

$$x(t) = 4t^3 + 2t^2 + t + 6$$

$$v(t) = \frac{dx}{dt} = \dot{x}(t) = 12t^2 + 4t + 1$$

$$a(t) = \frac{dv}{dt} = \dot{v}(t) = \ddot{x}(t) = 24t + 4$$

$$v(t) = 12t^2 + 4t + 1$$

$$t_0 = 0$$

$$x_0 = 6$$

$$a(t) = \frac{dv}{dt} = 24t + 4$$

$$x(t) = ?$$

$$v(t) = \frac{dx}{dt} \Rightarrow dx = \int v(t) dt$$

$$x_0$$

$$t_0$$

$$\Rightarrow x - x_0 = (4t^3 + 2t^2 + t + C) - (4t_0^3 + 2t_0^2 + t_0 + C)$$

$$\Rightarrow x(t) = 4t^3 + 2t^2 + t + 6$$

$$C_2 - C_1$$

$$C_1$$

$$v(t) = 12t^2 + 4t + 1$$

$$t_0 = 0$$

$$x_0 = 6$$

$$x(t) = ?$$

$$v = \frac{dx}{dt} \Rightarrow dx = v(t) dt$$

$$\Rightarrow \int dx = \int v(t) dt$$

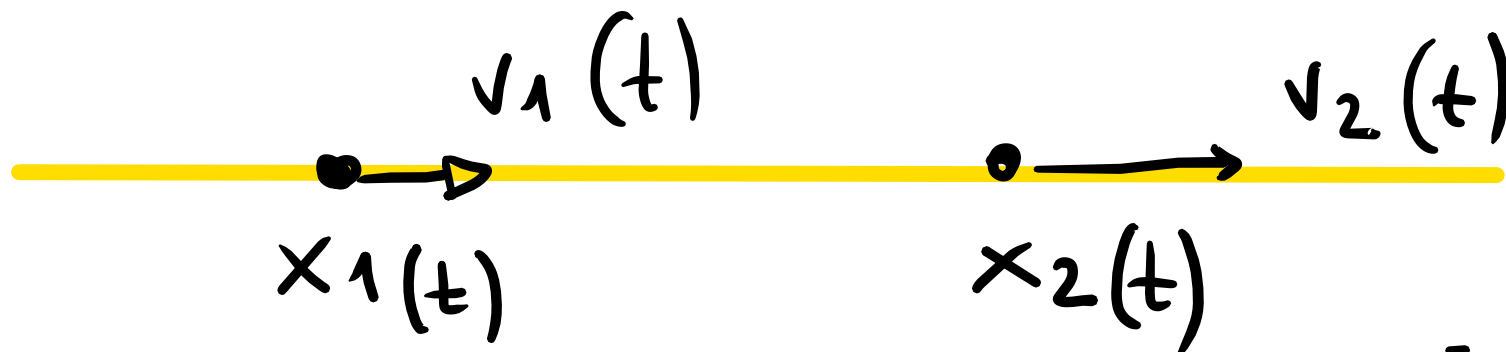
$$\Rightarrow x = 4t^3 + 2t^2 + t + \text{red arrow}$$

$$6 = \cancel{4 \cdot 0^3} + \cancel{2 \cdot 0^2} + \cancel{0} + C \leadsto \boxed{C = 6}$$

$$\boxed{x(t) = 4t^3 + 2t^2 + t + 6}$$

$$v(x)$$

$$v(t)$$



$$v = v(x)$$

$$x(t) = ?$$

$$\dot{v} = 2x$$

$$\int_{x_0}^x \frac{dx}{2x} = \int_{t_0}^t dt$$

$$\Leftrightarrow \frac{dx}{dt} = 2x$$

$$t - t_0 = \frac{1}{2} \ln(x/x_0)$$

$$v = 2\sqrt{x}$$

$$\{t_0 = 0, x_0 = 4\}$$

$$\frac{dx}{dt} = 2x^{1/2}$$

$$\Rightarrow \int \frac{dx}{2x^{1/2}} = \int dt \Rightarrow \frac{1}{2} x^{1/2} = t$$

$$a(t) = 2$$

$$v(t) = 2(t+2)$$

$$\rightarrow t = x^{1/2} + C$$

$$0 = 4^{1/2} + C$$

$$0 = 2 + C$$

$$\leadsto C = -2$$

$$t = x^{1/2} - 2 \Rightarrow x^{1/2} = t + 2$$

$$x = (t + 2)^2$$

$$a = a(x)$$

$$\{ a(x) = 3x^2 \}$$

$$a = \frac{dv}{dt} \cdot \frac{dx}{dx} = \frac{dv}{dx} \cdot \left(\frac{dx}{dt} \right) = \frac{dv}{dx} \cdot v$$

$$a = 3x^2 \Rightarrow \frac{dv}{dx} \cdot v = 3x^2 dx$$

$$\int v dv = \int a(x) \cdot dx \Rightarrow \frac{v^2}{2} = \int a(x) dx$$

$$y(t)$$

$$z = z(t)$$

$$\frac{dy}{dz} =$$

$$\frac{dy}{da} \cdot \frac{da}{db} \cdot \frac{db}{dc} \cdot \frac{dc}{dz}$$

$$\left(\frac{dy}{dz} \right) = \left(\frac{dy}{dt} \right) \left(\frac{dt}{dz} \right) = y'(t) \cdot \frac{1}{z'(t)}$$

$$a = a(x)$$

$$\frac{dv}{dt} = a(x) \Rightarrow \frac{dv}{dx} \cdot \left(\frac{dx}{dt} \right) = a(x)$$

$$\Rightarrow \frac{dv}{dx} \cdot v = a(x)$$

$$\underline{v = v(x)}$$

$$\Rightarrow \underline{v dv = a(x) dx}$$

$$\underline{a = 6\sqrt[3]{x} = 6x^{1/3}}$$

$$\{t_0 = 2, x_0 = 27, v_0 = 27\}$$

$$a = 6x^{1/3} \Rightarrow \frac{dv}{dt} = 6x^{1/3} \Rightarrow \frac{dv}{dx} \left(\frac{dx}{dt} \right) = 6x^{1/3}$$

$$\begin{aligned} 3^6 &= \cancel{6}^3 \cdot 3^4 \cdot \cancel{4}^3 + C \leadsto \begin{matrix} 6 & 6 \\ 3 & = 3 + C \end{matrix} \\ \cancel{2}^2 & \leadsto \begin{matrix} 6 & 6 \\ 3 & = 3 + C \end{matrix} \\ v^2 &= 9x^{4/3} \leadsto \boxed{v = 3x^{2/3}} \\ &\leadsto C = 0 \end{aligned}$$

$$\begin{aligned} \frac{dv}{dx} \cdot v &= 6x^{1/3} \\ \int v dv &= \int 6x^{1/3} dx \end{aligned}$$

$$\frac{27^2}{2} = 6 \cdot 27^{4/3} \cdot \frac{3}{4} + C$$

$$\Rightarrow \frac{v^2}{2} = 6x^{4/3} \cdot \frac{3}{4} + C$$

$$v(x) = 3x^{2/3} \Rightarrow \frac{dx}{dt} = 3x^{2/3} \Rightarrow \left(\frac{dx}{x^{2/3}} = 3 dt \right)$$

$$x = (t+1)^3 \leadsto (t+1) = \sqrt[3]{x}$$

$$v = 3(t+1)^2$$

$$a = 6(t+1)$$

$$a = 6\sqrt[3]{x}$$

$$\Rightarrow 3x^{1/3} + C = 3t$$

$$3 \cdot 27^{1/3} + C = 3 \cdot 2$$

$$\Rightarrow 3 \cdot 3 + C = 6 \Rightarrow C = -3$$

$$3x^{1/3} - 3 = 3t \Rightarrow x^{1/3} - 1 = t$$

$$\Rightarrow x = (t+1)^3$$

$$\underline{a = a(v)} \Rightarrow \frac{dv}{dt} = Sv \Rightarrow \int \frac{dv}{v} = \int S dt \quad \text{with } a = Sv$$

$$x = x(v) \Rightarrow \ln v = St + C \rightarrow 0$$

$$\boxed{x = 3v} \leadsto v = \frac{x}{3}$$

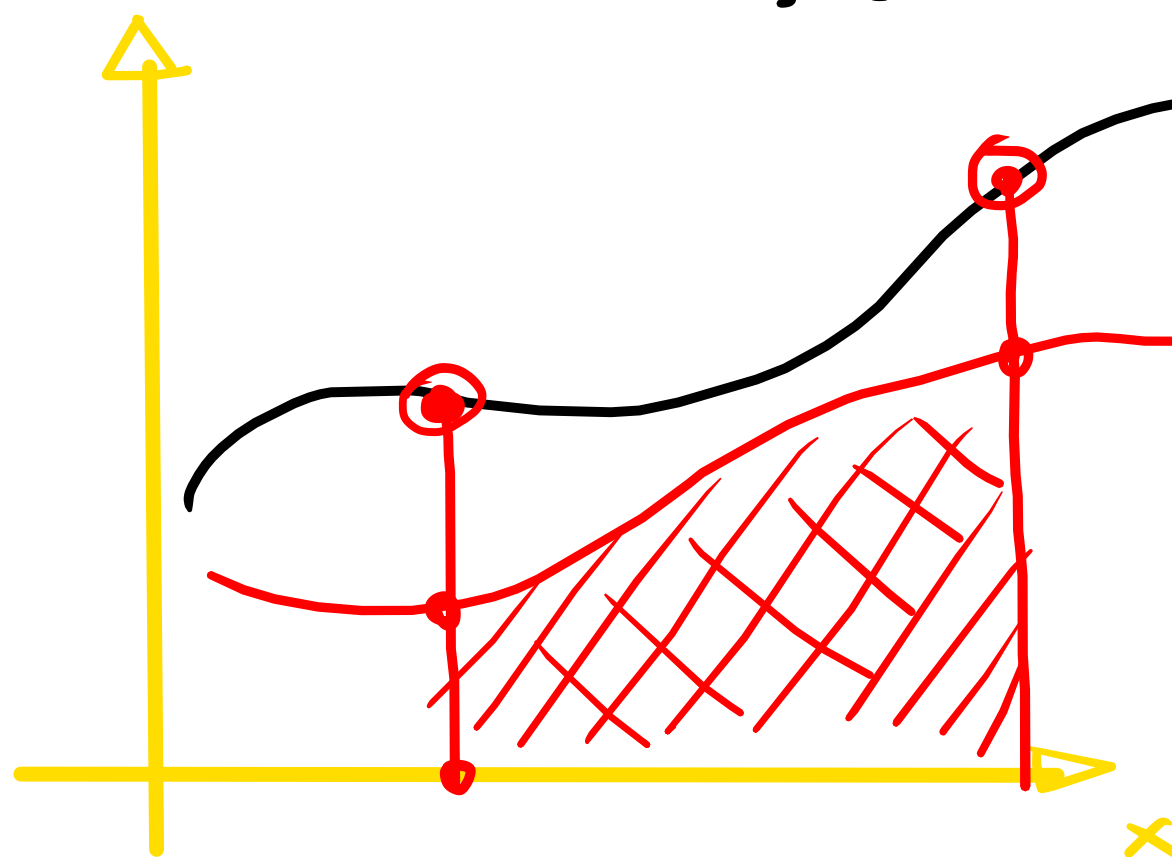
$$3 \frac{dx}{dt} = x$$

$$a = \frac{dv}{dt} = S \cdot e^{St} = Sv$$

$$\ln v = St \Rightarrow \boxed{v = e^{St}}$$

$f(x)$

$g(x) = f'(x)$



$g(x)$

$f(x) = ?$

$$f(x) = \int_a^b g(x) dx$$