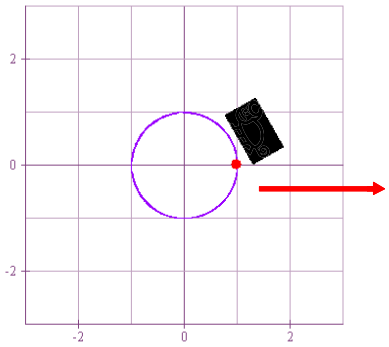
OTHER TRANSFORMATIONS

1. Aliens who live in the 2-dimensional world of Flatland have built a giant 2-dimensional wheel of radius 1 mile, and a coordinate system is set up so that the center of the wheel is situated at the origin. Furthermore, the wheel is slowly moving to the right at a rate of 1 mile per hour, and at the same time a bug, beginning at coordinates $(1,0)$ is walking the perimeter of the wheel counterclockwise at a rate of 1 mile per hour. Find a vector-valued function in the form $\vec{r}(t) = x(t)\hat{i} + y(t)\hat{j}$ that describes the bug's position after *t* hours, and find $\vec{r}'(t)$. Also, graph the bug's path over the interval $0 \le t \le 2\pi$, and find the values for *t* in that interval corresponding to when the bug reaches its highest elevation and when it reaches its lowest elevation, and find the bug's speed at each of those points. (NOTE: The wheel moves to the right, but does not rotate.)



2. Repeat problem 1, but this time assume that the bug is standing still on the wheel, and the wheel is rotating <u>clockwise</u> at a rate of 1 radian per hour.

3. Repeat problem 2, but this time assume that the center of the circle is at $(0,1)$ and the bug is initially at $(1,1)$

For each item below, find the vector-valued function $\vec{r}(t,\theta) = x(t,\theta)\hat{i} + y(t,\theta)\hat{j} + z(t,\theta)\hat{k}$ with $0 \le t \le 3$ and $0 \le \theta \le 2\pi$ that yields a rotation of the square root function about the given axis

4. the *x*-axis

5. the *y*-axis

6. the line $y = x$ in the *xy*-plane