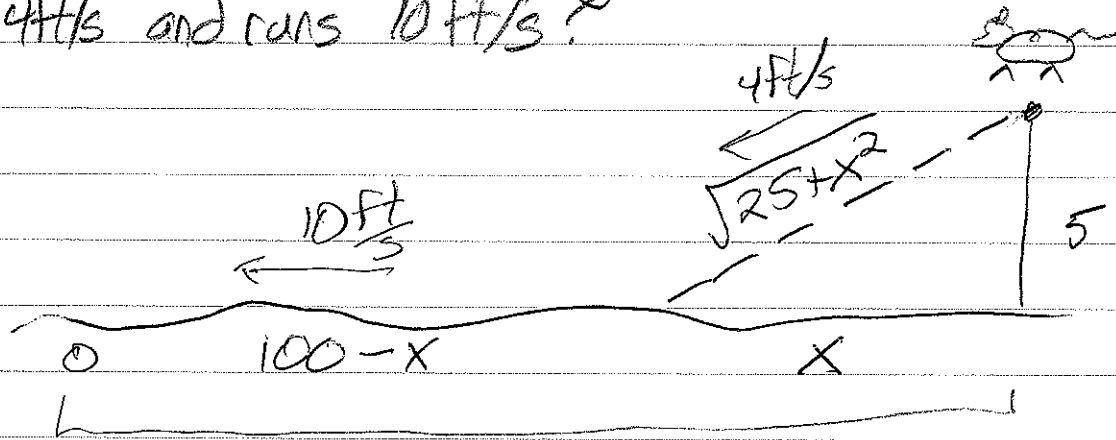


3:20 ish

Ex: Prof. Pennings and his dog Elvis are at the beach. Elvis is 5 feet out in the water when a ball is thrown 100 ft away on the shoreline. What is the fastest Elvis can get the ball if he swims 4ft/s and runs 10ft/s?



$$\text{Time} = \frac{\text{dist}}{\text{speed}} \quad T(x) = \frac{\sqrt{25+x^2}}{4} + \frac{100-x}{10}$$

$$\begin{aligned} \frac{\partial T}{\partial x}(x) &= \frac{1}{4} \left( \frac{1}{2} (25+x^2)^{-\frac{1}{2}} \cdot 2x \right) - \frac{1}{10} \\ &= \frac{x}{4\sqrt{25+x^2}} - \frac{1}{10} \quad \xrightarrow{\text{Set } 0} \text{ to optimize} \end{aligned}$$

$$\frac{x}{4\sqrt{25+x^2}} = \frac{1}{10}$$

$$(10x)^2 = (4\sqrt{25+x^2})^2$$

$$100x^2 = 400 + 16x^2$$

$$84x^2 = 400$$

$$x^2 = 400/84$$

$$x = \sqrt{\frac{100}{21}}$$

Here we are constrained to  $[0, 100]$ .

$$T(0) = \frac{5}{4} + 10 = 11.25s$$

$$T\left(\sqrt{\frac{100}{21}}\right) \approx 11.15s$$

$$T(100) = \frac{\sqrt{10,025}}{4} \approx 25.03s$$