# Math 124D – Midterm I
Autumn 2021

Time: 80 mins.

1. Answer all questions in the spaces provided. If you run out of room for an answer, continue on the back of the page. There are also two blank pages at the end for scratch work or continued answers.

2. Unless stated otherwise, justify your answers to receive full credit. Your answers do not have to be in complete sentences, but they do need to be understandable.

3. You can use a TI-30X IIS calculator. No other calculator is allowed.

4. You can use a page of notes during the midterm. It must be single sided on standard letter sized paper (8.5 by 11 inches), handwritten, and not an exact copy of another students page of notes. You should write your name on the sheet and turn it in with your exam.

Name: _____

Student ID #: _____

Question	Points	Score
1	12	
2	12	
3	12	
4	5	
5	6	
6	8	
Total:	55	

1. (12 points) Use the graph of the function $y = f(x)$ shown below to answer (a) – (f). For limit questions, your answer must be one of DNE, ∞, $-\infty$ or a number.
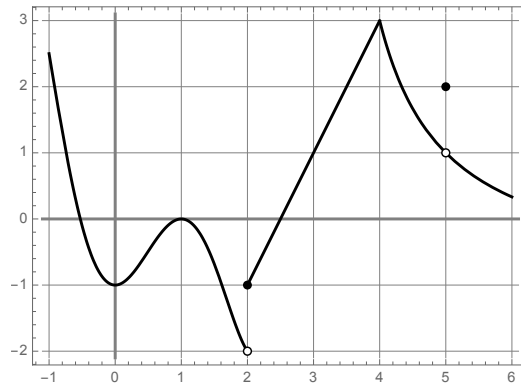
(a) Find $\lim_{x \to 2^+} f(x)$.

(b) At what values of x is the derivative of f undefined?

(c) List the intervals of values of x for which $f'(x) > 0$.

(d) Find the derivative of $f(x)$ at $x = 3$.

(e) Find the derivative of $\dfrac{1}{f(x)}$ at $x = 3$.

(f) What is $\lim_{x \to 1} \dfrac{1}{f(x)}$?

2. (12 points) A train leaves Station A at $t = 0$ along tracks that run straight east-west. Its distance east (in miles) of Station A t hours after departure is given by

$$d(t) = 80t^2 - 50t^4.$$

Make sure to **include appropriate units** in your answers.

(a) What is the average velocity of the train over the first hour of its trip?

(b) Find a formula for the instantaneous velocity of the train at time t.

(c) What is the acceleration of the train half an hour after departure?

(d) Does the train ever go backwards (westward) after starting its trip? If so, when?

3. (12 points) Find the following limits. Your answer must be one of DNE, ∞, $-\infty$ or a number.

(a) $\lim\limits_{x \to 0} \sin\left(\dfrac{x}{x+1}\right)$

(b) $\lim\limits_{x \to 0} \dfrac{2x+1}{x^3}$

(c) $\lim\limits_{x \to \infty} \dfrac{\sqrt{4x^2+1}}{5x+3}$

(d) $\lim\limits_{h \to 0} \dfrac{2e^h - 2}{h}$

4. (5 points) Find the equation of the tangent line to the curve $y = x \sin(x)$ at $x = \pi$.

5. (6 points) Use the *definition of the limit* to find $f'(1)$ where $f(x) = \sqrt{2x + 1}$.
   (You may not use any derivative rules.)

6. (8 points) Find the x-values of all points on the curve $y = \left(1 + \dfrac{1}{x}\right) e^x$ at which the tangent line is horizontal.