Problem 9: Write parametric equations to describe the curve traced by the following motion: A particle tracing a circle with center $(0, 0)$ and radius 2, starting at $(2, 0)$ at time $t = 0$, moving clockwise with speed $\sqrt{t}$. (Source: AoPS Calculus)

We can figure out how much distance the particle travels in t seconds.

$$\begin{aligned} d &= \int_0^t s(t)\,dt \\ &= \int_0^t \sqrt{t}\,dt \\ &= \frac{2}{3}t^{3/2}\Big|_0^t \\ &= \frac{2}{3}t^{3/2} \end{aligned}$$

The particle travels $\frac{2}{3}t^{3/2}$ distance in t time.

Thus it makes $\frac{\frac{2}{3}t^{3/2}}{4\pi}$ revolutions in t time, and travels $\frac{\frac{2}{3}t^{3/2}}{4\pi} \cdot 2\pi = \frac{\frac{2}{3}t^{3/2}}{2} = \frac{1}{3}t^{3/2}$ radians in t time.

Using this, we can write down the parametric equations.

$$\begin{aligned} x(t) &= 2\cos\left(\frac{1}{3}t^{3/2}\right) \\ y(t) &= -2\sin\left(\frac{1}{3}t^{3/2}\right) \end{aligned}$$

This gives a parameterization of

$$\boxed{\left(2\cos\left(\frac{1}{3}t^{3/2}\right), -2\sin\left(\frac{1}{3}t^{3/2}\right)\right)}$$