

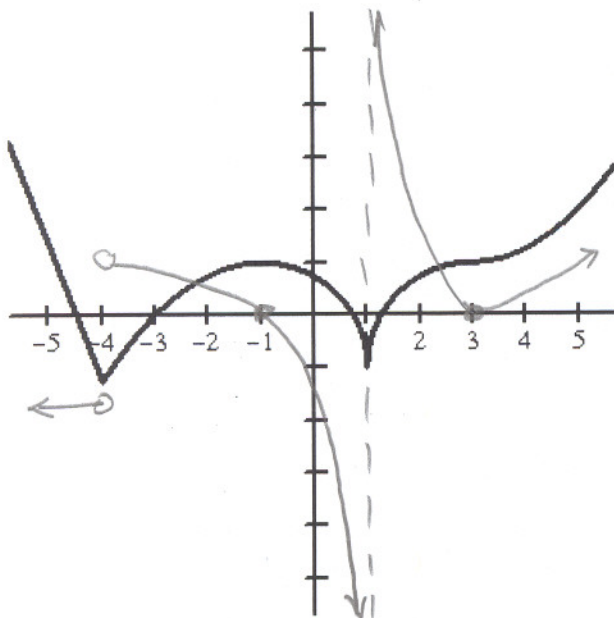
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**NO CALCULATORS OR DIFFERENTIATION SHORTCUTS (FROM CH 3) ALLOWED**  
**SHOW PROPER CALCULUS-LEVEL ALGEBRAIC WORK AND USE PROPER NOTATION**

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

SCORE: \_\_\_\_ / 18 POINTS



The number of pictures you can store on your computer depends on the size of each picture.

SCORE: \_\_\_\_ / 15 POINTS

Let  $p = g(s)$ , where  $p$  is the number of pictures (in hundreds of pictures), and  $s$  is the size of each picture (in kilobytes).

[a] What are the units of  $g'(s)$ ? **DO NOT SIMPLIFY.**

[b] Give the practical meaning (including units) of  $g'(12) = -9$ .

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[c] Is there a value of  $s_0$  for which you would expect  $g'(s_0) > 0$ ? Why or why not?

**STUDENT'S CHOICE: Circle the question you want to be graded**  
**If no question is circled, only Choice #1 will be graded**

**CHOICE #1:**

SCORE: \_\_\_ / 12 POINTS

State both the Squeeze Theorem and the Intermediate Value Theorem.

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**CHOICE #2:**

SCORE: \_\_\_ / 12 POINTS

One of the three statements below can be proven using the Intermediate Value Theorem (IVT).  
Circle the statement that can be proven using the IVT, and write the proof.

Statement #1:  $f(x) = \frac{x^4 - x - 1}{x^2 - 9}$  has a zero in the interval  $[-2, 4]$ .

Statement #2:  $f(x) = \frac{x^4 - x - 1}{x^2 - 9}$  has a zero in the interval  $[-2, 2]$ .

Statement #3:  $f(x) = \frac{x^4 - x - 1}{x^2 - 9}$  has a zero in the interval  $[-2, 0]$ .

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Find the equations of the horizontal asymptotes of  $f(x) = \frac{7-3e^x}{\sqrt{4e^{2x}+6}}$ .

SCORE: \_\_\_\_ / 15 POINTS

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Find the equations of the vertical asymptotes of  $f(x) = \frac{1-x}{x^3-4x^2+4x}$ .

SCORE: \_\_\_\_ / 18 POINTS

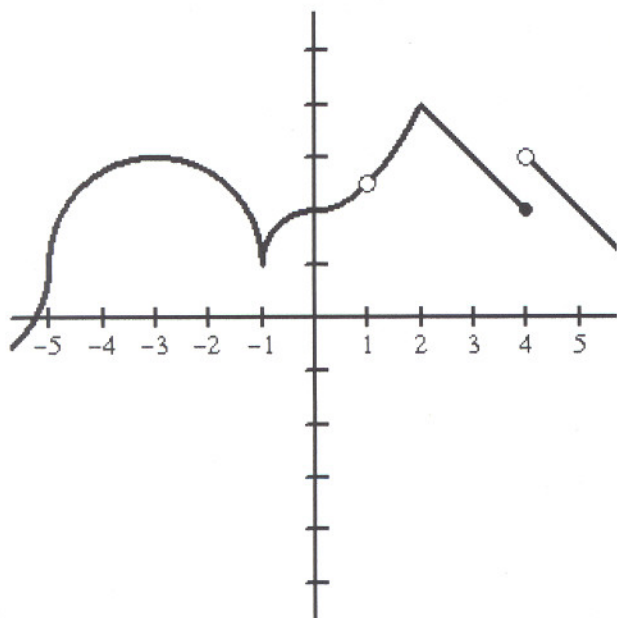
Find the values of both one-sided limits at each vertical asymptote.

When showing your "work", you may use the shorthand notation shown in class.

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The graph of  $f(x)$  is shown below. Find all  $x$ -coordinates where  $f'(x)$  is undefined, and explain briefly why. SCORE: \_\_\_ / 10 POINTS



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Suppose you are given a graph of  $y = 2x^3 - 5x^2 - 1$ .

SCORE: \_\_\_ / 18 POINTS

[a] Find  $\frac{dy}{dx}$ .

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[b] Find the equation of the tangent line to the graph above at  $x = 2$ .



The position of an object (in feet) at time  $t$  minutes, is given by the function  $s(t) = \frac{t}{\sqrt{t+6}}$ .

SCORE: \_\_\_\_ / 18 POINTS

Find the instantaneous velocity of the object at time  $t = 3$ . Specify the units.

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Give the definition of "horizontal asymptote".

SCORE: \_\_\_\_ / 6 POINTS

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Let  $f(x) = \begin{cases} x^{-1} & \text{if } x < 1 \\ x^2 - 2 & \text{if } 1 < x < 4 \\ 3x + 2 & \text{if } x > 4 \end{cases}$ .

SCORE: \_\_\_\_ / 20 POINTS

Find all discontinuities of  $f(x)$  and classify each as removable, jump or infinite. Justify your answer algebraically, without using a graph.

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