MAT 210 Brief Calculus
Sample Exam 1 (Practice Version B)

Instructor	XXXXXXX
Full Name (Print clearly!)	
Student ID	

Important Disclaimer for Students:

- This is a **sample exam**, not the actual in-class exam. Problems are of similar difficulty but may differ in type, numbers, or context.
- Success in the course depends on practicing concepts beyond this sample: lecture notes, Edfinity, Group Work, quizzes, and homework.
- You should complete this exam as if you were in the real exam room: no notes, no internet, no calculators beyond what is allowed, and an approximately 60-minute time limit.
- After finishing, check your answers against the provided solutions and grade yourself.
- If you could not complete within the time limit, practice again and attempt another sample exam.
- Treat every problem in your coursework (notes, quizzes, assignments) as fair game for the actual exam.

Part I - Multiple Choice: Circle the response that best completes the statement or answers the question. Then write the letter of your answer in the table after Problem 7.

1. (5 points) The table below shows the median monthly water bill (in dollars) for households in a town from January 2018 to January 2024, where t is years since the start of 2018. Compute the average rate of change of the bill from the start of 2020 to the start of 2024.

Year t (years after 2018)	0	1	2	3	4	5	6
Bill ($)	45	47	50	52	55	57	60

A. From the start of 2020 to the start of 2024, the bill increased by \$2.5 per year, on average.

B. From the start of 2020 to the start of 2024, the bill increased by \$3 per year, on average.

C. From the start of 2020 to the start of 2024, the bill increased by \$2 per year, on average.

D. From the start of 2020 to the start of 2024, the bill increased by \$3.5 per year, on average.

E. From the start of 2020 to the start of 2024, the bill decreased by \$2 per year, on average.

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2. (5 points) A population of rabbits (*in hundreds*) in a farm is modeled by the function

$$R(t) = 50e^{0.02t},$$

where t is measured in months after the start of observation. Find the instantaneous rate of change of the rabbit population at $t = 5$ months. Round to the nearest whole number.

A. 1359 rabbits per month

B. 610 rabbits per month

C. 500 rabbits per month

D. 272 rabbits per month

E. None of the above

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3. (5 points) Determine the constant c such that $\lim_{x\to 3} f(x)$ exists, where

$$f(x) = \begin{cases} 4x + c, & x < 3, \\ x^2 + 2, & x > 3 \end{cases}$$

A. $c = -4$

B. $c = -1$

C. $c = 2$

D. $c = 4$

E. None of the above

4. (5 points) At the age of t blinks, the height of a child is given by $H(t)$ (measured in blinkets). Which of the following calculations gives the *instantaneous rate of change* of the child's height at the age of 2 blinks?

   A. $\dfrac{H(2)}{2}$

   B. $H'(2)$

   C. $\dfrac{H'(2) - H'(0)}{2 - 0}$

   D. $H(2)$

   E. $\dfrac{H'(2)}{2}$

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5. (5 points) Which of the following functions is *not continuous* at $x = 5$? There is only **one** correct answer.

   A. $\dfrac{x - 5}{x + 2}$

   B. $\dfrac{x + 2}{x - 5}$

   C. $\ln(x + 5)$

   D. $(2x - 10)^2$

   E. None of the above

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6. (5 points) The number of trees (in hundreds) in a park from 2000 to 2020 can be modeled by the function

$$T(t) = 50t^2 - 200t + 2500$$

   where t is the number of years since 2000. Interpret the meaning of $T(10) = 5500$ and $T'(10) = 800$.

   A. In 2010, there were 5,500 trees, and the number of trees was increasing at a rate of 800 trees per year at that time.

   B. In 2010, there were 5,500 trees, and the total increase over the 10 years since 2000 was 800 trees.

   C. In 2010, there were 5,500 trees, and the number of trees was increasing at an average of 800 trees per year between 2000 and 2010.

   D. In 2010, there were 5,500 trees, and the number of trees was increasing at a rate of 800 trees every 10 years after 2000.

   E. None of the above

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7. (5 points) The graph of $f(x)$ is shown in Figure 1. Select all values of x where $f(x)$ is discontinuous.

A. $x = -3$

B. $x = -3,\ 1,\ 2$

C. $x = -3,\ 2$

D. All of the above

E. None of the above

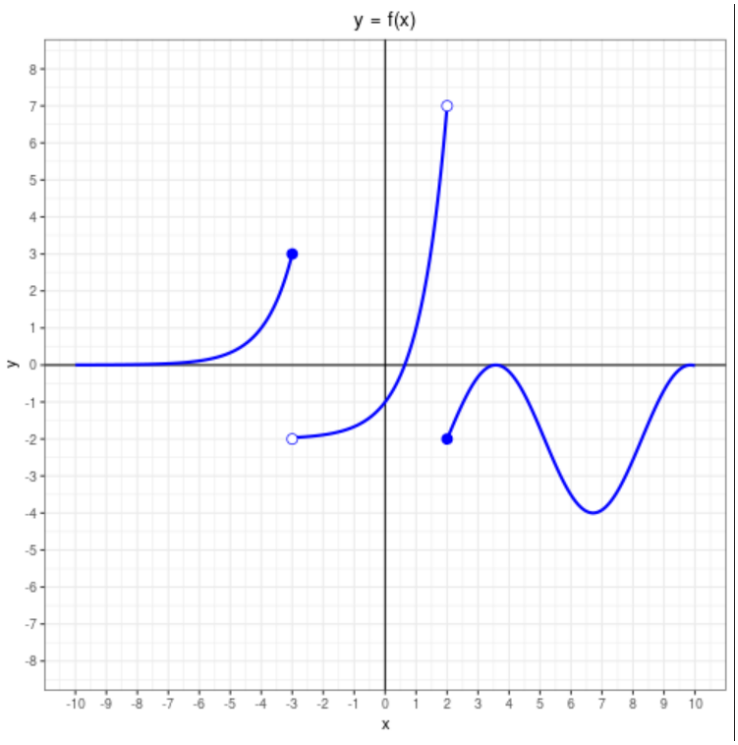

Figure 1

PART I Answers: Please write the letter of your selected answers to multiple choice questions 1 through 7 in the following table.

Problem	1	2	3	4	5	6	7
Answer							

Part II - Short Answer Type Problems

8. (5 points) The height (in meters) of a toy rocket above the ground after t seconds can be modeled by the quadratic function

$$h(t) = -5t^2 + 20t + 10,$$

where $t \geq 0$.

a) (2 points) Compute the average rate of change of the rocket's height over the interval $[3, 5]$ seconds. Include units.

b) (2 points) Find the instantaneous rate of change of the rocket's height at $t = 2$ seconds. Include units.

c) (1 point) Interpret the meaning of your answers from parts (a) and (b).

Part III - Free Response: You must show your work in the space provided to receive full credit. Correct final answers without sufficient supporting work may receive zero credit.

Please put a box around your final answers.

9. (5 points) (1 point each) Use the graph to calculate the following limits.

a) $\lim_{x \to -3^-} f(x) =$

b) $\lim_{x \to -3^+} f(x) =$

c) $\lim_{x \to -3} f(x) =$

d) $\lim_{x \to 2} f(x) =$

e) $f(2) =$

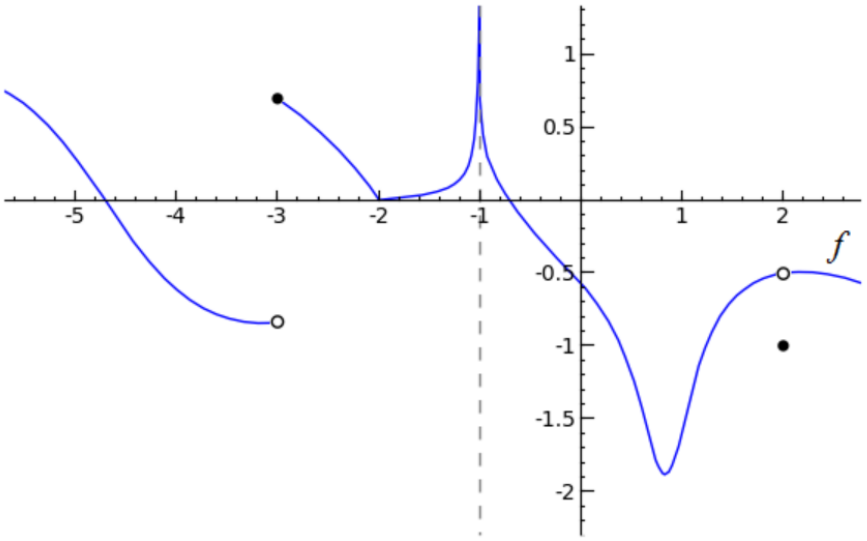

Figure 2

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10. (10 points) The monthly water usage for a household (in liters) can be modeled by

$$W(t) = 0.05t^3 - 0.4t^2 + 3t + 500,$$

where t measures time in months since the start of January 2020, and $W(t)$ is the water usage per month.

a) (4 points) Find $W'(t)$.

b) (4 points) Evaluate $W'(12)$, round to 2 decimal places, include units.

c) (2 points) Write a sentence to explain what the result from part (b) tells us about water usage.

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11. (10 points) Suppose a drone takes off with an initial velocity of 12 meters per second from a height of 50 meters. The height of the drone t seconds after taking off is given by

$$H(t) = -2t^2 + 12t + 50.$$

a) (7 points) Find the instantaneous rate of change of the drone's height at $t = 4$ seconds. Include units.

b) (3 points) Interpret the meaning of your answer in part (a).

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12. (15 points) (5 points each) Find the derivative of the following functions. Show your work. You **do NOT** need to simplify your results.

a) $f(x) = 9x^{\frac{7}{3}} - \dfrac{5}{x^4} + \dfrac{7}{2x^{-5}} + 88.2$

b) $g(t) = \sqrt[4]{t^{11}} - \sqrt[6]{t^{14}}$

c) $h(u) = 4\ln(u) + 9e^{15u}$

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13. (10 points) The number of cells in a petri dish from the start of the observation can be modeled by

$$C(t) = 3e^{0.05t} + 2e^{0.2t} + 0.8t \quad \text{thousand cells,}$$

where t is the number of hours since the start of the observation ($t = 0$ represents the beginning of the observation).

a) (4 points) Find $C'(t)$.

b) (4 points) Estimate the instantaneous rate of change in total number of cells at **after 8 hours**. Include units. (Round your answer to the nearest whole number.)

c) (2 points) Interpret your answer from part (b).

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14. (10 points) Let $f(x) = 7x^2 - 11x$. Answer the following:

(a) (3 points) Find $f(x + h)$.

(b) (4 points) Find the difference quotient.

(c) (3 points) Use the limit definition of the derivative to find $f'(-2)$.