

*I pledge that I have neither given nor received
unauthorized assistance during this examination.*

Signature:

- **DON'T PANIC!** If you get stuck, take a deep breath and go on to the next question.
- Unless the problem says otherwise **you must show your work** sufficiently much that it's clear to me how you arrived at your answer.
- You may use a scientific calculator on this exam, but you may not use a graphing calculator.
- You may bring a two-sided sheet of notes on letter-sized paper in your own handwriting.
- There are 6 problems on 9 pages.

Question	Points	Score
1	16	
2	18	
3	16	
4	10	
5	14	
6	9	
Total:	83	

Good luck!

[16 points] 1. (a)

$$\lim_{x \rightarrow 9} \frac{\sqrt{x} - 3}{x - 9} =$$

(b)

$$\lim_{y \rightarrow \infty} \frac{y^2 + y - 5}{1 - 2y - y^3} =$$

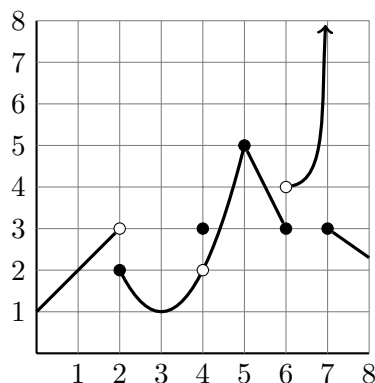
(c)

$$\lim_{x \rightarrow -\infty} \frac{3x^2 - 6x + 2}{2x^2 - 9} =$$

(d)

$$\lim_{t \rightarrow 3} \frac{t^2 - t + 1}{2t^2 - 8} =$$

[18 points] 2. Here is the graph of a function $f(x)$ on the domain $0 \leq x \leq 8$:



In the following questions, you do not need to justify your answers.

- (a) List all values of x where $f'(x) = 0$.
- (b) Compute the following limits. If they don't exist, say so.
- $\lim_{x \rightarrow 2} f(x) =$
 - $\lim_{x \rightarrow 4} f(x) =$
 - $\lim_{x \rightarrow 5} f(x) =$
 - $\lim_{x \rightarrow 6^-} f(x) =$
 - $\lim_{x \rightarrow 6^+} f(x) =$
 - $\lim_{x \rightarrow 7} f(x) =$
- (c) Circle true or false in the following questions. You do not need to justify your answers.
- | | | |
|---|------|-------|
| (i) $f(x)$ is continuous at $x = 1$. | True | False |
| (ii) $f(x)$ is continuous at $x = 2$. | True | False |
| (iii) $f(x)$ is continuous at $x = 3$. | True | False |
| (iv) $f(x)$ is continuous at $x = 4$. | True | False |
| (v) $f(x)$ is continuous at $x = 5$. | True | False |
| (vi) $f(x)$ is continuous at $x = 6$. | True | False |
| (vii) $f(x)$ is continuous at $x = 7$. | True | False |
- (d) Estimate the following derivatives as best you can from the graph. If the derivative does not exist, say so.
- $f'(1) =$
 - $f'(2) =$
 - $f'(3) =$

[16 points] 3. (a) Find the equation for the tangent line to the graph $y = x^2 - 5x + 1$ at $x = 3$.

(b) Compute $\frac{d}{dt} \left(\frac{e^t}{t^3} \right)$.

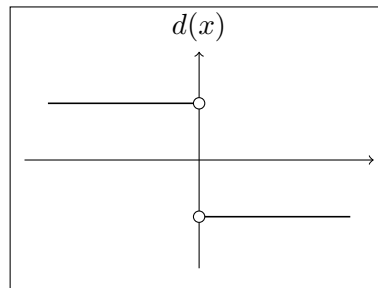
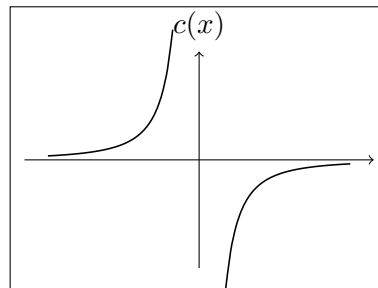
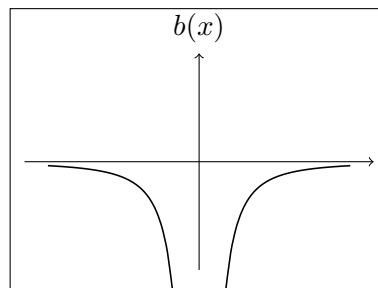
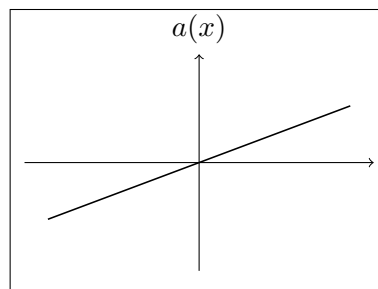
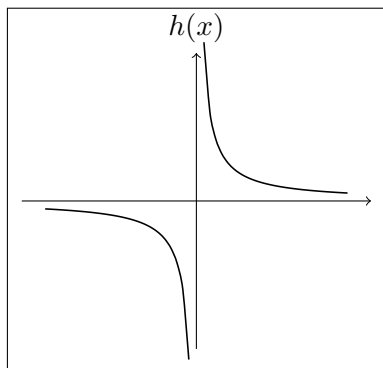
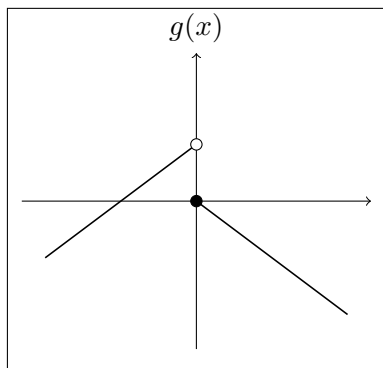
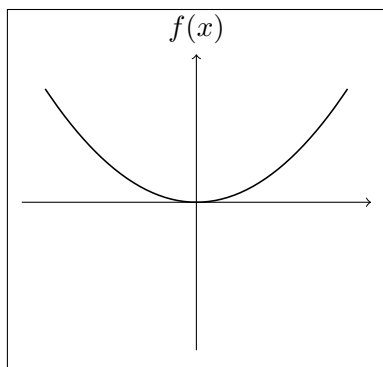
- [10 points] 4. Let $f(t) = \frac{4}{1+5t}$. Directly using the definition of the derivative, find $f'(-1)$.
Warning: You will receive no credit for using differentiation rules. You must use limits to compute the derivative directly from the definition.

[14 points] 5. Let $g(x) = x^3 + 3x^2 - 9x + 1$.

(a) What is the average rate of change of $g(x)$ from $x = 0$ to $x = 2$?

(b) Find all x -coordinates where the tangent line to $g(x)$ is horizontal.

[9 points] 6. On the left are three functions $f(x)$, $g(x)$, and $h(x)$. On the right are four functions, $a(x)$, $b(x)$, $c(x)$, and $d(x)$.



Circle one answer for each question:

- | | | | | | |
|------------------------------------|--------|--------|--------|--------|-------------------|
| (a) The derivative of $f(x)$ is... | $a(x)$ | $b(x)$ | $c(x)$ | $d(x)$ | none of the above |
| (b) The derivative of $g(x)$ is... | $a(x)$ | $b(x)$ | $c(x)$ | $d(x)$ | none of the above |
| (c) The derivative of $h(x)$ is... | $a(x)$ | $b(x)$ | $c(x)$ | $d(x)$ | none of the above |

This page can be used as scratch paper.