AMAT112: Calculus I
Worksheet 5

Due: Announced in Class or via Brighstspace

—— Instructions ——

- This homework should be submitted in class or digitally on the date listed above.
- There are three main ways you might want to write up your work.
  - Write on this pdf using a tablet
  - Print this worksheet and write in the space provided
  - Write your answers on paper, clearly numbering each question and part.
    - If using either of the last two options, you can use an app such as Microsoft Lens to take pictures of your work with your phone and convert them into a single pdf file.
- **You must show all work**. You may receive zero or reduced points for insufficient work. **Your work must be neatly organised and written**. You may receive zero or reduced points for incoherent work.
- If you are writing your answers on anything other than this sheet, you should only have **one question per page**. You can have parts a), b) and c) on the page for example, but problems 1) and 2) should be on separate pages.
- **Put a box or circle around your final answer** for each question.
- The problems on this assignment will be **graded on correctness and completeness**.
- These problems are designed to be done without a calculator. Whilst there is nothing stopping you using a calculator when working through this assignment, be aware of the fact that you are not permitted to use calculators on exams so you might want to practice without one.

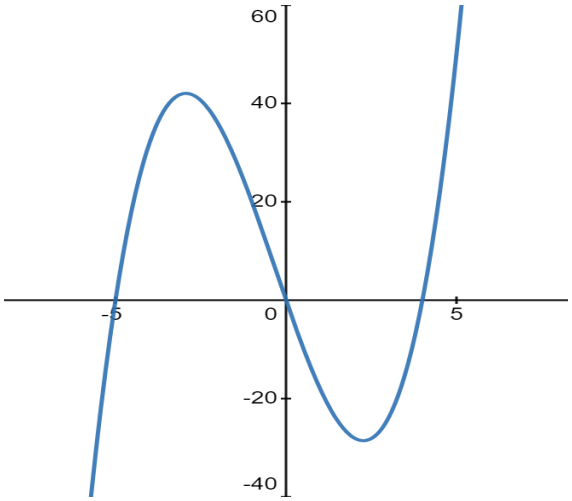
1. (a) A spherical water-tower of radius $15.1ft$ is half filled. Find the local linear approximation of the volume of water in the water-tower with $V(r) = \frac{2\pi}{3}r^3$ and $r = 15$.

   (b) Consider a different spherical water-tower whose radius is exactly 15 ft. Water is leaking out at a constant rate of $80\pi ft^3/sec$. Given that the volume of water in the water is $V(t) = \frac{\pi}{3} \cdot (h(t))^2(3R - h(t))$, where R is the radius of the water tower and $h(t)$ is the height of the water level, how fast is the water level dropping when the water level is at 10ft.

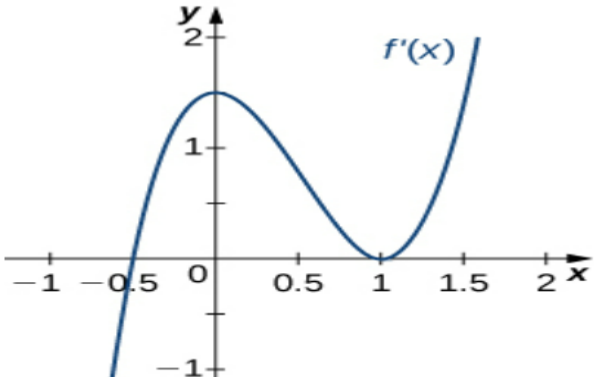
2. A company that produces cell phones has a cost function of $C(x) = (x-325)^2(x+452)^2 - 3.7 \times 10^9$, where $C(x)$ is cost in dollars and x is number of cell phones produced (in thousands). How many units of cell phone (in thousands) minimizes this cost function?

3. At 10:17 a.m., you pass a police car at 55 mph that is stopped on the freeway. You pass a second police car at 55 mph at 10:53 a.m., which is located 39 mi from the first police car. If the speed limit is 60 mph, can the police cite you for speeding?

4. (a) Given the graph of a function $f(x)$, graph $f'(x)$ and $f''(x)$.



(b) Below is the graph of $f'(x)$, graph $f(x)$ and $f''(x)$.



5. Without a calculator, draw the graph of the following function including horizontal and vertical asymptotes, local maxima and minima, and inflection points.

$$f(x) = \frac{(x-4)^2}{(x-2)^2}, \qquad f'(x) = \frac{4(x-4)}{(x-2)^3}, \qquad f''(x) = \frac{8(5-x)}{(x-2)^4},$$