Math 131 – Common Final Exam – Fall 2020 – Version 1

Directions: Important exam policies – please read these instructions. Good luck everyone!

- You must be in the final exam zoom room for your own Math 131 class (communicated to you by your instructor) for proctoring. Exams from students not in the zoom proctor room will not be graded.
- The final exam is on Wednesday, December 9 from 8:00 PM - 10:00 PM (CST - Chicago time). The exam will open at 7:50 pm and close at 10:10 pm to allow time for download and upload.
- Show your work. Answers (even correct ones) without the corresponding work will receive no credit.
- You may use a calculator and your own notes from class. You may NOT use any internet resources, in particular you may NOT use Desmos, Mathematica, Google, WileyPlus, or Sakai Resources during the exam. The only computer use during the exam should be Zoom for proctoring and any writing tool you are using to transcribe your answers.
- If you are giving a decimal answer, round your answer to 2 decimal places. If a problem asks for EXACT answers, do not give a calculator approximation (for example, write ln(5) rather than 1.609.)
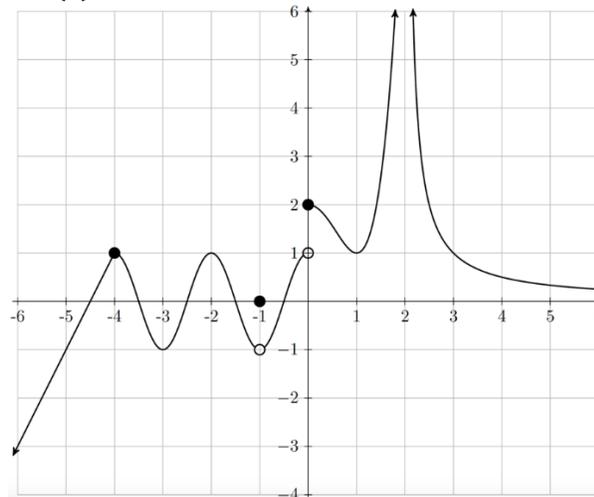- After you have finished your exam, convert it to a single pdf file and upload it to the test site in Sakai.

1. (8 points – 2 points each part) Use the graph of the function $f(x)$, to find the following values

(a) $\lim_{x \to -1} f(x)$

(b) $\lim_{x \to 0^+} f(x)$

(c) $\lim_{x \to -4} f(x)$

(d) Identify the intervals where $f(x)$ is continuous.

2. (4 points) Find the limit
$$\lim_{x \to \infty} \frac{6x^3 - 5x + 7}{3 + x - 3x^2 - 2x^3}$$

3. (6 points) Could the first graph, A, be the derivative of the second graph, B? Explain your answer in clear English sentences, making use of these words: "first derivative, second derivative, critical point, inflection point" as appropriate and giving *at least four criteria* that lead you to your conclusion.

A

Does Graph A equal f ' (x) ?

B

y = f(x)
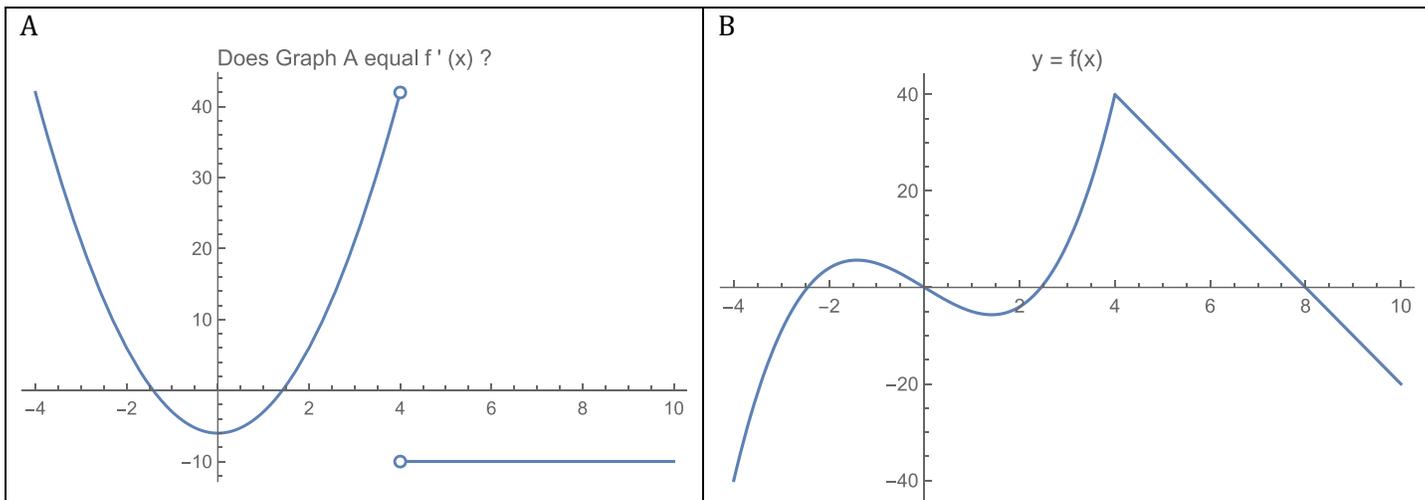
4. (9 points – 3 points each part) The depth, h (in mm), of the water runoff down a slope during a steady rain is a function of the distance, x (in meters), from the top of the slope. So $h = f(x)$.

   (a) What are the units of $f'(15)$?

   (b) What does $f'(15) = 0.03$ mean in practical terms? (Include units, and the meaning of both 15 and 0.03 in your answer.

   (c) Given that $f(15) = 4$ and $f'(15) = 0.03$, estimate the depth of the water runoff 17 meters from the top of the slope.

5.   (6 points) Find the derivative of $\ln(\sin^3(7x - 2))$. Show your work.

6.   (5 points) Find a formula for the slope of the tangent line to $y = 3(x - 9)^2$ when $x = b$. Show your work.

7.   (6 points) Find the derivative of $g(x) = \sqrt{3e^x + e^{x^5}}$. Show your work.

8.   (8 points) Find the global maximum and minimum for the function on the closed interval. Show your work and justify your answer. A calculator answer is not acceptable.

$$f(x) = x - 2\ln(x + 1), \quad \text{where } 0 \le x \le 2$$

9.   (8 points) The revenue for selling q items is $R(q) = 600{\cdot}q - 2{\cdot}q^2$ and the total cost of producing q items is $C(q) = 120 + 60 \cdot q$.
        (a) What quantity maximizes profit?
        (b) Find the value of the maximum profit.

10. (9 points, 3 points each) Find the following limits, use l'Hopital's Rule if applicable. Write "DNE" if the limit does not exist.

(a) $\lim\limits_{x \to 0} \left(\dfrac{e^{x^2} - 1}{3\cos(x) - 3} \right) =$

(b) $\lim\limits_{x \to \infty} \left(\dfrac{e^x}{\cos(x) - 1} \right) =$

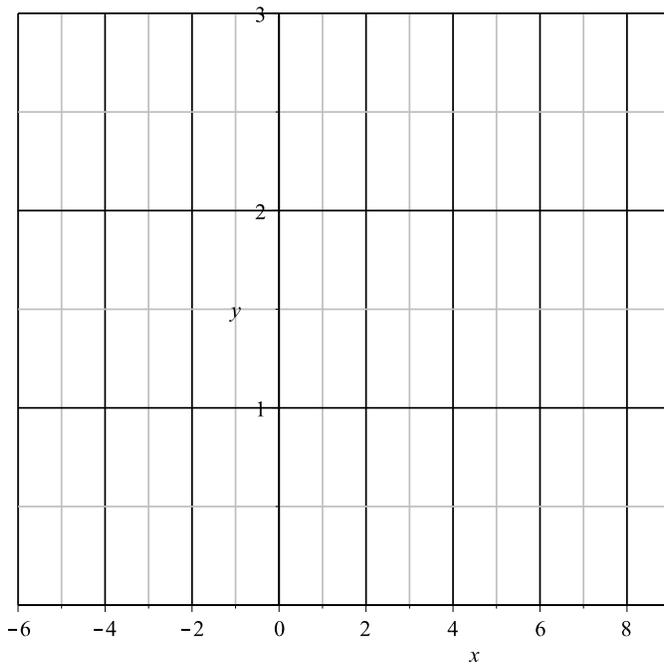(c) $\lim\limits_{x \to \infty} \left(\dfrac{\ln(x) + x^2}{3x + 1} \right) =$

11. (7 points) Use the table to estimate $\int_0^{40} f(x)\,dx$ with n=5 (Average the left-hand and right-hand sums)

x	0	8	16	24	32	40
$f(x)$	72	68	55	47	39	28

12. (7 points) Find

Find $\int_{-5}^{4} \frac{|x+2|}{5} dx$ geometrically. *(Sketch the graph.)*

13. (6 points) As a car is driving it emits carbon dioxide at a continuous rate of $c(t) = 4\sqrt{t} + 8$ kg/hr, where t is the hours the car has been driving. What is the total carbon dioxide emission of the car after it has been driving for 6 hours? Give your answer rounded to two decimal places with correct units.

14. (5 points) Find the indefinite integral

$$\int (3x^4 - e^x + \cos(x)) \, dx.$$

15. (6 points) Find the definite integral, leave exact answers:

a) $\int_{1}^{8} 3\sqrt{x} \, dx$

b) $\int_{0}^{\frac{\pi}{3}} (5 \sin(t) + 4) \, dt$