Exercise set 6.3

1. **The basics** Consider the function $f(x) = 1 + x^2 + x^3 + x^4 + x^5 + x^6$.
   a. What is its rate of change when x is 0?
   b. What is its rate of change when x is 1?
   c. What is its second derivative?
   d. What is its fifth derivative?

2. **Higher order derivatives** Find $f'''(x)$ if $f(x) = 6x^5 - 4x^2$.

3. **Graphing** Where does the graph of $y = \dfrac{x^2 + 9}{x}$ have a horizontal tangent line?

4. **HIV density** The viral load for a particular HIV patient undergoing treatment using ABT-538 is modeled by the function,

$$V = 96.39785(0.818656)^t$$

   Where V is the viral load measured in RNA copies per mL and t is the time in days since treatment began. Find $V'(1)$ and $V'(10)$ and interpret them.

5. **Ice and water** Why does ice float on water? Because the density of ice is lower! In fact, water is the only common liquid whose maximal density occurs above its freezing temperature, and this has important biological implications, e.g. stratification of water in lakes by temperature, and preventing ice from forming at the bottoms of lakes and them freezing solid. Between 0°C and 30°C the volume V (in cubic centimetres) of 1 kg of water at a temperature T is given by the formula,

$$V = 999.87 - 0.06426T + 0.0085043T^2 - 0.0000679T^3$$

   Find the temperature at which water has its maximum density.[1]

6. **EVT** Find the maximum and minimum values of $f(x) = x - 2\sin x$ on the interval $[0, 2\pi]$.

[1] *Hint*: Maximizing the density is equivalent to minimizing the volume.