

Hourglass Animation

$$(x(t), y(t)) = (\cos 3t, \sin t), \quad 0 \leq t < 2\pi$$

Five-petals Animation

$$(x(t), y(t)) = (2 \cos t + \cos 6t, 2 \sin t + \sin 6t), 0 \leq t < 2\pi$$

Cycloid Animation

Circle radius a rolls along x axis

At time t , moved distance at to the right

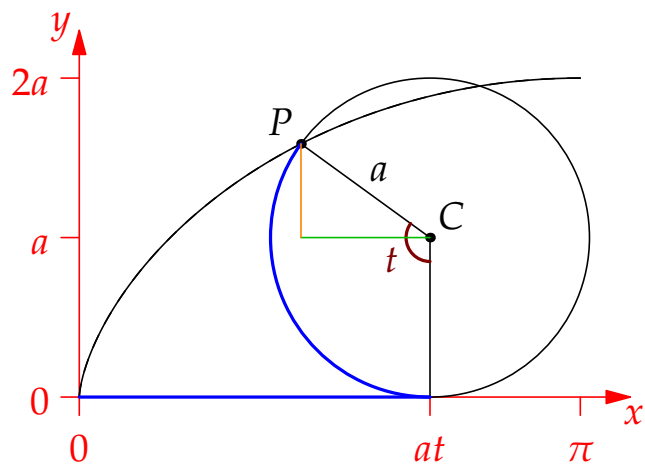
Center of circle $C = (at, a)$ at time t

Want co-ordinates of P

Arc-length equals horizontal distance at

Angle (in radians) equals t

Use right-triangle to get from C to P :



Subtract from $x = at$:

$$a \cos \left(t - \frac{\pi}{2} \right) = a \left(\cos t \cos \frac{\pi}{2} + \sin t \sin \frac{\pi}{2} \right) = a \sin t$$

Add to $y = a$:

$$a \sin \left(t - \frac{\pi}{2} \right) = a \left(\sin t \cos \frac{\pi}{2} - \cos t \sin \frac{\pi}{2} \right) = -a \cos t$$

Resulting parameterized curve

$$(x(t), y(t)) = (a(t - \sin t), a(1 - \cos t))$$

Cardioid Animation

$$r(\theta) = 2a(1 - \sin \theta), 0 \leq t < 2\pi$$

(θ labeled mainly in [degrees](#) for clarity)