

- 8 (6 points) Given  $f(x) = \frac{3}{x}$  the derivative of  $f(x)$  is given by  $f'(x) = -\frac{3}{x^2}$ . Using this derivative find the equation of the tangent line to  $f(x)$  when  $x = 3$ . Give your final answer in slope-intercept form.

- 9 (10 points)

(a) (2 points) State the limit definition of the derivative of  $f(x)$ .

(b) (8 points) Given  $f(x) = \sqrt{3x}$ , find  $f'(x)$  using the definition. **No credit will be given for answers found using derivative short-cut formulas.** Simplify your derivative.

- 10 (4 points) The number of bacteria after  $t$  hours in a controlled laboratory setting is given by the function  $n = f(t)$  where  $n$  is the number of bacteria and  $t$  is measured in hours.

(a) Suppose  $f'(5) = 2000$ . What are the units of the derivative?

(b) In the context of this situation, explain what  $f'(5) = 2000$  means using complete sentences.

- ~~11 (5 points) Extra Credit: Prove that  $\lim_{x \rightarrow 0} x^4 \cos \frac{2}{x} = 0$ . You must clearly explain your work and cite any relevant theorems for full credit.~~

- 3 (18 points) Evaluate the following limits. Justify your answers with words and/ or any relevant algebra. Be sure to use proper notation, as points will be deducted for not doing so.

(a)  $\lim_{x \rightarrow -3} \frac{x^2 + 3x}{x^2 - x - 12}$

(b)  $\lim_{x \rightarrow 1} \ln \left( \frac{5 - x^2}{1 + x} \right)$

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

- 4 (18 points) Evaluate the following limits. Justify your answers with words and/ or any relevant algebra. Be sure to use proper notation, as points will be deducted for not doing so.

(a)  $\lim_{x \rightarrow 4^-} \frac{\sqrt{x}}{(x-4)^5}$

(b)  $\lim_{x \rightarrow 3} \frac{\frac{1}{x^2} - \frac{1}{9}}{x-3}$

(c)  $\lim_{x \rightarrow -\infty} \frac{\sqrt{1+4x^6}}{2-x^3}$

Exercise 5. (8 pts.) The position function of a particle is given by  $s = \frac{1}{3}t^3 - 4t^2 + 12t$  where  $t$  is measured in seconds and  $s$  in meters. Further, assume the first and second derivatives are  $s'(t) = t^2 - 8t + 12$  and  $s''(t) = 2t - 8$ .

a.) What is the velocity function of the particle?

b.) What is the acceleration function of the particle?

c.) When is the particle at rest?

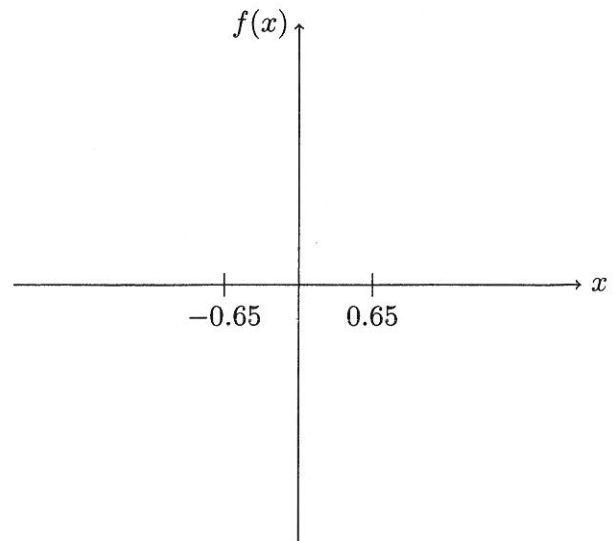
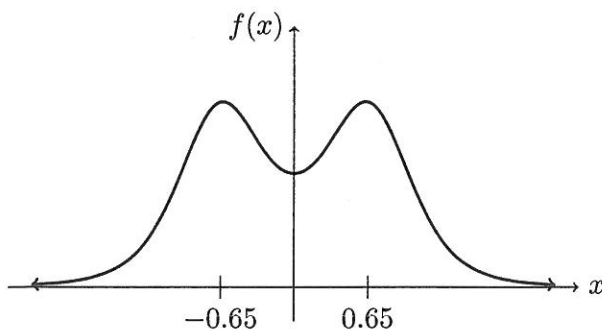
d.) When is the particle moving to the right?

e.) At time  $t = 3$ , is the particle speeding up or slowing down? Explain your answer.

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↓ Midterm I Spring 2018

4. (12 points) The axis on the left is the graph of a function  $f(x)$ . In the axis on the right, sketch the graph of  $f'(x)$ .



Math 251 Fall 2017

Quiz #4, October 3rd  
version 1

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

There are 25 points possible on this quiz. This is a closed book quiz. Calculators and notes are not allowed. **Please show all of your work!** If you have any questions, please raise your hand.

Exercise 1. (5 pts.) Find the derivatives of the following functions.

(a)  $f(x) = e^5$

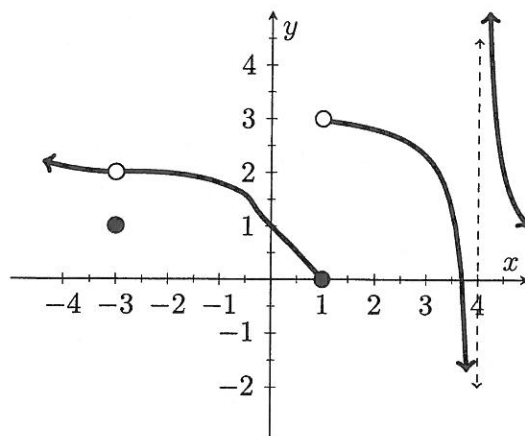
(b)  $g(x) = \frac{5}{x^3}$

(c)  $y = x^e$

Exercise 2. (3 pts.) Differentiate the function  $H(u) = (3u - 1)(u + 2)$ . Simplify your derivative.

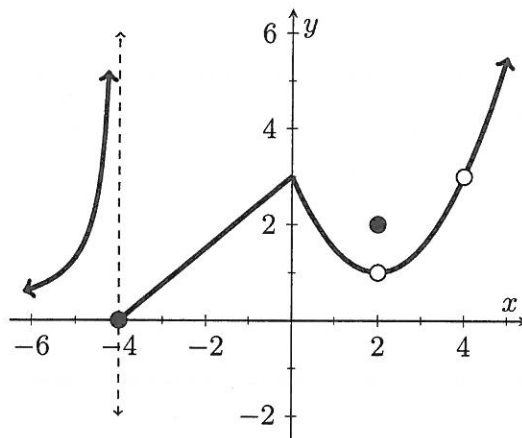
Exercise 3. (4 pts.) Differentiate the function  $y = \frac{5 - 2x + x^2}{\sqrt{x}}$ . Simplify your derivative.

- 1 (8 points) For the function  $f(x)$  whose graph is given below, state the value of each quantity if it exists.



- (a)  $\lim_{x \rightarrow -3} f(x) = \underline{\hspace{2cm}}$       (d)  $\lim_{x \rightarrow 1^+} f(x) = \underline{\hspace{2cm}}$       (g)  $\lim_{x \rightarrow 4^-} f(x) = \underline{\hspace{2cm}}$   
 (b)  $f(-3) = \underline{\hspace{2cm}}$       (e)  $\lim_{x \rightarrow 1} f(x) = \underline{\hspace{2cm}}$   
 (c)  $\lim_{x \rightarrow 1^-} f(x) = \underline{\hspace{2cm}}$       (f)  $f(1) = \underline{\hspace{2cm}}$       (h)  $\lim_{x \rightarrow 4^+} f(x) = \underline{\hspace{2cm}}$

- 2 (10 points) A graph of the function  $f(x)$  is displayed below.



- (a) (6 points) From the graph of  $f$ , state the numbers at which  $f$  is discontinuous and why.
- (b) (4 points) From the graph of  $f$ , state the numbers at which  $f$  fails to be differentiable and why.

- 5 (10 points) Given  $f(x) = \begin{cases} 3 & x \geq 4 \\ \frac{3x-12}{|x-4|} & x < 4 \end{cases}$  find  $\lim_{x \rightarrow 4} f(x)$  or explain why this limit does not exist.

- 6 (8 points) Using complete sentences, use the Intermediate Value Theorem to show that there is a root of the equation  $e^x = 3 - 2x$  in the interval  $(0, 1)$ .