1. (27 points) The following two problems are not related.

   (a) Suppose that A and B are constants. Find the derivative of $h(x) = \dfrac{A\sin(x)}{x} + \tan(Bx)$. (Please do not simplify your final answer.)

   (b) Consider $s(x) = \sqrt{x^2+1} \cdot \cos x$.

   i. Find the value of $s'\left(\dfrac{\pi}{2}\right)$.

   ii. Find the formula for the linearization of $y = s(x)$ at $a = \dfrac{\pi}{2}$. (Please do not simplify your final answer. Your final answer will be in terms of π.)

   iii. Use your linearization from (ii) to approximate $s\left(\frac{3}{2}\right)$. (Please do not simplify your final answer. Your final answer will be in terms of π.)

2. (16 points) Consider the curve defined by $8x + 2xy + y^3 = 11$. Complete the following.

   (a) Find y' at the point $(1, 1)$.

   (b) Find y'' at the point $(1, 1)$.

3. (18 pts) Given $f(x) = x^{4/3} + 4x^{1/3} + 4x^{-2/3}$

   (a) Determine the x-coordinate(s) for all critical number(s) of f.

   (b) Determine the interval(s) where f is decreasing.

   (c) Determine the x-coordinate(s) of all local maxima and minima of f. (Clearly indicate which x-coordinates correspond to a local maximum and which correspond to a local minimum.)

4. (13 points) Consider $g(x) = 3\sqrt{4-x} + 5$. Use the definition of the derivative to show that $g'(x) = \dfrac{-3}{2\sqrt{4-x}}$. (Note: You must use the definition of the derivative to earn any credit on this problem.)

5. (13 points) Ralphie is riding his bicycle east away from an intersection at 12 kilometers per hour when he is 2 kilometers east of the intersection. Chip is also riding a bicycle, but he is heading south towards that same intersection at a speed of 17 kilometers per hour when he is 3 kilometers north of the intersection. What is the rate of change of the straight-line distance between Ralphie and Chip at that moment? Include the correct unit of measurement in your answer.

6. (13 points) Suppose that $r(0) = 2$ and $r'(x) \leq 6$ for all values of x. How large can $r(3)$ possibly be? Correctly use a theorem to justify your answer. (You should state the name of the theorem used and clearly show that its hypotheses are satisfied.)