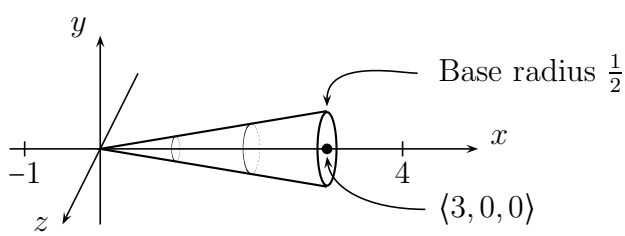
Math 155A - Spring 2022 - Quiz #4 - April 12

Name: Answer Key

PID:

1. A cone $\mathcal{C}$ has height 1 and its base has radius 1. The cone is positioned upright, centered around the y-axis. The apex (the top point) of the cone $\mathcal{C}$ is at $\langle 0, 1, 0\rangle$; the base of the cone is lying in the xz-plane; and the center of the base is at the origin.

A transformation f maps the cone $\mathcal{C}$ to have the following shape, centered on the x-axis with the apex of the cone at the origin, now with height equal 3 and base radius equal to $\frac{1}{2}$:



Express the transformation f as a composition of a translation $T_{\mathbf{u}}$, a rotation $R_{\theta,\mathbf{v}}$, and a non-uniform scaling $S_{\langle a,b,c\rangle}$. (The composition may not necessarily be in that order!) Use the usual "$\circ$" notation to denote composition. There are many possible correct answers.

Most common answer: $T_{\langle 3,0,0\rangle} \circ R_{\pi/2, \langle 0,0,1\rangle} \circ S_{\langle \frac{1}{2}, 3, \frac{1}{2}\rangle}$

Other equally good, correct answers:

$T_{\langle 3,0,0\rangle} \circ S_{\langle 3, \frac{1}{2}, \frac{1}{2}\rangle} \circ R_{\pi/2, \langle 0,0,1\rangle}$

$S_{\langle 3, \frac{1}{2}, \frac{1}{2}\rangle} \circ R_{\pi/2, \langle 0,0,1\rangle} \circ T_{\langle 0,-1,0\rangle}$

$S_{\langle 3, \frac{1}{2}, \frac{1}{2}\rangle} \circ T_{\langle 1,0,0\rangle} \circ R_{\pi/2, \langle 0,0,1\rangle}$

$R_{\pi/2, \langle 0,0,1\rangle} \circ S_{\langle \frac{1}{2}, 3, \frac{1}{2}\rangle} \circ T_{\langle 0,-1,0\rangle}$

$R_{\pi/2, \langle 0,0,1\rangle} \circ T_{\langle 0,-3,0\rangle} \circ S_{\langle \frac{1}{2}, 3, \frac{1}{2}\rangle}$.

Another correct answer:

$T_{\langle 3,0,0\rangle} \circ R_{\pi, \langle 1,-1,0\rangle} \circ S_{\langle \frac{1}{2}, 3, \frac{1}{2}\rangle}$

Many other correct answers are possible.