INSTRUCTIONS: Books, notes, and electronic devices are **not** permitted. Write **your full name** on every piece of paper that will be uploaded to gradescope. Do all problems. **Start each problem on a new page.** $\boxed{\textbf{Box}}$ **your answers.** A correct answer with incorrect or no supporting work may receive no credit, while an incorrect answer with relevant work may receive partial credit. **Justify your answers, show all work. Only use techniques from sections 1.1-3.7.**

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1. (20pts) Short answer. Box your answer. No justification required.

   (a) True or False: Newton's Method will always converge to the desired answer (i.e $\lim_{n\to\infty} x_n = r$)?

   (b) For the function $f(x) = x^3 + 1345$ does the point at $(0, 1345)$ have any significance (in the curve sketching sense) other than being a y-intercept?

   (c) Suppose you know for some function $f(x)$ that $f(r) = 0$, that is $x = r$ is a root of the function $f(x)$. If you are using Newton's method applied to $f(x)$ and let $x_1 = r$ what is x_2?

   (d) Find the most general antiderivative for $f'(x) = \sin(x) + 2x$

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2. (20pts) Sketch the curve in parts.

$$f(x) = \frac{1}{1+x^2}$$

   (a) Domain, Asymptotes, Symmetry, Intercepts

   (b) Interval of Increasing or Decreasing, location and value of Maxima/Minima

   (c) Intervals of Concavity

   (d) Sketch (indicate with a label any intercepts, max/mins, asymptotes, inflection points).

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3. (20pts) Show all work.
   Maximize the product of two positive numbers that sum to 300.

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4. (20pts) Show all work. Parts (a) and (b) are unrelated.

   (a) Use Newton's Method to find a solution to $\sin(x) = x$. Find x_2 given $x_1 = \pi/2$.

   (b) Set up the formula for x_{n+1} if using Newton's method to find a maxima/minima of a function $g(x)$.

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5. (20pts) Show all work.
   Given the acceleration of a particle moving in a straight line is $a(t) = 6t$, find the position function given $v(0) = 1$ and $s(1) = 0$.