

**College of the Holy Cross**  
**Math 135, Section 1 – Makeup Midterm Exam 2**  
**Monday, October 31**

Your Name: \_\_\_\_\_

**Instructions** For full credit, you must show *all work* on the test pages. Use the back of the preceding page if you need more space for scratch work. The numbers next to each part of the questions are their point values. I will be liberal with partial credit, so even if you don't see how to complete a problem, do as much as you can and be sure to write what you know.

Please do not write in the space below

Problem	Points/Poss
1	/ 20
2	/ 35
3	/ 30
4	/ 15
Total	/100

1. Compute the indicated limits. You must show all necessary work to justify your answer to receive full credit.

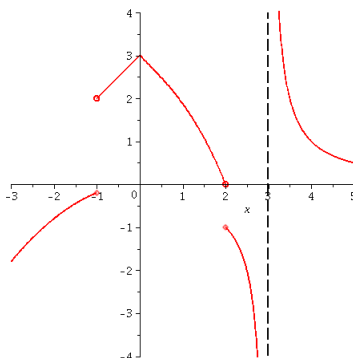
(a) (5)  $\lim_{x \rightarrow 1} \frac{x^2 - 6x + 5}{2x^2 - 3x + 1}$

(b) (5)  $\lim_{x \rightarrow 2} \frac{x^2 - 6x + 5}{2x^2 - 3x + 1}$

(c) (5)  $\lim_{x \rightarrow \infty} \frac{x^2 - 6x + 5}{2x^2 - 3x + 1}$

(d) (5)  $\lim_{\theta \rightarrow 0} \frac{\sin(4\theta)}{\sin(9\theta)}$

2. The graph of a function  $f$  with  $f(-1) = -2$  and  $f(2) = -1$  is shown below.



- (a) (10) What are  $\lim_{x \rightarrow 2^-} f(x)$  and  $\lim_{x \rightarrow 2^+} f(x)$ ? (In your answer say clearly which is which.)
- (b) (15) Find all  $x$  in  $(-3, 5)$  where  $f$  is discontinuous. Give the types of each of the discontinuities.
- (c) (10) Given that  $f(x) = x + 3$  for  $-1 < x < 0$  and  $f(x) = 3 - x - \frac{x^3}{8}$  for  $0 \leq x < 2$ , does  $f'(0)$  exist? Why or why not?

3. Do not use the short-cut differentiation rules from Chapter 3 in this question.

(a) (5) State the limit definition of the derivative  $f'(x)$ .

(b) (10) Estimate the derivative of  $f(x) = \frac{1}{x^2}$  at  $x = 2$  *numerically* by computing difference quotients of  $f$  with  $h = \pm.1$ , then  $h = \pm.01$ . Enter your values in the table below, and then state what your estimate of  $f'(2)$  is.

$h$	-.1	-.01	.01	.1
difference quotient value				

$f'(2) \doteq$  \_\_\_\_\_

(c) (10) Use the definition to compute the derivative function of  $f(x) = \frac{1}{x^2}$ .

(d) (5) Find the equation of the line tangent to the graph  $y = \frac{1}{x^2}$  at  $x = 2$ .

4. Use the short-cut rules to compute the following derivatives. You may use any correct method, but must show work for full credit.

(a) (5)  $\frac{d}{dx} \left( \frac{5}{x^2} + 4e^x + 3x^{1/3} \right)$

(b) (5)  $\frac{d}{dv} ((v^2 + 4)(v^3 + 3v))$

(c) (5)  $\frac{d}{dx} \left( \frac{2^\pi + \pi^2 - x^2}{3} \right)$