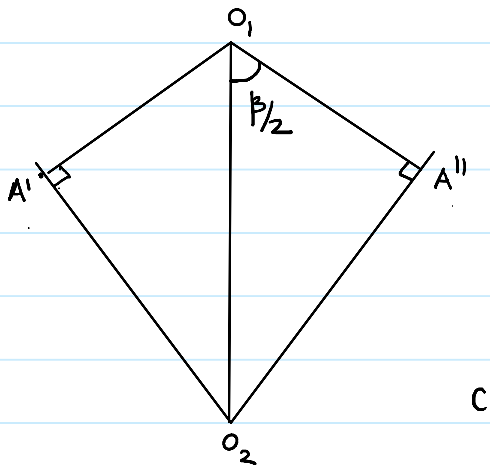
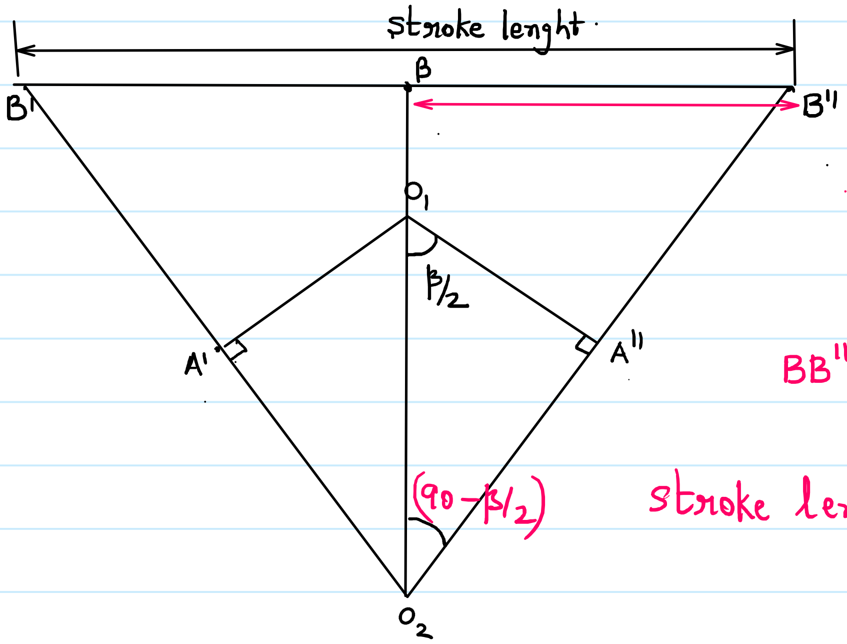


In $\Delta O_1O_2A''$

$$\cos\beta/2 = \frac{O_1A''}{O_1O_2}$$

$$\cos\beta/2 = \frac{\text{lenght of crank} / L_{min}}{\text{lenght of fixed link}}$$



In $\Delta^{le}\ O_2BB''$

$$\sin(90-\beta/2) = \frac{BB''}{O_2B''}$$

$$BB'' = O_2B'' \cdot \sin(90-\beta/2)$$

$$\text{stroke lenght} = 2 \times BB''$$

$$\text{stroke lenght} = 2 \times O_2B'' \times \cos(\beta/2)$$

$$= \frac{2 \times \text{Lenght of slotted bar} \times \text{Lenght of crank}}{\text{lenght of fixed link}}$$

Observations

- The stroke length in Whitworth Quick Return Mechanism is dependent on **extension of slotted bar** diametrically opposite to the slider.
- In the Crank Slotted lever Mechanism the stroke length is dependent on **length of slotted bar , length of Crank and length of Fixed link**.

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case. If Q.R.R. = 2 or Q.R.R. = 1/2

$$Q.R.R. = \frac{\theta_{cutting}}{\theta_{Return}} = 2 \checkmark$$

$$Q.R.R. = \frac{1}{2} = \frac{\theta_{Return}}{\theta_{cutting}}$$

$$Q.R.R. = \frac{360-\beta}{\beta} = 2 \Rightarrow \beta = 120^\circ$$

Whitworth mechanism.

$$\cos(\beta/2) = \frac{\text{lenght of fixed link} / L_{min}}{\text{lenght of crank}}$$

$$\cos\left(\frac{120}{2}\right) = \frac{1}{2} = \frac{\text{lenght of fixed link} / L_{min}}{\text{lenght of crank}} = \frac{1}{Q.R.R.}$$

Crank slotted lever mechanism.

$$\cos(\beta/2) = \frac{\text{lenght of crank} / L_{min}}{\text{lenght of fixed link}}$$

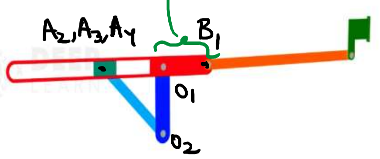
$$\cos\left(\frac{120}{2}\right) = \frac{1}{2} = \frac{\text{lenght of crank} / L_{min}}{\text{lenght of fixed link}} = \frac{1}{Q.R.R.}$$

stroke lenght

Whitworth Mechanism

stroke lenght = 2 × extension of slotted bar diametrically opposite to link 3 / slider.

extension of slotted bar diametrically opposite to link 3 / slider



Crank Slotted Lever Mechanism

$$\text{stroke} = \frac{2 \times \text{lenght of slotted bar} \times \text{lenght of crank}}{\text{lenght of fixed link}}$$

If Q.R.R. = 2 $\quad \frac{1}{2} = \frac{\text{lenght of crank} / L_{min}}{\text{lenght of fixed link}}$

stroke lenght = 2 × lenght of slotted bar × 1/2

stroke lenght = lenght of slotted bar.

01. A round bar A passes through the cylindrical hole in B as shown in the given figure. Which one of the following statements is correct in this regard?

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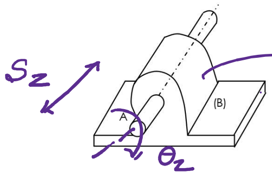


→ cylinderical pair

DOF = 2

(a) The two links shown form a kinematic pair
(b) The pair is completely constrained
(c) The pair has incomplete constraint — / Lower pair.
(d) The pair is successfully constrained

03. For a four – bar linkage in toggle position, the value of mechanical advantage is → Extreme positions of Rocker
(a) 0.0 (b) 0.5
(c) 1.0 (d) ∞ ✓

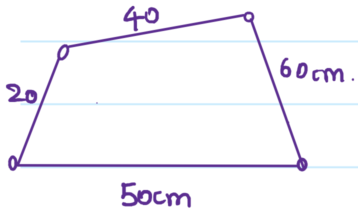
$\phi = 0^\circ, 180^\circ$

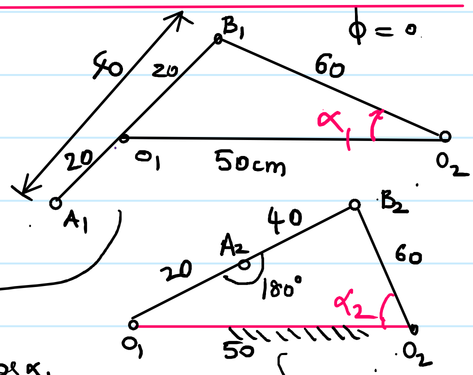
$$M.A. = \frac{\sin \gamma}{\sin \phi} = \infty$$

Statement for Common data Q 04 & 05

In a crank rocker mechanism the lengths of the fixed link, crank, coupler and rocker are respectively 50, 20, 40 and 60 cm.

$\phi = 0^\circ, 180^\circ$





04. Extreme positions of rocker measured with the fixed link are
(a) 60° & 134.43° (b) 60° & 13.77°
(c) 134.43° & 13.77° (d) 65.37° & 18.19°

In $\Delta^{le}\ O_1B_1O_2$

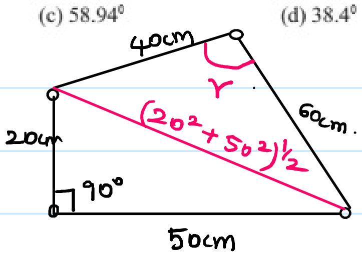
$$20^2 = 50^2 + 60^2 - 2(50)(60)\cos\alpha_1$$

$$\alpha_1 = 18.19^\circ$$

$$60^2 = 60^2 + 50^2 - 2(50)(60)\cos\alpha_2$$

$$\alpha_2 = 65.37^\circ$$

05. Transmission angle when the crank is perpendicular to the fixed link is
(a) 61.37° (b) 60°
(c) 58.94° (d) 38.4°



$$20^2 + 50^2 = 40^2 + 60^2 - 2\cdot(40)(60)\cdot\cos\gamma$$

$$\gamma = 61.37^\circ$$

Statement for Common data Q. 06 & Q. 07

In an offset slider crank mechanism the length of crank is 20 cm and that of the connecting rod is 40 cm. The offset between the line of stroke and the centre of crank is 10 cm

offset $e = 10$cm.
crank lenght $r = 20$cm.
lenght of connecting Rod $= 40$cm.

06. The stroke of the slider is
(a) 40 cm (b) 20 cm
(c) 41.8 cm (d) 38.2 cm

$$\text{stroke lenght} = \sqrt{(l+r)^2 - e^2} - \sqrt{(l-r)^2 - e^2}$$

$$= \sqrt{(40+20)^2 - 10^2} - \sqrt{(40-20)^2 - 10^2}$$

$$= 41.8 \text{ cm.}$$

07. The quick return ratio is
(a) 1.0 (b) 1.25
(c) 1.12 (d) 1.414

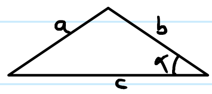
$$\sin\theta_2 = \frac{e}{l-r} \Rightarrow \theta_1 = \sin^{-1}\left(\frac{10}{40-20}\right) = 30^\circ$$

$$\sin\theta_1 = \frac{e}{l+r} \Rightarrow \theta_1 = \sin^{-1}\left(\frac{10}{40+20}\right) = 9.594$$

$$Q.R.R. = \frac{180 + (\theta_2 - \theta_1)}{180 - (\theta_2 - \theta_1)}$$

$$Q.R.R. = \frac{180 + (30 - 9.594)}{180 - (30 - 9.594)}$$

$$Q.R.R. = 1.25$$



$a^2 = b^2 + c^2 - 2bc\cdot\cos\alpha$

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08. In a quick return mechanism of the crank and slotted lever type the length of the crank is 20cm and that of the fixed link is also 40cm. The quick return ratio is

(a) 1.5 (b) 1.75

$\boxed{\text{(c) 2}}$ ✓ (d) None

lenght of crank = 20 cm.

lenght of fixed link = 40cm.

Ratio 1:2

Q.R.R. = 2

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Kinematic Analysis of Planer Mechanisms

It is the study of parameters that describe the relative motion between the connected bodies without considering the effect of force/Torque acting on the body/link.

Mass or inertia of the link is not considered.

1. Velocity Analysis
2. Acceleration Analysis. (Vector Alegbra)

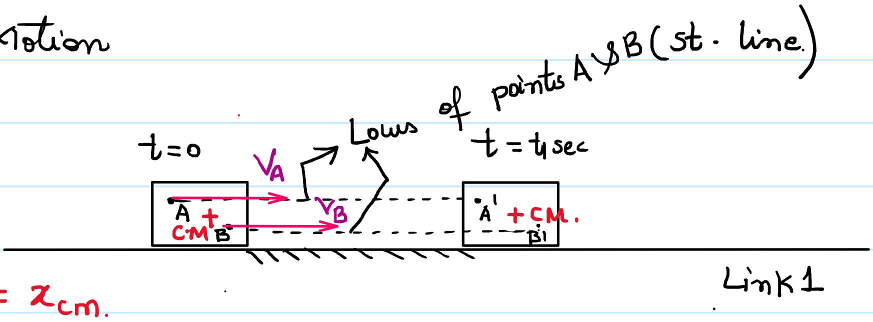
Types of Tensors.

1. Zero Order Tensor :- Quantities which has only magnitude / Scalers.
   Ex:- time, lenght, Mass
2. First order Tensor :- Quantities which has magnitude & direction / Vectors.
   Ex:- Force, velocity.
3. Second Order Tensor :- Quantities which has magnitude, direction and plane of reference is called Tensor
   Ex:- stress, strain, Moment of Inertia.

Types of Motion

1. Rectilinear Motion
2. Curvilinear Motion
3. Angular Motion
4. General Plane Motion/Rolling Motion

Rectilinear Motion



$x_A = x_B = x_{cm}.$

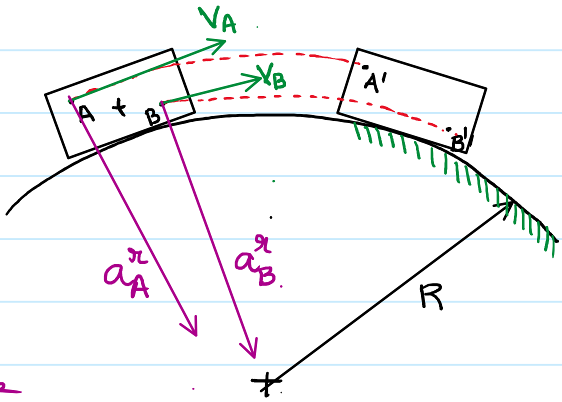
$V_A = V_B = V_{cm}.$

$a_A = a_B = a_{cm}.$

$$a^{r}_{cm} = \frac{V_{cm}^2}{R}.$$

As $R \to \infty$ $a^{r}_{cm} \to 0$

2. Curvilinear Motion



Locus of points A & B is arc of circle.

$V_A = V_B = V_{cm}$.

$a_A = a_B = a_{cm}$.

Radial acceleration

$a_A^r = a_B^r = a_{cm}^r$

$a_A^r = \dfrac{V_A^2}{R}$.

$a_B^r = \dfrac{V_B^2}{R}$.

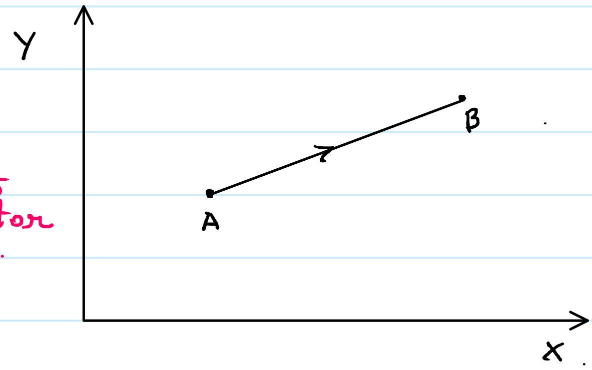
$a_{cm}^r = \dfrac{V_{cm}^2}{R}$.

Vectors

$\vec{AB} = |\vec{AB}| \cdot \hat{AB}$

$|\vec{AB}|$ → Magnitude.

$\hat{AB}$ → unit vector



$\vec{AB}$ → point of interest (B)

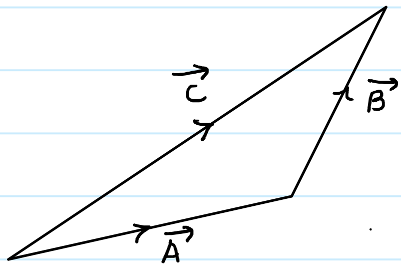
→ point of reference (A).

Addition of Vectors

$\vec{A} + \vec{B} = \vec{C}$ → Resultant

Head

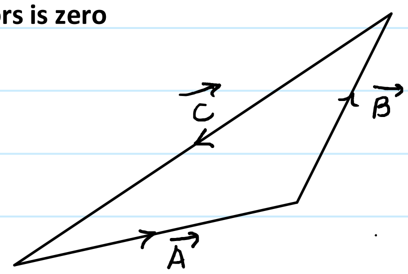
Tail



In a closed polygon the summation of all vectors is zero

$\vec{A} + \vec{B} + (-\vec{C}) = 0$

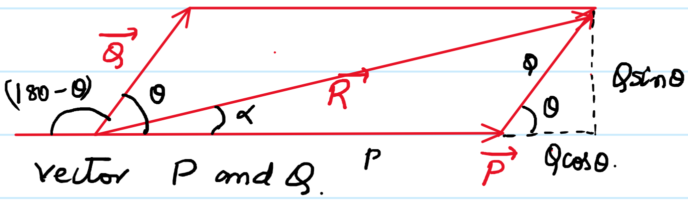
$(-\vec{C})$ → Equilibrant.



$$\vec{F} = \underbrace{\vec{A} + \vec{B} + \vec{C} + \vec{D} + \vec{E}}_{\text{Head}}$$

Tail

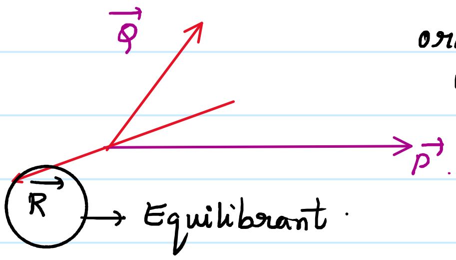
Parallelogram law of Vectors.



Resultant of vector P and Q.

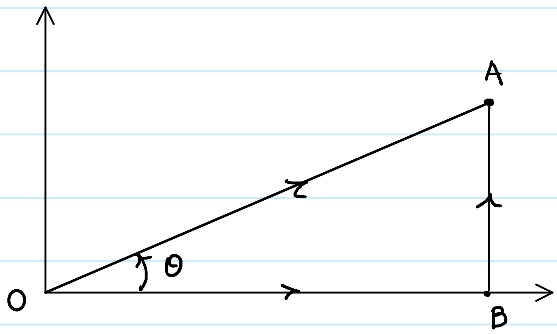
$$R^2 = P^2 + Q^2 + 2PQ.\cos\theta$$

$$\tan\alpha = \frac{Q\sin\theta}{P + Q\cos\theta}$$



orientation of vectors when a body is in equilibrium.

Resolution of Vector

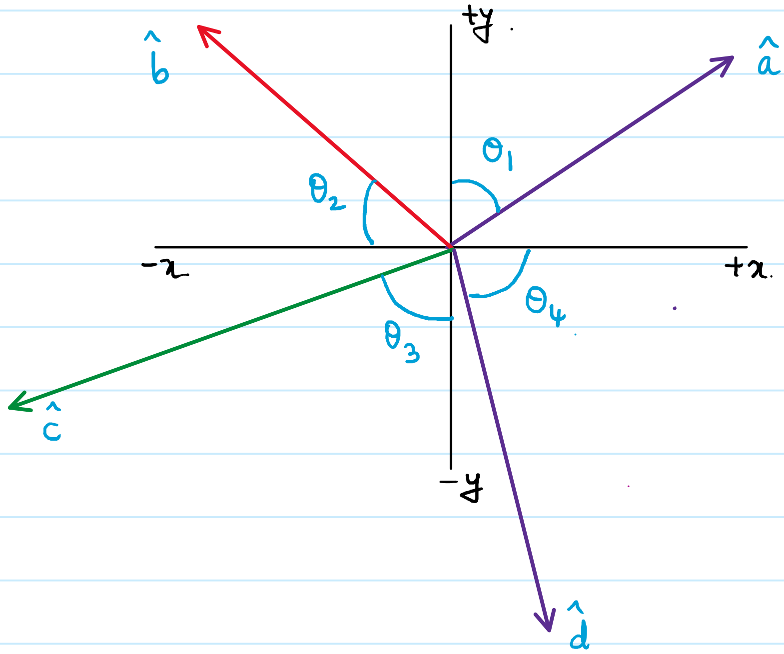


$$\vec{OA} = \vec{OB} + \vec{AB}$$

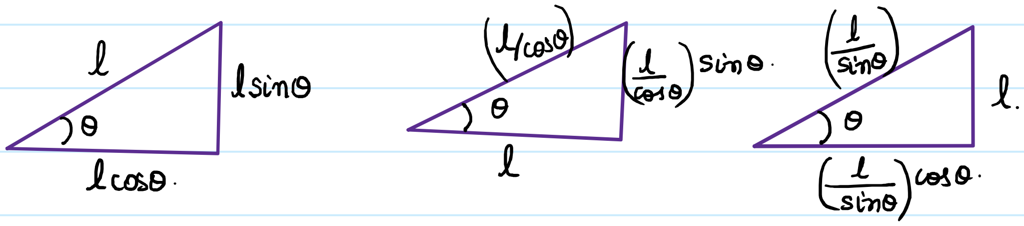
$$|\vec{OA}| \cdot \hat{OA} = |\vec{OB}| \cdot \hat{OB} + |\vec{AB}| \cdot \hat{AB}$$

$$\hat{OA} = \frac{|\vec{OB}|}{|\vec{OA}|} \cdot \hat{OB} + \frac{|\vec{AB}|}{|\vec{OA}|} \cdot \hat{AB}$$

$$\hat{OA} = \cos\theta\,\hat{i} + \sin\theta\,\hat{j}$$



$$\hat{a} = \sin\theta_1 \hat{i} + \cos\theta_1 \hat{j}$$
$$\hat{b} = -\cos\theta_2 \hat{i} + \sin\theta_2 \hat{j}$$
$$\hat{c} = -\sin\theta_3 \hat{i} - \cos\theta_3 \hat{j}$$
$$\hat{d} = \cos\theta_4 \hat{i} - \sin\theta_4 \hat{j}$$

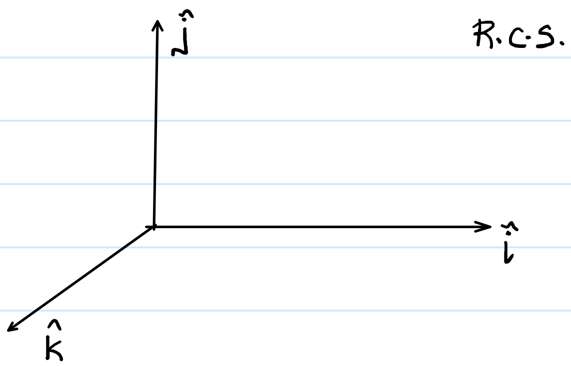


Dot product.

$$i \cdot i = j \cdot j = k \cdot k = 1$$
$$i \cdot j = j \cdot k = k \cdot i = 0$$

$$\cos\theta = \frac{a \cdot b}{|a||b|}$$

Cross. Product.

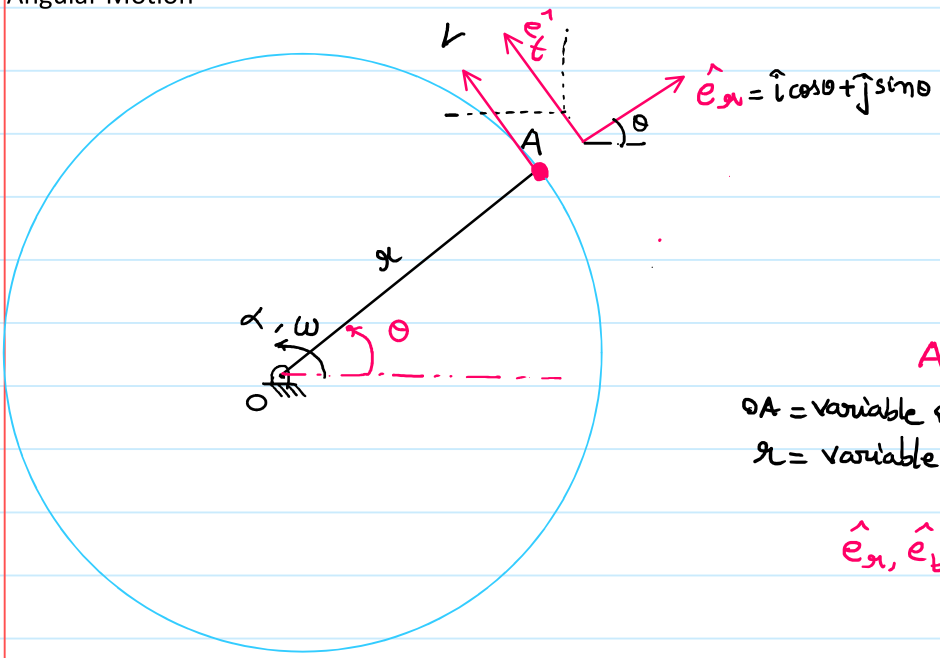


$$\hat{i} \times \hat{j} = \hat{k} \qquad \hat{j} \times \hat{k} = \hat{i}$$

$$-i \times j = -\hat{k}$$

$$-\hat{i} \times -\hat{k} = -\hat{j}$$

→ Angular Motion



ω – Angular Velocity

α – Angular Acceleration

A – point A is having relative motion along the rod.

OA = variable

r = variable

$\hat{e}_r, \hat{e}_t$ – unit vectors describing radial and tangential direction.

OA = r = variable.

$\hat{OA} = \hat{i}\cos\theta + \hat{j}\sin\theta$

$$\vec{OA} = |\vec{OA}| \cdot \hat{OA}$$

$$\vec{r} = r[\hat{i}\cos\theta + \hat{j}\sin\theta]$$

Velocity $\vec{V} = \frac{d\vec{r}}{dt} = \frac{dr}{dt}[\hat{i}\cos\theta + \hat{j}\sin\theta] + r\cdot\frac{d}{dt}[\hat{i}\cos\theta + \hat{j}\sin\theta]$

$$\vec{V} = \dot{r}\hat{e}_r + r\cdot[\underbrace{-\hat{i}\sin\theta + \hat{j}\cos\theta}_{\hat{e}_t}]\frac{d\theta}{dt} \to \dot{\theta}$$

$$\boxed{\vec{V} = \dot{r}\hat{e}_r + r\dot{\theta}\cdot\hat{e}_t}$$

$\dot{r}$ – Rate of change in position of point A along Rod.

$\dot{\theta}$ – Angular Velocity of Rod.

if r = constant $\dot{r} = 0$ $\boxed{\vec{V} = r\cdot\dot{\theta}\,\hat{e}_t = r\omega\cdot(\hat{e}_t)}$

$$\vec{V} = \dot{r}\hat{e}_r + r\dot{\theta}(\hat{e}_t)$$

$uv' + vu'$ — uv

$uv\cdot w' + u'vw + uw\cdot v'$ — uvw

Acceleration $\vec{a} = \frac{d\vec{v}}{dt} = \frac{d}{dt}[\dot{r}\hat{e}_r] + \frac{d}{dt}[r\dot{\theta}\,\hat{e}_t]$

$$\vec{a} = \ddot{r}\hat{e}_r + \dot{r}\frac{d}{dt}[\hat{e}_r] + \frac{dr}{dt}\cdot\dot{\theta}\cdot\hat{e}_t + r\cdot\frac{d\dot{\theta}}{dt}\cdot\hat{e}_t + r\cdot\dot{\theta}\cdot\frac{d}{dt}[\hat{e}_t]$$

$$\vec{a} = \ddot{r}\hat{e}_r + \dot{r}\frac{d}{dt}[\hat{e}_r] + \frac{dr}{dt}\cdot\dot{\theta}\cdot\hat{e}_t + r\cdot\frac{d\dot{\theta}}{dt}\cdot\hat{e}_t + r\cdot\dot{\theta}\cdot\frac{d}{dt}[\hat{e}_t]$$

$$\vec{a} = \ddot{r}[\hat{i}\cos\theta + \hat{j}\sin\theta] + \dot{r}\frac{d}{dt}[\hat{i}\cos\theta + \hat{j}\sin\theta] + \dot{r}\dot{\theta}\cdot[-\hat{i}\sin\theta + \hat{j}\cos\theta] + r\cdot\ddot{\theta}[-\hat{i}\sin\theta + \hat{j}\cos\theta] + r\dot{\theta}\frac{d}{dt}[-\hat{i}\sin\theta + \hat{j}\cos\theta]$$

$$\vec{a} = \ddot{r}\underbrace{[\hat{i}\cos\theta + \hat{j}\sin\theta]}_{(\hat{e}_r)} + \dot{r}\underbrace{[-\hat{i}\sin\theta + \hat{j}\cos\theta]}_{\hat{e}_t}\dot{\theta} + \dot{r}\dot{\theta}\cdot\underbrace{[-\hat{i}\sin\theta + \hat{j}\cos\theta]}_{\hat{e}_t} + r\cdot\ddot{\theta}\underbrace{[-\hat{i}\sin\theta + \hat{j}\cos\theta]}_{\hat{e}_t} + r\dot{\theta}^2\underbrace{[-\hat{i}\cos\theta - \hat{j}\sin\theta]}_{-\hat{e}_r}$$

$$\vec{a} = \ddot{r}(\hat{e}_r) + \dot{r}\dot{\theta}(\hat{e}_t) + \dot{r}\dot{\theta}(\hat{e}_t) + r\cdot\ddot{\theta}(\hat{e}_t) + r\dot{\theta}^2(-\hat{e}_r)$$

$$\boxed{\vec{a} = \ddot{r}(\hat{e}_r) + r\dot{\theta}^2(-\hat{e}_r) + 2\dot{r}\dot{\theta}(\hat{e}_t) + r\ddot{\theta}(\hat{e}_t)}$$

Acceleration of point A along the Rod.

Radial acceleration of rod OA.

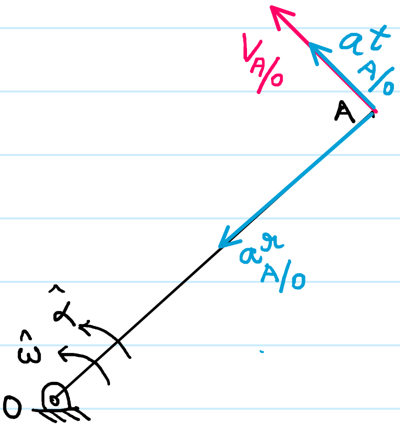
Coriolis acceleration.

Tangential Acceleration of Rod OA.

$r = \text{constant}$ $\quad \dot{r} = 0 \quad \ddot{r} = 0$

$$\boxed{\begin{aligned} \vec{a} &= r\dot{\theta}^2(-\hat{e}_r) + r\ddot{\theta}(\hat{e}_t) \\ \vec{a} &= r\omega^2(-\hat{e}_r) + r\alpha(\hat{e}_t) \end{aligned}}$$

(i)



$\hat{\omega} = \hat{\alpha} = +\hat{k}$

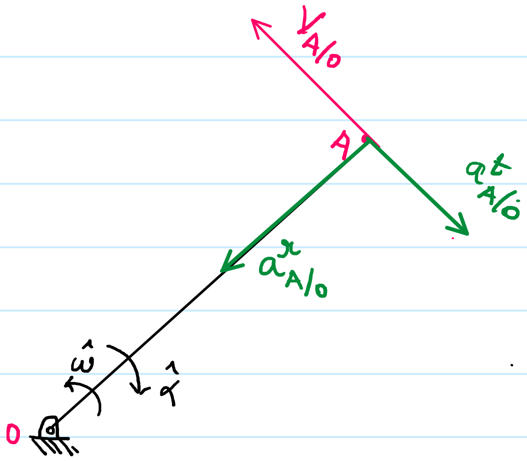
Link is accelerating

OA = constant.

$V_{A/O}$
→ Reference point
→ Point of interest.

$a^{\sigma}_{O/O}$
→ Type of acceleration: radial / Tangent / Coriolis
→ Reference point.
→ Point of interest.

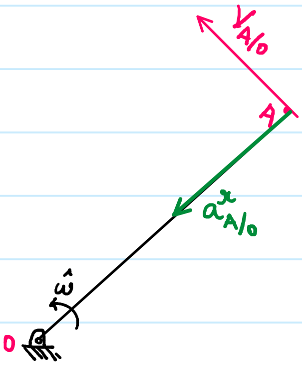
(ii)



$\hat{\omega} = +\hat{k}$, $\hat{\alpha} = -\hat{k}$

Link is retarding.

(iii)



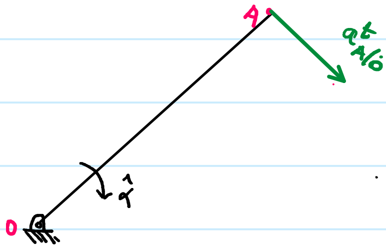
$\hat{\omega} = +\hat{k}$

ω = constant

$\alpha = 0$

$a^t_{A/O} = OA \cdot \alpha = 0$

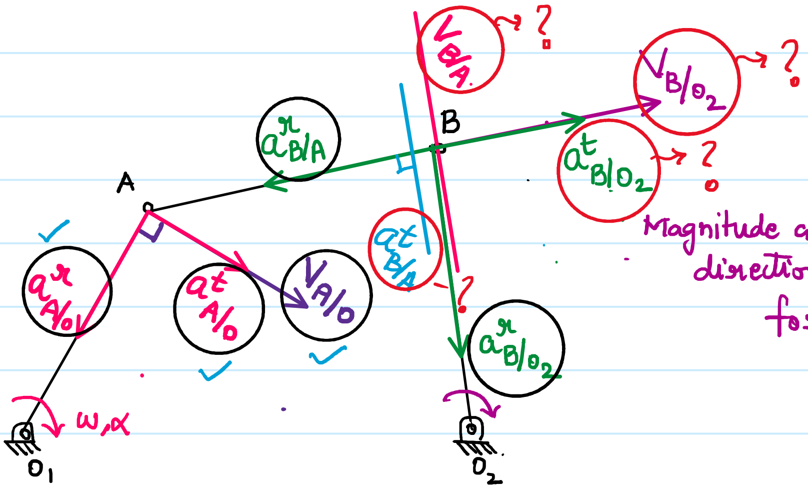
(iv)



ω = constant. $\alpha \neq 0$.

$\hat{\alpha} = -\hat{k}$

Maximum Retardation.

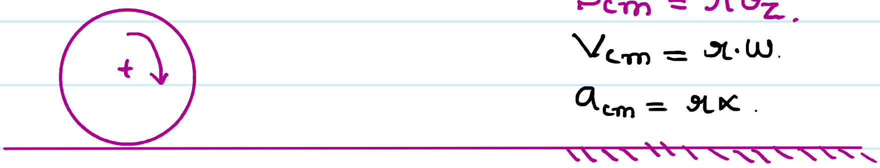


Magnitude and direction is unknown for $a^t_{B/A}$, a^t_{B/O_2}, $V_{B/A}$, V_{B/O_2}

Rolling Motion

Velocity Analysis for Rolling motion

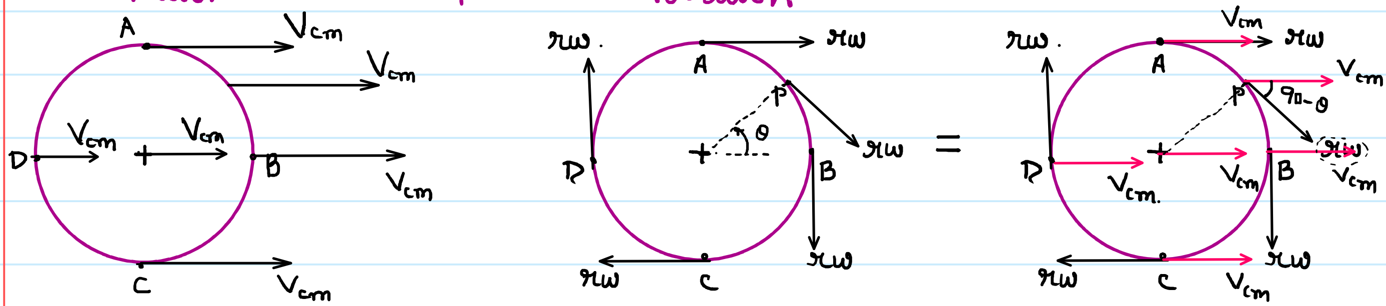
Rolling = Rotation + Translation.



$S_{cm} = r\theta_z$.
$V_{cm} = r\cdot\omega$.
$a_{cm} = r\alpha$.

$a^r = r\omega^2$
$a^t = r\alpha$

Translation + Rotation



Velocities at points A, B, C, D, P.

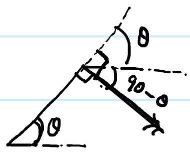
$$\vec{V_A} = V_{cm}(\hat{i}) + r\omega(\hat{i}) = 2V_{cm}.(\hat{i})$$

$$\vec{V_P} = V_{cm}.(\hat{i}) + r\omega.[\hat{i}\cos(90-\theta) - \hat{j}\sin(90-\theta)] = V_{cm}\hat{i} + V_{cm}[\hat{i}\sin\theta - \hat{j}\cos\theta]$$

$$\vec{V_B} = V_{cm}(\hat{i}) + r\omega(-\hat{j}) = V_{cm}[(\hat{i}) - (\hat{j})]$$

$$\vec{V_C} = V_{cm}(\hat{i}) + r\omega(-\hat{i}) = 0$$

$$\vec{V_D} = V_{cm}(\hat{i}) + r\omega.(\hat{j}) = V_{cm}.[\hat{i}+\hat{j}]$$



★ In pure rolling motion velocity at the point of contact is zero. About Point C the disc will undergo pure rotation.

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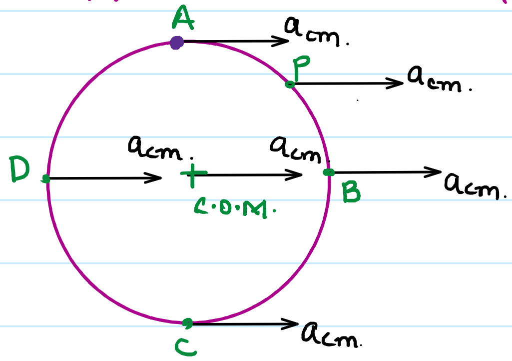
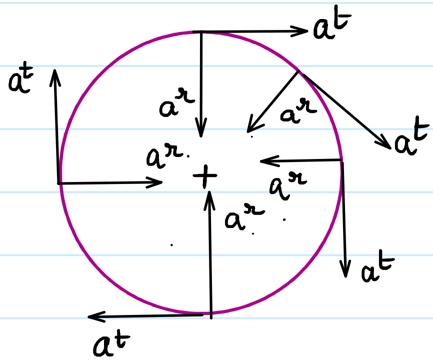
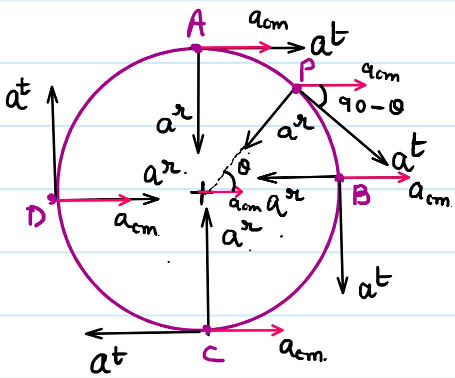
Translation + Rotation





Rotation + Translation.



Acceleration at points A, B, C, D & P.

$$\vec{a}_A = \vec{a}_{cm} + \vec{a}^t + \vec{a}^r = a_{cm}(\hat{i}) + r\alpha(\hat{i}) + r\omega^2(-\hat{j})$$
$$= r\alpha(\hat{i}) + r\alpha(\hat{i}) + r\omega^2(-\hat{j}) = 2r\alpha(\hat{i}) + r\omega^2(-\hat{j})$$

$$\vec{a}_B = \vec{a}_{cm} + \vec{a}^t + \vec{a}^r = a_{cm}(\hat{i}) + r\alpha(-\hat{j}) + r\omega^2(-\hat{i})$$
$$= r\alpha(\hat{i}) + r\omega^2(-\hat{i}) + r\alpha(-\hat{j})$$

$$\vec{a}_C = \vec{a}_{cm} + \vec{a}^t + \vec{a}^r = r\alpha(\hat{i}) + r\alpha(-\hat{i}) + r\omega^2(\hat{j}) = r\omega^2(\hat{j})$$

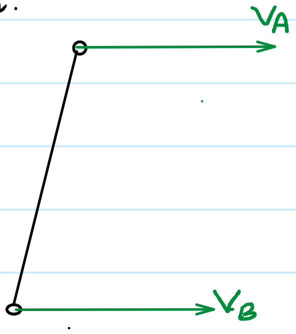
$$\vec{a}_D = \vec{a}_{cm} + \vec{a}^t + \vec{a}^r = r\alpha(\hat{i}) + r\alpha(\hat{j}) + r\omega^2(\hat{i})$$

Acceleration at point P.

$$\vec{a}_P = \vec{a}_{cm} + \vec{a}^r + \vec{a}^t = r\alpha(\hat{i}) + r\omega^2(-\hat{i}\cos\theta - \hat{j}\sin\theta) + r\alpha(\hat{i}\cos(90-\theta) - \hat{j}\sin(90-\theta))$$
$$= r\alpha(\hat{i}) + r\omega^2(-\hat{i}\cos\theta - \hat{j}\sin\theta) + r\alpha(\hat{i}\sin\theta - \hat{j}\cos\theta)$$

Recognition of Motion

1. Translation



$$\left.\begin{array}{l} V_A = V_B \\ a_A = a_B \end{array}\right\} \text{Translation.}$$

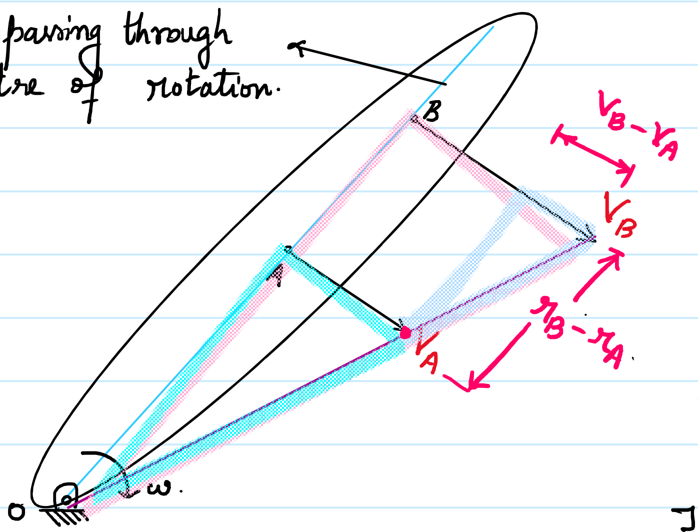
$$V = u + at$$
$$S = ut + \tfrac{1}{2}at^2$$
$$V^2 - u^2 = 2as$$

2. Angular Motion

Angular Motion → oscillatory motion
→ circular motion

$V_{B/A}$ – Velocity of B wrt A

line passing through centre of rotation.



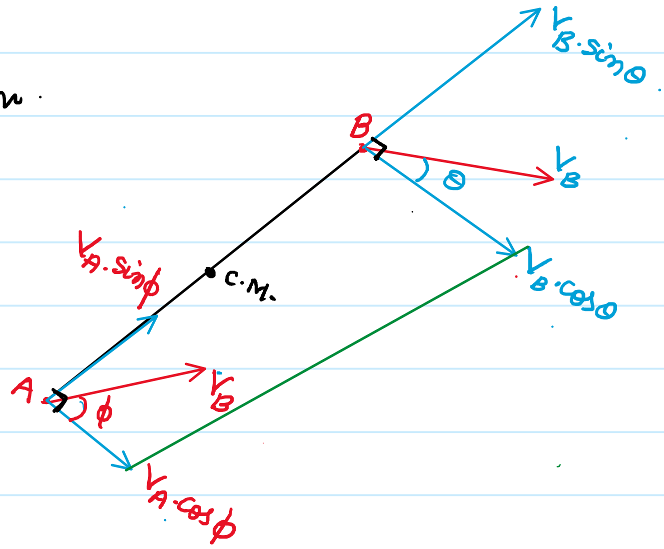
$$\boxed{\frac{V_B}{OB} = \frac{V_A}{OA} = \frac{V_B - V_A}{r_B - r_A} = \frac{V_{B/A}}{r_{B/A}} = \omega}$$

Point O is permanent center of rotation.
It is having zero velocity permanently.

★ Line passing through the centre of rotation will be always perpendicular to the Velocity Vectors at any point.

★ If there is velocity gradient across any dimension then the body will be subjected rotation

3. General Plane Motion



Rotation

$$\omega = \frac{V_B\cos\theta - V_A\cos\phi}{AB}$$

Translation.

$$V_A \sin\phi = V_B \sin\theta$$

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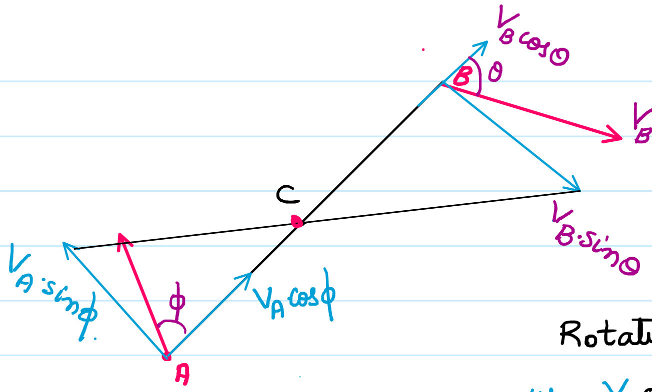


C - center of Rotation (having only Translation velocity)

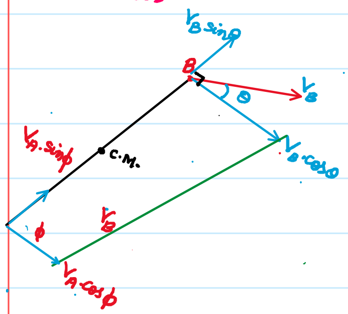
Rotation

$$\omega = \frac{V_B \sin\theta - (-V_A \sin\phi)}{AB}$$

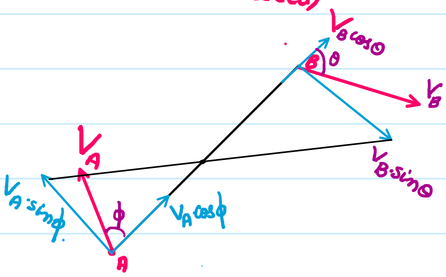
Translation

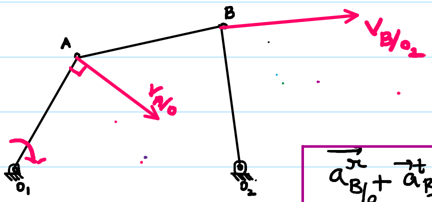
$$V_A \cos\phi = V_B \cdot \cos\theta$$

case(i)



case(ii)

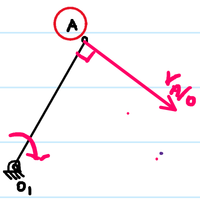




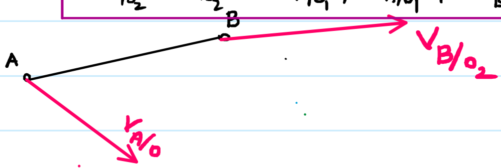
$$\vec{V}_B = \vec{V}_A + \vec{V}_{B/A}$$

$$\vec{a}_B = \vec{a}_A + \vec{a}^r_{B/A} + \vec{a}^t_{B/A}$$

$$\boxed{\vec{a}^r_{B/O_2} + \vec{a}^t_{B/O_2} = a^r_{A/O_1} + a^t_{A/O_1} + \vec{a}^r_{B/A} + \vec{a}_{B/A}}$$

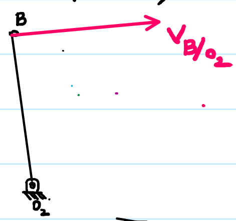


Angular motion
(i/p link)



General plane Motion
Coupler link

(o/p link)



Angular motion

Absolute velocity and acceleration of point A

$$V_{A/O_1} = O_1A \cdot \omega_{O_1A}$$

$$\vec{a}_{A/O_1} = \vec{a}^r_{A/O_1} + \vec{a}^t_{A/O_1}$$

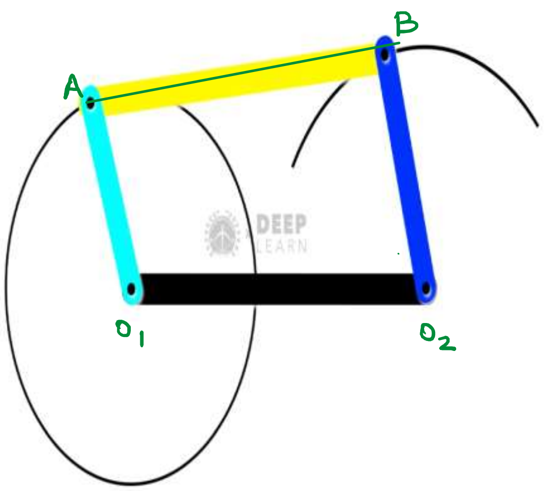
$$\vec{a}_A = O_1A \cdot \omega^2_{O_1A} \cdot (-\hat{e}_r) + O_1A \cdot \alpha_{O_1A} \cdot (\hat{e}_t)$$

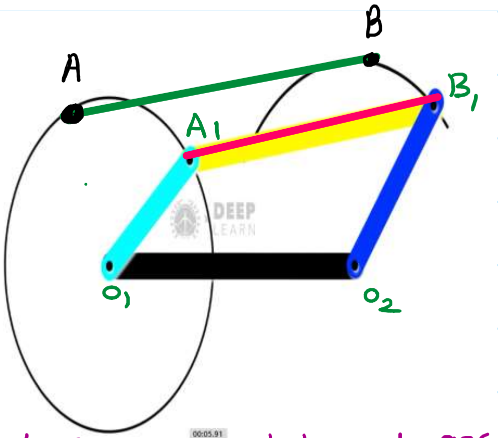
Absolute velocity and acceleration of point

$$V_{B/O_2} = O_2B \cdot \omega_{O_2B}$$

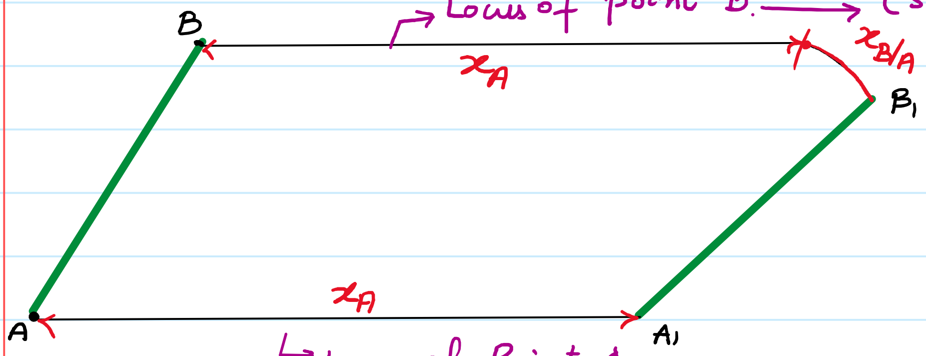
$$\vec{a}_{B/O_2} = \vec{a}^r_{B/O} + \vec{a}^t_{B/O_2}$$

$$\vec{a}_B = O_2B \cdot \omega^2_{O_2B} (-\hat{e}_r) + O_2B \cdot \alpha_{O_1} \ (\hat{e}_t)$$





Locus of point B → (st line + arc of circle)



↳ Locus of Point A.
st line

Rotation/Angular motion

Displacement of point B $\Rightarrow$ $x_B = x_A + x_{B/A}$

Absolute velocity of A/
Velocity of A wrt fixed point.

$\vec{V_B} = \vec{V_A} + \vec{V_{B/A}}$

Relative velocity of B wrt A.

Absolute velocity of point B/
Velocity of B wrt fixed point

$$\vec{a_B} = \vec{a_A} + \vec{a_{B/A}}$$

$$\vec{a_B} = \vec{a_A} + \vec{a}^{r}_{B/A} + \vec{a}^{t}_{B/A}$$

Instanteous Centre - It is a imaginary point in plane about which the link will undergo pure rotation.

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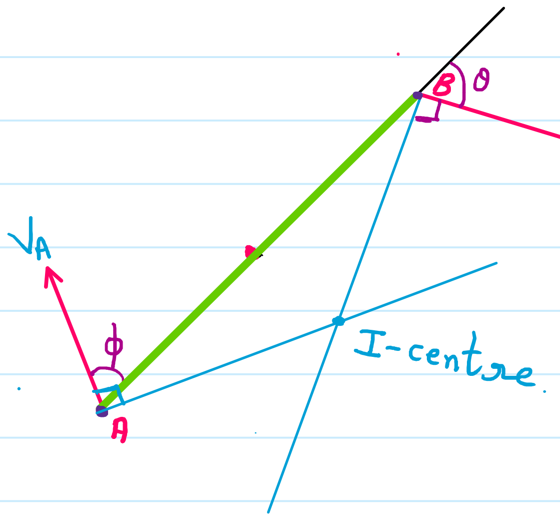
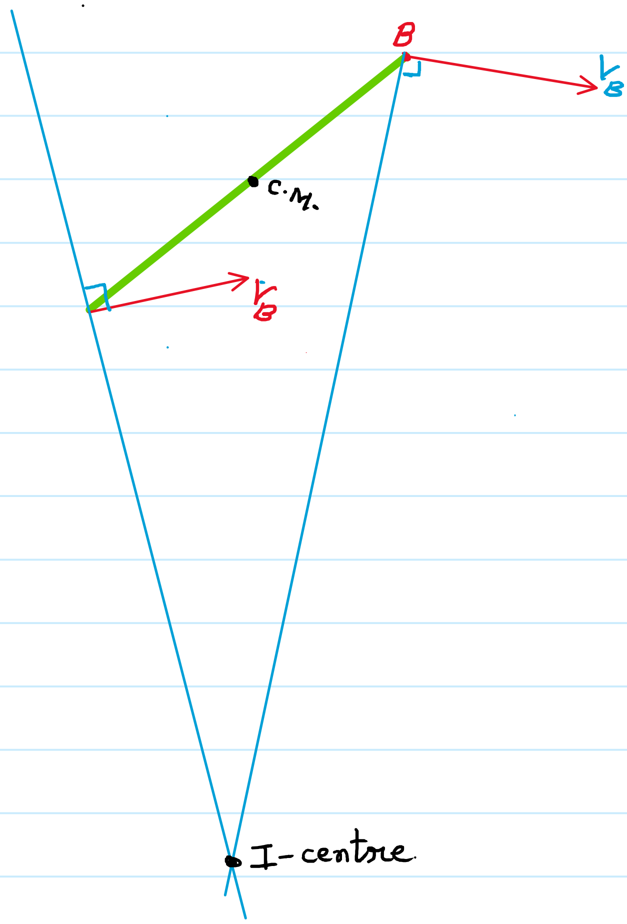
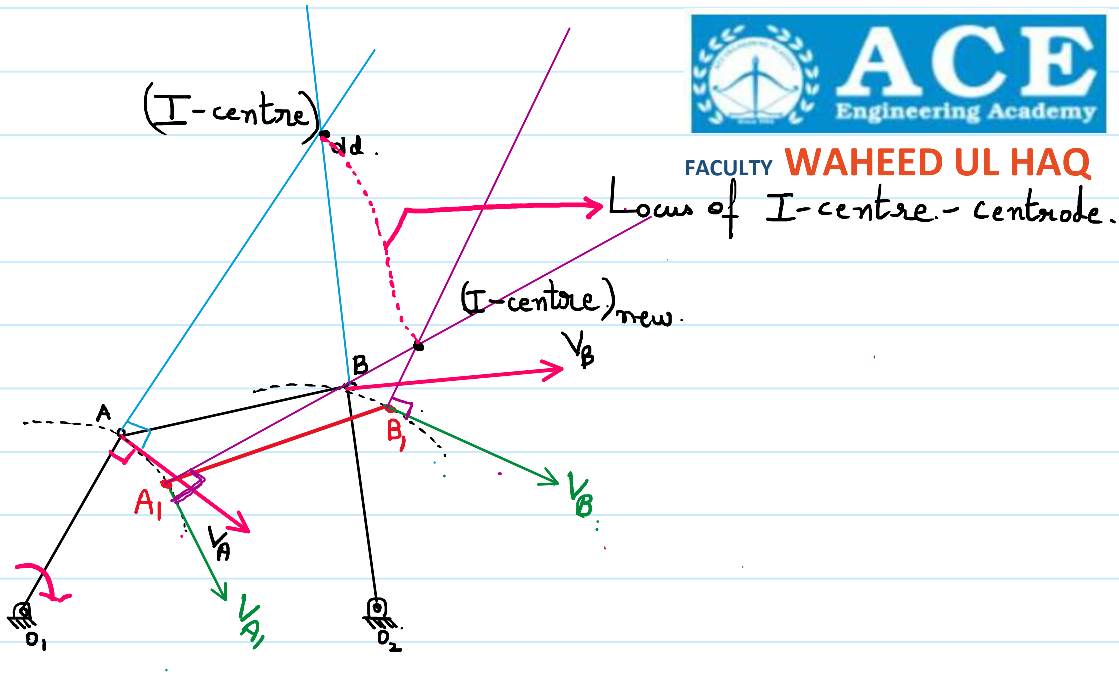


If a body is in general plane motion it will undergo pure Rotation about the I-center





Line passing through the I-center is called I-axis of Rotation.

Locus of I-axis of Rotation is called as axode(plane).

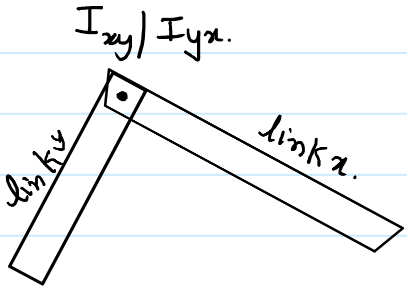
No. of I-centres is given by $^{n}C_2 = \frac{n(n-1)}{2}$

n – no. of links.

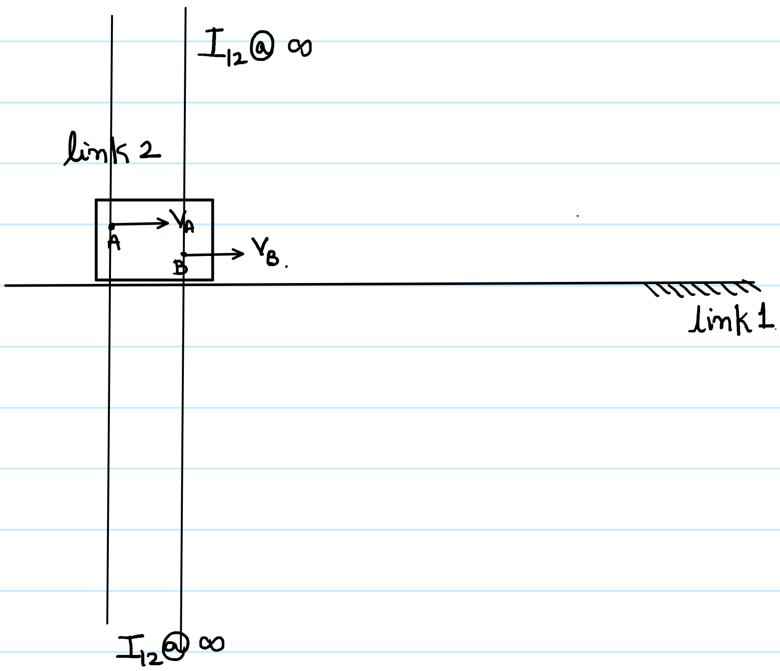
- If the body/link is in pure rotation the I -centre will lie on the physical boundary of the body/link.
- If the body/link is in translation the I -centre will lie at infinity in the plane of rotation.
- If the body/link is in General Plane Motion the I-centre will lie anywhere in the plane of rotation.

Some of the Common I-centres

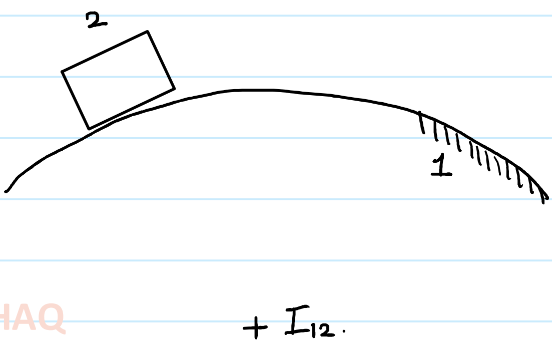
1. Revolute Joint.



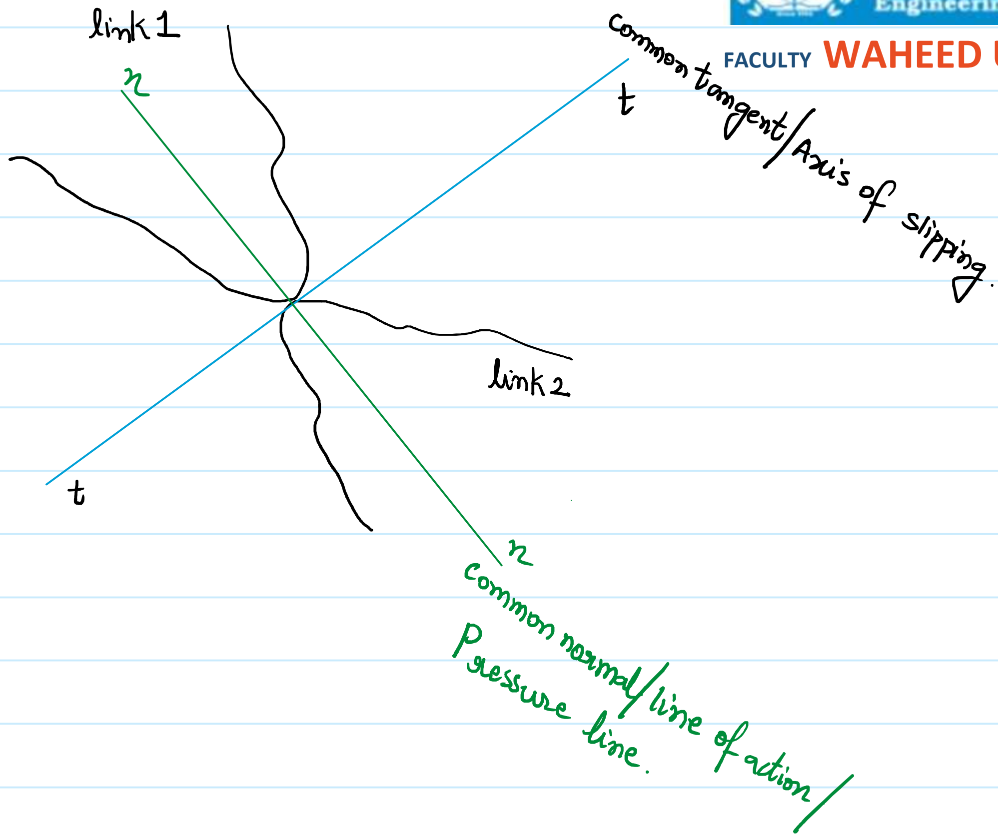
2. Prismatic Joint.



3. Curvilinear Motion - Centre of curvature becomes the I-centre.

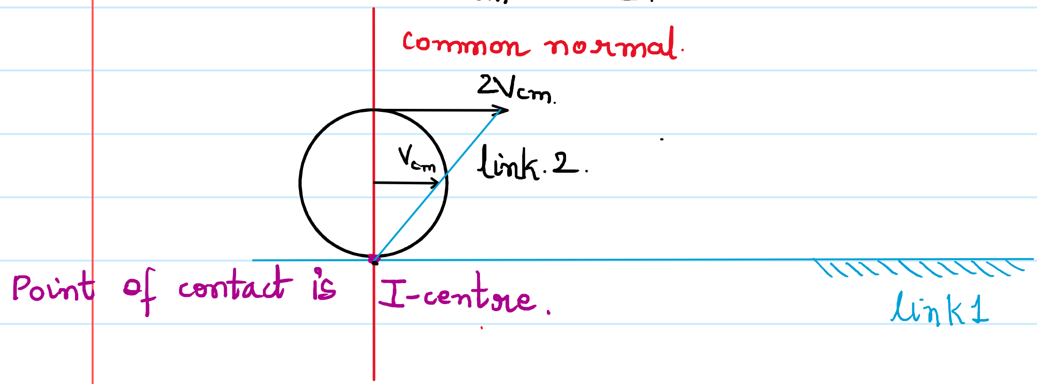


Higher Pair. – The I-centre lies somewhere on the common normal.



1. Pure Rolling Motion

$$S_{cm} = r \cdot \theta_z .$$



2. Pure Rotation