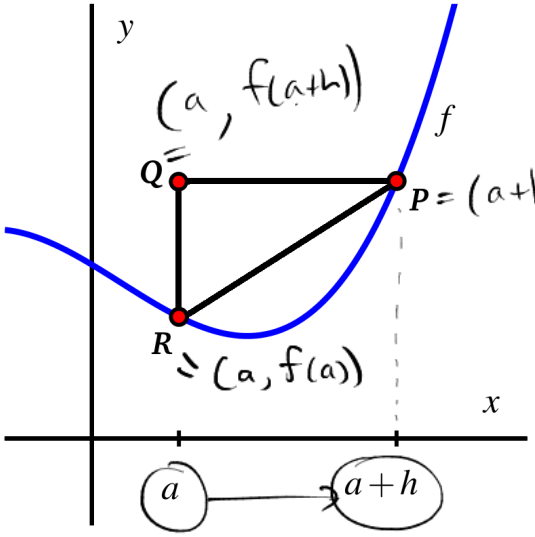


$\overline{QP} = h$

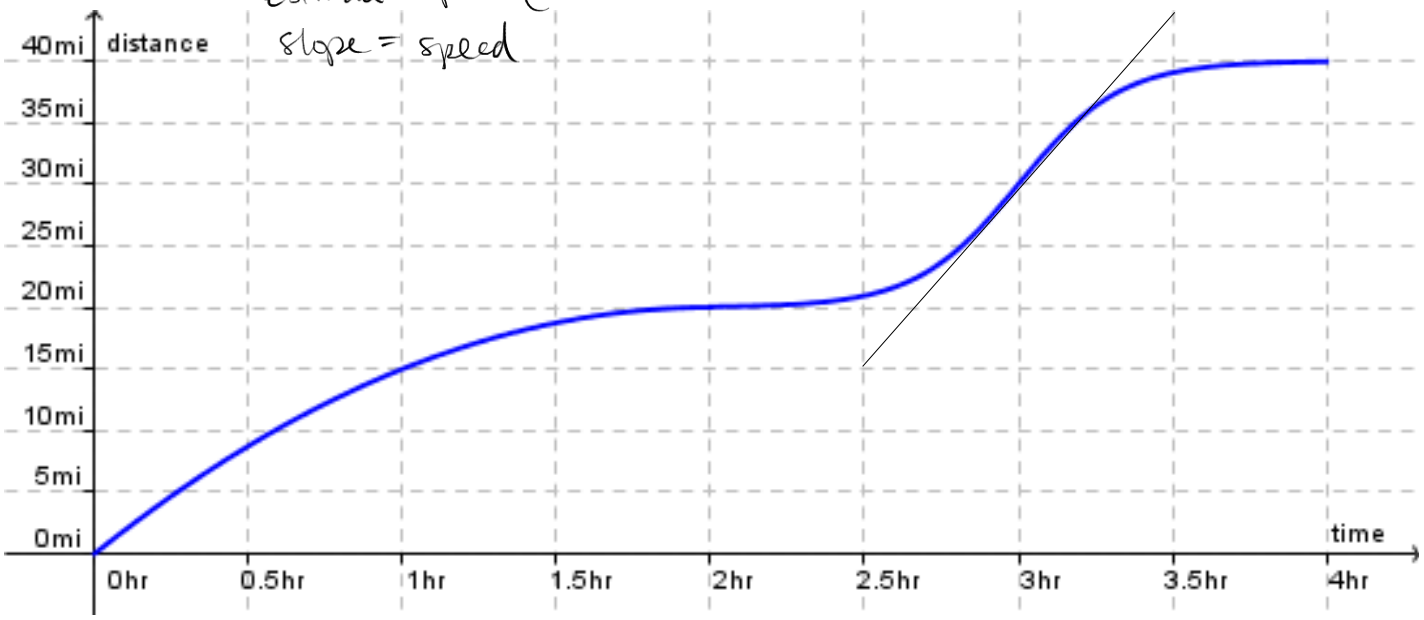
$\overline{QR} = f(a+h) - f(a)$

slope of PR is $\frac{\text{rise}}{\text{run}}$

$= \frac{f(a+h) - f(a)}{h}$

Estimate speed @ $t = 3$.

slope = speed



$(\ln x)' = 1/x$

$(\tan x)' = \sec^2 x$

$(\sin x)' = \cos x$

$(\cos x)' = -\sin x$

$(e^x)' = e^x$

$(\sec x)' = \left(\frac{1}{\cos x}\right)' = \left(\frac{Hi}{Ho}\right)' = \frac{Ho\,dHi - Hi\,dHo}{Ho\,Ho} = \frac{\cos x \cdot 0 - 1\cdot(-\sin x)}{\cos^2 x}$

$= \frac{\sin x}{\cos^2 x}$

$= \frac{\sin x}{\cos x} \cdot \frac{1}{\cos x}$

$= \tan x \cdot \sec x$

$(f \cdot g)' = f \cdot g' + f' \cdot g$

11

Differentiation - Product Rule

Find $f'(x)$.

1. $f(x) = x^2 \sin x$ (f, g)

$f'(x) = x^2 \cdot \cos x + 2x \cdot \sin x$

2. $f(x) = x^3 \cos x$

$f'(x) = x^3 \cdot (-\sin x) + 3x^2 \cos x$

$= -x^3(\sin x) + 3x^2 \cos x$

3. $f(x) = x \tan x$

$f'(x) = x \cdot \sec^2 x + 1 \cdot \tan x = x \cdot \sec^2 x + \tan x$

4. $f(x) = x^4 \sec x$

$f'(x) = x^4 \cdot \sec x \tan x + 4x^3 \cdot \sec x$

5. $f(x) = x^5 e^x = x^5 \cdot e^x + 5x^4 \cdot e^x$

6. $f(x) = \sqrt{x}\, e^x = x^{1/2} e^x$

$f'(x) = x^{1/2} e^x + \frac{1}{2} x^{-1/2} e^x = \sqrt{x}\, e^x + \frac{e^x}{2\sqrt{x}}$

$= e^x \left(\sqrt{x} + \frac{1}{2\sqrt{x}} \right)$

7. $f(x) = x \ln x$

$f'(x) = x \cdot \frac{1}{x} + 1 \cdot \ln x = 1 + \ln(x)$

8. $f(x) = \left(\frac{\ln x}{x}\right) = \frac{1}{x} \ln x$ $\qquad \frac{x \cdot \left(\frac{1}{x}\right) - \ln(x) \cdot 1}{x^2} = \frac{1 - \ln(x)}{x^2}$

$x^{-3} \to -3x^{-4}$

9. $f(x) = \frac{e^x}{x^3} = \frac{1}{x^3} e^x$

$f'(x) = \frac{1}{x^3} e^x - 3x^{-4} e^x = e^x \left(\frac{1}{x^3} - \frac{3}{x^4} \right)$

product rule

10. $f(x) = e^x \sin x$

$f'(x) = e^x \cdot \cos x + e^x \sin x = e^x (\cos x + \sin x)$