This exam is closed book. No graphing calculators or cell phones are allowed. No bathroom breaks are permitted while taking the exam. Good luck!

1 Multiple Choice **(2 points each)**

(1) Find the limit if it exists: $\lim_{x \to -4} \dfrac{x^2 - 16}{x + 4}$

(A) 16
(B) 8
(C) -24
(D) -8

(2) Find the limit if it exists (i.e. the horizontal asymptote):

$$\lim_{x \to \infty} \frac{5x^4 + 3x^3 + \frac{17}{5}x + 12.3}{8x^5 + 5x^4 + 2x^2 + 1}$$

(A) $\frac{5}{8}$
(B) ∞
(C) 0
(D) $-\infty$

(3) Suppose that the value V of a certain product diminishes, or depreciates, with time t (measured in months) where

$$V(t) = 100 - \frac{60t^2}{(t+2)^2}$$

Find $\lim_{t \to \infty} V(t)$

(A) 60
(B) 40
(C) 70
(D) 100

(4) Find the average rate of change for $f(x) = \sqrt{2x}$ if x changes from 2 to 18 .

(A) $\frac{-3}{10}$
(B) $\frac{1}{3}$
(C) $\frac{4}{9}$
(D) 2

(5) Find the instantaneous rate of change for $f(x) = 2x^2 + 3x$, at $x = 7$.

(A) 17
(B) 31
(C) 10
(D) 14

(6) Find the values of x where the tangent line is horizontal for

$$f(x) = 3x^3 - 2x^2 - 9.$$

(A) $x = 0, \frac{4}{9}$
(B) $x = 0, \frac{-4}{9}$
(C) $x = 0, \frac{-2}{3}$
(D) $x = 0, \frac{2}{3}$

(7) Suppose that the total profit (in hundreds of dollars) from producing x units is modeled by the function $P(x) = 4x^2 - 5x + 10$. Find the marginal profit of an additional unit when producing 5 units.

(A)\$32
(B) \$15
(C) \$35
(D) \$45

(8) Find the inverse, if it exists, of the following matrix: $\begin{bmatrix} 5 & 6 \\ 4 & 5 \end{bmatrix}$

(A) $\begin{bmatrix} 5 & 4 \\ 6 & 5 \end{bmatrix}$
(B) $\begin{bmatrix} -5 & 4 \\ 6 & -5 \end{bmatrix}$
(C) $\begin{bmatrix} 5 & -6 \\ -4 & 5 \end{bmatrix}$
(D) Does not exist, matrix is singular.

(9) Perform the operation if possible. Let $\mathrm{A} = \begin{bmatrix} -1 & 5 & 1 \end{bmatrix}$ and $\mathrm{B} = \begin{bmatrix} -6 & -2 & 9 \\ -5 & -7 & -3 \\ 6 & -8 & 2 \end{bmatrix}$.

Find the product AB.

(A) $\begin{bmatrix} 13 & 41 & 22 \end{bmatrix}$
(B) $\begin{bmatrix} -13 \\ -41 \\ 22 \end{bmatrix}$
(C) $\begin{bmatrix} -13 & -41 & -22 \end{bmatrix}$
(D) $\begin{bmatrix} 6 & -10 & 9 \\ 5 & 35 & -3 \\ -6 & -40 & 2 \end{bmatrix}$

(10) The below matrix is in *reduced row echelon form* and is the final matrix form of a linear system in two variables, x_1 and x_2. Find the solution of the system.

$$\left[\begin{array}{cc|c} 1 & -4 & 10 \\ 0 & 0 & 0 \end{array}\right]$$

(A) $\begin{array}{ll} x_1 = & 4t + 10 \\ x_2 = & t \in \mathbb{R} \end{array}$
(B) No solution
(C) $\begin{array}{ll} x_1 = & t \in \mathbb{R} \\ x_2 = & 10 \end{array}$
(D) $\begin{array}{ll} x_1 = & t - 4 \\ x_2 = & t \in \mathbb{R} \end{array}$

2 Short Answer **(3 points each)**

To receive credit: number each problem clearly, show all of your work, and circle your final answer.

(11) Is the matrix B $= \begin{bmatrix} \frac{7}{2} & 9 \\ \frac{3}{2} & 4 \end{bmatrix}$ the inverse of matrix A $= \begin{bmatrix} 8 & -18 \\ -3 & 7 \end{bmatrix}$?

(12) Let $C(x) = 0.0001x^3 - 0.06x^2 + 300x + 10,000$ be the total cost function and $R(x) = 350x$ be the total revenue function for some firm. Find the following:

(i) Marginal cost function

(ii) Marginal revenue function

(iii) Marginal profit function

(13) Suppose a company is planning to produce a new cell phone. After market research it estimates that weekly demand for a new cell phone is 600 phones at a price of \$50 per phone and 800 phones at a price of \$40 per phone. If one assumes a linear demand function, find the revenue function in terms of phones demanded, x.

(14) Please answer the following:

(i) Show that the *limit* of the difference quotient of $f(x) = \sqrt{x}$ is equal to its derivative, $f'(x)$.

(ii) Describe, in words, what a derivative is.