

Math 10350 Review for Exam 1

1. Find the $\frac{dy}{dx}$ if (a) $y = \frac{3x^3 - \sqrt{x} + \pi x^2}{x^2}$, (b) $y = \frac{4^t + 1}{2^t}$.
Hint: Divide first.

2. Consider the function $f(x) = \sqrt{x+3}$.

- 2a. Find the average rate of change of the function $f(x)$ over the interval $[1, 6]$.

- 2b. Find the average rate of change of the function $f(x)$ over the interval $[1, 1+h]$. Assuming that $h \neq 0$, completely simplify your answer.

- 2b. Find the derivative of the function $f(x) = \sqrt{x+3}$ at $x = 1$ using the limit definition of derivative. What other names does this value have?

- 2c. Find the equation of the tangent line to the graph of $y = \sqrt{x+3}$ at $x = 1$.

3. A differentiable function $g(x)$ is such that

$$g(2) = -1, \quad g'(2) = 2, \quad f(2) = 2 \quad \text{and} \quad f'(2) = -4$$

- (a) If $A(x) = 2g(x) + 3f(x) + e^2$ find $A'(2) \stackrel{?}{=} \underline{\hspace{2cm}}$.

- (b) If $B(x) = g(x) \cdot (2e^x - 3)$ find the slope of the graph of $B(x)$ at $x = 2$.

- (c) If $C(x) = \frac{4x + g(x)}{f(x) + g(x)}$ find the instantaneous rate of change of $C(x)$ at $x = 2$

4. Solve the x in the following equations: (a) $\frac{e^t + 3}{e^t - 2} = 5$; (b) $\log_2(3t^2) - \log_2(t^2 - 1) = 2$

5. An exponential function $y = a \cdot b^x$ passes through the points $(2, 9)$ and $(4, 1)$. (i) Find the values of a and b . Is this an exponential decay or growth function? (ii) For what value of x is $y = 27$?

6. Find c so that $f(x)$ given below is continuous at $x = 1/3$.

$$f(x) = \begin{cases} \frac{9x^2 - 1}{3x^2 - 7x + 2} & x \neq 1/3, -2 \\ c & x = 1/3 \end{cases}$$

7. The position $s(t)$ (in feet) of a particle moving on a straight line at time t minutes is given by the graph below. The line is the tangent line to the graph of $s(t)$ at $t = 2$.

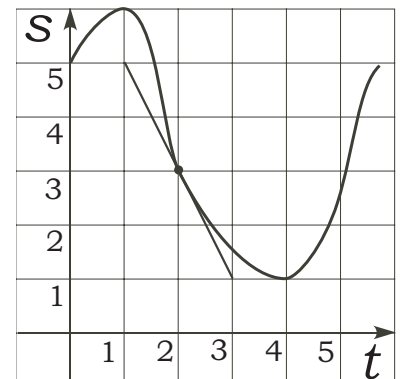
- a. Find the average velocity of the particle over the time duration $0 \leq t \leq 3$.

- b. Find the instantaneous velocity of the particle at $t = 2$.

- c. What is the equation of the tangent line at $t = 3$?

- d. Compare the velocities of the particle at $t = 1, 2$ and 5 minutes.

- e. Are there any time for which the velocity of the particle is momentarily zero?



8. If $\log_2 3 = x$ and $\log_2 5 = y$ express the following in terms of x and y : (a) $\log_2(45)$; (b) $\log_2(60)$; (c) $\log_2(9/10)$.

9. Consider the curve given by $f(x) = x + \frac{1}{x}$.

a. Find the points on the curve $y = f(x)$ at which the tangent lines are horizontal.

b. Find the equations of the tangent lines to the curve $y = f(x)$ which are parallel to the line $3x - 4y = 5$.

10. Consider the function

$$f(x) = \begin{cases} 3 + x & -\infty < x < 5 \\ x^2 & 5 \leq x < 11 \\ 5 - 3x & 11 \leq x < +\infty \end{cases}$$

Compute the following limits

a. $\lim_{x \rightarrow 5^+} 2f(x) - 5$

b. $\lim_{x \rightarrow 11^-} f(x) + \frac{2}{f(x)}$

c. $\lim_{x \rightarrow 7} (f(x))^2$

d. If $f(x)$ continuous? Explain with limits.

11. The graph of the function $f(x)$ is given in Figure 1 below. Find exactly or state that it does not exist each of the following quantity. If it does not exist explain why.

(a) $\lim_{x \rightarrow 2} f(x)$

(b) $\lim_{x \rightarrow 1^-} f(x)$

(c) $\lim_{x \rightarrow 1} f(x)$

(d) $\lim_{x \rightarrow -1} f(x)$

(e) $\lim_{h \rightarrow 0} \frac{f(h) - f(0)}{h}$

(f) $\lim_{h \rightarrow 0} \frac{f(2+h) + 2}{h}$

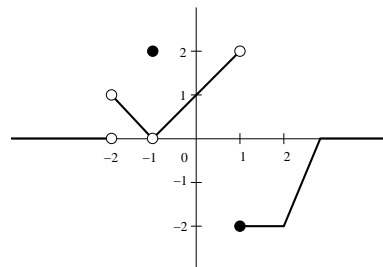


Figure 1

12. If $f'(a) = \lim_{h \rightarrow 0} \frac{\frac{2}{3+h} - \frac{2}{3}}{h}$, then $f(x) \stackrel{?}{=} \underline{\hspace{2cm}}$ and the value of $a \stackrel{?}{=} \underline{\hspace{2cm}}$.

13. If $g'(a) = \lim_{h \rightarrow 0} \frac{\cos(\pi + h) + 1}{h}$, then $g(x) \stackrel{?}{=} \underline{\hspace{2cm}}$ and the value of $a \stackrel{?}{=} \underline{\hspace{2cm}}$.

14. In 20 years, the balance of a bank account grew from 1000 to 3000.

14a. If interest is compounded continuously, find the annual interest rate r . Write down a formula for the balance of the account t years after the account is set up. How long would it take for the account to double its balance.

Answer: $r = \ln(3)/20$; double time = $20 \ln(2) / \ln(3)$ years.

14b. If interest is compounded weekly, find the annual interest rate r . Write down a formula for the balance of the account t years after the account is set up. How long would it take for the account to double its balance.

Answer: $r = 52(3^{1/1040} - 1)$; double time = $20 \ln(2) / \ln(3)$ years.

Math 10350: Calculus A
Exam I Sample
September 16, 2018

Name: _____

Class Time: _____

- The Honor Code is in effect for this examination. All work is to be your own.
- No calculators.
- The exam lasts for one hour and 15 minutes.
- Be sure that your name is on every page in case pages become detached.
- Be sure that you have all 10 pages of the test.

Honor pledge. “As a member of the Notre Dame community, I will not participate in or tolerate academic dishonesty.”:

Good Luck!

PLEASE MARK YOUR ANSWERS WITH AN X, not a circle!					
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Multiple Choice _____

11. _____

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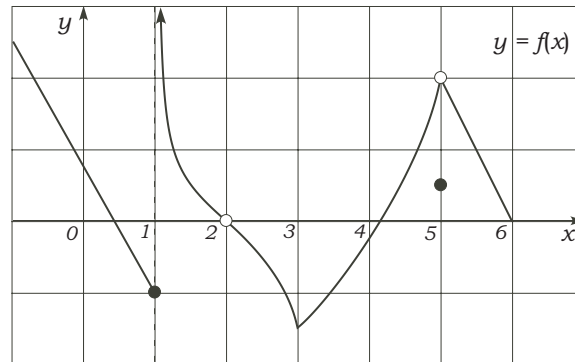
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Name: _____

Class Time: _____

Multiple Choice

1.(5 pts.)



The graph of $y = f(x)$ is given above. Which one of the following statements is **FALSE**?

- (a) $\lim_{x \rightarrow 2} f(x)$ exists.
- (b) $\lim_{x \rightarrow 1^+} f(x)$ is infinite.
- (c) The slope of $f(x)$ at $x = 4$ is positive.
- (d) $f(x)$ has a removable discontinuity at $x = 5$.
- (e) $\lim_{h \rightarrow 0} \frac{f(3+h) - f(3)}{h}$ exists.

2.(5 pts.) Find the average rate of change of the function

$$f(x) = \sqrt{x+2}$$

over the interval $[-1, 2]$.

- (a) $1/6$
- (b) $1/2$
- (c) $1/4$
- (d) $1/3$
- (e) 1

Name: _____

Class Time: _____

3.(5 pts.) Treating x as a constant, find the following derivative:

$$\frac{d}{dy} \left(\frac{4x - y}{3x - 2y} \right).$$

(a) $\frac{5x}{(3x - 2y)^2}$

(b) $\frac{4 - y}{3 - 2y}$

(c) $\frac{1}{2}$

(d) $\frac{4x - 1}{3x - 2}$

(e) $-\frac{5y}{(3x - 2y)^2}$

4.(5 pts.) Find the value of the limit:

$$\lim_{h \rightarrow 0} \frac{(2 + h)^5 - 2^5}{h}$$

(a) 10

(b) Does not exist.

(c) 24

(d) 80

(e) 0

Name: _____

Class Time: _____

5.(5 pts.) Find the equation of the tangent line to the graph of the function

$$f(x) = \sqrt[5]{x} + 4$$

at $x = -1$.

(a) $y - 3 = \frac{x^{-4/5}}{5}(x + 1)$

(b) $y + 1 = \frac{1}{5}(x - 3)$

(c) $y - 3 = \frac{1}{5}(x + 1)$

(d) $y + 3 = \frac{1}{5}(x - 1)$

(e) $y + 3 = \frac{x^{-4/5}}{5}(x - 1)$

6.(5 pts.) Consider the function

$$f(x) = \begin{cases} \frac{e^x - 1}{kx} & \text{if } x < 0 \\ 2x + 5 & \text{if } x \geq 0 \end{cases}$$

Find the value of k , if it exists, so that $f(x)$ is continuous at $x = 0$.

(a) $\frac{1}{2}$

(b) 2

(c) $\frac{1}{5}$

(d) Does not exist.

(e) 5

Name: _____

Class Time: _____

7.(5 pts.) Find the derivative of the function

$$y = \frac{3x^5 - 4x^3 + x^2}{x^3}.$$

(a) $\frac{15x^4 - 12x^2 + 2x}{3x^2}$

(b) $6x^3 - 1$

(c) $x^3 - 4x - x^{-2}$

(d) $\frac{15x^6 - 12x^4 + 2x^3}{3x^4}$

(e) $6x - x^{-2}$

8.(5 pts.) Find the value of the **left-hand** limit: $\lim_{x \rightarrow 2^-} \frac{|x - 2|}{4 - x^2}$

(a) $\frac{1}{4}$

(b) $+\infty$

(c) $-\frac{1}{4}$

(d) Does not exist.

(e) -1

Name: _____

Class Time: _____

9.(5 pts.) Find the constant c so that the function

$$f(x) = \begin{cases} x^3 + 3x - 3c, & x > 1 \\ (x - 1)^2 + c, & x \leq 1. \end{cases}$$

is continuous.

- (a) -2
- (b) 0
- (c) 2
- (d) 1
- (e) -1

10.(5 pts.) Find the value of the limit:

$$\lim_{x \rightarrow 2} \frac{\sqrt{x+7} - 3}{x - 2}$$

- (a) Does not exist.
- (b) $1/6$
- (c) 1
- (d) $1/3$
- (e) $+\infty$

Name: _____

Class Time: _____

Partial Credit

You must show your work on the partial credit problems to receive credit!

11.(12 pts.)

11a. Find ALL equations of the vertical asymptotes of the curve $y = \frac{x^2 - 9}{x^2 - x - 6}$

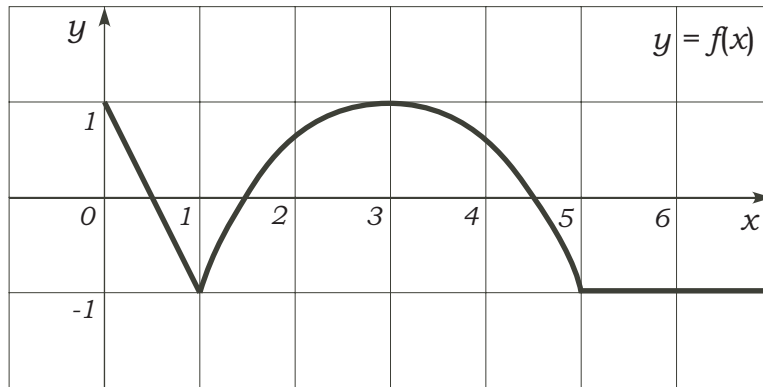
(Remark: Your answers should be in the form: $x = c$.)

11b. Find ALL values of x for which the graph of $g(x) = 16x + \frac{1}{x^2}$ has a horizontal tangent line.

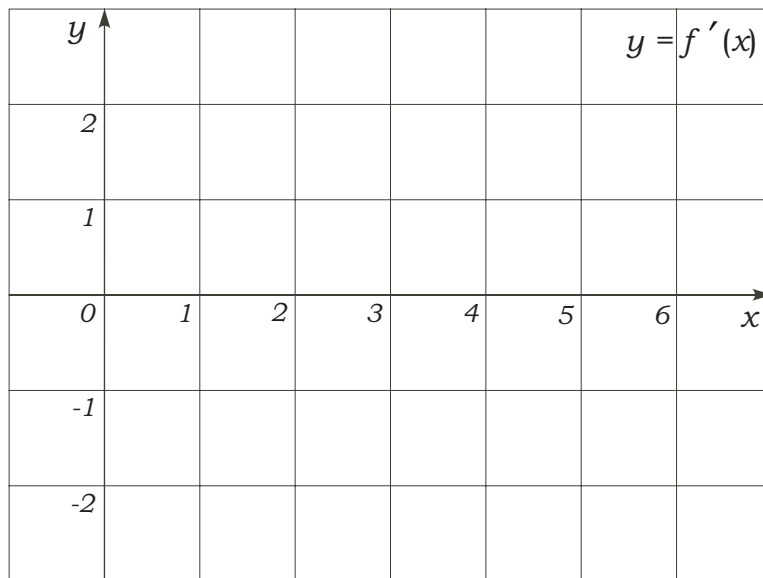
Name: _____

Class Time: _____

12.(12 pts.) The graph of the function $f(x)$ for $0 \leq x \leq 7$ is given below.



12a. Sketch the graph of the **derivative** $f'(x)$ of the function $f(x)$ in the axes given below for $0 \leq x \leq 7$.



12b. For what values of x in the interval $0 < x < 6$ is $f'(x)$ undefined?

Answer: _____

Name: _____

Class Time: _____

13.(12 pts.) The position function of a ball thrown upward , measured from ground level, is given by the function

$$s(t) = -5t^2 + 4t + 1.$$

13a. Find the time at which the ball hits the ground.

13b. Find the instantaneous **velocity** at time t .

13c. Find the instantaneous rate of change of the **velocity** at time t .

13d. Find the velocity at the moment when the ball hits the ground.

Name: _____

Class Time: _____

14.(12 pts.) Consider the function

$$f(x) = \frac{1}{x}.$$

14a. Write down the average rate of change of $f(x)$ over the interval $2 \leq x \leq 2+h$. You may assume that $h \neq 0$.

14b. Using Part (a) above and limits (only), find the **slope** of the curve $y = \frac{1}{x}$ at $x = 2$.

Math 10350: Calculus A
Exam I Sample
September 16, 2018

Name: _____

Class Time: ANSWERS

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- No calculators.
- The exam lasts for one hour and 15 minutes.
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Multiple Choice _____

11. _____

12. _____

13. _____

14. _____

Total _____

Math 10350: Calculus A
Exam I
September 22, 2019

Name: _____

Class Time: _____

- The Honor Code is in effect for this examination. All work is to be your own.
- No calculators.
- The exam lasts for one hour and 15 minutes.
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Multiple Choice _____

13. _____

14. _____

15. _____

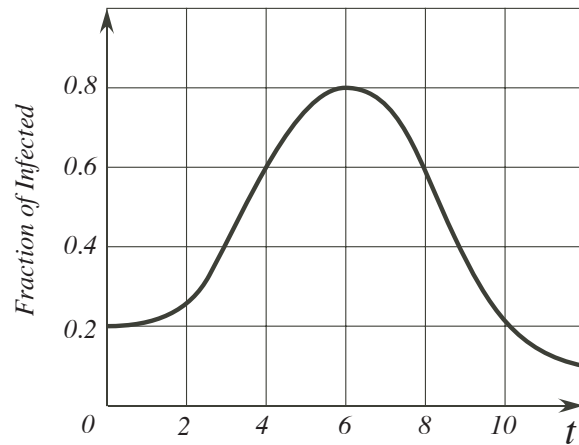
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Name: _____

Class Time: _____

Multiple Choice

1.(5 pts.)



The graph above shows the fraction of the population of a city infected by a flu virus over the a 12-month duration. What is average rate of change of the fraction of infected people over the duration of the first six months?

- (a) 0.6
- (b) 0.1
- (c) $\frac{5}{3}$
- (d) 10
- (e) -0.6

2.(5 pts.) Referring to the graph above, let $v(t)$ be the **instantaneous** rate of change of the fraction of infected people in the city at time t where $0 < t < 12$. Listing the values of $v(2)$, $v(6)$, and $v(9)$ from the smallest to the biggest, we have:

- (a) $v(6) < v(2) < v(9)$
- (b) $v(2) < v(6) < v(9)$
- (c) $v(6) < v(9) < v(2)$
- (d) $v(2) < v(9) < v(6)$
- (e) $v(9) < v(6) < v(2)$

Name: _____

Class Time: _____

3.(5 pts.) Let $f(x)$ be a differentiable function such that

$$f(0) = 2 \quad \text{and} \quad f'(0) = -3$$

Find the slope of the tangent line to the graph of $P(x) = f(x) \cdot e^x$ at $x = 0$.

- (a) -1
- (b) -2
- (c) 2
- (d) 1
- (e) -3

4.(5 pts.) Let $f(x)$ be a differentiable function such that

$$f(0) = 2 \quad \text{and} \quad f'(0) = -3$$

Find the derivative of $Q(x) = \frac{x}{f(x) + 2}$ at $x = 0$.

- (a) $-\frac{1}{4}$
- (b) $\frac{1}{16}$
- (c) 0
- (d) $\frac{1}{4}$
- (e) $-\frac{1}{3}$

Name: _____

Class Time: _____

5.(5 pts.) Find the equation of the tangent line to the graph of the function

$$f(x) = \frac{1}{x^4} + 3$$

at $x = -1$.

- (a) $y + 1 = 4(x - 4)$
- (b) $y - 4 = 4(x + 1)$
- (c) $y + 4 = -4x^{-5}(x - 1)$
- (d) $y + 4 = 4(x - 1)$
- (e) $y - 4 = -4x^{-5}(x + 1)$

6.(5 pts.) If $\log_3 x = -1$ and $\log_3 y = 4$, find the exact value of

$$\log_3 (81x\sqrt{y})$$

- (a) -7
- (b) -8
- (c) -5
- (d) 7
- (e) 5

Name: _____

Class Time: _____

7.(5 pts.) Consider the function

$$f(x) = \begin{cases} \frac{x^2 + 3x - 4}{x^2 - 3x + 2} & \text{if } x < 1 \\ kx + 1 & \text{if } x \geq 1 \end{cases}$$

Find the value of k , if it exists, so that $f(x)$ is continuous at $x = 1$.

- (a) -5 (b) 6 (c) 5
(d) -6 (e) Does not exist.

8.(5 pts.) On her 20th birthday, Joan decided to set up a certificate of deposit (CD) which will mature when she is 30 years old. If her initial deposit was \$2000 and interests is compounded **monthly** at a rate of 3% per year, how much will she receive when the certificate reaches maturity?

- (a) $2000 \left(1 + \frac{0.03}{12}\right)^{120}$
(b) $2000 \left(1 + \frac{0.03}{12}\right)^{30}$
(c) None of these.
(d) $2000 (1 + 0.03)^{10}$
(e) $2000 \left(1 + \frac{0.03}{12}\right)^{10}$

Name: _____

Class Time: _____

9.(5 pts.) Find $\frac{dy}{dx}$ if $y = \frac{2x^6 + 9x^2 - 1}{x^2}$.

(a) $8x^4 + 2x^{-1}$

(b) $\frac{12x^6 + 18x^3 - x}{2x^3}$

(c) $\frac{2}{5}x^5 + 9x + x^{-1}$

(d) $8x^3 + 2x^{-3}$

(e) $\frac{12x^5 + 18x}{2x}$

10.(5 pts.) Let $f(x)$ be the function whose graph is shown below. Which of the following statements is **FALSE**?

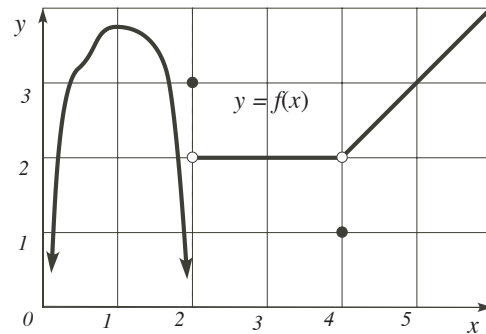
(a) $f(x)$ is continuous at $x = 3$.

(b) $f(x)$ is not continuous at $x = 4$.

(c) $\lim_{x \rightarrow 4} f(x) = 1$.

(d) $\lim_{x \rightarrow 2^-} f(x) = -\infty$.

(e) $f(2) = 3$.



Name: _____

Class Time: _____

11.(5 pts.) The temperature F (in Fahrenheit) of a hot liquid at time t hours is given by the equation

$$F(t) = 100(0.5)^t + 70.$$

Find the time at which the temperature is 95 °F.

- (a) 1 hour
- (b) $\ln(2)$ hours
- (c) 2 hours
- (d) $1/2$ hour
- (e) $[\ln(0.25) - \ln(0.5)]$ hours

12.(5 pts.) Let $F(t)$ be the temperature of the hot liquid at time t hours as in the above problem. How fast is the temperature of the liquid changing at the moment when $t = 1$ hour?

- (a) 50 °F/hr
- (b) 120 °F/hr
- (c) $120 \ln(0.5)$ °F/hr
- (d) $[50 \ln(0.5) + 70]$ °F/hr
- (e) $50 \ln(0.5)$ °F/hr

Name: _____

Class Time: _____

Partial Credit

You must show your work on the partial credit problems to receive credit!

13.(12 pts.)

13a. Solve for x that satisfies the equation:

$$\log_{10}(3x + 2) - \log_{10}(x - 1) = 1$$

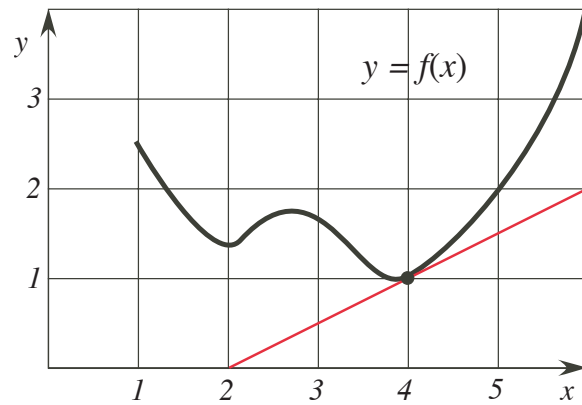
13b. (Not related to above.)

If $f'(a) = \lim_{h \rightarrow 0} \frac{3^{5+h} - 3^5}{h}$ then $f(x) \stackrel{?}{=} \underline{\hspace{2cm}}$ and $a \stackrel{?}{=} \underline{\hspace{2cm}}$.

Name: _____

Class Time: _____

14.(12 pts.)



14a. The figure above describes the graph of $y = f(x)$ and its tangent line at $x = 4$. Answer the problems below:

i. $f(4) \stackrel{?}{=} \underline{\hspace{2cm}}$ and $f'(4) \stackrel{?}{=} \underline{\hspace{2cm}}$

ii. Find the equation of the tangent line at $x = 4$. Give your answer in slope-intercept form.

14b. (Not related to above.)

Find the equations of the tangent lines to the graph of $f(x) = 4x^3$ such that they are parallel to the line $y - 12x = 8$.

Name: _____

Class Time: _____

15.(12 pts.) Consider the function $f(x) = x^2 + 2x$.

15a. Compute the average rate of change of $f(x)$ over the interval $2 \leq x \leq 2 + h$. You may assume that $h \neq 0$ and simplify your answer.

15b. Using Part (a) above and limits (only), find the **slope** of the curve $y = x^2 + 2x$ at $x = 2$.

Math 10350: Calculus A
Exam I
September 22, 2019

Name: _____
Class Time: ANSWERS

- The Honor Code is in effect for this examination. All work is to be your own.
- No calculators.
- The exam lasts for one hour and 15 minutes.
- Be sure that your name is on every page in case pages become detached.
- Be sure that you have all 10 pages of the test.

Honor pledge. “As a member of the Notre Dame community, I will not participate in or tolerate academic dishonesty.”:

Good Luck!

PLEASE MARK YOUR ANSWERS WITH AN X, not a circle!					
1.	<input type="checkbox"/> a	<input checked="" type="checkbox"/>	<input type="checkbox"/> c	<input type="checkbox"/> d	<input type="checkbox"/> e
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Please do NOT write in this box.

Multiple Choice _____

13. _____

14. _____

15. _____

Total _____