MAT137

- Today: The chain rule.

- Homework before Wednesday's class: watch videos 3.12, 3.13.

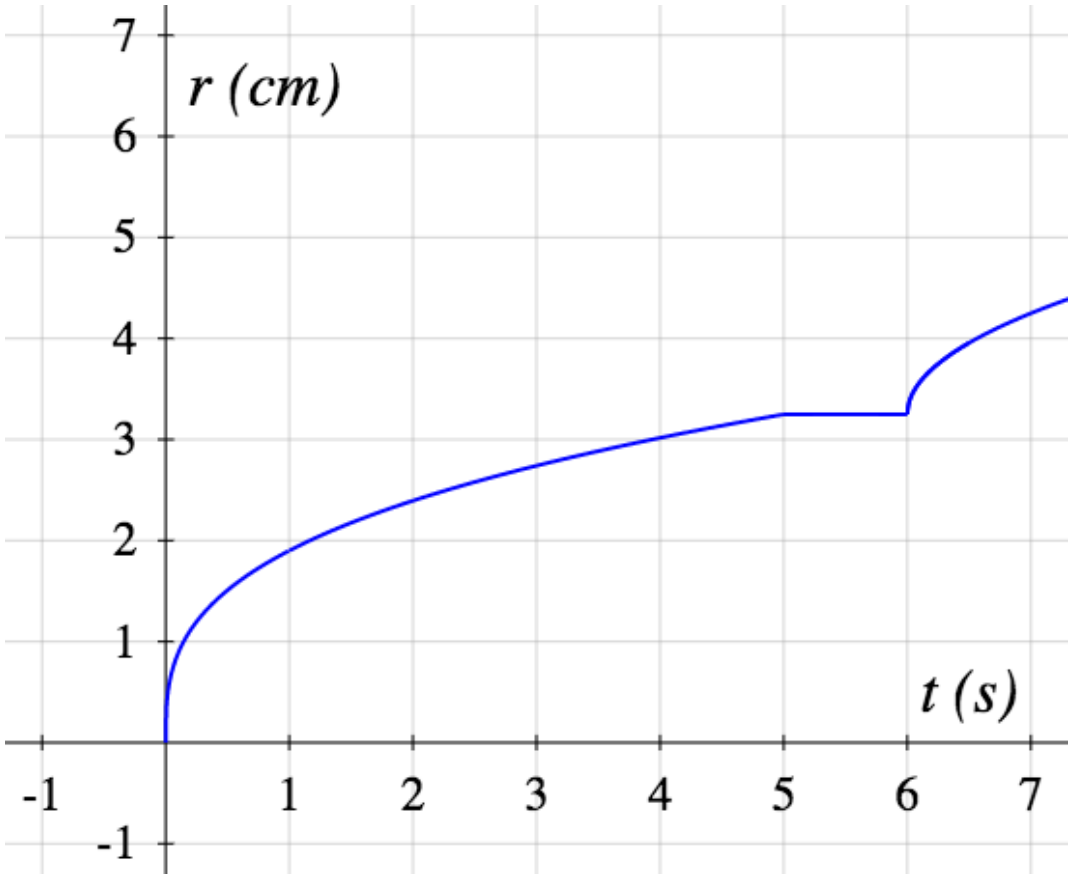
Computations

Compute the derivative of

1. $f(x) = \sqrt{2x^2 + x + 1}$
2. $f(x) = \sqrt{x + \sqrt{x + \sqrt{x + 1}}}$

Balloon

I am inflating a spherical balloon. Below is the graph of the radius r (in cm) as a function of time t (in s). At what rate is the volume of the balloon increasing at time $4s$?



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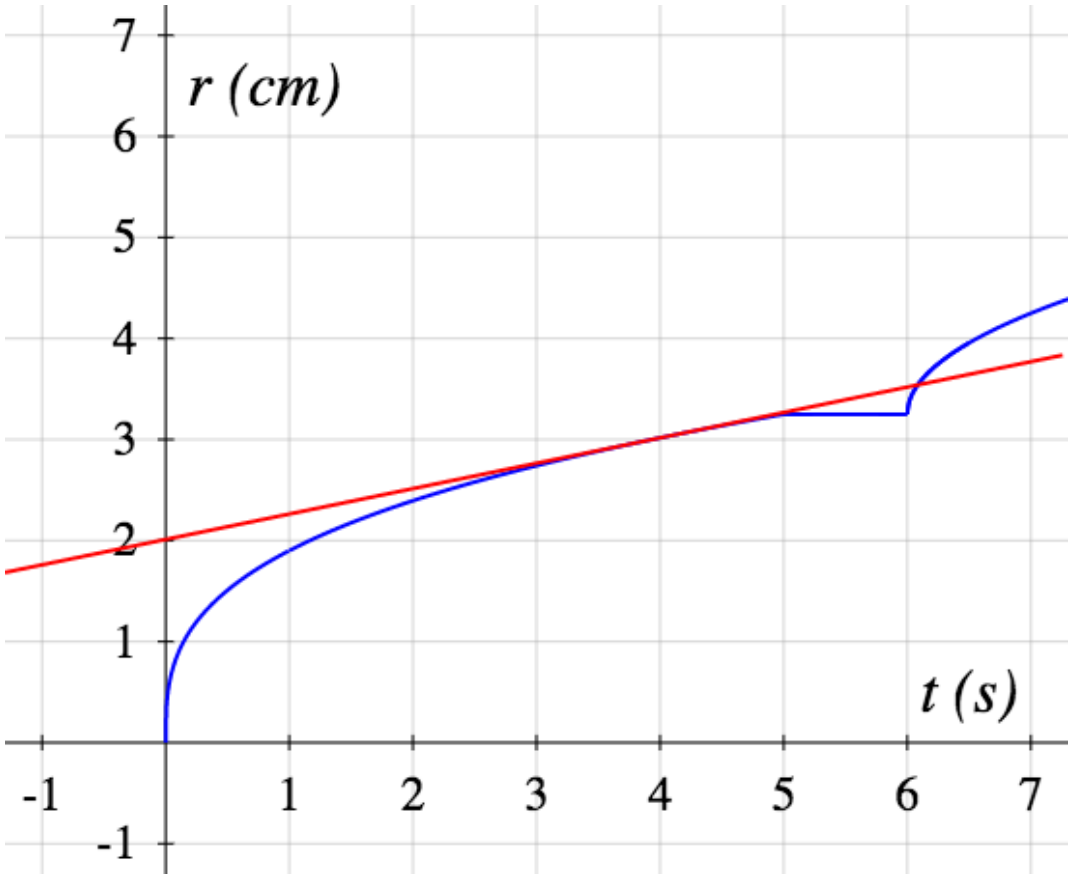

A different proof for the quotient rule

Assume we have already proven the product rule, the power rule, and the chain rule.

Obtain a formula for the derivative of $h(x) = \dfrac{f(x)}{g(x)}$.

Hint: $\dfrac{f(x)}{g(x)} = f(x) \cdot g(x)^{-1}$

A pesky function

Let $h(x) = x^2 \sin \frac{1}{x}$.

1. Calculate $h'(x)$ for any $x \neq 0$.
2. Using the definition of derivative, calculate $h'(0)$.
3. Is h continuous at 0?
4. Is h differentiable at 0?
5. Is h' continuous at 0?

Hint: The last two questions have different answers.

Derivatives of $(f \circ g)$

Assume f and g are functions that have all their derivatives.
Find formulas for

1. $(f \circ g)'(x)$
2. $(f \circ g)''(x)$
3. $(f \circ g)'''(x)$

in terms of the values of f, g and their derivatives.

Hint: The first one is simply the chain rule.