A long pole is positioned vertically in a swimming pool. The length of the pole above the water is $2\sqrt{3}$ m, the length below the water is $\sqrt{55}$ m. Sunlight is incident at 60 degrees above the horizon. What is the length of the shadow of the pole on the level bottom of the pool? (index of refraction for water is $\frac{1}{3}$)

\[ \tan 60^\circ = \frac{2\sqrt{3}}{x_1} \]

\[ x_1 = \frac{2\sqrt{3}}{\tan 60^\circ} = 2 \]

\[ N_1 \sin 30^\circ = N_2 \sin \theta_2 \]

\[ \sin \theta_2 = \frac{N_1}{N_2} \sin 30^\circ = \frac{\frac{1}{3}}{\frac{1}{3}} (\frac{1}{2}) = \frac{3}{8} \]

\[ \theta_2 = 22.024^\circ \]

\[ \tan \theta_2 = \frac{x_2}{\sqrt{55}} \]

\[ x_2 = \sqrt{55} \tan (22.024^\circ) = 3 \text{ m}. \]

Shadow 5 m