

SCORE: ____ / 150 POINTS

NO CALCULATORS OR DIFFERENTIATION SHORTCUTS (CH 3) ALLOWED
SHOW PROPER CALCULUS LEVEL ALGEBRAIC WORK AND USE PROPER NOTATION
YOU DO NOT NEED TO SHOW THE USE OF THE LIMIT LAWS
UNLESS SPECIFICALLY ASKED FOR

State the complete definition of “horizontal asymptote”.

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State the complete definition of “the derivative (function)”.

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State the Intermediate Value Theorem.

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The number of students who register for classes at a community college depends on the cost per unit for classes. SCORE: ____ / 15 POINTS
Let $s = p(c)$, where s is the number of students (in hundreds of students), and c is the cost per unit (in dollars).

[a] What are the units of $p'(c)$?

[b] Give the practical meaning (including units) of $p'(18) = -11$.

[c] Is there a value of c_0 for which you would expect $p'(c_0) > 0$? Why or why not?

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Let $f(x) = \frac{x^2 - x - 6}{4 - x^2}$.

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[a] Find all discontinuities of f .

[b] Find the limit of f at each discontinuity.

Each limit should be a number, ∞ or $-\infty$. Write DNE only if the other possibilities do not apply.

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[c] State the type of each discontinuity of f .

Let $f(x) = 4x^2 - 2x^3$.

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[a] Find $f'(x)$.

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[b] Find the equation of the tangent line to $y = f(x)$ at $x = -1$.

Find the equation(s) of the horizontal asymptote(s) of $f(x) = \frac{\tan^{-1} x}{2 + e^{-x}}$.

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Show the proper use of the limit laws.

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The population of a city t years after the year 2000 is $p(t) = \frac{3 + \sqrt{t}}{6 + t}$ million people.

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- [a] What was the average rate of change of the population from the year 2000 to the year 2009 ?
Specify the units of your answer.

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- [b] What was the instantaneous rate of change of the population in 2004 ?
Specify the units of your answer, and specify if the population was increasing or decreasing.

$$p'(4) = \lim_{h \rightarrow 0} \frac{p(4+h) - p(4)}{h}$$

$$= \lim_{h \rightarrow 0} \frac{\frac{3 + \sqrt{4+h}}{10+h} - \frac{1}{2}}{h} \cdot \frac{2(10+h)}{2(10+h)}$$

$$= \lim_{h \rightarrow 0} \frac{2\sqrt{4+h} - (4+h)}{2h(10+h)} \cdot \frac{2\sqrt{4+h} + (4+h)}{2\sqrt{4+h} + (4+h)}$$

$$= \lim_{h \rightarrow 0} \frac{-4h - h^2}{2h(10+h)(2\sqrt{4+h} + (4+h))}$$

$$= -\frac{1}{40} \text{ MILLION PEOPLE PER YEAR (DECREASING)}$$

★ SEE ALSO
7:30 VERSION A
(PREFERRED)

Consider the function $f(x) = \frac{7}{x^2 - 2}$ on the interval $[-3, 1]$ with $d = -4$.

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[a] Does this situation satisfy the conditions of the Intermediate Value Theorem? Why or why not?

[b] Does this situation satisfy the conclusion of the Intermediate Value Theorem? Why or why not?

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[c] Can the Intermediate Value Theorem be used to prove that $\frac{7}{x^2 - 2} = -4$ somewhere in the interval $[-3, 1]$? Why or why not?

The graph of $f(x)$ is shown below. Sketch a graph of $f'(x)$ on the same axes.

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