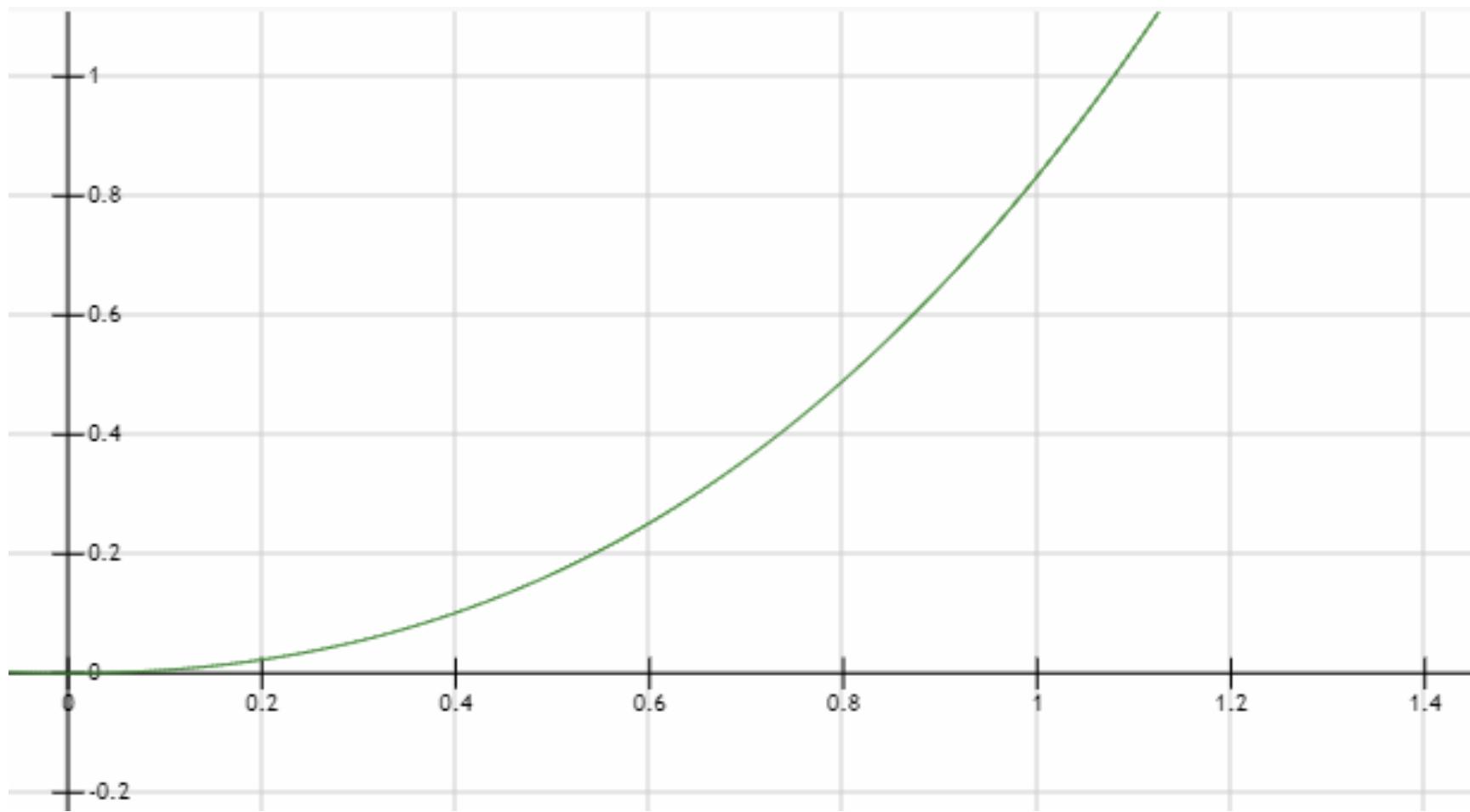


Derivative

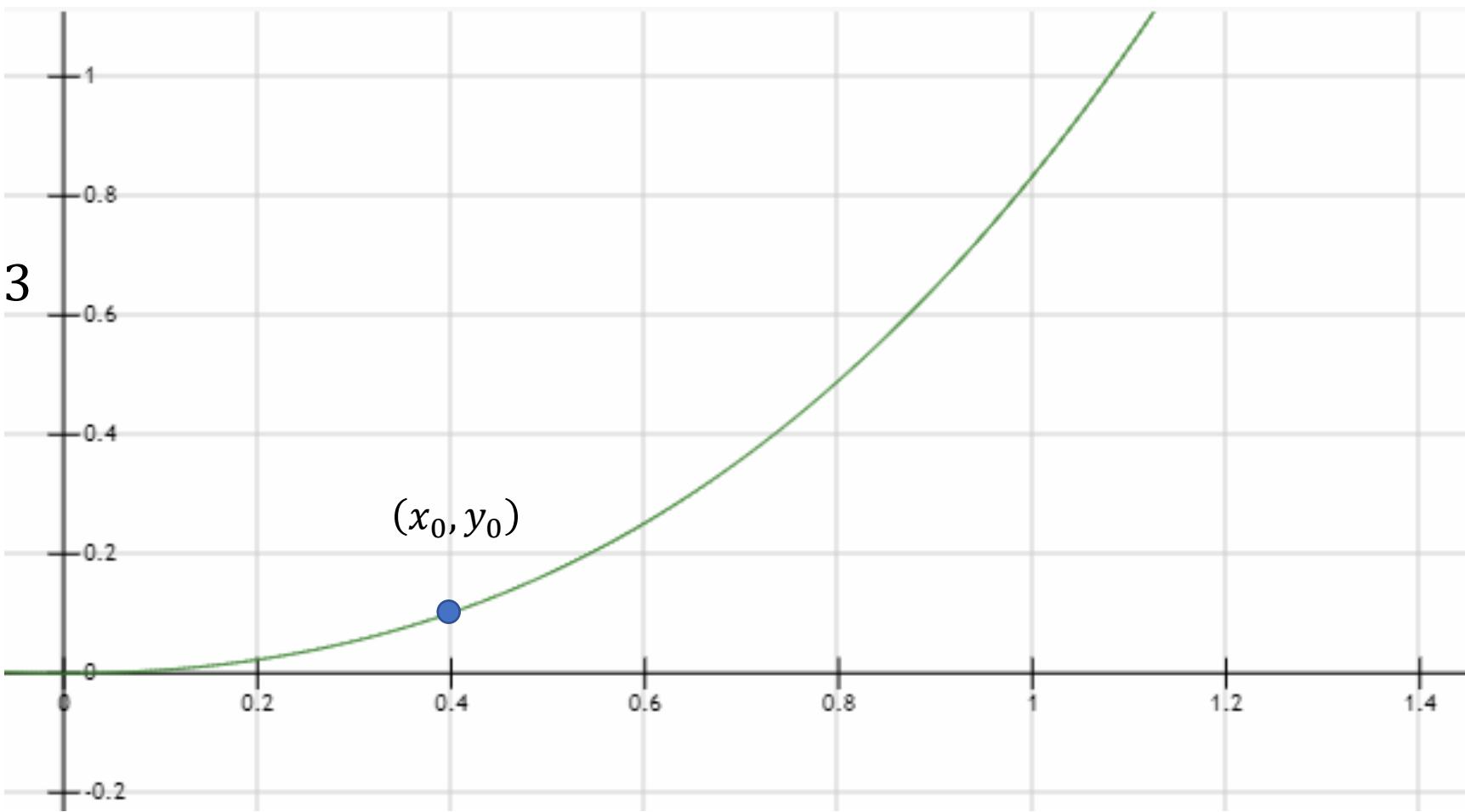
$$y = \frac{x^3}{3} + \frac{x^2}{2}$$



Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2}$$

$$x_0 = 0.4; y_0 = 0.101333$$

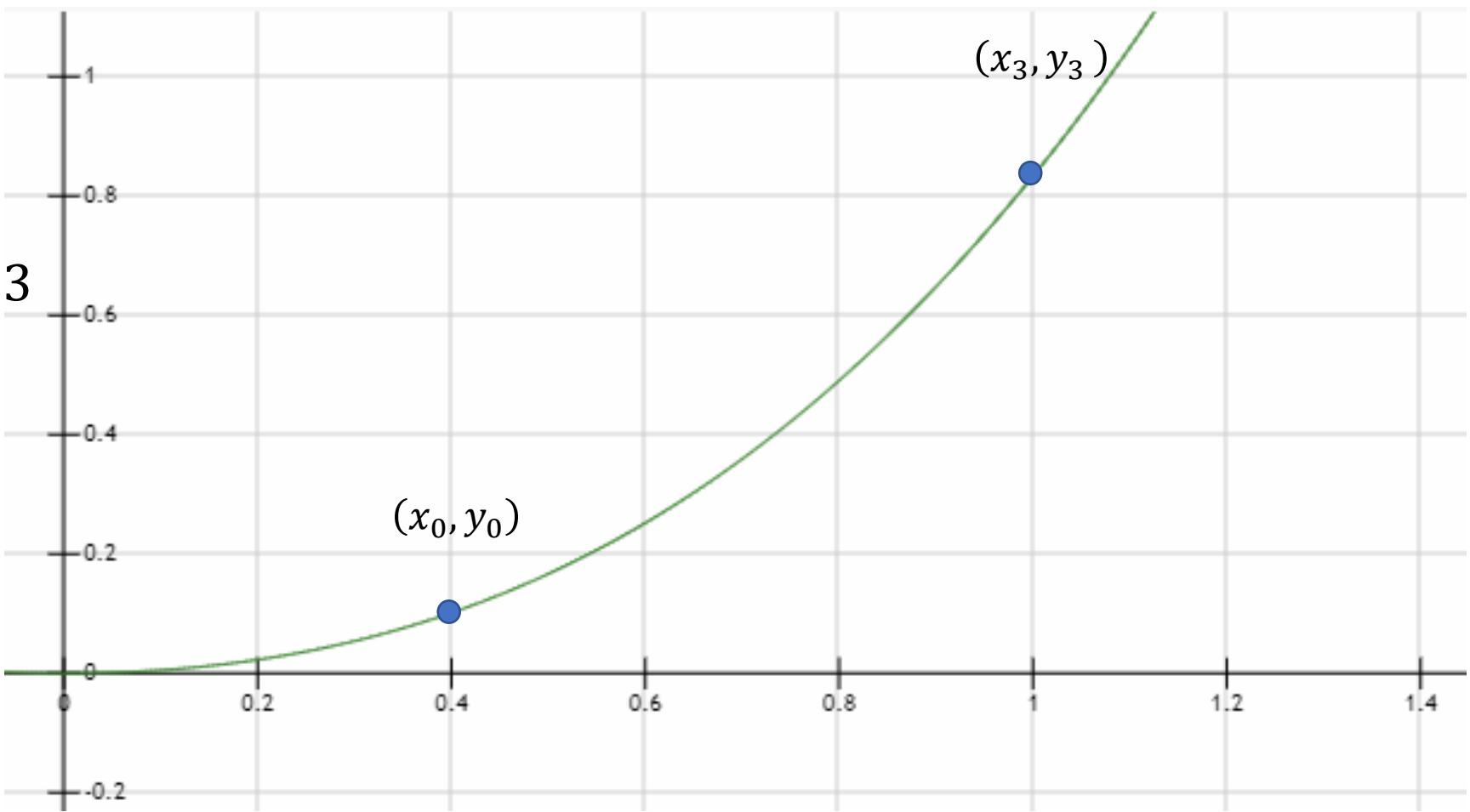


Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2}$$

$$x_0 = 0.4; y_0 = 0.101333$$

$$x_3 = 1; y_3 = \frac{5}{6}$$

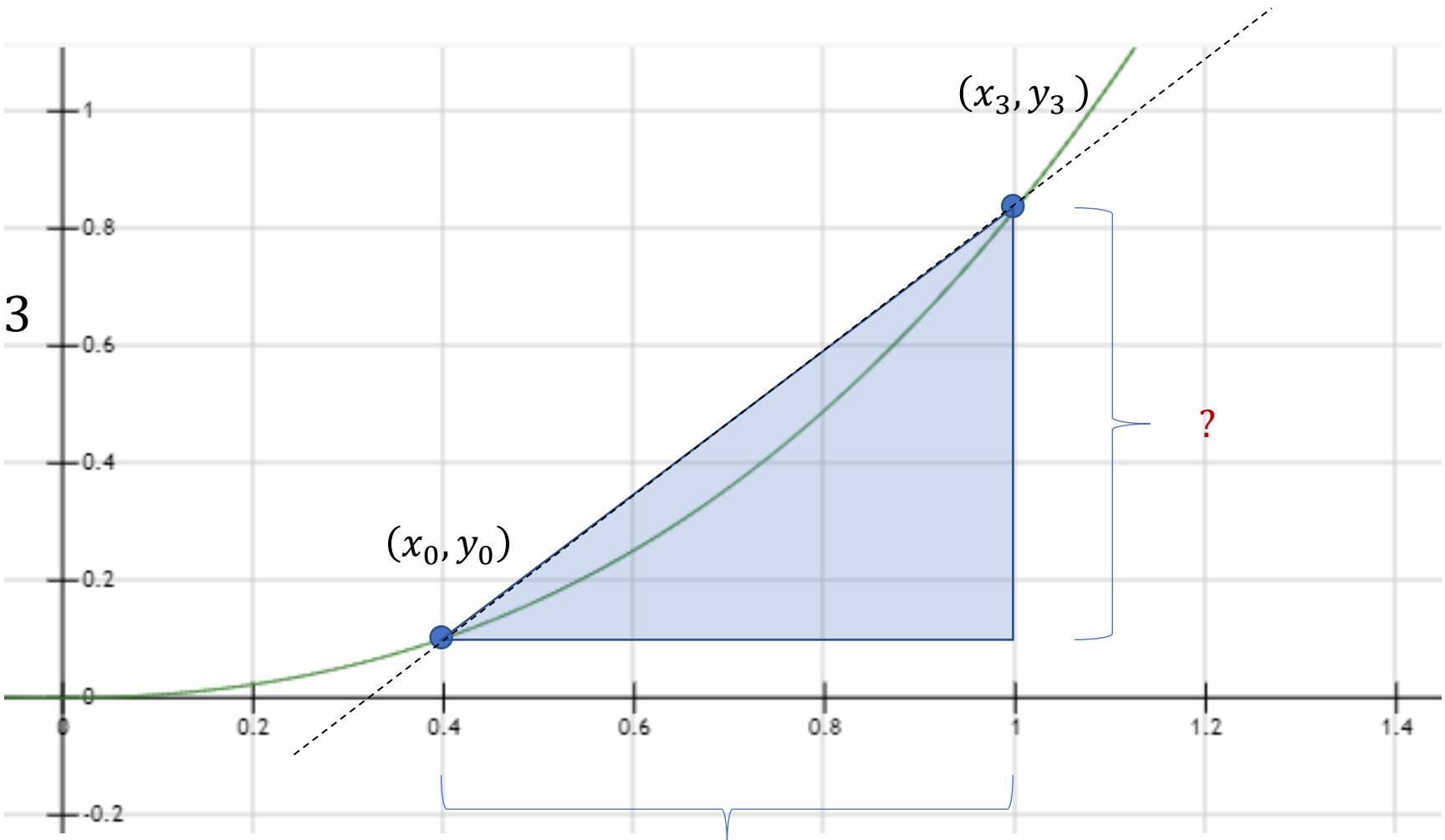


Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2}$$

$$x_0 = 0.4; y_0 = 0.101333$$

$$x_3 = 1; y_3 = \frac{5}{6}$$



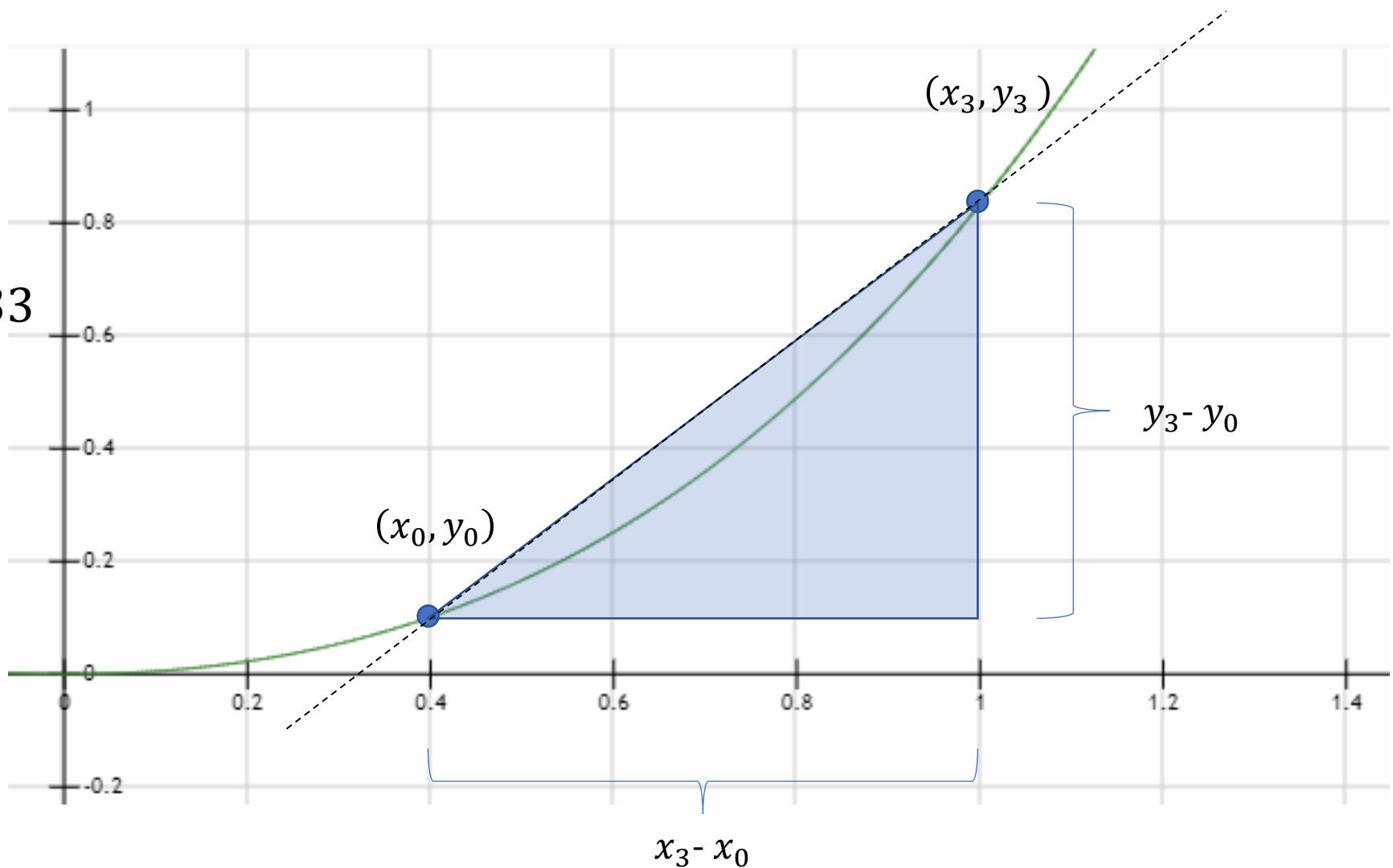
?

Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2}$$

$$x_0 = 0.4; y_0 = 0.101333$$

$$x_3 = 1; y_3 = \frac{5}{6}$$

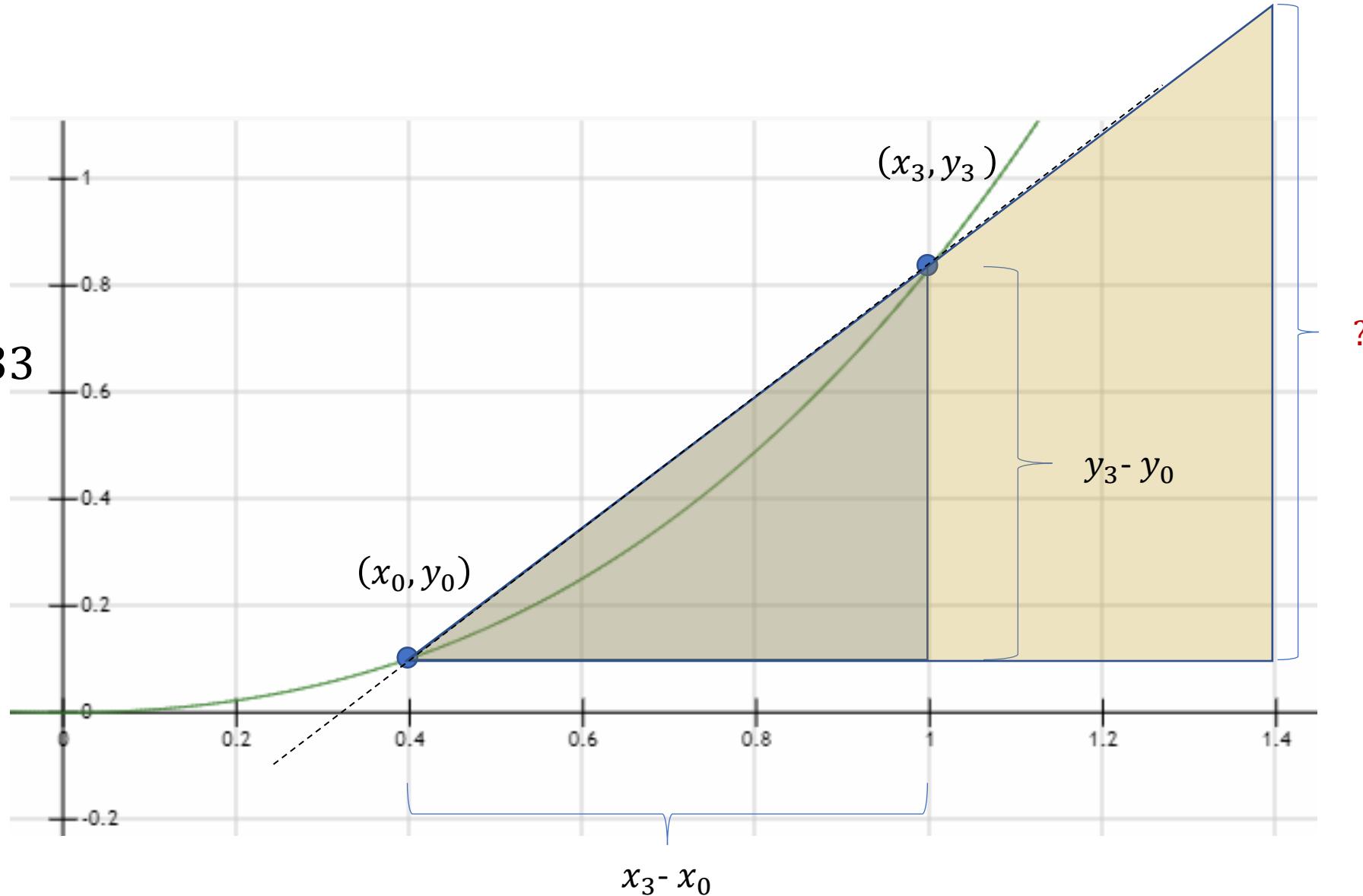


Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2}$$

$$x_0 = 0.4; y_0 = 0.101333$$

$$x_3 = 1; y_3 = \frac{5}{6}$$

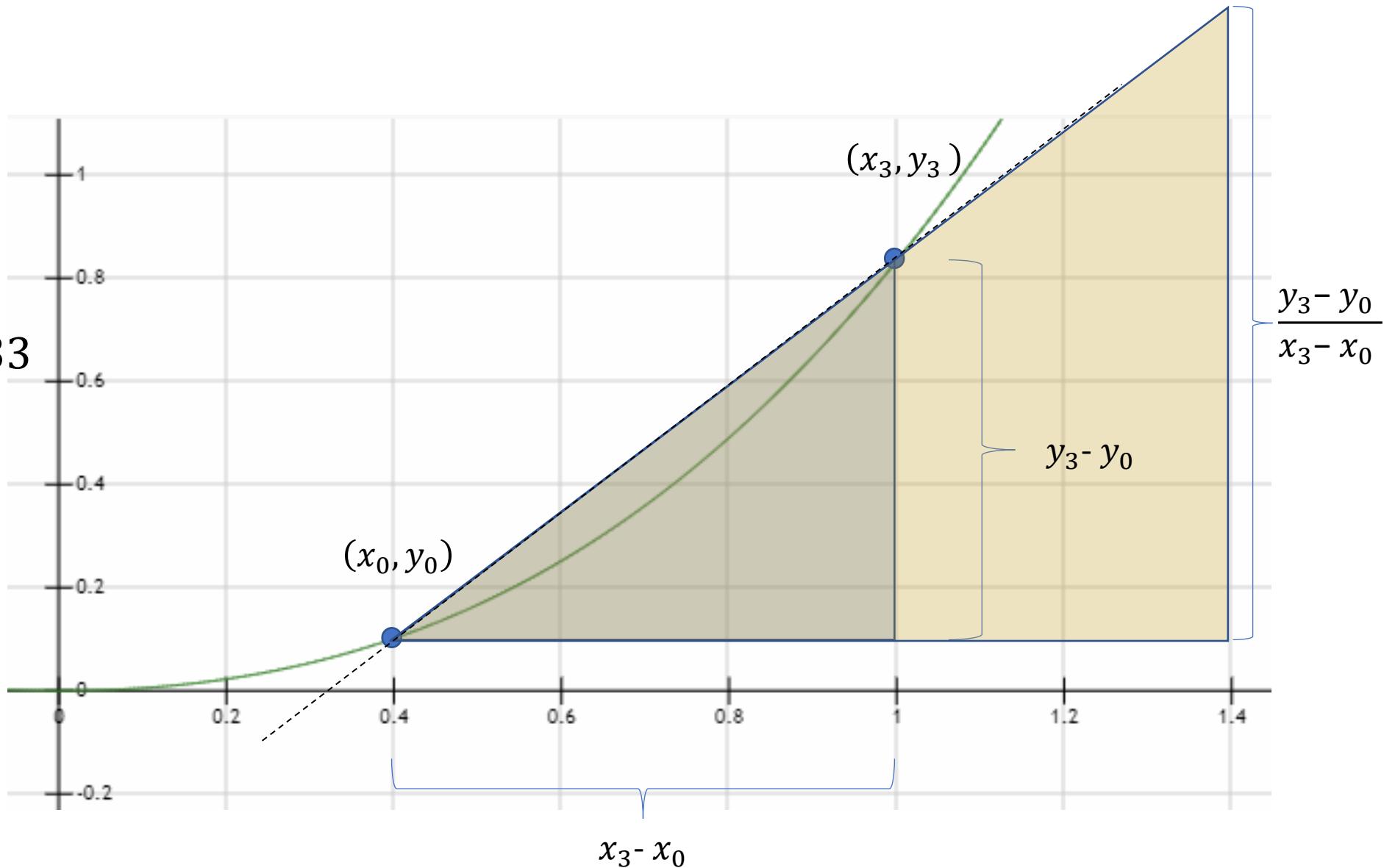


Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2}$$

$$x_0 = 0.4; y_0 = 0.101333$$

$$x_3 = 1; y_3 = \frac{5}{6}$$

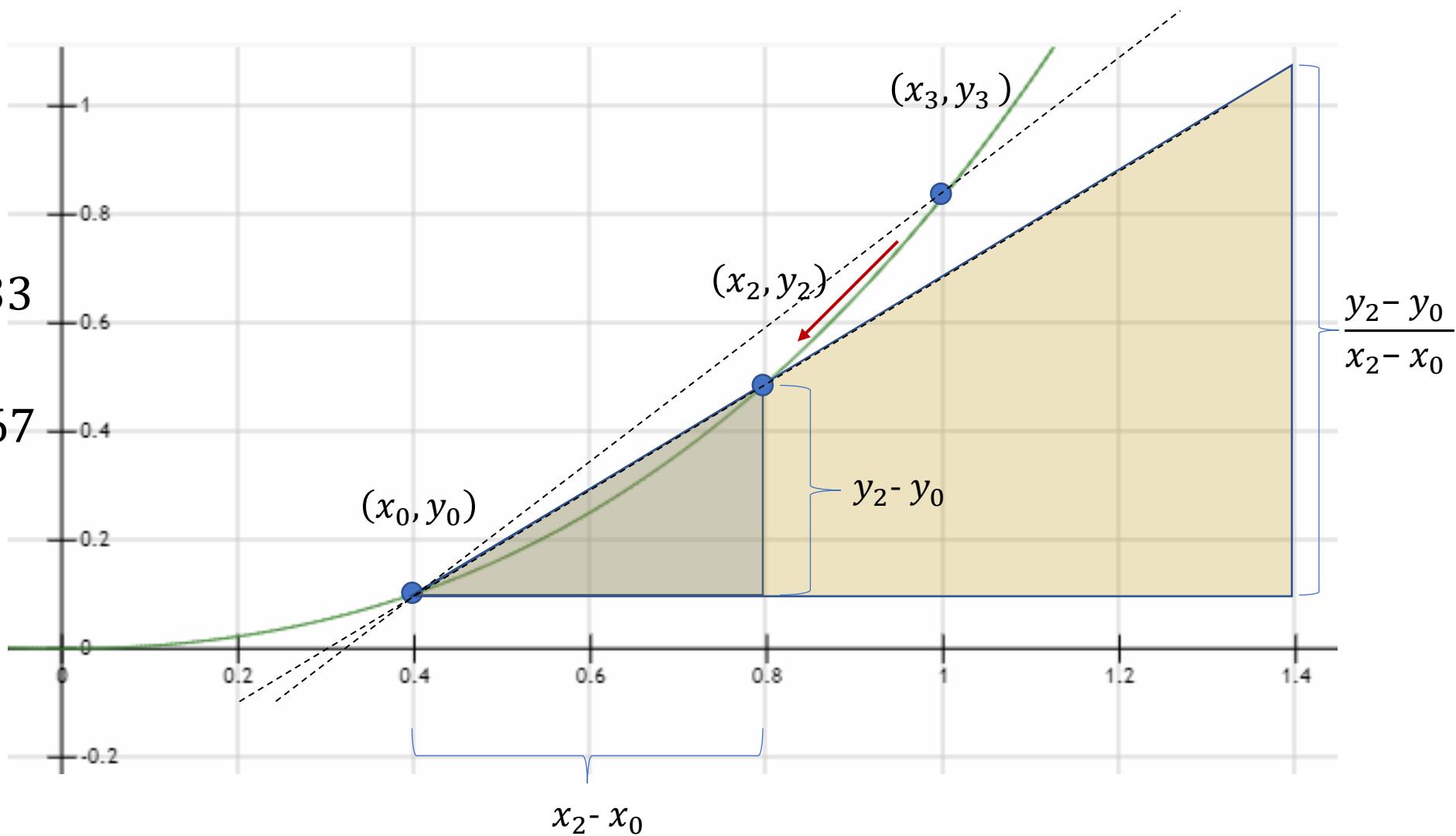


Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2}$$

$$x_0 = 0.4; y_0 = 0.101333$$

$$x_2 = 0.8; y_2 = 0.490667$$

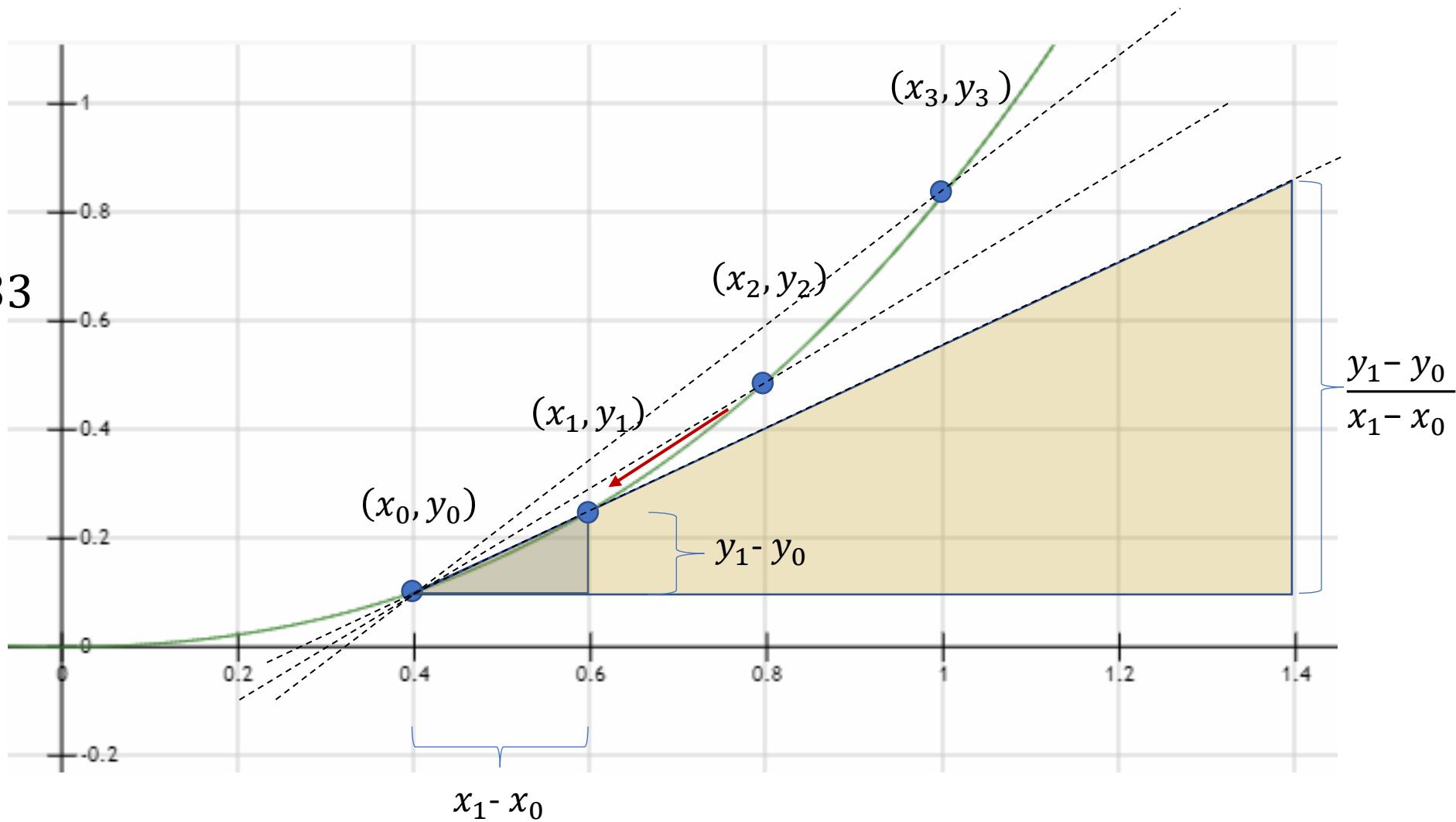


Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2}$$

$$x_0 = 0.4; y_0 = 0.101333$$

$$x_1 = 0.6; y_1 = 0.252$$



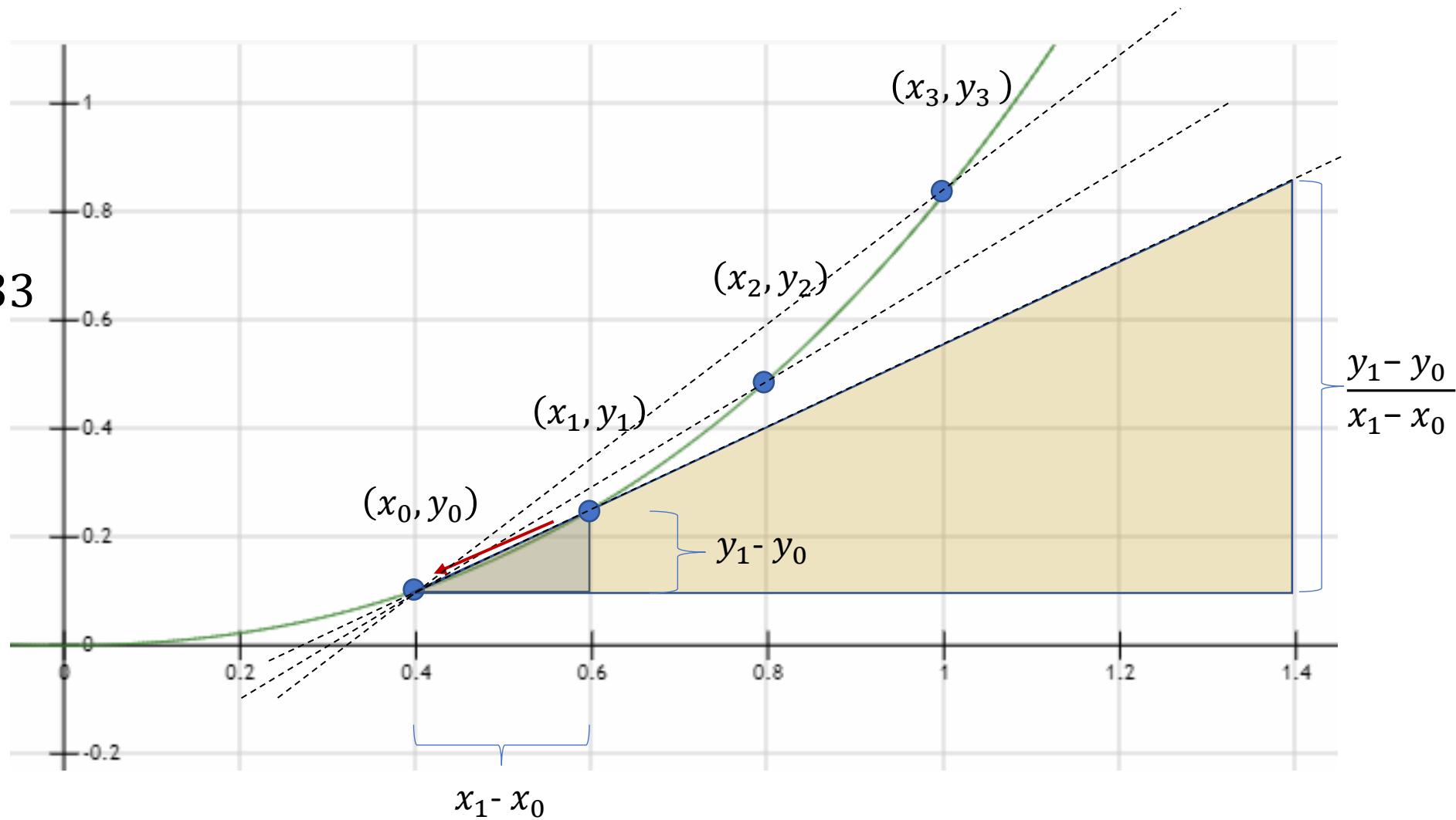
Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2}$$

$$x_0 = 0.4; y_0 = 0.101333$$

$$x_1 = 0.6; y_1 = 0.252$$

$$\lim_{x \rightarrow x_0} \frac{y - y_0}{x - x_0}$$

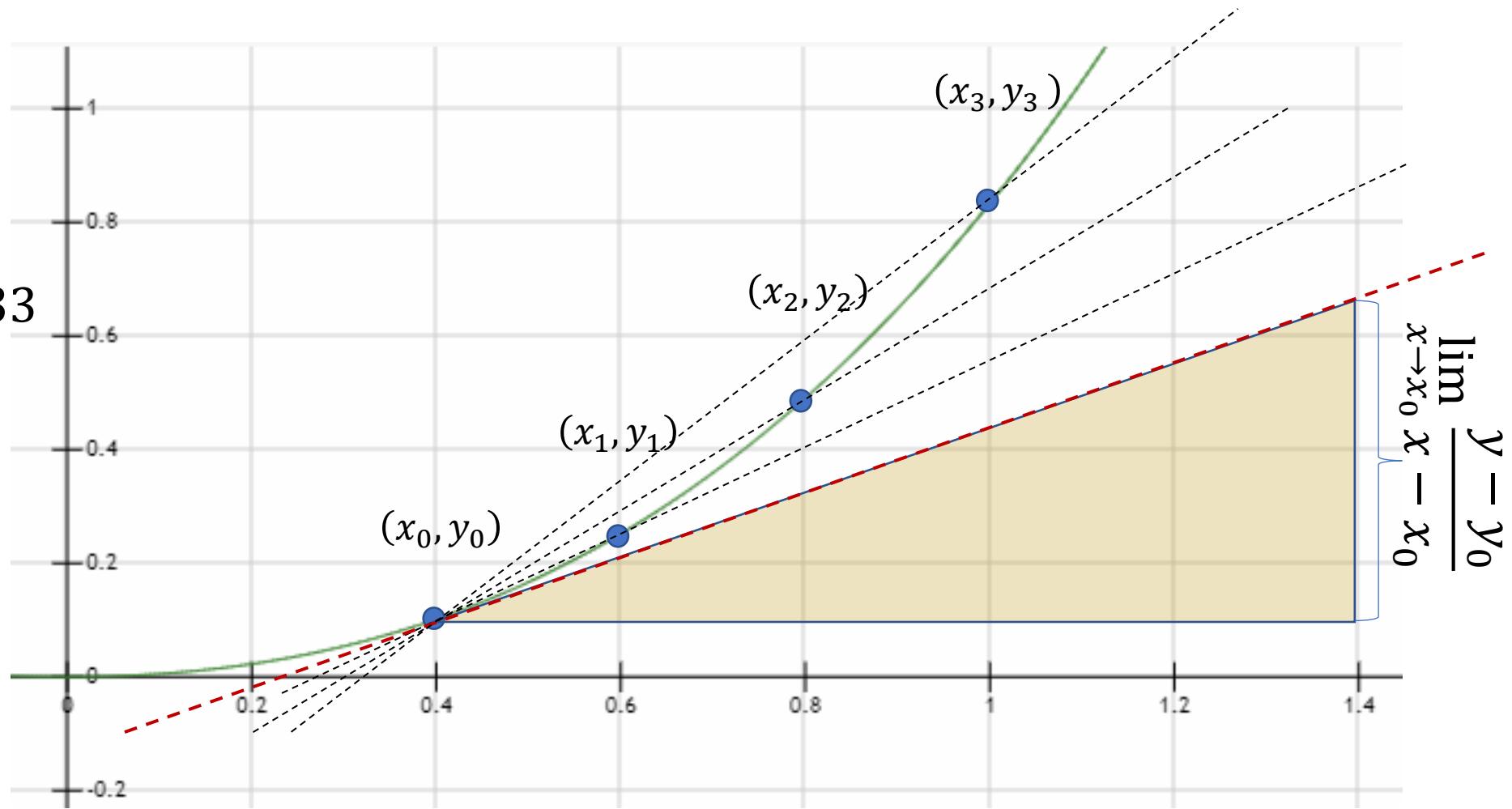


Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2}$$

$$x_0 = 0.4; y_0 = 0.101333$$

$$x_1 = 0.6; y_1 = 0.252$$



Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2}$$

$$\lim_{x \rightarrow x_0} \frac{y - y_0}{x - x_0}$$

Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2}$$

$$\lim_{x \rightarrow x_0} \frac{y - y_0}{x - x_0} = \lim_{x \rightarrow x_0} \frac{\frac{x^3}{3} + \frac{x^2}{2} - \frac{x_0^3}{3} - \frac{x_0^2}{2}}{x - x_0}$$

Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2}$$

$$\lim_{x \rightarrow x_0} \frac{y - y_0}{x - x_0} = \lim_{x \rightarrow x_0} \frac{\frac{x^3}{3} + \frac{x^2}{2} - \frac{x_0^3}{3} - \frac{x_0^2}{2}}{x - x_0} = \lim_{x \rightarrow x_0} \frac{x^3 - x_0^3}{3(x - x_0)} + \lim_{x \rightarrow x_0} \frac{x^2 - x_0^2}{2(x - x_0)}$$

Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2}$$

$$\lim_{x \rightarrow x_0} \frac{y - y_0}{x - x_0} = \lim_{x \rightarrow x_0} \frac{\frac{x^3}{3} + \frac{x^2}{2} - \frac{x_0^3}{3} - \frac{x_0^2}{2}}{x - x_0} = \lim_{x \rightarrow x_0} \frac{x^3 - x_0^3}{3(x - x_0)} + \lim_{x \rightarrow x_0} \frac{x^2 - x_0^2}{2(x - x_0)}$$

$$\lim_{x \rightarrow x_0} \frac{x^2 - x_0^2}{2(x - x_0)} = \frac{1}{2} \lim_{x \rightarrow x_0} \frac{(x - x_0)(x + x_0)}{x - x_0} = \frac{1}{2} \lim_{x \rightarrow x_0} (x + x_0) = \lim_{x \rightarrow x_0} x$$



Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2}$$

$$\lim_{x \rightarrow x_0} \frac{y - y_0}{x - x_0} = \lim_{x \rightarrow x_0} \frac{\frac{x^3}{3} + \frac{x^2}{2} - \frac{x_0^3}{3} - \frac{x_0^2}{2}}{x - x_0} = \lim_{x \rightarrow x_0} \frac{x^3 - x_0^3}{3(x - x_0)} + \lim_{x \rightarrow x_0} x$$

$$\lim_{x \rightarrow x_0} \frac{x^3 - x_0^3}{3(x - x_0)} = \frac{1}{3} \lim_{x \rightarrow x_0} \frac{(x - x_0)(x^2 + xx_0 + x_0^2)}{x - x_0} = \frac{1}{3} \lim_{x \rightarrow x_0} (x^2 + xx_0 + x_0^2) = \lim_{x \rightarrow x_0} x^2$$

Derivative

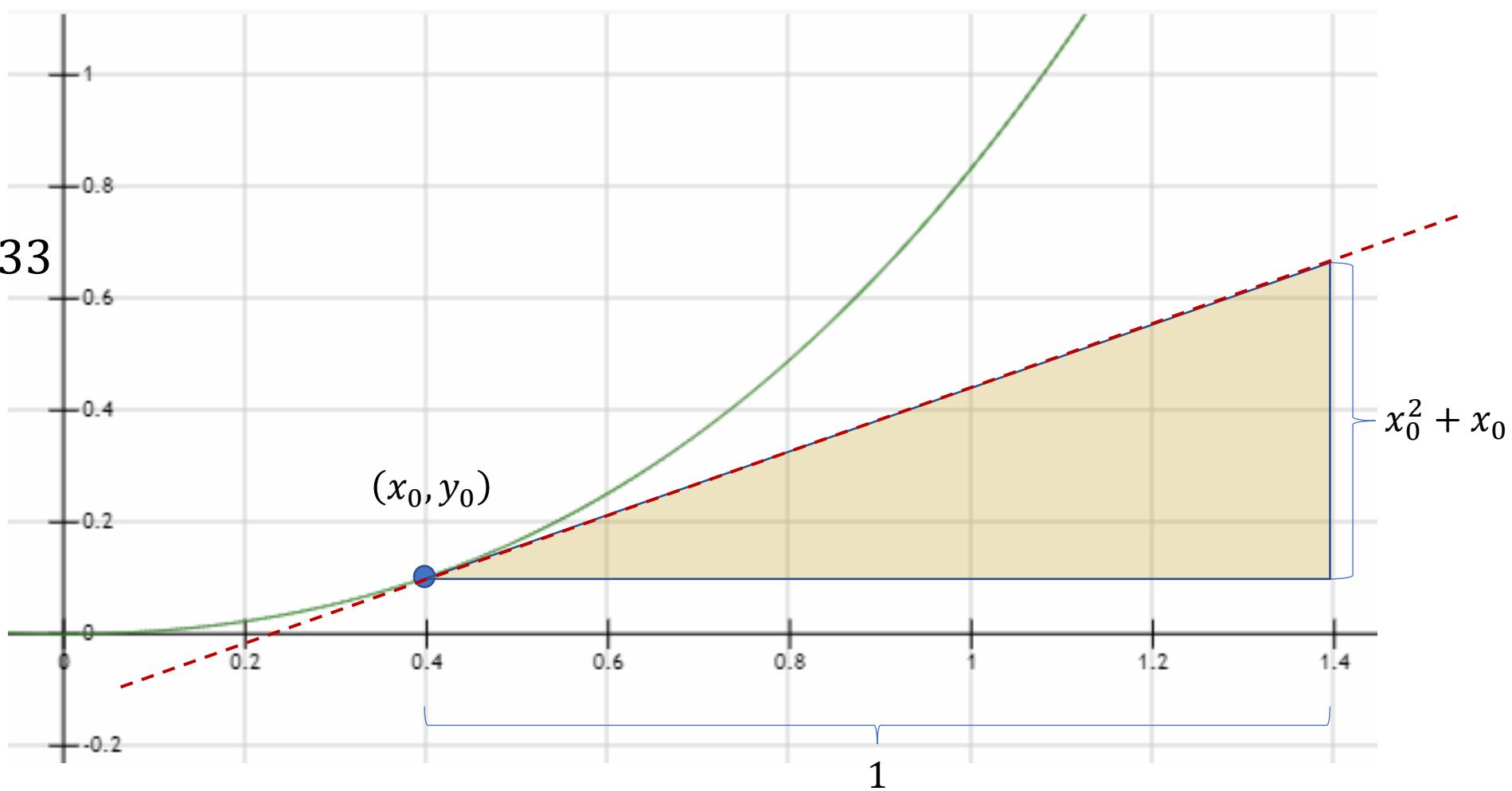
$$y = \frac{x^3}{3} + \frac{x^2}{2}$$

$$\lim_{x \rightarrow x_0} \frac{y - y_0}{x - x_0} = \lim_{x \rightarrow x_0} \frac{\frac{x^3}{3} + \frac{x^2}{2} - \frac{x_0^3}{3} - \frac{x_0^2}{2}}{x - x_0} = \lim_{x \rightarrow x_0} (x^2 + x) = x_0^2 + x_0$$

Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2}$$

$$x_0 = 0.4; y_0 = 0.101333$$

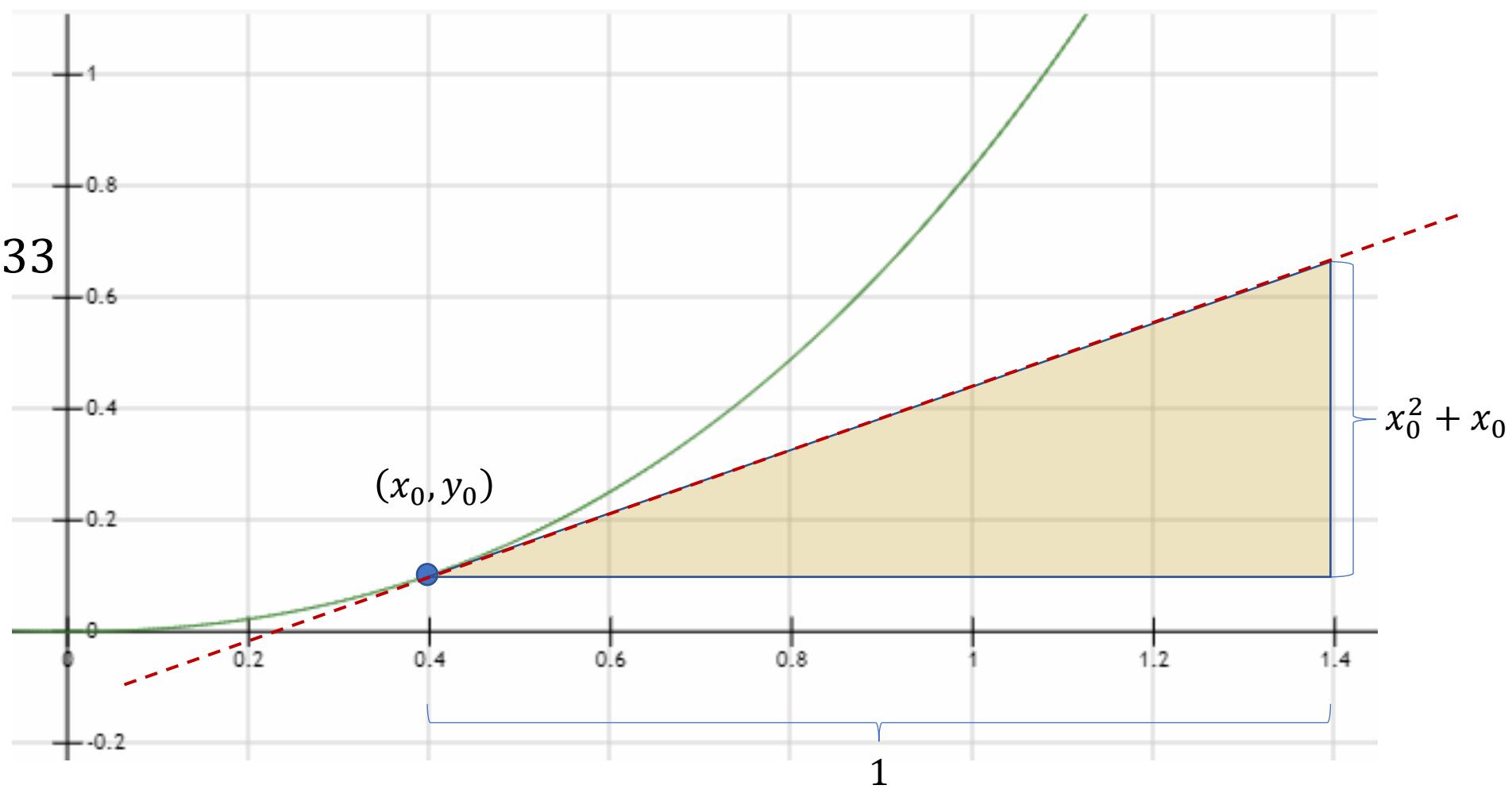


Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2}$$

$$x_0 = 0.4; y_0 = 0.101333$$

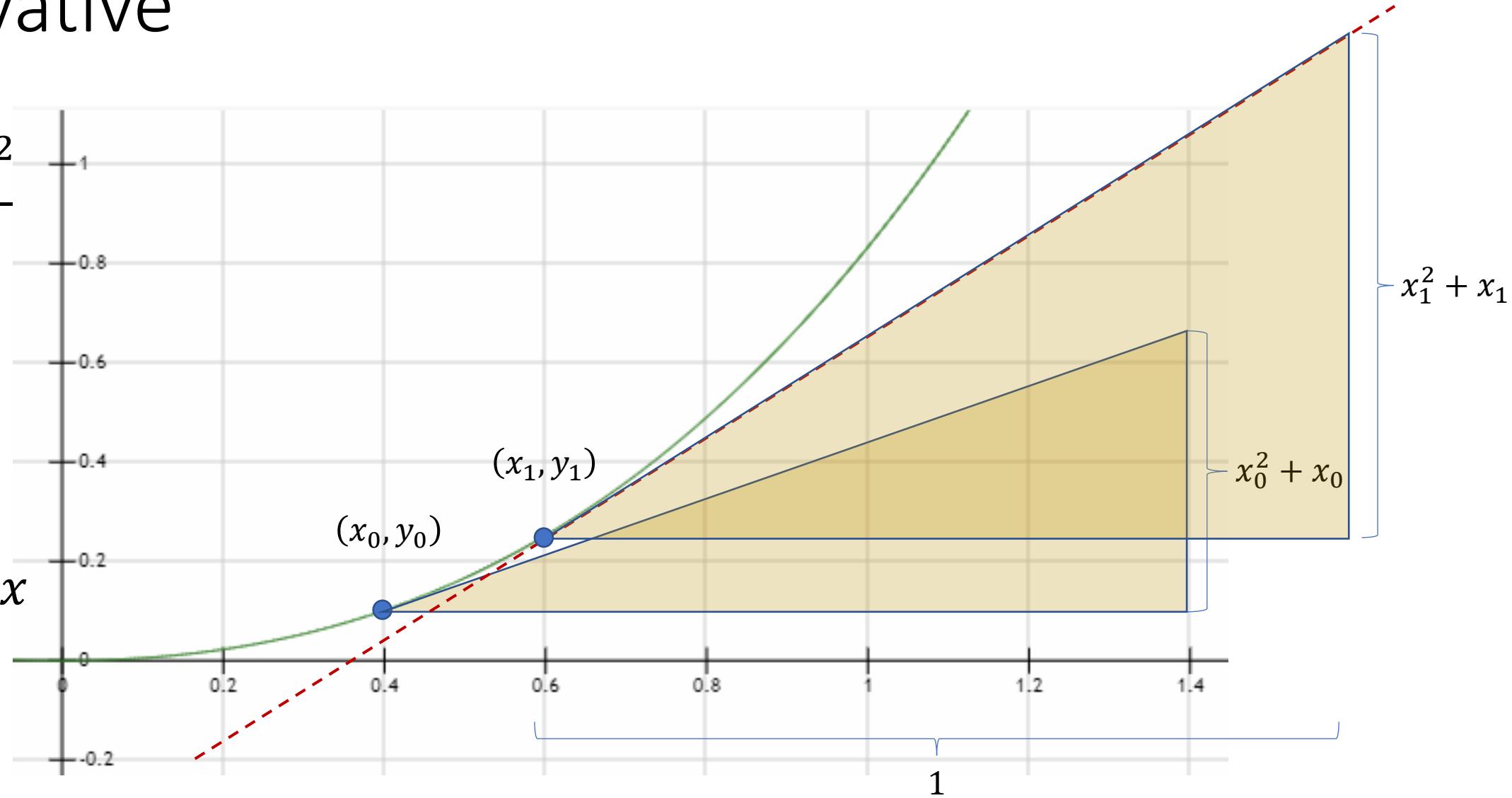
$$\frac{dy}{dx} = x^2 + x$$



Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2}$$

$$\frac{dy}{dx} = x^2 + x$$



Derivative

plot ($y = -1/x$), x from -10 to 10



derivative $-1/x$



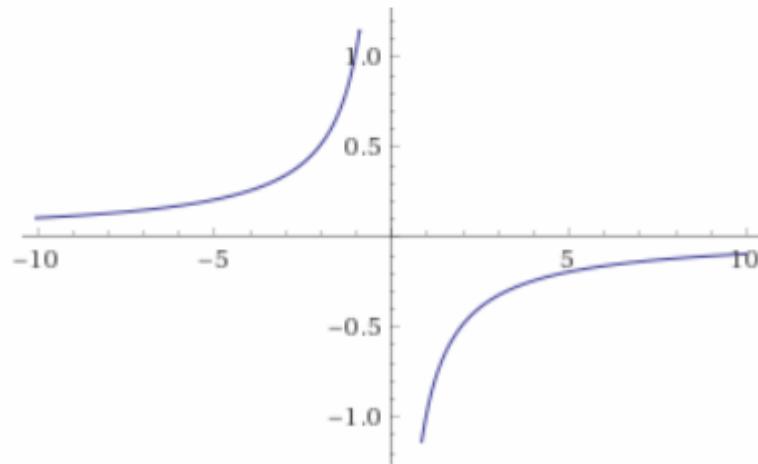
derivative $-1/x$, $x = 0$



Input interpretation:

plot	$y = -\frac{1}{x}$	$x = -10 \text{ to } 10$
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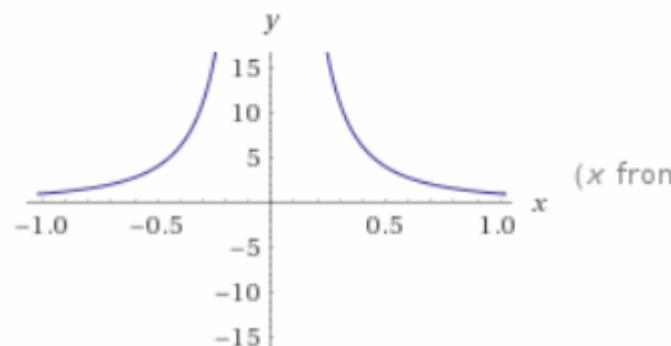
Plot:



Derivative:

$$\frac{d}{dx}\left(-\frac{1}{x}\right) = \frac{1}{x^2}$$

Plots:



Input interpretation:

$$\frac{\partial}{\partial x}\left(-\frac{1}{x}\right) \text{ where } x = 0$$

Result:

∞

Limit from the left:

$$\lim_{x \rightarrow 0^-} \frac{\partial}{\partial x}\left(-\frac{1}{x}\right) = \infty$$

Limit from the right:

$$\lim_{x \rightarrow 0^+} \frac{\partial}{\partial x}\left(-\frac{1}{x}\right) = \infty$$

Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2} + 9$$

$$\lim_{x \rightarrow x_0} \frac{y - y_0}{x - x_0} = \lim_{x \rightarrow x_0} \frac{\frac{x^3}{3} + \frac{x^2}{2} + 9 - \frac{x_0^3}{3} - \frac{x_0^2}{2} - 9}{x - x_0} = \lim_{x \rightarrow x_0} (x^2 + x) = x_0^2 + x_0$$

Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2} + 9$$

$$\lim_{x \rightarrow x_0} \frac{y - y_0}{x - x_0} = \lim_{x \rightarrow x_0} \frac{\frac{x^3}{3} + \frac{x^2}{2} + 9 - \frac{x_0^3}{3} - \frac{x_0^2}{2} - 9}{x - x_0} = \lim_{x \rightarrow x_0} (x^2 + x) = x_0^2 + x_0$$

$$\frac{dy}{dx} = x^2 + x$$

Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2} + 9$$

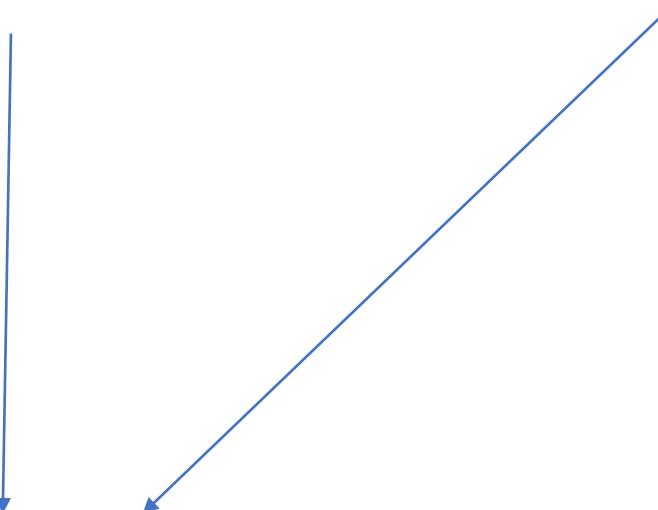


$$\frac{dy}{dx} = x^2 + x$$

Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2} + 9$$

$$y = \frac{x^3}{3} + \frac{x^2}{2} - 11$$



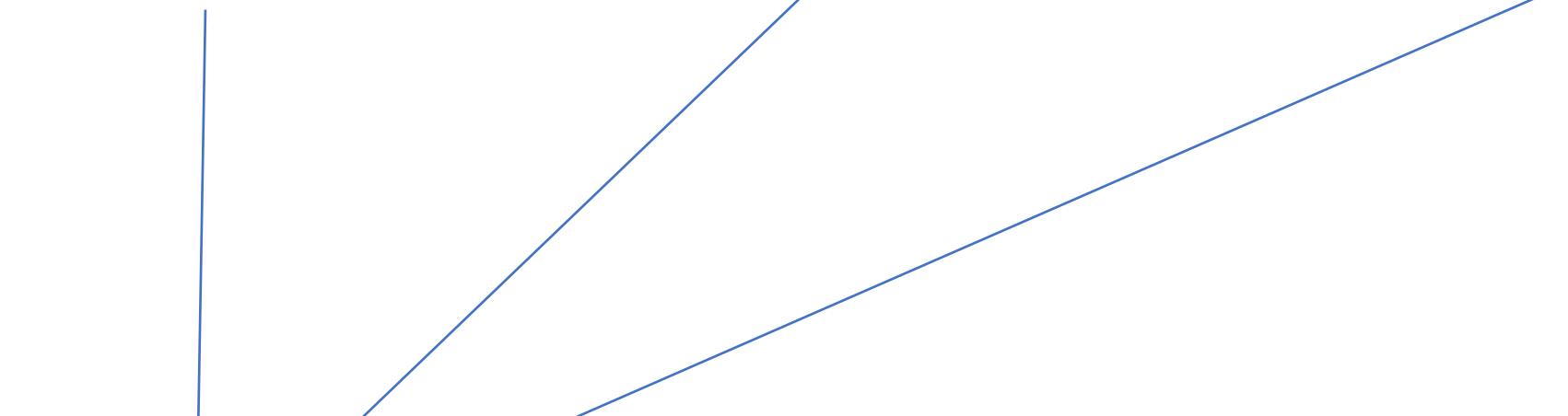
$$\frac{dy}{dx} = x^2 + x$$

Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2} + 9$$

$$y = \frac{x^3}{3} + \frac{x^2}{2} - 11$$

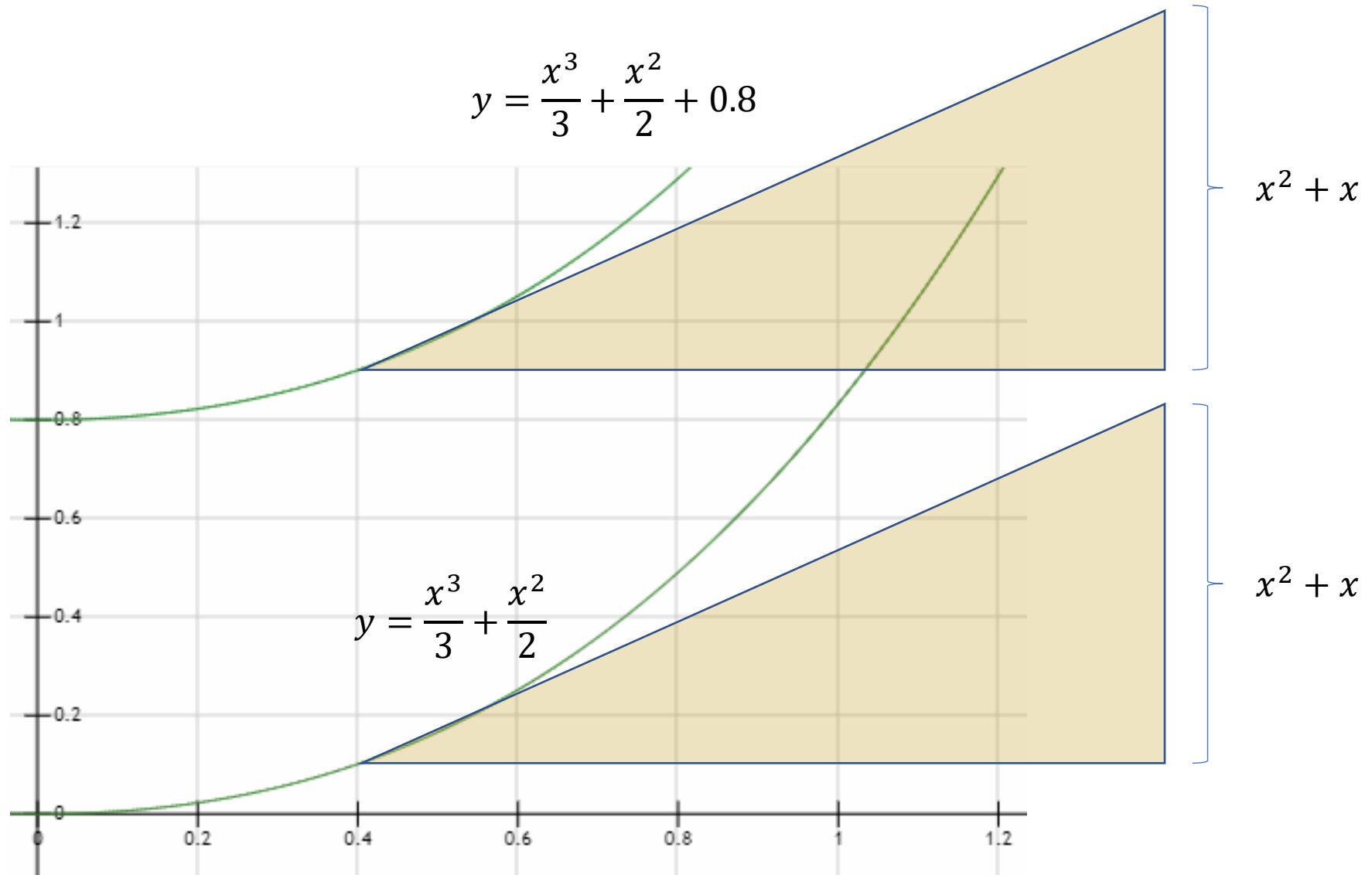
$$y = \frac{x^3}{3} + \frac{x^2}{2} + 3.14$$



$$\frac{dy}{dx} = x^2 + x$$

Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2} + 0.8$$

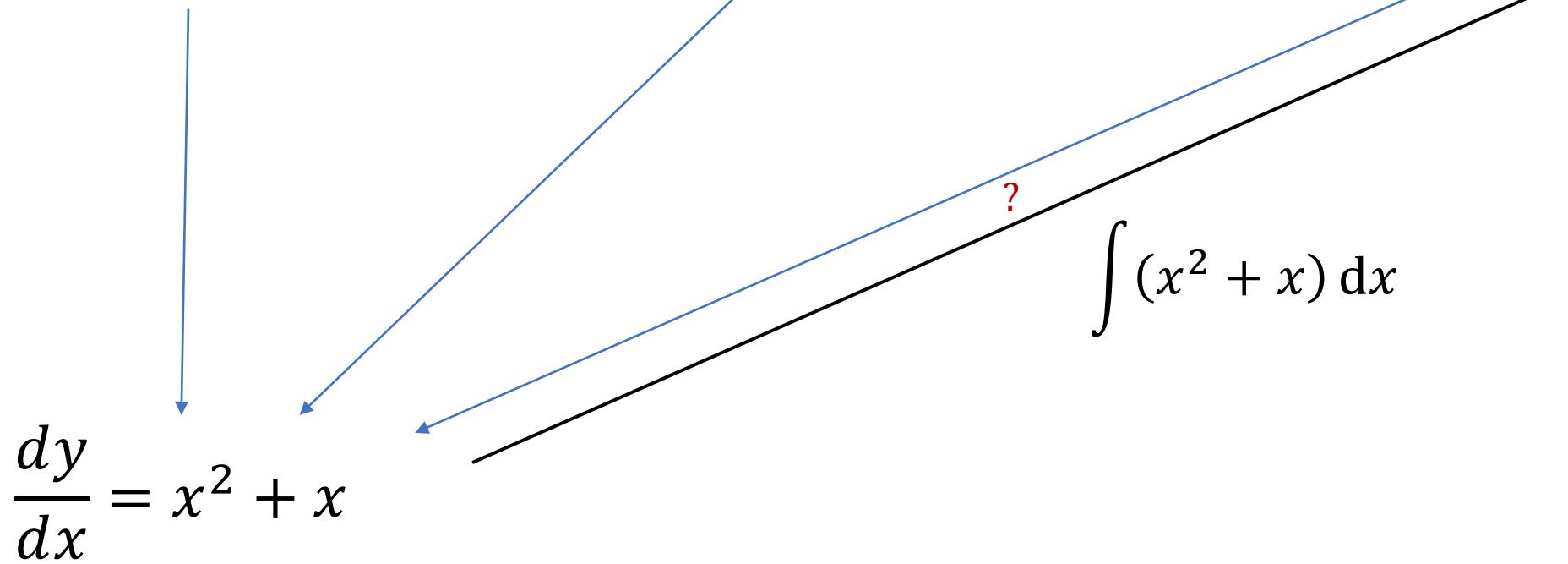


Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2} + 9$$

$$y = \frac{x^3}{3} + \frac{x^2}{2} - 11$$

$$y = \frac{x^3}{3} + \frac{x^2}{2} + 3.14$$



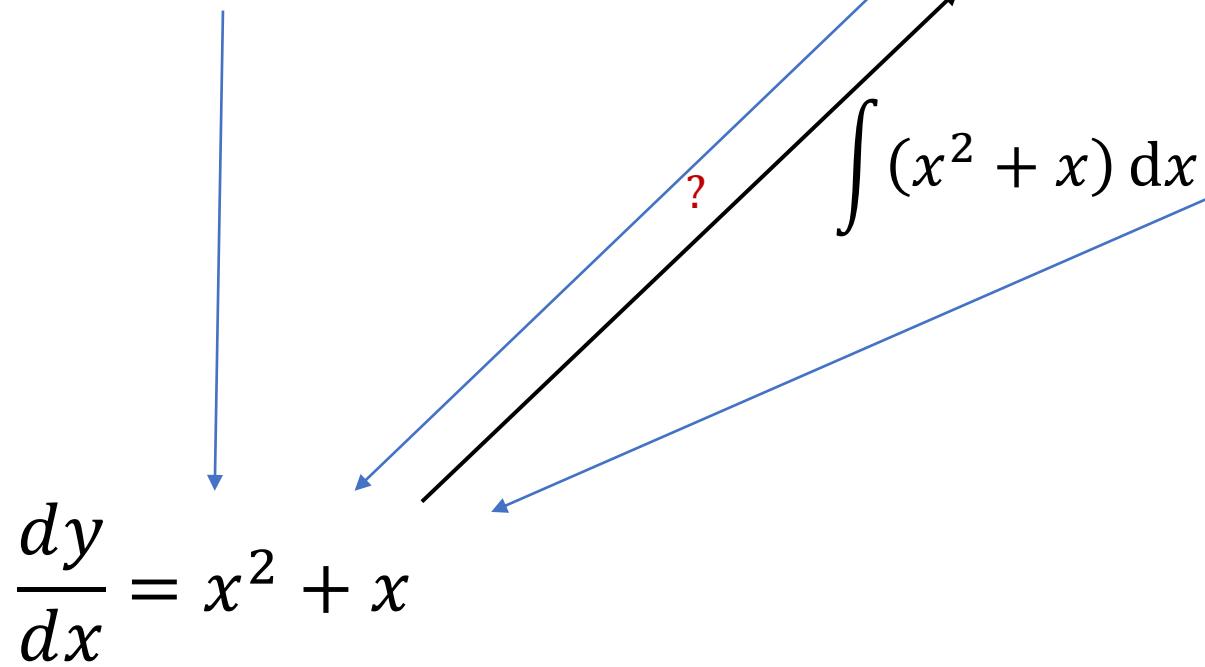
$$\int (x^2 + x) \, dx$$

Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2} + 9$$

$$y = \frac{x^3}{3} + \frac{x^2}{2} - 11$$

$$y = \frac{x^3}{3} + \frac{x^2}{2} + 3.14$$

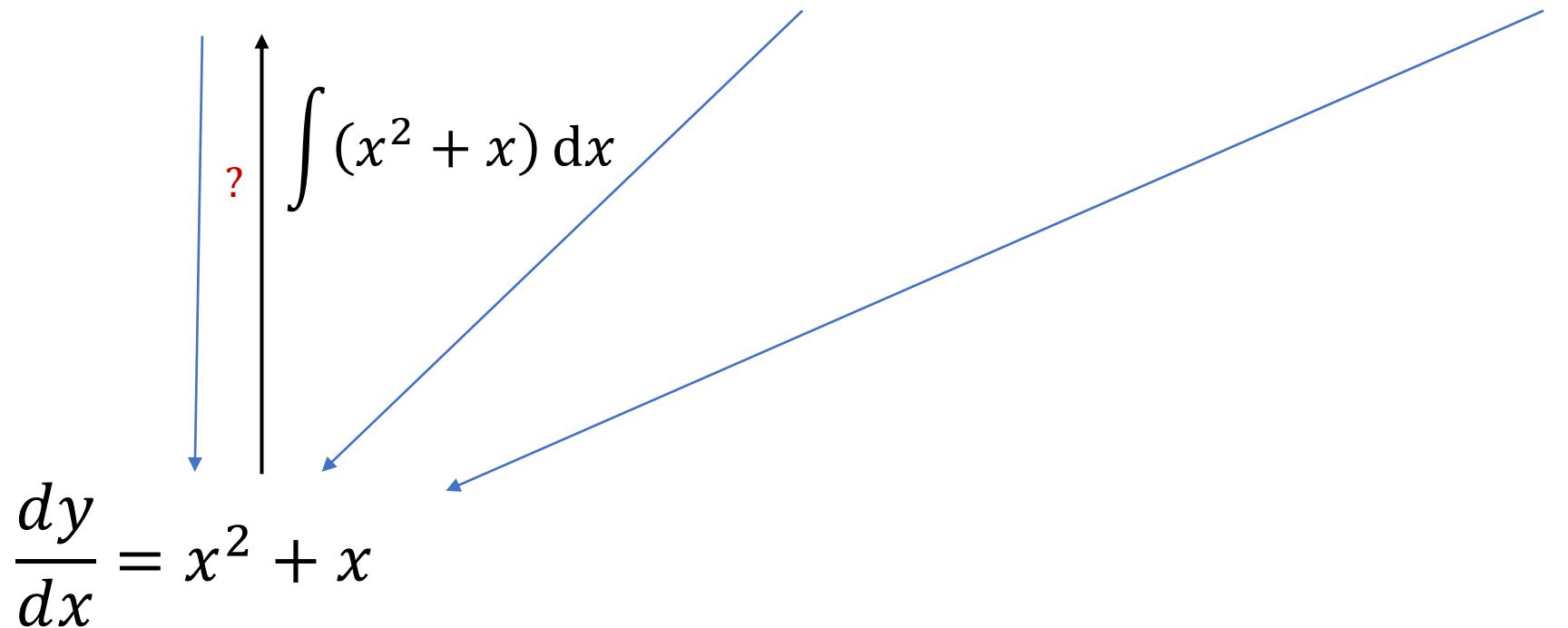


Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2} + 9$$

$$y = \frac{x^3}{3} + \frac{x^2}{2} - 11$$

$$y = \frac{x^3}{3} + \frac{x^2}{2} + 3.14$$

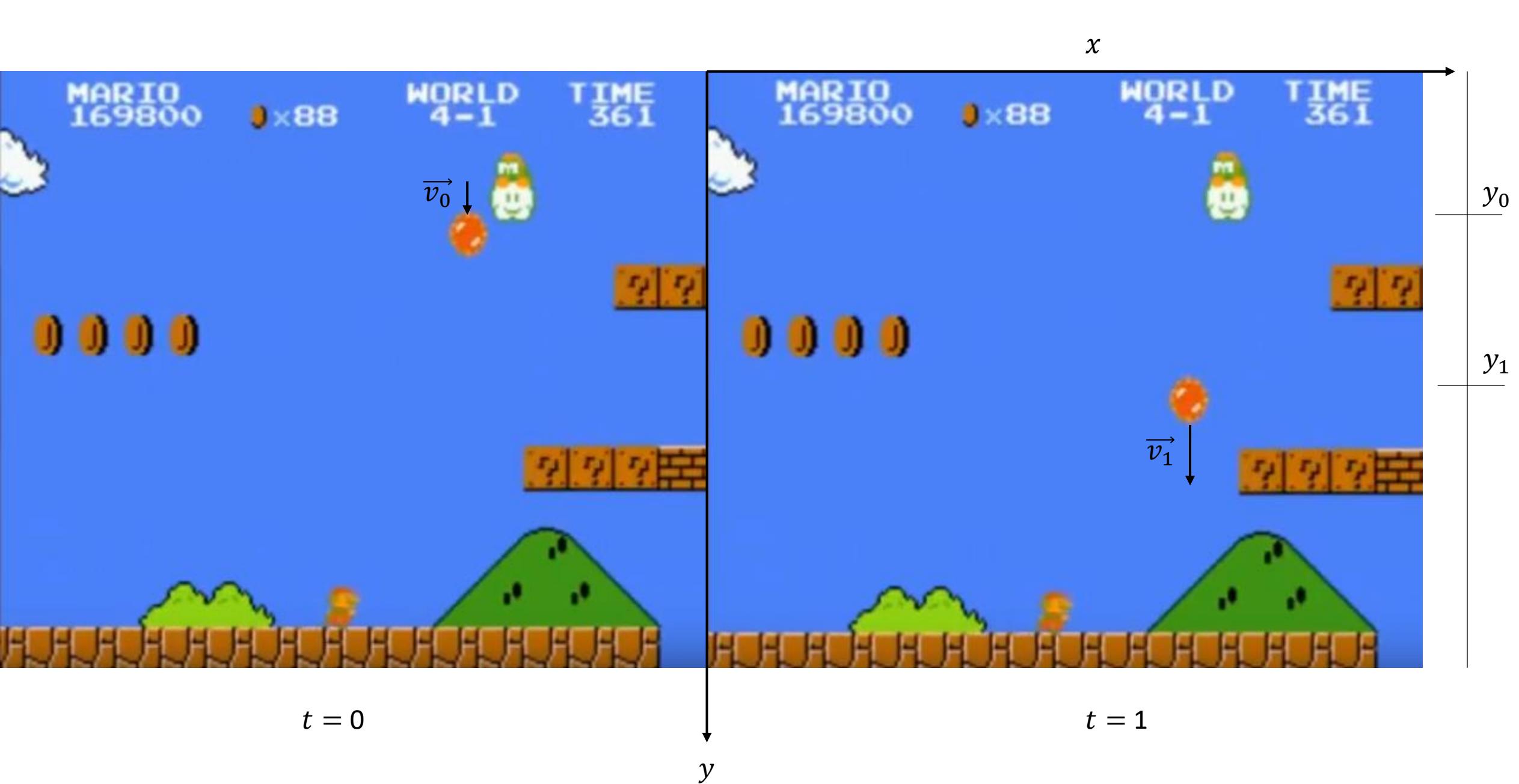


Derivative

$$y = \frac{x^3}{3} + \frac{x^2}{2} + \mathbf{C}$$


$$\int (x^2 + x) \, dx$$

$$\frac{dy}{dx} = x^2 + x$$



Differential equations

- Velocity:
 - If the velocity is constant

$$v = \frac{\Delta y}{\Delta t}$$

Differential equations

- Velocity:
 - If the velocity is constant

$$v = \frac{\Delta y}{\Delta t}$$

- As a function of t

$$v(t) = \frac{dy}{dt}$$

Differential equations

- Velocity:
 - As a function of t

$$v(t) = \frac{dy}{dt}$$

Differential equations

- Velocity:
 - As a function of t

$$v(t) = \frac{dy}{dt}$$

$$v(t)dt = dy$$

Differential equations

- Velocity:
 - As a function of t

$$v(t) = \frac{dy}{dt}$$

$$v(t)dt = dy$$

$$\int v(t) dt = \int dy$$

Differential equations

- Velocity:
 - As a function of t

$$v(t) = \frac{dy}{dt}$$

$$v(t)dt = dy$$

$$\int v(t) dt = \int dy$$

$$v(t)=?$$

Differential equations

- Acceleration:
 - If the acceleration is constant

$$a = \frac{dv}{dt}$$

Differential equations

- Acceleration:
 - If the acceleration is constant

$$a = \frac{dv}{dt}$$

- Earth:

$$a \approx 9.81 \frac{m}{s^2}$$

- Moon:

$$a \approx 1.62 \frac{m}{s^2}$$

Differential equations

- Acceleration:
 - If the acceleration is constant

$$a = \frac{dv}{dt}$$

$$a dt = dv$$

$$\int a dt = \int dv$$

$$a t + c_0 = v + c_1$$

Differential equations

- Acceleration:
 - If the acceleration is constant

$$a = \frac{dv}{dt}$$

$$a dt = dv$$

$$\int a dt = \int dv$$

$$a t + c_0 - c_1 = v$$

Differential equations

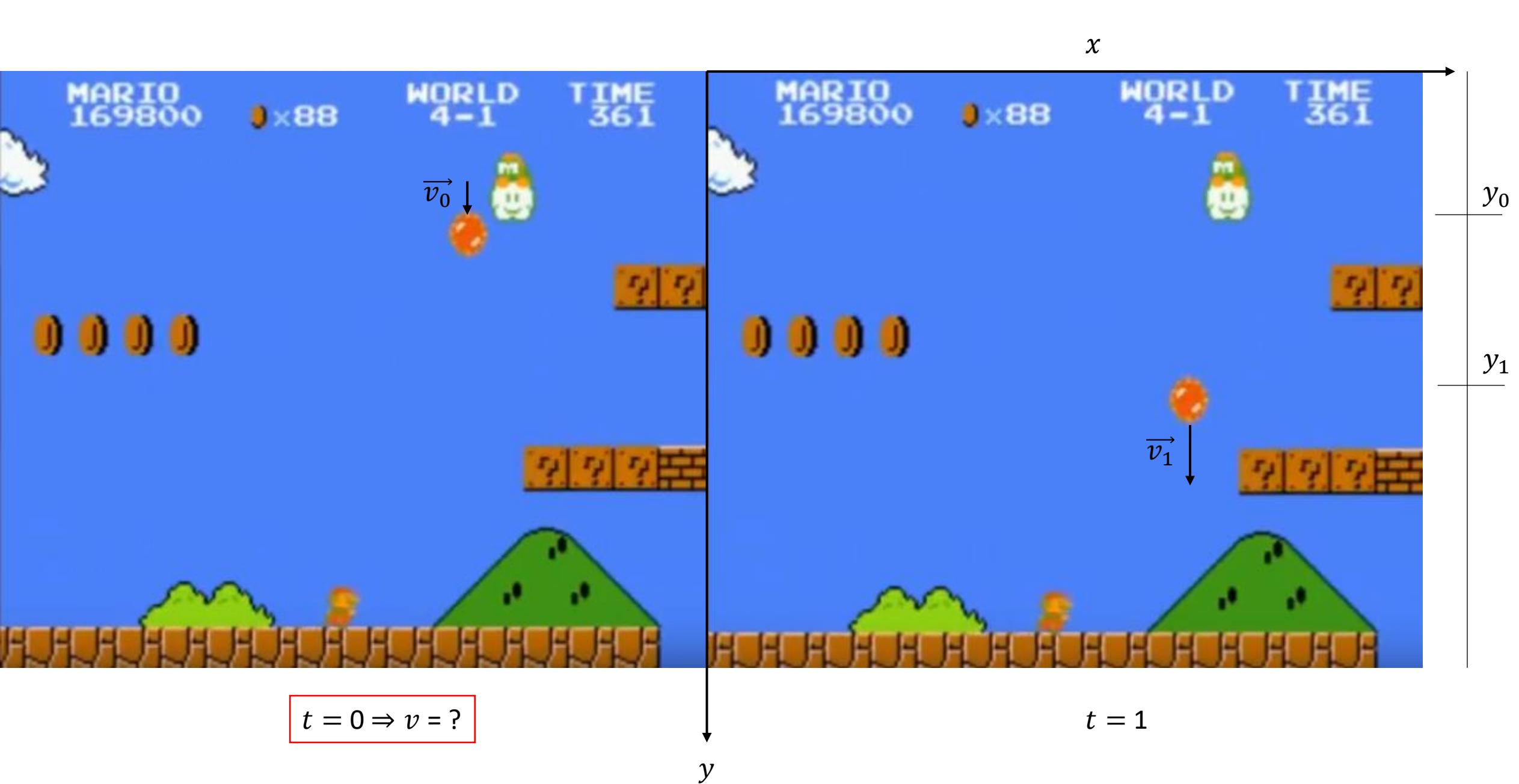
- Acceleration:
 - If the acceleration is constant

$$a = \frac{dv}{dt}$$

$$a dt = dv$$

$$\int a dt = \int dv$$

$$a t + \textcolor{red}{c}_2 = v$$



Differential equations

- Acceleration:
 - If the acceleration is constant

$$a = \frac{dv}{dt}$$

$$a dt = dv$$

$$\int a dt = \int dv$$

$$a t + c_2 = v$$

$$t = 0 \Rightarrow v = v_0$$

\downarrow \downarrow

$$a 0 + c_2 = v_0$$

\nearrow \nearrow

Differential equations

- Acceleration:
 - If the acceleration is constant

$$a = \frac{dv}{dt}$$

$$t = 0 \Rightarrow v = v_0$$

\downarrow \downarrow

$$a \cdot 0 + c_2 = v_0$$

$$a dt = dv$$

$$c_2 = v_0$$

$$\int a dt = \int dv$$

$$a t + v_0 = v$$

Differential equations

- Acceleration:
 - If the acceleration is constant

$$a = \frac{dv}{dt}$$

$$a dt = dv$$

$$\int a dt = \int dv$$

$$a t + \textcolor{red}{v_0} = v \Rightarrow v(t) = at + v_0$$

Differential equations

- Velocity:
 - As a function of t

$$v(t) = \frac{dy}{dt}$$

$$v(t)dt = dy$$

$$\int v(t) dt = \int dy$$

$$v(t) = at + v_0$$

Differential equations

- Velocity:
 - As a function of t

$$v(t) = \frac{dy}{dt}$$

$$v(t)dt = dy$$

$$\int (at + v_0) dt = \int dy$$

$$v(t) = at + v_0$$

Differential equations

- Velocity:
 - As a function of t

$$v(t) = \frac{dy}{dt}$$

$$v(t)dt = dy$$

$$\int (at + v_0) dt = \int dy$$

$$\frac{at^2}{2} + v_0 t + c_3 = y + c_4$$

Differential equations

- Velocity:
 - As a function of t

$$v(t) = \frac{dy}{dt}$$

$$v(t)dt = dy$$

$$\int (at + v_0) dt = \int dy$$

$$\frac{at^2}{2} + v_0 t + c_3 - c_4 = y$$

Differential equations

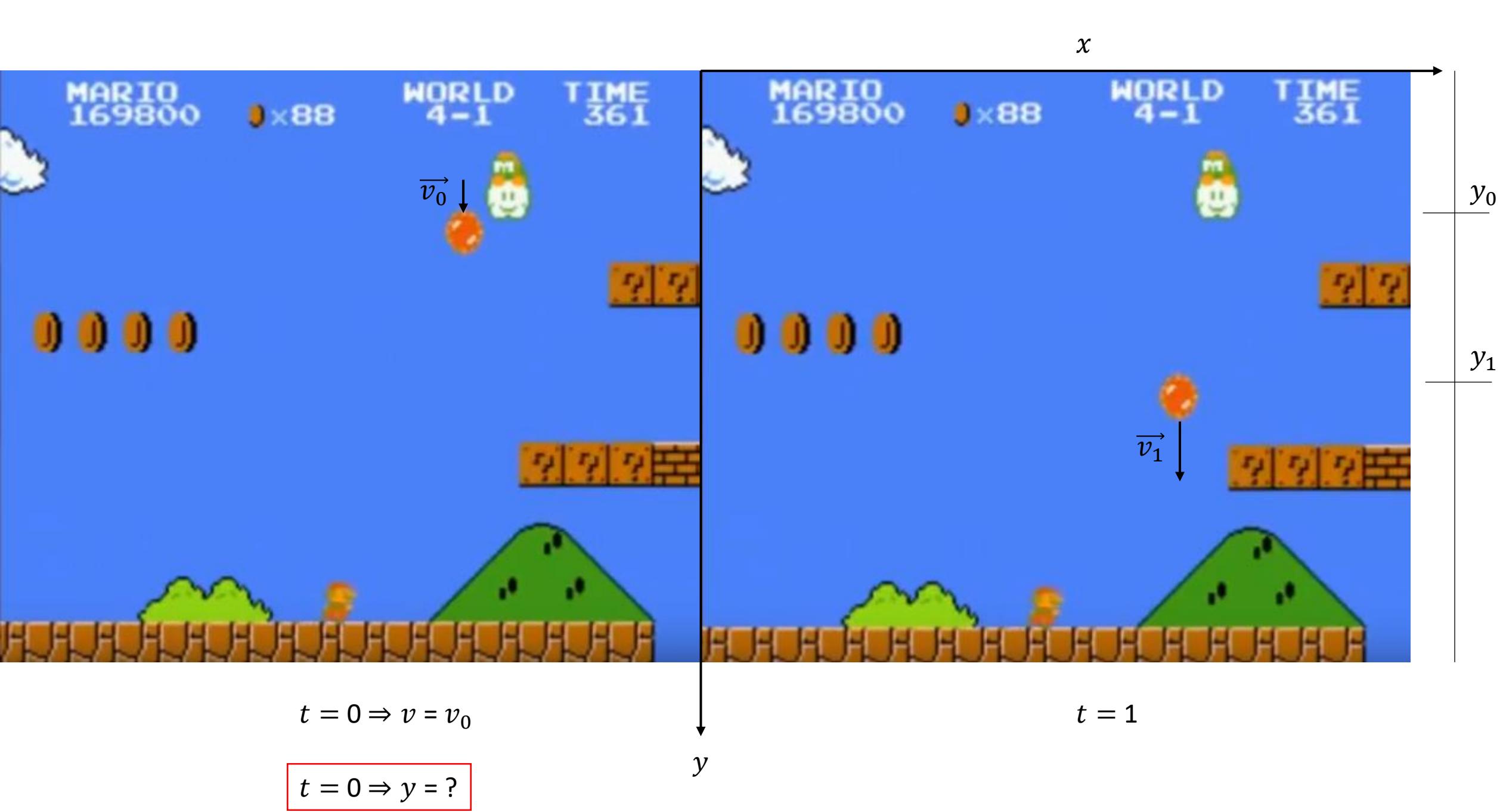
- Velocity:
 - As a function of t

$$v(t) = \frac{dy}{dt}$$

$$v(t)dt = dy$$

$$\int (at + v_0) dt = \int dy$$

$$\frac{at^2}{2} + v_0 t + \textcolor{red}{c}_5 = y$$



Differential equations

- Velocity:
 - As a function of t

$$v(t) = \frac{dy}{dt}$$

$$v(t)dt = dy$$

$$\int (at + v_0) dt = \int dy$$

$$\frac{at^2}{2} + v_0 t + c_5 = y$$

$$\begin{aligned} t &= 0 \Rightarrow y = y_0 \\ \frac{a0^2}{2} + v_0 0 + c_5 &= y_0 \end{aligned}$$

Differential equations

- Velocity:
 - As a function of t

$$v(t) = \frac{dy}{dt}$$

$$v(t)dt = dy$$

$$\int (at + v_0) dt = \int dy$$

$$\frac{at^2}{2} + v_0 t + y_0 = y$$

$$\begin{aligned} t = 0 &\Rightarrow y = y_0 \\ \frac{a0^2}{2} + v_0 0 + c_5 &= y_0 \\ c_5 &= y_0 \end{aligned}$$

Differential equations

- Velocity:
 - As a function of t

$$v(t) = \frac{dy}{dt} \quad t = 0 \Rightarrow y = y_0$$

$$\begin{aligned} v(t)dt &= dy & \frac{a0^2}{2} + v_00 + c_5 &= y_0 \\ \int (at + v_0) dt &= \int dy & c_5 &= y_0 \end{aligned}$$

$$\frac{at^2}{2} + v_0t + y_0 = y \Rightarrow y(t) = \boxed{\frac{at^2}{2} + v_0t + y_0}$$

Differential equations

$$v(t) = \frac{dy}{dt} \quad y_0 = 10$$

$$9.81 = \frac{dv}{dt} \quad v_0 = 0$$

```
rovnice = {y'[t] == v[t], v'[t] == 9.81}
podmienky = {y[0] == 10, v[0] == 0}
premenne = {y, v}
riesenie = NDSolve[{rovnice, podmienky}, premenne, {t, 2}, Method -> "ExplicitRungeKutta"]
ParametricPlot[{y[t], v[t]} /. riesenie, {t, 0, 2}]
```

Differential equations

$$dy = \frac{-y}{l} |\vec{v}| dt$$

$$\frac{dy}{y} = \frac{-|\vec{v}|}{l} dt$$

$$\int \frac{dy}{y} = \frac{-|\vec{v}|}{l} \int dt$$

Differential equations

$$dy = \frac{-y}{l} |\vec{v}| dt$$

$$y = e^{\frac{-|\vec{v}|t}{l} + c_1}$$

$$\frac{dy}{y} = \frac{-|\vec{v}|}{l} dt$$

$$y = ce^{\frac{-|\vec{v}|t}{l}}$$

$$\int \frac{dy}{y} = \frac{-|\vec{v}|}{l} \int dt$$

$$\ln y = \frac{-|\vec{v}|}{l} t + c_1$$

Differential equations

$$\frac{dy}{dt} = \frac{y^2}{9} - 2y + 9$$

$$t = 0 \Rightarrow y(t) = 8$$

Differential equations

$$\frac{dy}{dt} = \frac{y^2}{9} - 2y + 9$$

$$t = 0 \Rightarrow y(t) = 8$$

$$\frac{dy}{dt} = \left(\frac{y}{3} - 3\right)\left(\frac{y}{3} - 3\right)$$

Differential equations

$$\frac{dy}{dt} = \frac{y^2}{9} - 2y + 9$$

$$t = 0 \Rightarrow y(t) = 8$$

$$\frac{dy}{dt} = \left(\frac{y}{3} - 3\right)\left(\frac{y}{3} - 3\right)$$

$$u = \frac{y}{3} - 3$$

$$\frac{dy}{dt} = u^2$$

Differential equations

$$\frac{dy}{dt} = \frac{y^2}{9} - 2y + 9$$

$$t = 0 \Rightarrow y(t) = 8$$

$$\frac{dy}{dt} = \left(\frac{y}{3} - 3\right)\left(\frac{y}{3} - 3\right)$$

$$u = \frac{y}{3} - 3$$

$$\frac{dy}{u^2} = dt$$

Differential equations

$$\frac{dy}{dt} = \frac{y^2}{9} - 2y + 9$$

$$t = 0 \Rightarrow y(t) = 8$$

$$\frac{dy}{dt} = \left(\frac{y}{3} - 3\right)\left(\frac{y}{3} - 3\right)$$

$$u = \frac{y}{3} - 3$$

$$\int \frac{d\textcolor{red}{y}}{\textcolor{blue}{u}^2} = \int dt$$

Differential equations

$$\frac{dy}{dt} = \frac{y^2}{9} - 2y + 9$$

$$t = 0 \Rightarrow y(t) = 8$$

$$\frac{dy}{dt} = \left(\frac{y}{3} - 3\right)\left(\frac{y}{3} - 3\right)$$

differentiate each side of the equation with respect to t :

$$u = \frac{y}{3} - 3$$

$$\int \frac{d\textcolor{red}{y}}{\textcolor{blue}{u}^2} = \int dt$$

Differential equations

$$\frac{dy}{dt} = \frac{y^2}{9} - 2y + 9$$

$$t = 0 \Rightarrow y(t) = 8$$

$$\frac{dy}{dt} = \left(\frac{y}{3} - 3\right)\left(\frac{y}{3} - 3\right)$$

differentiate each side of the equation with respect to t :

$$\int \frac{d\textcolor{red}{y}}{\textcolor{blue}{u}^2} = \int dt$$

$$\textcolor{blue}{u} = \frac{\textcolor{red}{y}}{3} - 3$$

$$\frac{d\textcolor{blue}{u}}{dt} = \frac{1}{3} \frac{dy}{dt}$$

Differential equations

$$\frac{dy}{dt} = \frac{y^2}{9} - 2y + 9$$

$$t = 0 \Rightarrow y(t) = 8$$

$$\frac{dy}{dt} = \left(\frac{y}{3} - 3\right)\left(\frac{y}{3} - 3\right)$$

differentiate each side of the equation with respect to t :

$$\int \frac{d\textcolor{red}{y}}{\textcolor{blue}{u}^2} = \int dt$$

$$\textcolor{blue}{u} = \frac{\textcolor{red}{y}}{3} - 3$$

$$\frac{d\textcolor{blue}{u}}{dt} = \frac{1}{3} \frac{dy}{dt} \Rightarrow d\textcolor{red}{y} = 3 d\textcolor{blue}{u}$$

Differential equations

$$\frac{dy}{dt} = \frac{y^2}{9} - 2y + 9$$

$$t = 0 \Rightarrow y(t) = 8$$

$$\frac{dy}{dt} = \left(\frac{y}{3} - 3\right)\left(\frac{y}{3} - 3\right)$$

differentiate each side of the equation with respect to t :

$$u = \frac{y}{3} - 3$$

$$\frac{du}{dt} = \frac{1}{3} \frac{dy}{dt} \Rightarrow dy = 3 du$$

$$\int \frac{d\textcolor{red}{y}}{\textcolor{blue}{u}^2} = \int dt$$

$$\int \frac{3 du}{\textcolor{blue}{u}^2} = \int dt$$

Differential equations

$$\frac{dy}{dt} = \frac{y^2}{9} - 2y + 9$$

$$t = 0 \Rightarrow y(t) = 8$$

$$\frac{dy}{dt} = \left(\frac{y}{3} - 3\right)\left(\frac{y}{3} - 9\right)$$

$$3 \int \textcolor{blue}{u}^{-2} d\textcolor{blue}{u} = t + c_2$$

$$\textcolor{blue}{u} = \frac{\textcolor{red}{y}}{3} - 3$$

$$\int \frac{d\textcolor{red}{y}}{\textcolor{blue}{u}^2} = \int dt$$

$$\int \frac{3 du}{\textcolor{blue}{u}^2} = \int dt$$

Differential equations

$$\frac{dy}{dt} = \frac{y^2}{9} - 2y + 9$$

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$$\frac{dy}{dt} = \left(\frac{y}{3} - 3\right)\left(\frac{y}{3} - 9\right)$$

$$3 \int \textcolor{blue}{u}^{-2} d\textcolor{blue}{u} = t + c_2$$

$$\textcolor{blue}{u} = \frac{\textcolor{red}{y}}{3} - 3$$

$$\int \frac{d\textcolor{red}{y}}{\textcolor{blue}{u}^2} = \int dt$$

$$\frac{3\textcolor{blue}{u}^{-1}}{-1} + c_1 = t + c_2$$

$$\int \frac{3 du}{\textcolor{blue}{u}^2} = \int dt$$

$$\frac{3(\frac{\textcolor{red}{y}}{3} - 3)^{-1}}{-1} = t + c$$

Differential equations

$$\frac{dy}{dt} = \frac{y^2}{9} - 2y + 9$$

$$t = 0 \Rightarrow y(t) = 8$$

$$\frac{dy}{dt} = \left(\frac{y}{3} - 3\right)\left(\frac{y}{3} - 9\right)$$

$$3 \int \textcolor{blue}{u}^{-2} d\textcolor{blue}{u} = t + c_2$$

$$\frac{-3}{\frac{y}{3} - 3} = t + c$$

$$\int \frac{d\textcolor{red}{y}}{\textcolor{blue}{u}^2} = \int dt$$

$$\frac{3\textcolor{blue}{u}^{-1}}{-1} + c_1 = t + c_2$$

$$\int \frac{3 du}{\textcolor{blue}{u}^2} = \int dt$$

$$\frac{3(\frac{y}{3} - 3)^{-1}}{-1} = t + c$$

Differential equations

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$$\int \frac{3 du}{\textcolor{blue}{u}^2} = \int dt$$

$$\frac{3(\frac{\textcolor{red}{y}}{3} - 3)^{-1}}{-1} = t + c$$

$$\frac{-3}{y-9} = t + c$$

$$\frac{-9}{y-9} = t + c$$

$$9 - \frac{9}{t+c} = y$$

Differential equations

$$\frac{dy}{dt} = \frac{y^2}{9} - 2y + 9$$

$$t = 0 \Rightarrow y(t) = 8$$

$$y(t) = 9 - \frac{9}{t + c}$$

Differential equations

$$\frac{dy}{dt} = \frac{y^2}{9} - 2y + 9$$

$$t = 0 \Rightarrow y(t) = 8$$

$$y(t) = 9 - \frac{9}{t + c}$$

$$8 = 9 - \frac{9}{0 + c}$$

$$\frac{9}{c} = 9 - 8 \Rightarrow c = 9$$

Differential equations

$$\frac{dy}{dt} = \frac{y^2}{9} - 2y + 9$$

$$t = 0 \Rightarrow y(t) = 8$$

$$y(t) = 9 - \frac{9}{t+9}$$

$$\frac{dy}{dt} = \frac{y^2}{9} - 2y + 9$$

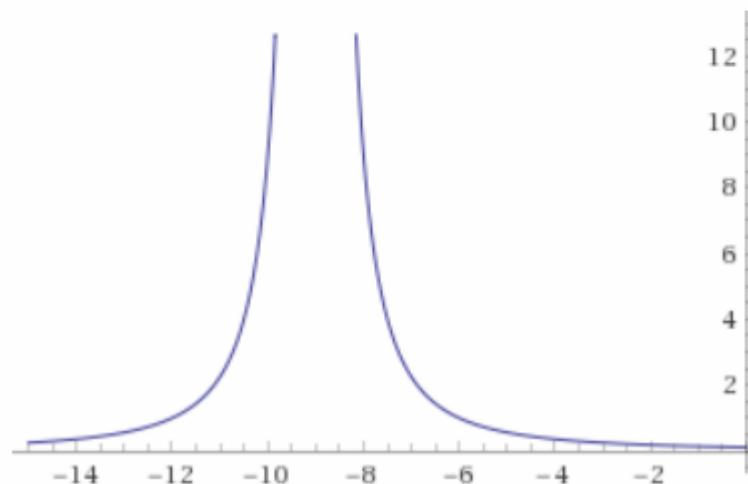
derivative $9 - 9/(t+9)$, t from -15 to 0



Input interpretation:

plot	$\frac{\partial}{\partial t} \left(9 - \frac{9}{t+9} \right)$	$t = -15 \text{ to } 0$
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Plot:



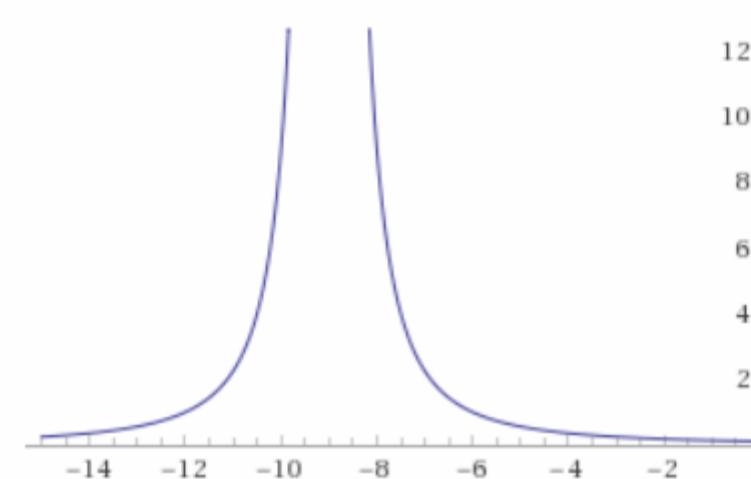
$(9 - 9/(t+9))^2/9 - 2(9 - 9/(t+9)) + 9$, t from -15 to 0



Input interpretation:

plot	$\frac{1}{9} \left(9 - \frac{9}{t+9} \right)^2 - 2 \left(9 - \frac{9}{t+9} \right) + 9$	$t = -15 \text{ to } 0$
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Plot:



Differential equations

$$\frac{dy}{dt} = \frac{y^2}{9} - 2y + 9 \quad t = 0 \Rightarrow y(t) = 8$$

```
In[19]:= eq = y'[t] == y[t]^2/9 - 2 y[t] + 9
          con = y[0] == 8
          sol = NDSolve[{eq, con}, y, {t, -8, -2}]
          Plot[y[t] /. sol, {t, -8, -2}, PlotRange -> All]
```

```
Out[19]= y'[t] == 9 - 2 y[t] +  $\frac{y[t]^2}{9}$ 
```

```
Out[20]= y[0] == 8
```