Homework 4 - Math 140 **Name:** _____

Due by 5:00pm Monday, March 15. Send a PDF with your solutions to `blins@hsc.edu`.

Calculate the following limits.

1. $\lim_{x\to 0^+} \dfrac{x-3}{x}$

2. $\lim_{x\to 2} |x+3|$

3. $\lim_{x\to 3^+} \sqrt{x-3}$

4. $\lim_{x\to 5^-} \dfrac{1}{x(x-5)}$

5. $\lim_{x\to 2} \dfrac{x^2+3x-10}{x^2-5x+6}$

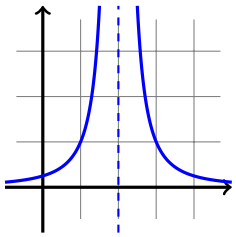
6. $\lim_{x\to -4} \dfrac{x^2+5x+4}{x+4}$

7. $\lim_{x\to 0} \dfrac{x^3+3x^2-4x}{x^2-4x}$

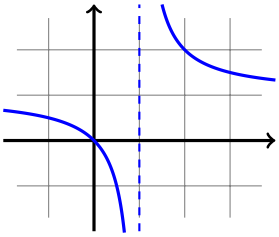
8. $\lim_{x\to 1} \dfrac{x^2-2x+1}{2x+3}$

Use the graphs below to find the given limits without calculating anything.

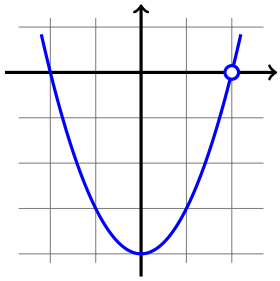
9. $\lim_{x\to 2} \dfrac{1}{x^2-4x+4}$



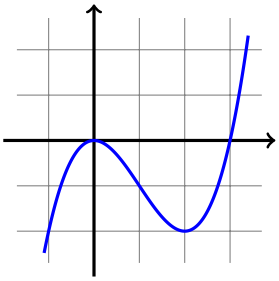
10. $\lim_{x\to 1} \dfrac{x}{x-1}$



11. $\lim_{x\to 2} \dfrac{x^3-2x^2-4x+8}{x-2}$



12. $\lim_{x\to 2} \dfrac{x^3-3x^2}{2}$



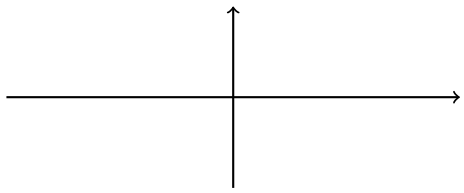
Use the definition of derivative to find the derivatives of the following functions.

13. $f(x) = 5x$

14. $f(x) = \dfrac{1}{x}$

In math, the sign(x) function returns 1 if x is positive, 0 if x is exactly zero, and -1 if x is negative.

15. Draw a graph of $y = \text{sign}(x)$. What kind of discontinuity does sign(x) have at $x = 0$?



Using the function sign(x)*, calculate the following.*

16. sign(-3)

17. sign(0)

18. $\lim_{x \to 4} \text{sign}(x)$

19. $\lim_{x \to 0^-} \text{sign}(x)$

20. $\lim_{x \to 0^+} \text{sign}(x)$

21. $\lim_{x \to 0} \text{sign}(x)$

In 2021, the Virginia state income tax for individuals is calculated as follows.

Taxable Income	Tax Calculation
0 to \$3,000	2%
\$3,000 to \$5,000	\$60 + 3% of excess over \$3,000
\$5,000 to \$17,000	\$120 + 5% of excess over \$5,000
\$17,000+	\$720 + 5.75% of excess over \$17,000

22. Let x represent an individual's income and let $T(x)$ denote the income tax they owe. Calculate $T(15{,}000)$.

23. To verify that $T(x)$ is continuous, you would need to check the limit of $T(x)$ as x approaches three different points. What are those three points?