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Quiz – January 24, 2006

Find the length of

$$\begin{cases} x = \frac{1}{3}t^3 \\ y = \frac{1}{2}t^2 \end{cases}$$

for $0 \leq t \leq 1$.

Answer: The arc length is equal to

$$\begin{aligned} \int_0^1 \sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2} dt &= \int_0^1 \sqrt{(t^2)^2 + (t)^2} dt = \int_0^1 t\sqrt{t^2 + 1} dt \\ &= \frac{1}{2} \frac{2}{3} (t^2 + 1)^{3/2} \Big|_0^1 = \boxed{\frac{1}{3}((2)^{3/2} - 1)}. \end{aligned}$$