1. Differentiate each of the following functions.

    (a) (8 points) $F(x) = (e^{3x} + x^2)^5$

    (b) (8 points) $G(x) = \dfrac{(2x + 1)^5}{(3x - 1)^4}$

2. (8 points) Use log rules to simplify the following expression for $f(x)$. Then find $f'(x)$.

$$f(x) = \ln\left(\frac{(x^2+1)e^x}{\sqrt{x}}\right)$$

3. (12 points) Use implicit differentiation to find an equation for the tangent line to the following curve at the point $(1, 2)$.

$$x^2 + 2xy - y^2 + x = 2$$

4. (12 points) A spherical snowball with radius r and volume $V = \frac{4}{3}\pi r^3$ begins to melt at 9am. At 10am the volume is 36π cubic inches and the volume is decreasing at a rate of 1 cubic inch per minute. What is the rate of change of the radius at that time?

5. (16 points) Let $f(x) = x^4 - 4x^3$.

   (a) Find the intervals on which f is increasing/decreasing.

   (b) List any/all local maximums and minimums.

   (c) Find the intervals on which f is concave up/down.

   (d) List any/all inflection points for the graph $y = f(x)$.

   (e) Use the information from parts (a)-(d) to sketch (roughly) the graph $y = f(x)$.