# In-class Activity 6

Chain Rule

**Question 1** Complete the following differentiation formulas:

- $\dfrac{\mathrm{d}}{\mathrm{d}x}c =$
- $\dfrac{\mathrm{d}}{\mathrm{d}x}x^n =$
- $\dfrac{\mathrm{d}}{\mathrm{d}x}\sin(x) =$
- $\dfrac{\mathrm{d}}{\mathrm{d}x}\cos(x) =$
- $\dfrac{\mathrm{d}}{\mathrm{d}x}e^x =$
- $\dfrac{\mathrm{d}}{\mathrm{d}x}\ln(x) =$
- $\dfrac{\mathrm{d}}{\mathrm{d}x}\tan(x) =$
- $(f(x)+g(x))' =$
- $(f(x)-g(x))' =$
- $(cf(x))' =$
- $(f(x)g(x))' =$
- $\left(\dfrac{f(x)}{g(x)}\right)' =$

**Question 2**
Write the formula for the **CHAIN RULE**:

$$\Big(f\big(g(x)\big)\Big)' =$$

Now use it to compute the following derivatives:

- $\Big((x^6+2x+3)^5\Big)' =$
- $\Big(e^{-10x}\Big)' =$
- $\Big(\sin(x^6+7)\Big)' =$
- $\Big(\cos^9(x)\Big)' =$
- $\left(\dfrac{1}{\ln(x)}\right)' =$
- $\Big(\sqrt{x^3-x+\sin(x)}\Big)' =$

**Question 2**
Complete the following formula for the generalized chain rule:

$$\Big(f\big(g(h(x))\big)\Big)' =$$

Now use it to compute the following derivatives:

- $\left(\sqrt[3]{e^{x^2-7}}\right)' =$

- $\left(\sin^4\left(3x\right)\right)' =$

**Question 4**
Compute the following derivatives by combining the appropriate rules:

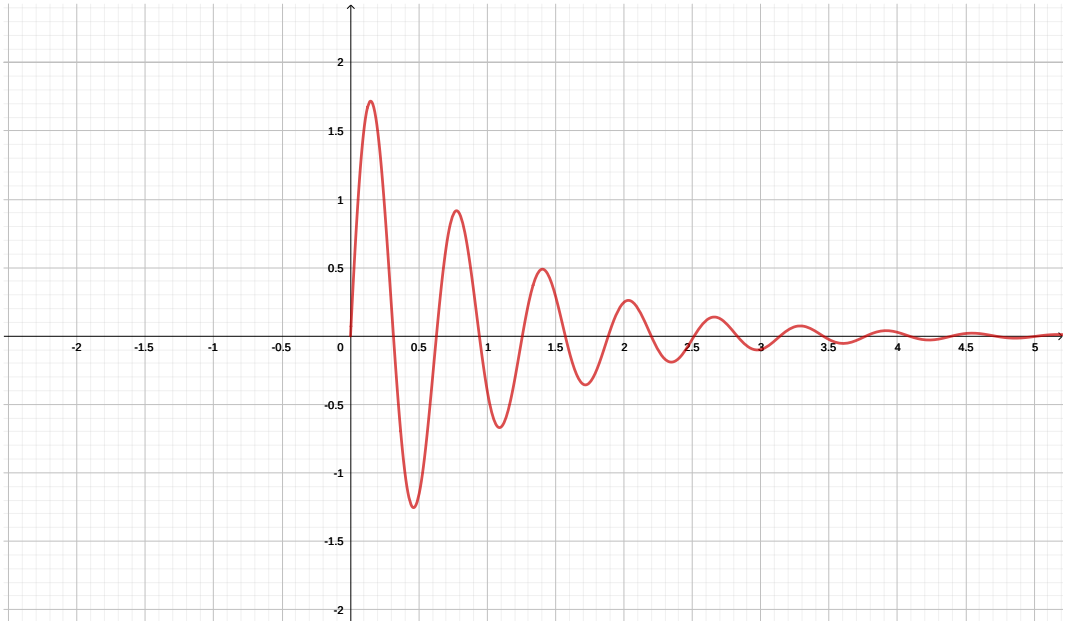
- $\left(x^3 e^{9x}\right)' =$

- $\left(\dfrac{e^{-x}+\ln(x)}{x\sin(\sqrt{x})}\right)' =$

- $\Big(\sec(x)\Big)' =$

**Question 5**

Below is the graph of the function $s(t) = 2e^{-t}\sin(10t)$ which describes the motion of a damped pendulum.




- Find the velocity function $v(t)$.

- Describe what happens to the motion of the pendulum after a very large period of time by employing limits at infinity. In particular compute $\lim_{t\to\infty} s(t)$ and $\lim_{t\to\infty} v(t)$.