Name:_____

Notesheet. Section 3.5: Higher Order Derivative

Math 1210

Definition 1. A second derivative of a function $f(x)$ is

Definition 2. Similarly, a higher-order derivative of a function $f(x)$ is

Challenge 3. What is the second derivative of $f(x) = x^5 + 2x^4 + 3x^2 + 7x + 17$? What is the third derivative of $f(x) = \frac{2}{21}x^{\frac{7}{2}}$?

Challenge 4. Acceleration is defined to be the rate of change in velocity. If a car is driving at a constant speed of 16 meters per second, what is its acceleration? At time $t = 0$, a car going $16\,\frac{\text{m}}{\text{s}}$ slams the brake and its position is measured by the function

$$x(t) = -4t^2 + 16t, \quad 0 \leq t \leq 2$$

What is the velocity of the car over time? What is the acceleration of the car over time? How far did the car travel from $t = 0$ to when the car came to a stop?

Challenge 5. In fall of 1972 during a time of massive inflation, President Nixon famously said "the rate of increase of inflation is going down." This convoluted statement can be understood using calculus. One definition of inflation is the change in the average price of goods and services. Thus, if $C(t)$ is the average price of goods and services, what is inflation in terms of $C(t)$? What does "the rate of increase of inflation is going down" mean in terms of $C(t)$?

Challenge 6. Any quadratic function $f(x)$ acheives either a maximum or a minimum when $f'(x) = 0$. Let

$$h(x) = x^2 + 6x + 17, \quad g(x) = -x^2 + 4x - 20$$

For which x do $h(x)$ and $g(x)$ achieve minimum or maximum values? What is $h''(x)$ and $g''(x)$ at those values?

Challenge 7. A ball is dropped from the top of a 125 meter tower. The distance the ball falls is given by

$$d(t) = 5t^2$$

What is the ball's velocity when it hits the ground?