Instructions:

• You have 55 minutes to complete this exam. It consists of 7 problems on 9 pages including this cover sheet and is worth a total of 100 points. The value of each question is listed below and with each question.

• You may not use any books or notes during this exam.

• Calculators are permitted EXCEPT those calculators that have symbolic algebra or calculus capabilities. In particular, the following calculators and their upgrades are not permitted: TI-89, TI-92, and HP-49. In addition, neither PDAs, laptops nor cell phones are permitted.

• Make sure to read each question carefully.

• Please write clearly and make sure to justify your answers. Correct answers with no supporting work may receive no credit. Unless otherwise stated, solutions found by graphing will receive no credit.

• Please write your answers on the indicated lines.

• A random sample of graded exams will be xeroxed before being returned.

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(1). Find the following limits:

(a) (3 points) \(\lim_{x \to 3} \frac{4x^2 - 7x - 15}{x^2 + 4x - 21} = \ldots\)

(b) (3 points) \(\lim_{x \to \infty} \frac{3 - 4x - 2x^3}{5x^3 - 8x - 1} = \ldots\)
(Problem (1) cont.)

(c) (3 points) \[ \lim_{x \to -4^-} \frac{5x^2 + 19x - 4}{x^2 + 4x} = \]

(d) (5 points) \[ \lim_{x \to 6} \frac{\sqrt{x-2} - 2}{x-6} = \]
(2). Given

\[ f(x) = \begin{cases} \frac{36}{x^2} & \text{if } x < 3 \\ 3x - 5 & \text{if } x \geq 3 \end{cases} \]

Find the following:

(a) (2 points) \( \lim_{x \to 3^-} f(x) = \) 

(b) (2 points) \( \lim_{x \to 3^+} f(x) = \) 

(c) (2 points) \( \lim_{x \to 3} f(x) = \) 

(d) (3 points) Is \( f(x) \) continuous at \( x = 3 \)? Explain your answer. 

(e) (2 points) Find all points of discontinuity for \( f(x) \) 

(f) (1 point) \( \lim_{x \to -\infty} f(x) = \) 

4
(3). (10 points) Solve the given inequality using a sign graph:

\[
\frac{x^2 - 2x - 15}{x^2 + 5x - 14} \geq 0
\]

Answer (3): ______________________

(4). (12 points) Find an equation of the line that is tangent to the graph of the function

\[
f(x) = x^4 - 17x^2 + 28
\]

at \( x = -2 \).

Answer (4): \( y = \) ______________________

5
(5). (12 points) Use definition of the derivative given below to find $f'(x)$ where $f(x) = \sqrt{7x}$

$$f'(x) = \lim_{h \to 0} \frac{f(x + h) - f(x)}{h}$$

Answer (5): $f'(x) = \underline{6}$
(6). Use differentiation rules to find the derivative, \( \frac{dy}{dx} \), of each of the following: (You do not need to simplify your answers.)

(a) (7 points) \( y = (x^3 + 6x^2 + 9)^{3/5} \)

Answer (6a): \( \frac{dy}{dx} = \) ____________

(b) (7 points) \( y = (x^3 + 7x^2)(x^5 - x^2 + 5) \)

Answer (6b): \( \frac{dy}{dx} = \) ____________
(Problem (1) cont.)

(c) (7 points) \( y = \frac{x^2 + 6}{\sqrt{x^3 + 5}} \)

Answer (6c): \( \frac{dy}{dx} = \) ________________

(d) (7 points) \( y = \sqrt[3]{(7 - 3x^2)^2} \)

Answer (6d): \( \frac{dy}{dx} = \) ________________
(7). (12 points) If the total-cost function for a manufacturer is given by:

\[ c = \frac{4q^2}{q^2 + 2} + 6000 \]

find the marginal cost function.

Answer (7): Marginal cost function: ________________