**Math 152 Learning Target Quiz 6**

March 26, 2021

Name: _____

**Instructions:** Read the following instructions carefully.

- You do not need to complete every question. Choose the learning targets that are most important for you and focus on those.
- **You must show ALL of your work in order to earn full credit on any of the learning targets.**
- You may use any calculator you wish, so long as it does not have communications abilities (e.g., iPods, iPads, smartphones, laptops, etc.) or symbolic manipulation capabilities (e.g., TI-89).
- You may not use any notes, notecards, books, formula sheets, etc.
- Feel free to ask any questions you want – especially if instructions are unclear, or if you want advice about which learning targets to attempt.

| Learning Target | Assessment | Learning Target | Assessment |
|:---:|:---:|:---:|:---:|
| 1 | | 8 | |
| 2 | | 9 | |
| 3 | | 10 | |
| 4 | | 11 | |
| 5 | | 12 | |
| 6 | | 13 | |
| 7 | | CE | |

**Given information about a function (either a table of data or a graph), answer questions about its average and/or instantaneous rates of change.**

    1.

**Sketch a graph that has specific behaviors at indicated points and intervals.**

2. Sketch the graph of a function satisfying: $f(0) = 0$; $f'(x) > 0$ for all $x$; and $f''(x) < 0$ for $x < 0$ and $f''(x) > 0$ for $x > 0$.

**Make sure to label your grid with an appropriate scale!**
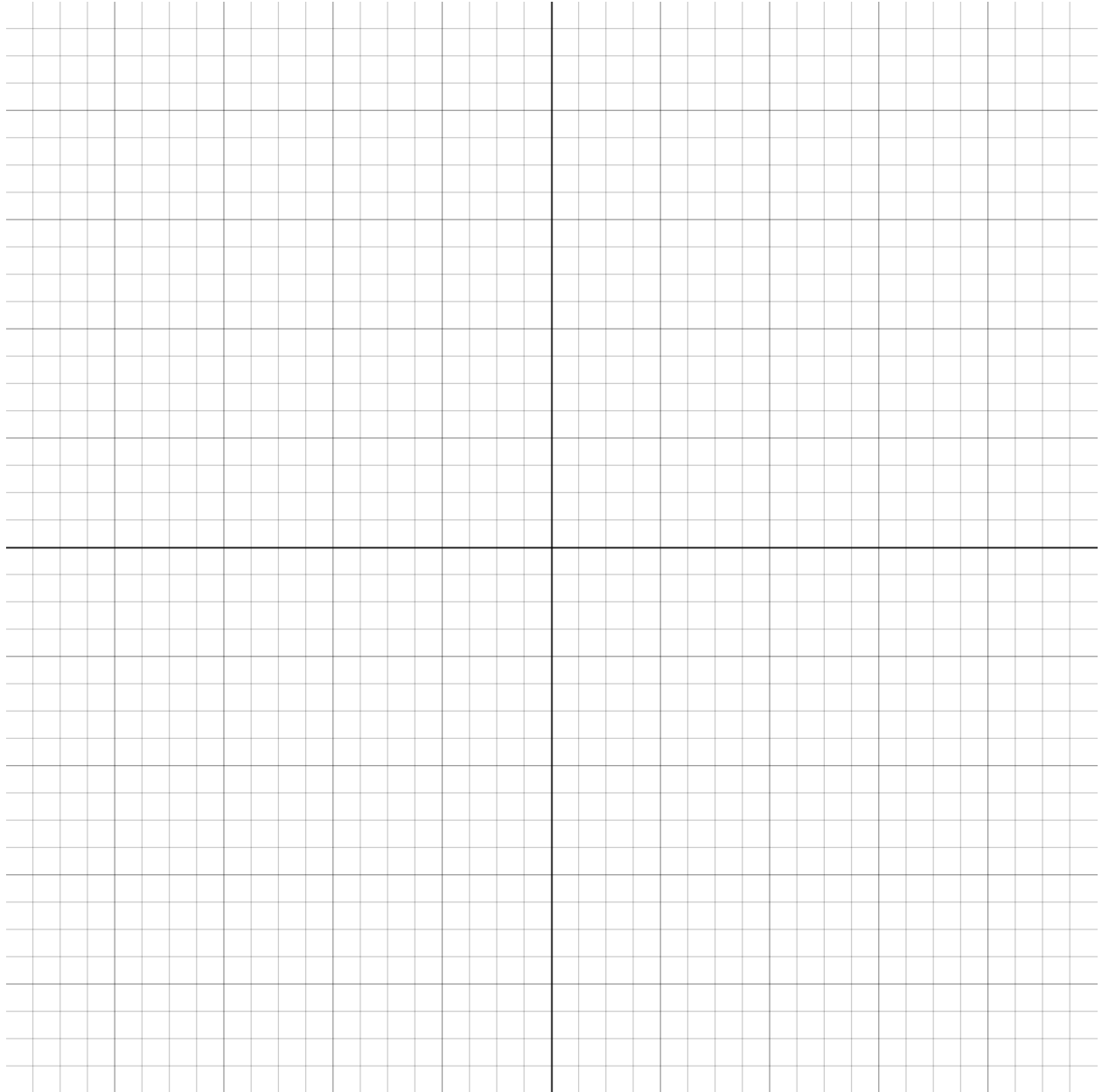
**Given the graph of a function, answer questions about the function, its derivative, and its second derivative.**

3. Consider the graph of $f(x)$ below. At which of the marked value(s) of $x$, if any, is

    a. $f(x)$ greatest?
    b. $f(x)$ least?
    c. $f'(x)$ positive?
    d. $f'(x)$ negative?
    e. $f''(x) = 0$?

**Note that there may be more than one answer.** You should clearly explain why your identified point satisfies the stated condition.
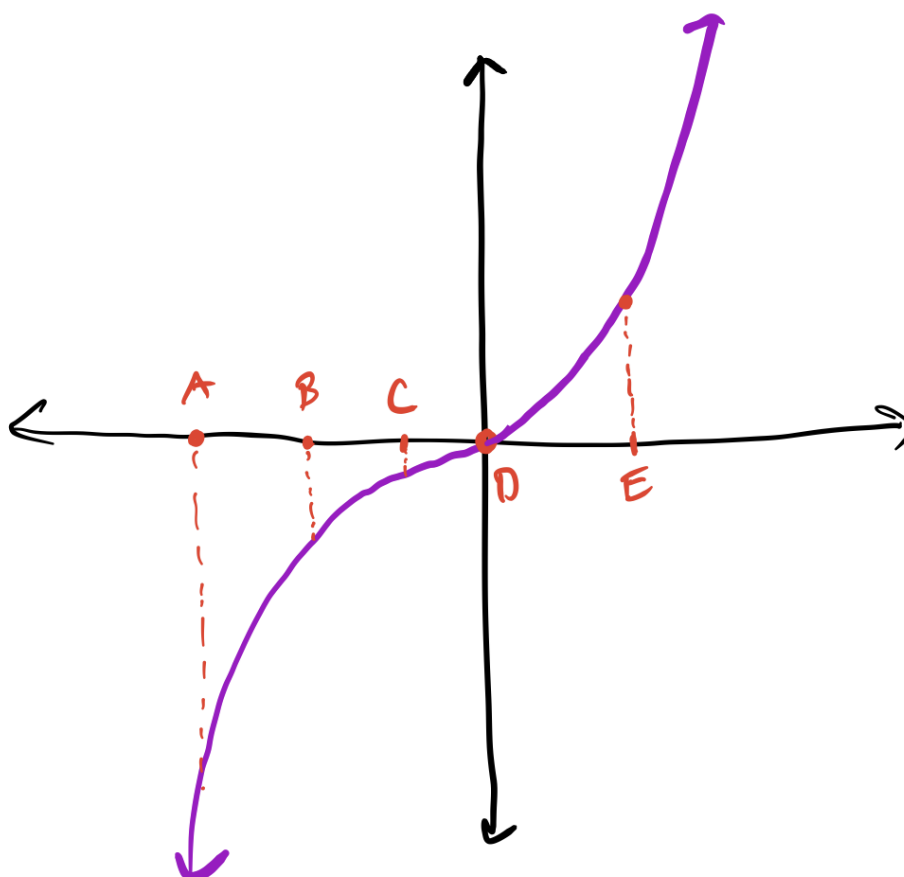
**Use the limit definition to find the derivative function.**

4. Recall that $f'(x) = \lim\limits_{h \to 0} \frac{f(x+h)-f(x)}{h}$. Use the limit definition to calculate the derivative of $f(x) = x^2 + 2x + 1$. Note: to earn credit, you are required to use the limit definition, but may check your work using appropriate derivative rules if you would like.

**Use the central difference and other estimation techniques to answer questions about applications of the derivative.**

5. The data below give an estimate for the population of the world, $P(t)$, in millions, where $t$ is measured in years and $t = 0$ corresponds to the year 1900. Use a central difference to estimate $P'(70)$. Then interpret your answer in the context of the problem.

| $t$ (density) | 0 | 20 | 40 | 60 | 80 |
|---|---|---|---|---|---|
| $P(t)$ (speed) | 1650 | 1860 | 2300 | 3040 | 4450 |

**Given the graph of the derivative, answer questions about the function, the first derivative, and the second derivative.**

6. Consider the graph of a derivative below.

   a. State an interval on which the **original function** is increasing.
   b. State an interval on which the **original function** is decreasing.
   c. Give the location of a point of inflection of the original function, or explain why none exist.
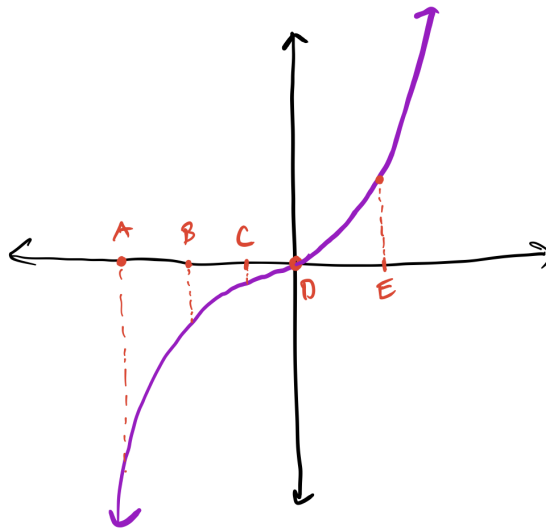
**Given the graph of a function, determine the values of indicated limits.**

    7.

**Given the graph of a function, determine the $x$-values where the function is not continuous and the points where it is not differentiable.**

8.

**Find a local linearization, use it to estimate the function at a nearby point, and answer questions about the accuracy of that estimate.**

9. Given $f(x) = \ln(x)$, it is known that $f'(x) = \frac{1}{x}$.

    a. Calculate the local linearization $L(x)$ at $a = 1$.

    b. Use your answer from part (a) to estimate $\ln(0.9)$.

**Find the equation of a tangent line.**

10. Find the equation of the line tangent to $g(x)$ at $x = 5$ if $g'(5) = 4$ and $g(5) = -3$.

**Given information about two or more functions (either graphs or values, but not the equations), answer questions about new functions involving those functions and their derivatives.**

11. Values of $f, f', g$, and $g'$ are given in the table. Let $u(x) = f(g(x))$ and $v(x) = f(x)/g(x)$.

   a. Find $u'(1)$.

   b. Find $v'(3)$.

| | $f(x)$ | $f'(x)$ | $g(x)$ | $g'(x)$ |
|---|---|---|---|---|
| $x = 1$ | 3 | 4 | 2 | 6 |
| $x = 2$ | 1 | 5 | 8 | 7 |
| $x = 3$ | 7 | 7 | 2 | 9 |

**Find $dy/dx$ for a function given implicitly.**

12. Find $\frac{dy}{dx}$ given $e^{x-y} = 2x^2 - y^2$.

**Use L'Hopital's Rule to evaluate limits involving indeterminate forms.**

13. Calculate $\lim\limits_{x \to \pi/2} \frac{\cos(x)}{\sin(x)}$.