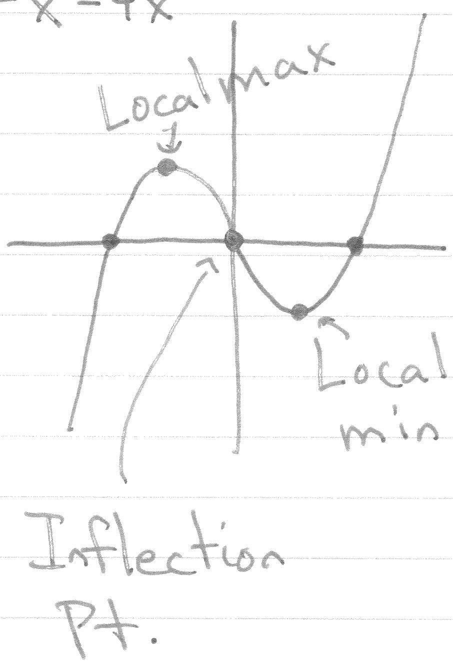
Today: • Calculating these for particular functions

• An application (optimization)

Ex: $f(x) = x^3 + ax$ for a some number

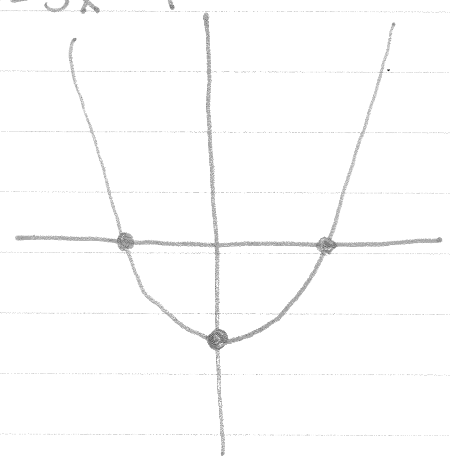
$f(x)$ Ex. $a = -4$.

$y = x^3 - 4x$



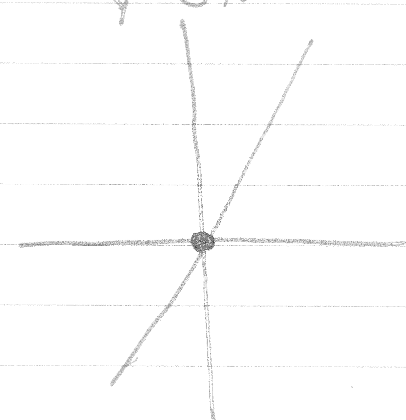
$f'(x)$

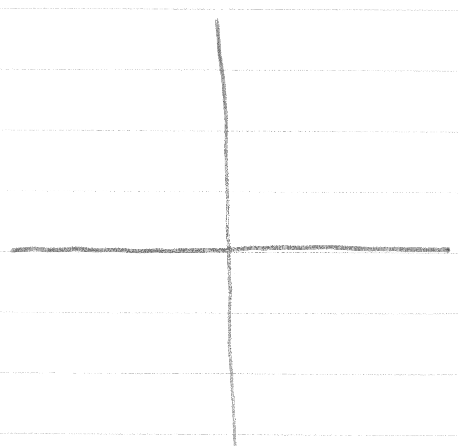
$y = 3x^2 - 4$

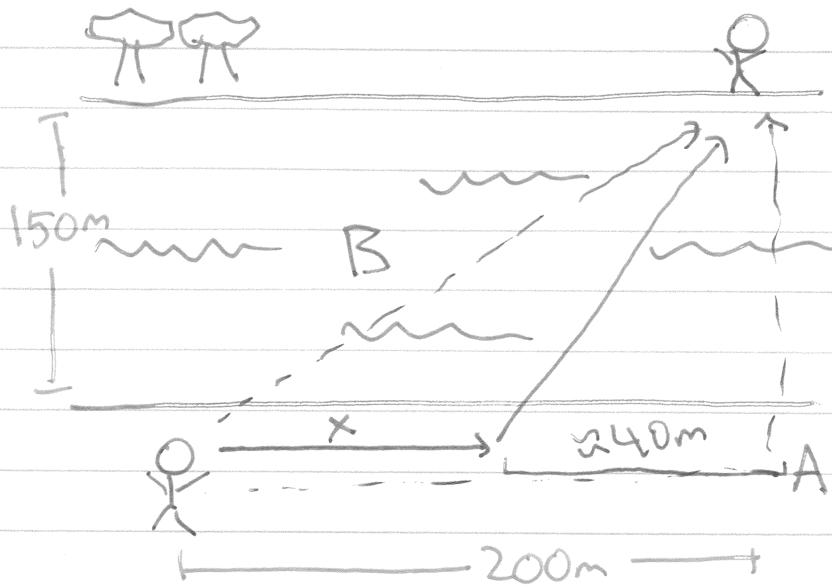


$f''(x)$

$y = 6x$







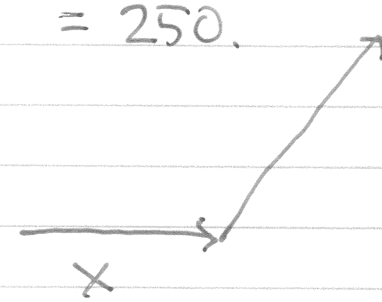
Speed Swimming : 1 m/s

Speed Running : 4 m/s

$$\text{Time}(A) = \frac{200}{4} + 150$$
$$= 50 + 150$$
$$= 200$$

$$\text{Time}(B) = \sqrt{200^2 + 150^2}$$
$$= 250.$$

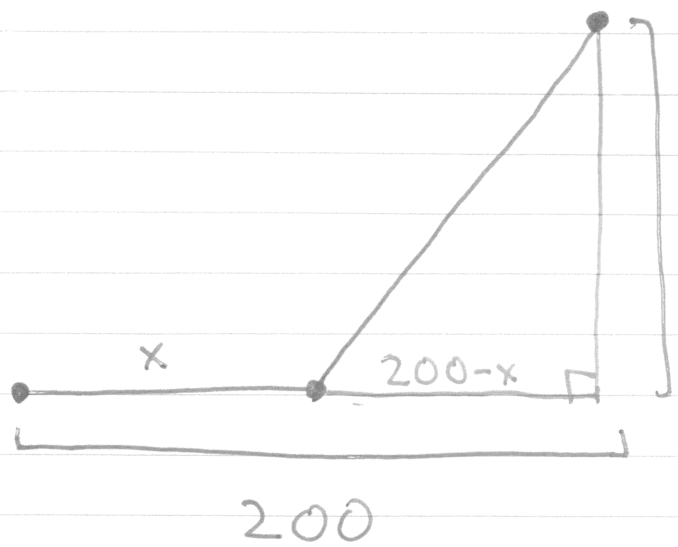
Q: How to find the route taking minimal time?



Approach:
- Write a function $f(x)$ which equals the amount of time required by the path
- Find a minimum val of $f(x)$ (taking the derivative, ...)

Contined from: Page 3 $200 - x = 10\sqrt{15}$.

$$\boxed{x = 200 - 10\sqrt{15}}$$



$$f(x) = \underset{\text{Running}}{\text{Time}} + \underset{\text{Swimming}}{\text{Time}}$$

$$= \frac{x}{4} + \sqrt{(200-x)^2 + 150^2}$$

$$f'(x) = \frac{1}{4} + \frac{1}{\cancel{2}\sqrt{(200-x)^2+150^2}} \cdot \left(\cancel{2}(200-x)(-1)\right)$$

$$= \frac{1}{4} - \frac{200-x}{\sqrt{(200-x)^2+150^2}} \rightsquigarrow 4(200-x) = \sqrt{(200-x)^2 + 150^2}$$

$$\rightsquigarrow 16(200-x)^2 = (200-x)^2 + 150^2$$

$$\rightsquigarrow 15(200-x)^2 = 22500 \rightsquigarrow (200-x)^2 = 1500$$