1. A 6 foot tall man is walking uphill away from a 15 foot tall light pole. (As depicted, hopefully, at right.) If the length of his shadow is changing at 1.2 ft/s, how fast is he walking?

\[ \frac{15}{x+y} = \frac{6}{y} \]

\[ 15y = 6x + 6y \]

\[ 9y = 6x \]

\[ y' = 6x' \]

\[ q(1.2) = 6x' \]

\[ x' = \frac{q(1.2)}{6} = 1.8 \text{ ft/s} \]
2. Same hill, same pole, same man, same speed. If the hill slopes up at 15°, how fast is the angle α changing when the shadow is 7 feet long?

\[ \frac{\sin \alpha}{y} = \frac{\sin \beta}{6} \Rightarrow 6 \sin \alpha = y \sin \beta \]

\[ 6 \sin \alpha \cdot \alpha' = y' \sin \beta + y \cos \beta \cdot \beta' \]

4. (i) \[ \sqrt{6^2 + 7^2 - 2 \cdot 6 \cdot 7 \cos 75^\circ} \approx 7.954 \]

(ii) \[ \frac{\sin \alpha}{7} = \frac{\sin 75^\circ}{7.954} \Rightarrow \sin \alpha \approx 0.8501 \Rightarrow \alpha \approx 58.22^\circ \]

(iii) \[ \beta = 180 - \alpha - 75 \Rightarrow \beta \approx 46.78^\circ \]

Also \[ \beta' = 180 - \alpha' \]

(iv) \[ 6 \cos 58.22^\circ \alpha' = (1.2)(0.8501) + 7 \cos 46.78^\circ (-\alpha') \]

\[ 3.160 \alpha' = 1.020 - 4.794 \alpha' \]

\[ 7.954 \alpha' = 1.020 \]

\[ \alpha' = 0.13 \text{ radians/second} \]
3. The trough at right is filling with water at a rate of $10 \text{ ft}^3/\text{min}$. How fast is the water level rising when the water is 1 foot deep?

Water Volume $V$ is also changing.

\[ V = \left( \frac{1}{2}xy + \frac{1}{2}xy + 2y \right) y = 4xy + 8y \]

\[ \frac{x}{y} = \frac{0.5}{1.5} = \frac{1}{3} \Rightarrow 3x = y \Rightarrow x = \frac{y}{3} \]

\[ V = 4\left(\frac{y}{3}\right)y + 8y = \frac{4}{3}y^2 + 8y \]

\[ V' = \frac{8}{3}yy' + 8y' \]

\[ 10 = \frac{8}{3} (1) y' + 8y' \]

\[ 30 = 8y' + 24y' \]

\[ 30 = 32y' \]

\[ y' = \frac{30}{32} \text{ feet/min} \]