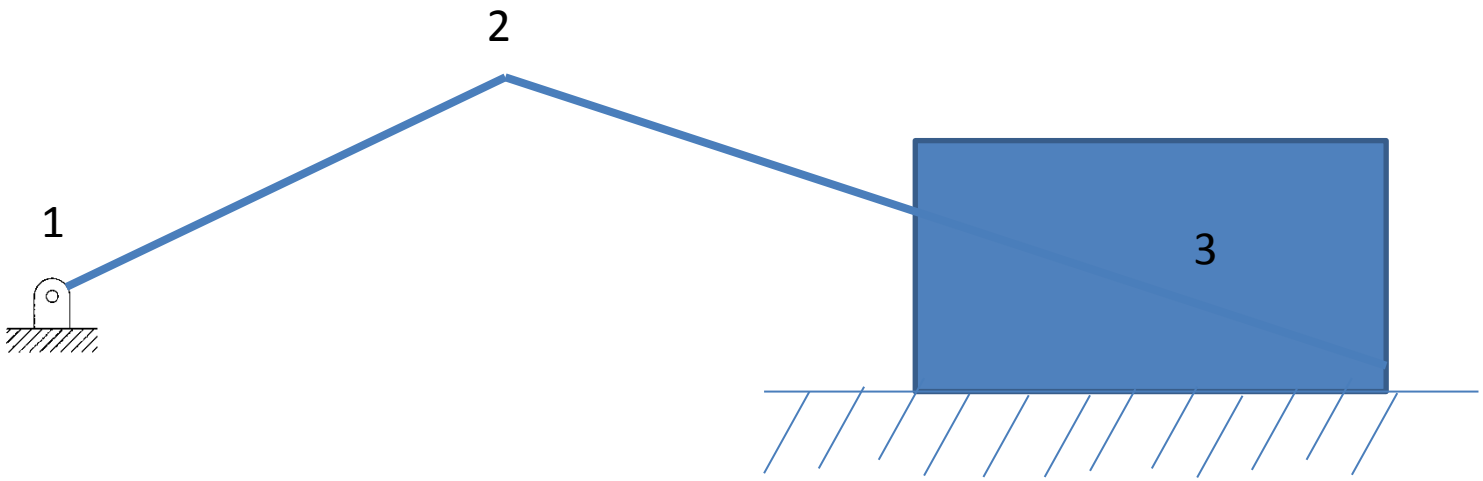
Example



Example



Assignment



Number of CR = n(n-1)/2
4*3/2=6
CR1, CR2, CR3 are obvious. Where are 4,5, 6??

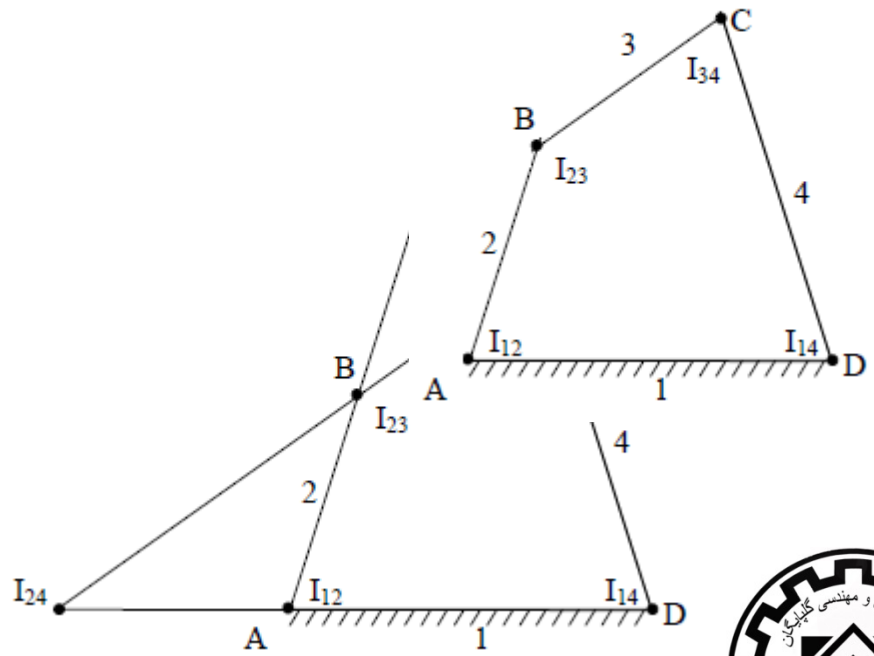
Example

A four bar mechanisms has links AB = 300 mm, BC = CD = 360 mm and AD = 600 mm. Angle $\angle BAD = 60°$. Crank AB rotates in Cω direction at a speed of 100 rpm. Locate all the instantaneous centers and determine the angular velocity of link BC.

$$V_b = \omega_2 \times BI_{12} = \frac{2\pi \times 100}{60} \times 0.3 = \text{m/sec}$$

Also $V_b = \omega_3 \times BI_{13}$

$$\omega_3 = \frac{V_b}{BI_{13}} = \text{rad/sec}$$



Example

A slider crank mechanism has lengths of crank and connecting rod equal to 200 mm and 200 mm respectively locate all the instantaneous centers of the mechanism for the position of the crank when it has turned through 30° from IOC. Also find velocity of slider and angular velocity of connecting rod if crank rotates at 40 rad/sec.

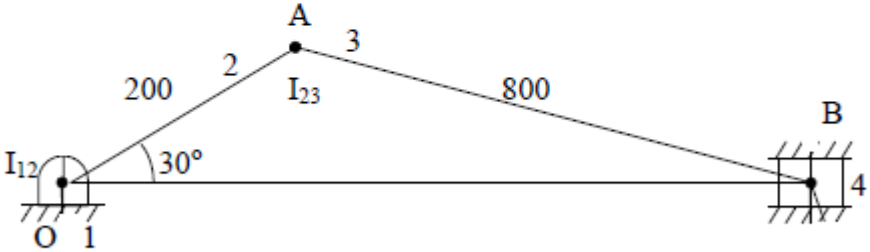
Velocity of different points.

$V_a = \omega_2 \, AI_{12} = 40 \times 0.2 = 8$ m/s

also $V_a = \omega_3 \times A_{13}$

$$\therefore \omega_3 = \frac{V_a}{AI_{13}}$$

$V_b = \omega_3 \times BI_{13}$ = Velocity of slider.



Example

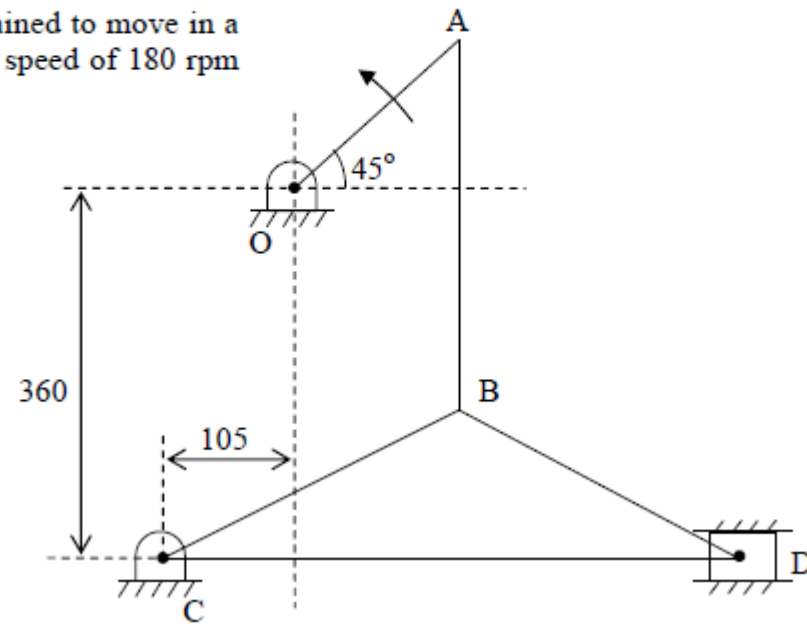
In the toggle mechanism shown in figure the slider D is constrained to move in a horizontal path the crank OA is rotating in CCW direction at a speed of 180 rpm the dimensions of various links are as follows:

OA = 180 mm	CB = 240 mm
AB = 360 mm	BD = 540 mm

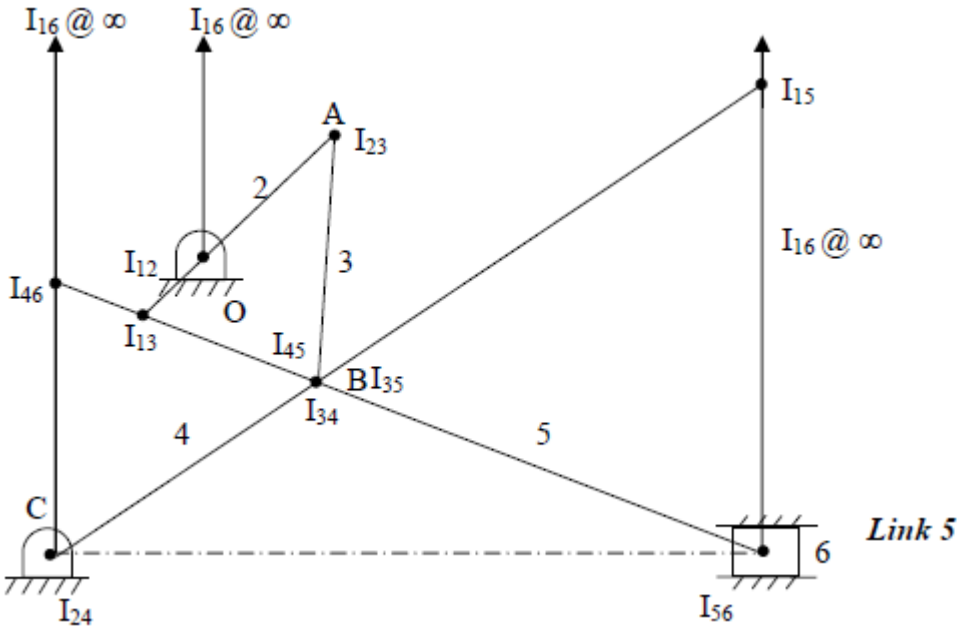
Find,

i) Velocity of slider

ii) Angular velocity of links AB, CB and BD.

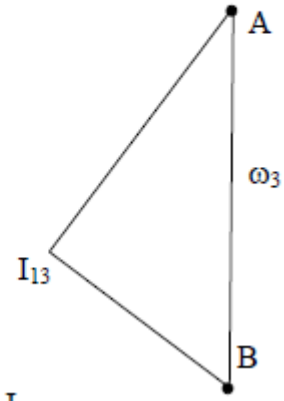


Example



$V_a = \omega_2 \times AI_{12} = 3.4 \ \text{m/s}$

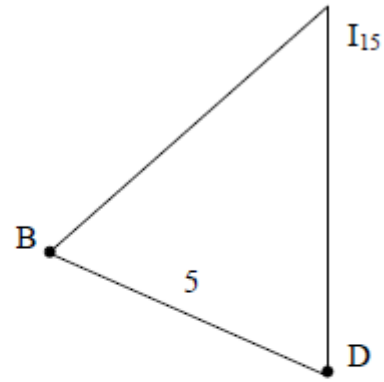
Link 3



$V_a = \omega_3 \times AI_{13}$

$\omega_3 = \dfrac{V_a}{AI_{13}} = 2.44 \ \text{rad/sec}$

$V_b = \omega_3 \times BI_{13}$



Answers

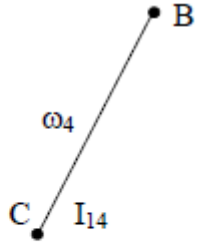
$V_d = 2$ m/s

$\omega_{ab} = 2.44$ rad/sec

$\omega_{bc} = 11.875$ rad/sec

$\omega_{cd} = 4.37$ rad/sec

Link 4



$V_b = \omega_4 \times BI_{14}$

$\omega_4 = \dfrac{V_b}{AI_{14}} = 11.875 \ \text{rad/sec}$

$V_b = \omega_5 \times BI_{15}$

$\omega_5 = \dfrac{V_b}{AI_{15}} = 4.37 \ \text{rad/sec}$

$V_d = \omega_5 \times DI_{15} = 2 \ \text{m/s}$

Thank you for your attention!

Questions, please!