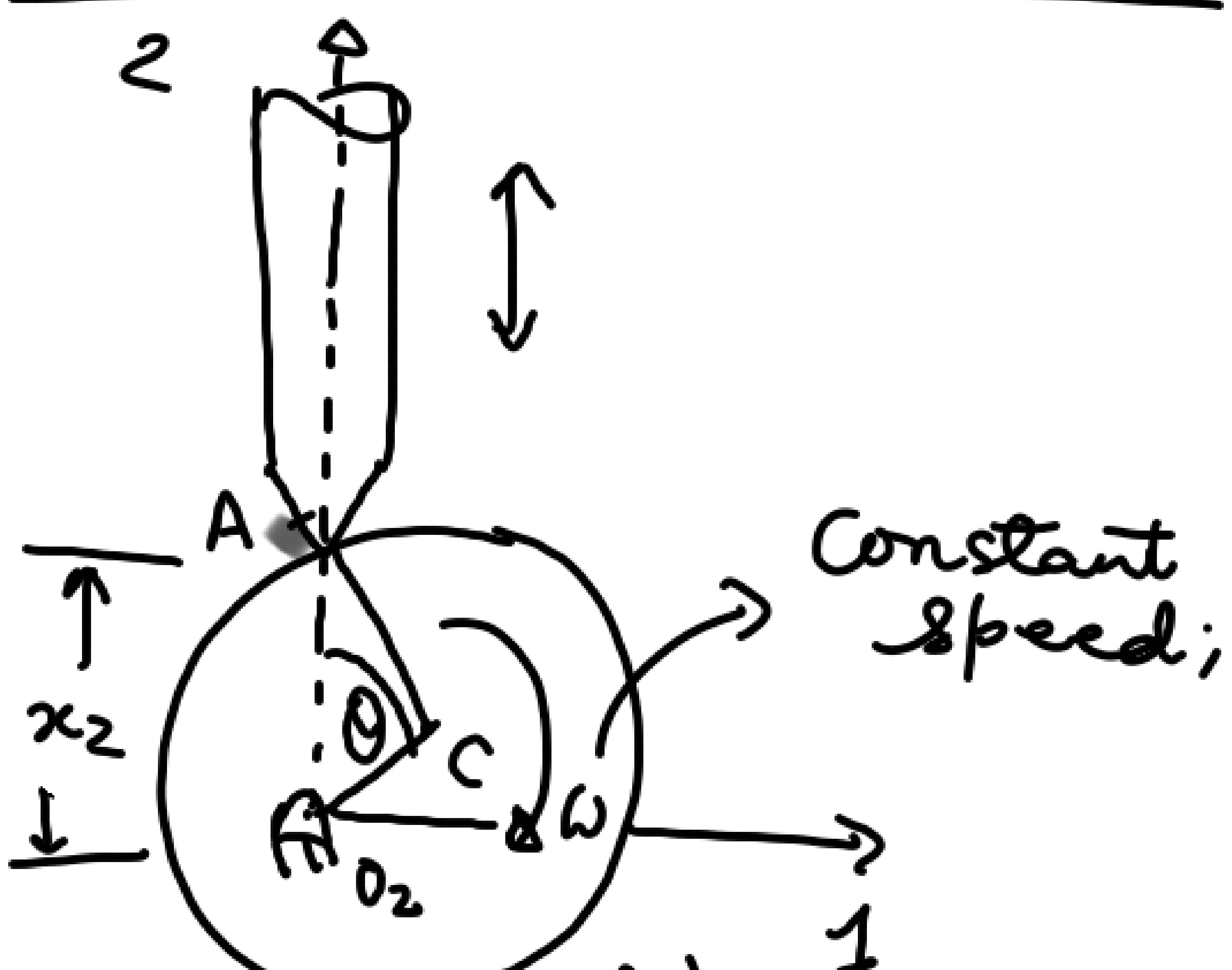
Circular disc and Knife edge follower;



$AC = a$

$O_2C = e$ (Eccentricity)

$$\cos\theta = \frac{x_2^2 + e^2 - a^2}{2x_2 e}$$

$$x_2^2 - (2e\cos\theta)x_2 + (e^2 - a^2) = 0$$

$$x_2 = \frac{\cancel{2}e\cos\theta \pm \sqrt{\cancel{4}e^2\cos^2\theta - \cancel{4}(e^2 - a^2)}}{\cancel{2}}$$

$$x_2 = e\cos\theta \pm \sqrt{a^2 - e^2\sin^2\theta}$$

We choose "+" root such that $\theta = 0^\circ$; $x_2 = a + e$ is the starting position.

$$V = \frac{dx_2}{dt}; \quad a = \frac{d^2x_2}{dt^2};$$

$$V = \frac{dx_2}{dt} = \frac{dx_2}{d\theta}\left(\frac{d\theta}{dt}\right) = \omega\frac{dx_2}{d\theta};$$

$$a = \frac{d^2x_2}{d\theta^2}\omega^2$$

$$V = \omega\frac{dx_2}{d\theta}$$

$$= \omega\left[-e\sin\theta + \frac{(-e^2\cancel{2}\sin\theta\cos\theta)}{\cancel{2}\sqrt{a^2 - e^2\sin^2\theta}}\right]$$

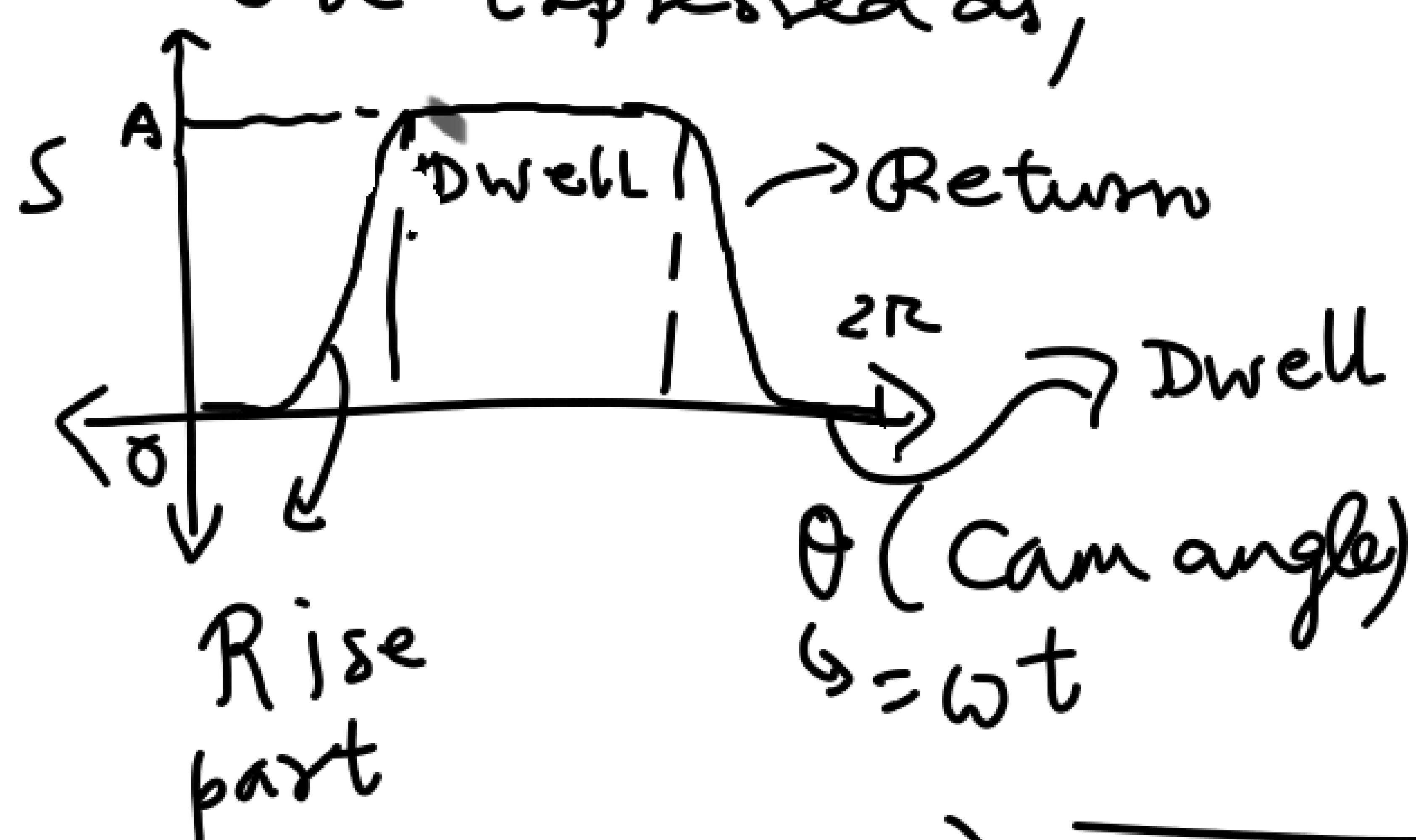
$$= -\omega e\sin\theta\left[1 + \frac{e\cos\theta}{\sqrt{a^2 - e^2\sin^2\theta}}\right]$$

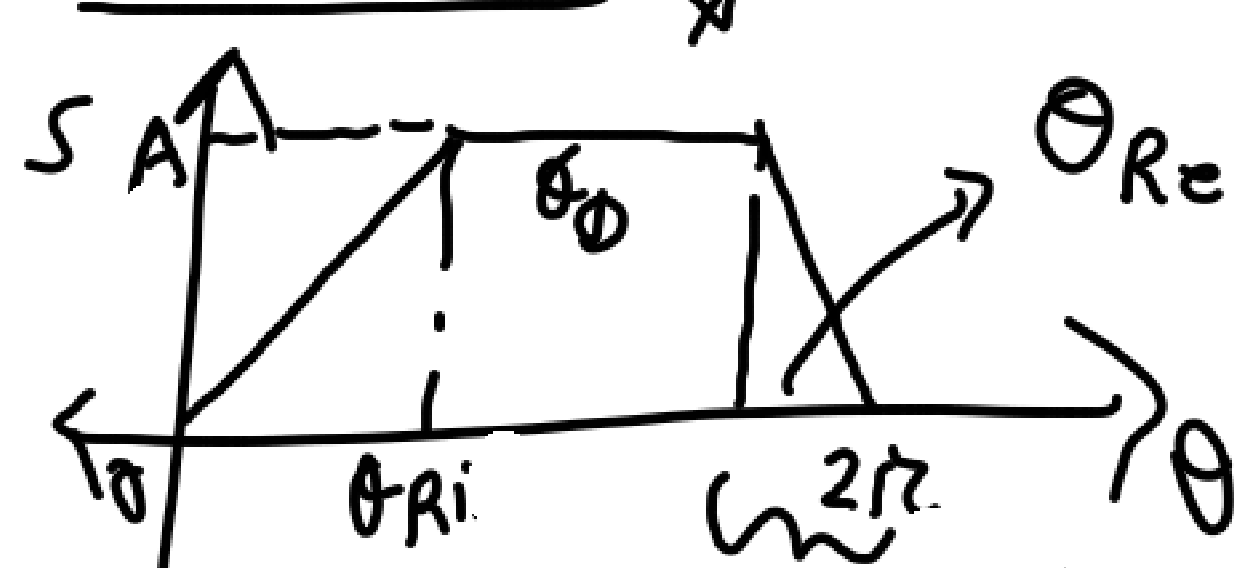
Similarly a can be computed.

In this example, no control on the resulting velocity and acceleration.

High values of v and a can lead to noise and vibration.

In the context of translating follower, usually the displacement (s) can be expressed as,





Rise

$$s = \left(\frac{\theta}{\theta_{Ri}}\right) A \qquad 0 \le \theta \le \theta_{Ri}$$

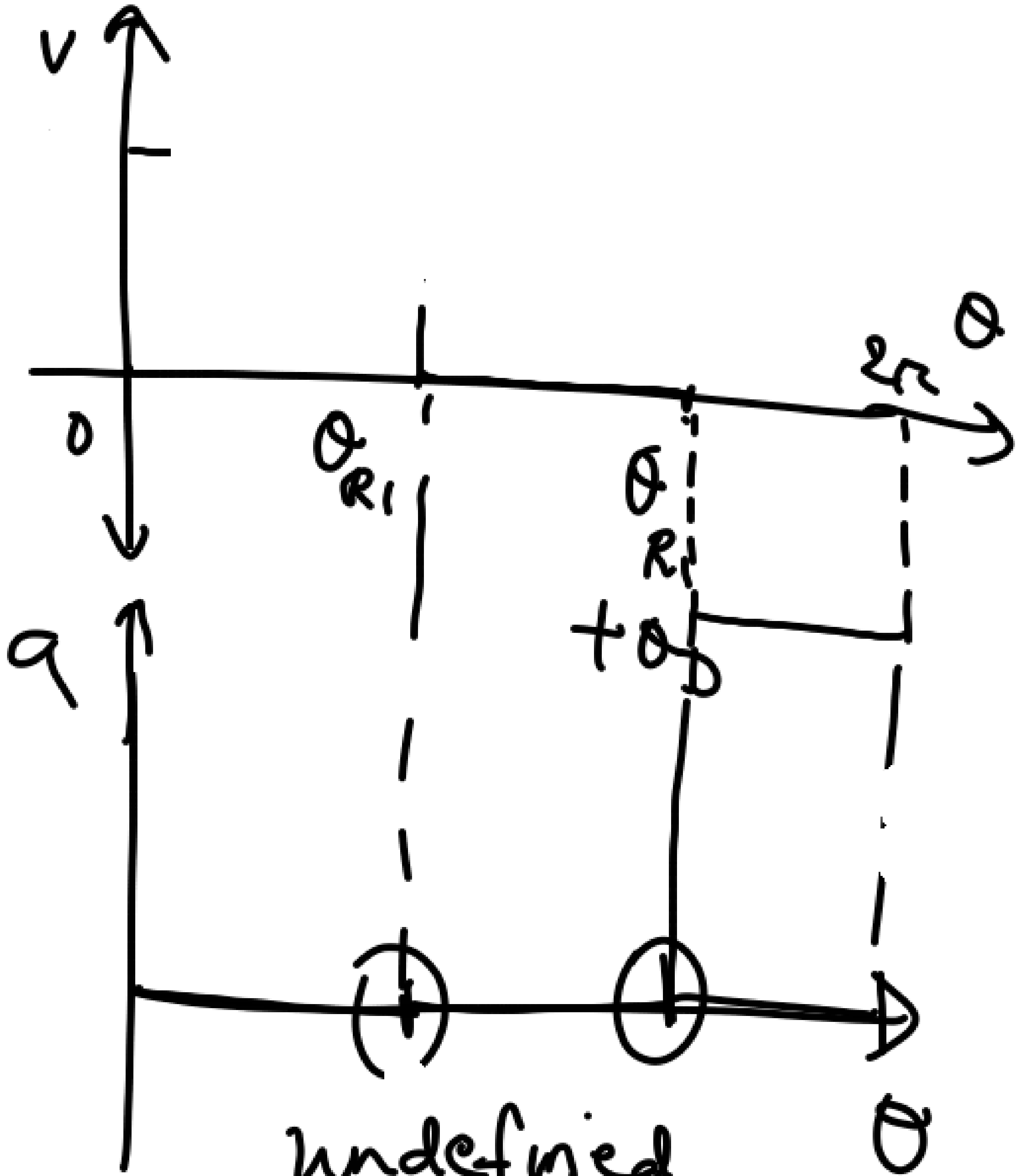
(Dwell)

$$= A \qquad \theta_{Ri} \le \theta \le \theta_{Ri} + \theta_D$$

$$= \alpha\theta + \beta \qquad \theta_{Ri} + \theta_D \le \theta \le 2\pi$$

Return

$$V_{Ri} = \frac{\omega A}{\theta_{Ri}}$$



undefined as velocity is not continuous

Options:

① Higher order polynomial

③ Trignometric functions.

Example: → (Engineering curve)

Cycloidal function

$$S = A\left[\frac{\theta}{\theta_{Ri}} - \frac{1}{2\pi}\sin\left(\frac{2\pi\theta}{\theta_{Ri}}\right)\right]$$

→ Rise part.

$$s(0) = 0\ ;\ s(\theta_{Ri}) = A$$

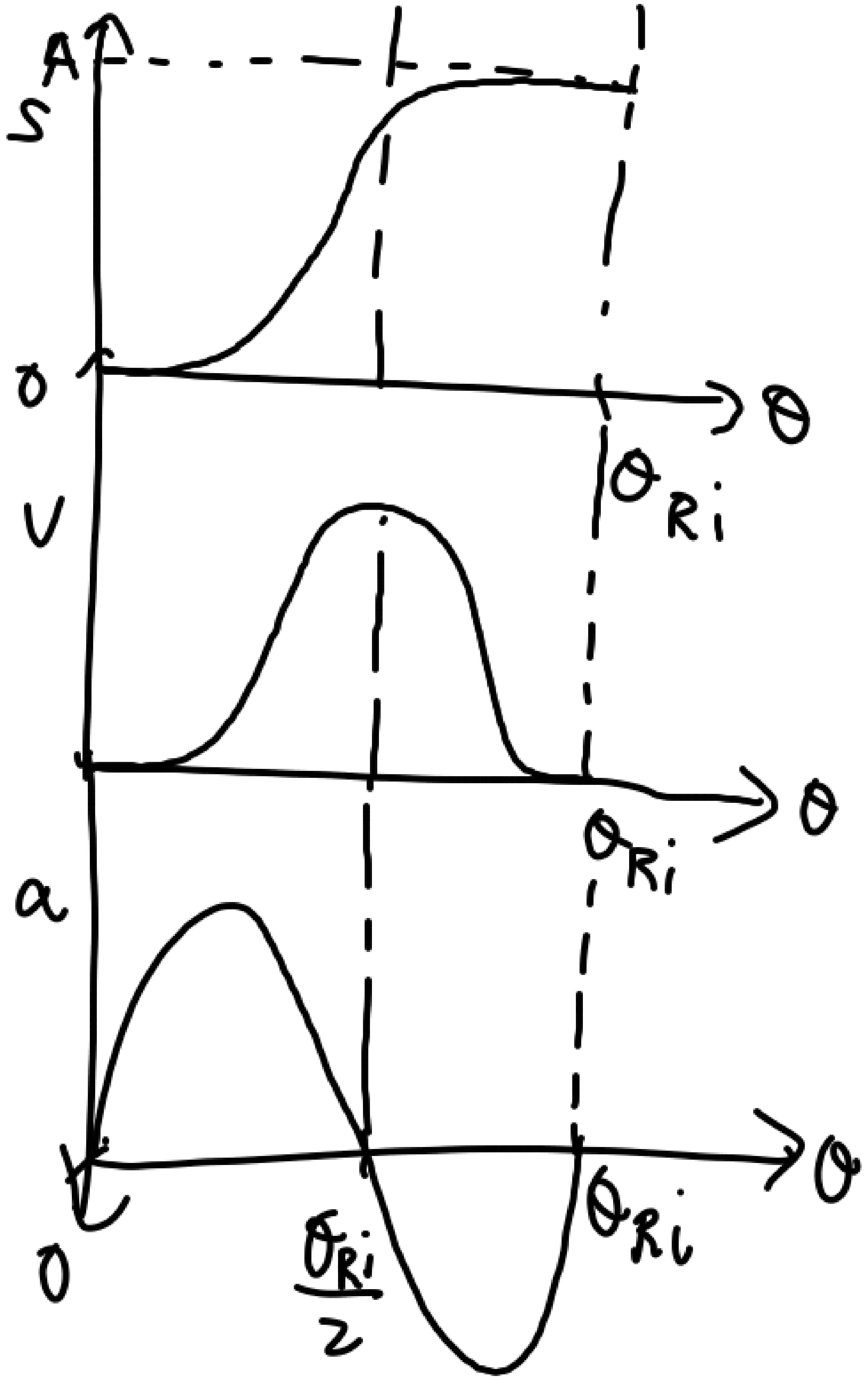
$$v = \frac{ds}{dt} = \frac{ds}{d\theta}\frac{d\theta}{dt} = \omega\frac{ds}{d\theta}$$

$$v = \omega A\left[\frac{1}{\theta_{Ri}} - \frac{1}{\cancel{2\pi}}\left(\frac{\cancel{2\pi}}{\theta_{Ri}}\right)\cos\left(\frac{2\pi\theta}{\theta_{Ri}}\right)\right]$$

$$\boxed{v = \frac{\omega A}{\theta_{Ri}}\left[1 - \cos\left(\frac{2\pi\theta}{\theta_{Ri}}\right)\right]}$$

$$a = \omega\frac{dv}{d\theta}$$

$$= \frac{\omega^2 A}{\theta_{Ri}}\left(\frac{2\pi}{\theta_{Ri}}\right)\sin\left(\frac{2\pi\theta}{\theta_{Ri}}\right)$$

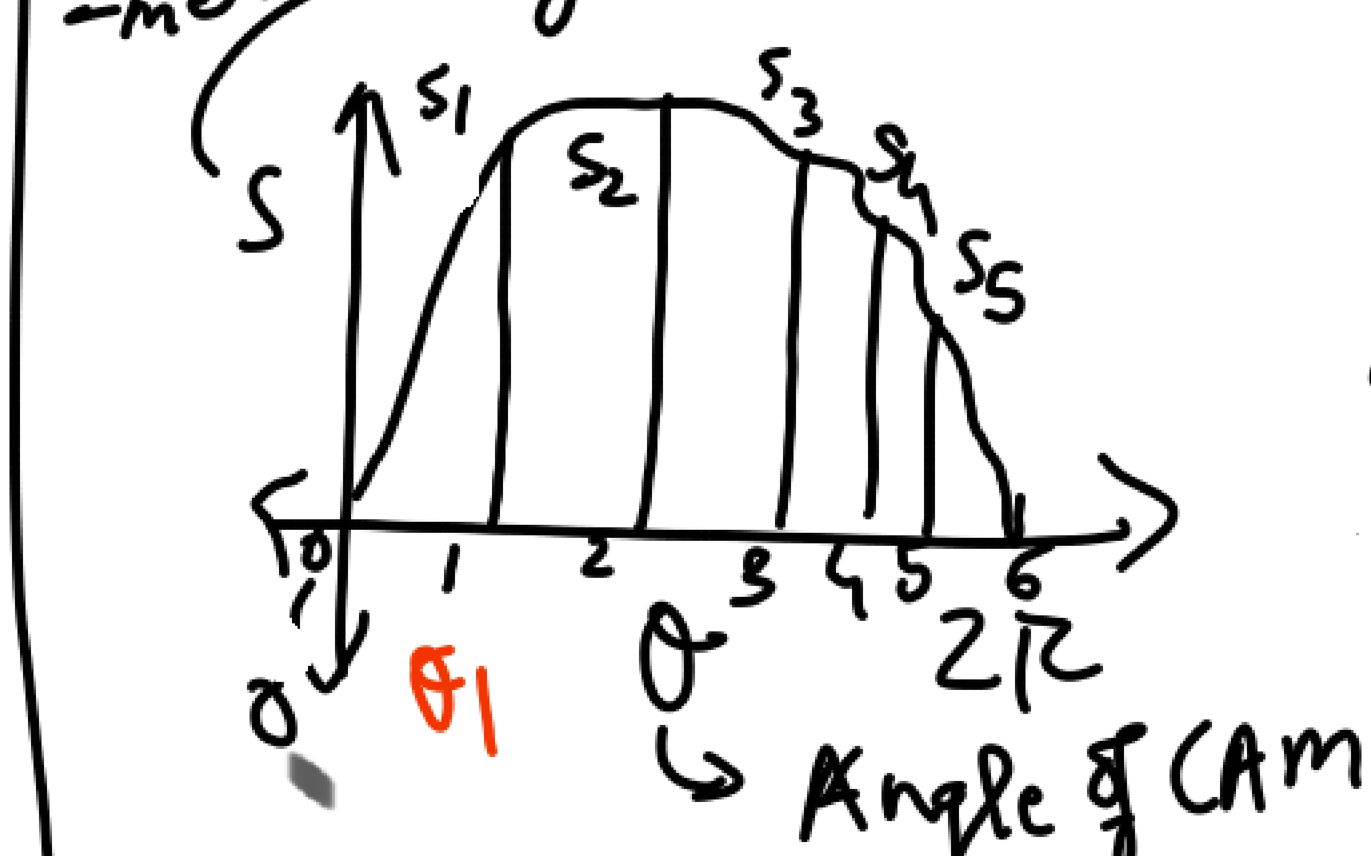


Cycloidal curve ensures zero velocity and zero acceleration at the start & end of Rise.

Given displacement profile, what is shape of the CAM profile?

CAM – synthesis.

① knife edge translating follower.

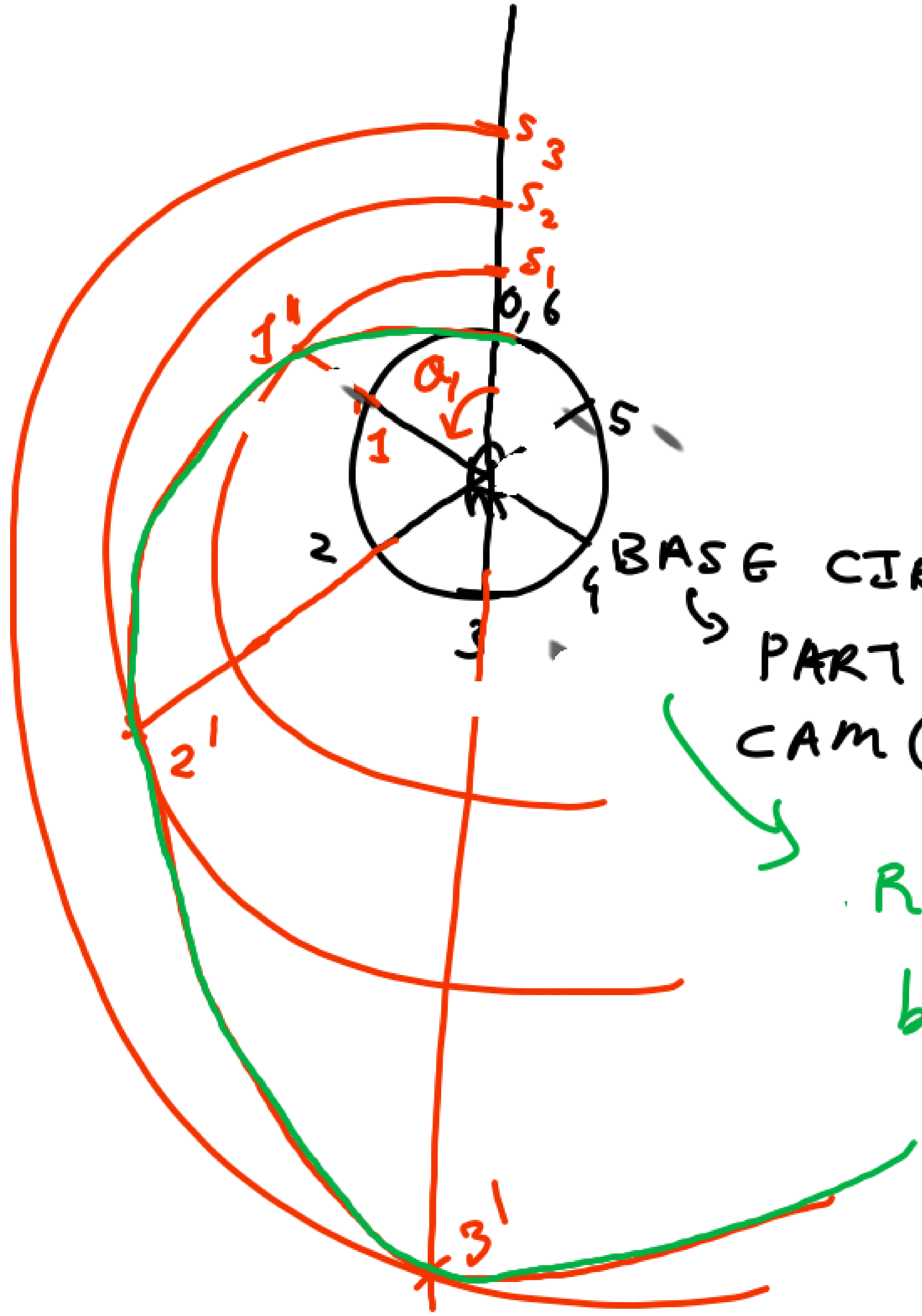


θ	S
0	0
θ_1	S_1
θ_2	S_2
θ_3	S_3
θ_4	S_4
θ_5	S_5
2π	0

Graphical approach;

Principle of inversion.

We will fix CAM and release the ground.



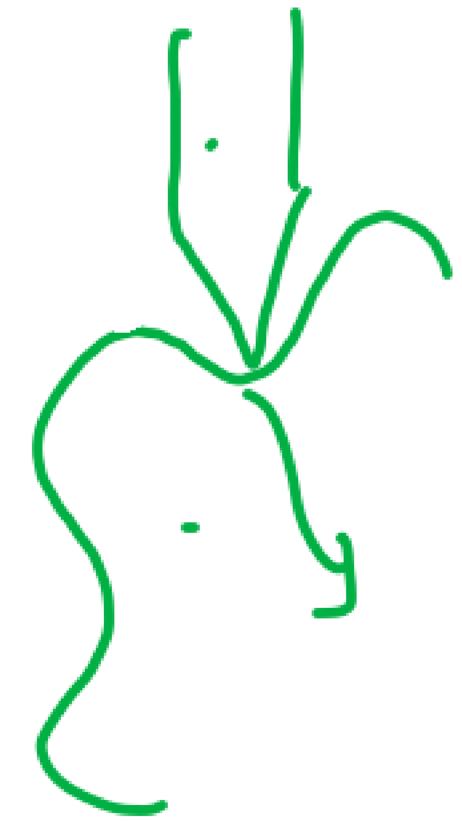
BASE CIRCLE
PART OF CAM (Fixed)

Radius of base circle is chosen by us.

Cam profile

$$= R_b + f(\theta)$$

$$= R_b\left[1 + \frac{f(\theta)}{R_b}\right]$$



CAM profile has to be convex shape