

Instructions: There are 11 questions on 4 pages (including this cover sheet). Show all your work and explain your answers. Unsupported answers will receive **little credit**. Good luck.

Name _____

Circle your instructor's name and also your TA's name (underneath your instructor's name) if you have one.

Instructor	True		
Instructor	Radcliffe	Rebarber	Deng
TA	Bravo	Becklin	Becklin
	Ferraro	Gensler	Gensler
	Groothuis	Gunderson	Pike
	Ikram	Ray	
	Pike	Seewald	
	von Kampen		

Question	Out Of	Score
1	30	
2	15	
3	20	
4	20	
5	15	
6	15	
7	15	
8	20	
9	15	
10	15	
11	20	
Total:	200	

Question 1.

Compute the following:

- (7) (a) $\frac{d}{dx} \frac{x^2}{e^{3x}}$
- (7) (b) $\int (x^{1/3} + 5 \sin(x)) \, dx$
- (8) (c) $\int_0^{\sqrt{\pi}} x \cos(x^2) \, dx$
- (8) (d) $\lim_{x \rightarrow 9} \frac{\sqrt{x} - 3}{\ln(x) - \ln(9)}$

Question 2.

You have 200 feet of fencing and want to enclose a rectangular area up against a long straight wall running north/south.

- (9) (a) Draw a labeled diagram of the area you will design, clearly marking relevant variables. Express the area and perimeter of the habitat in terms of your variables.
- (6) (b) By eliminating one of the variables, write down the mathematical problem that you need to solve, expressed as “Minimize the function ... on the domain ...”. **Do not solve this problem.**

Question 3. (20 points)

Using the limit definition of the derivative, find $f'(x)$ if $f(x) = \frac{1}{x+3}$.

Question 4.

The equation

$$\sin(x) + xy = x$$

defines y implicitly as a function of x .

- (10) (a) Find $\frac{dy}{dx}$ in terms of x and y .
- (10) (b) Find the equation of the tangent line to this curve at $(\pi, 1)$.

Question 5. (15 points)

A rectangle with base w , height h , and area A has dimension that are varying with time. At a certain point in time we have $w = 5$, $h = 3$, $\frac{dh}{dt} = -2$ and $\frac{dA}{dt} = 0$. What is the value of $\frac{dw}{dt}$ at that moment?

Question 6.

Some values of the decreasing function $f(x)$ are given below.

x	0.0	0.5	1.0	1.5	2.0	2.5	3
$f(x)$	7.2	6.8	6.3	4.1	3.7	2.8	1.2

- (8) (a) Compute the right hand sum estimating $\int_{0.5}^{2.5} f(x) dx$ using 4 subintervals.
- (7) (b) How many intervals would we need to take to ensure the the left hand sum and right hand sum approximating $\int_{0.5}^{2.5} f(x) dx$ would be within 0.01 of one another?

Question 7.

Let the function $f(x)$ be defined by

$$f(x) = \int_1^x (\ln(t) + 2t) dt.$$

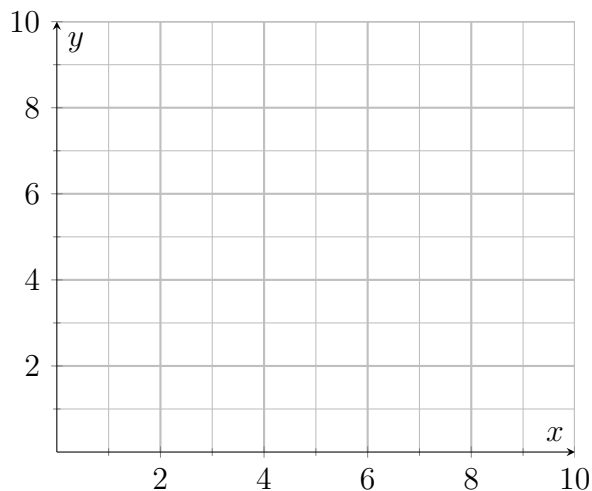
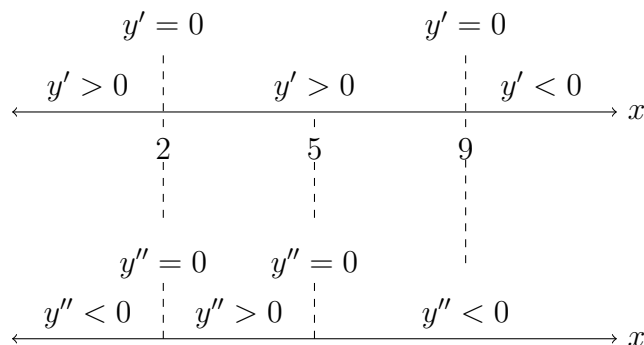
- (8) (a) Find $f'(x)$.
- (7) (b) Find the local linearization of $f(x)$ around $a = 1$.

Question 8. (20 points)

Find the maximum and minimum values of the function $f(x) = x^3 - 6x^2 - 15x + 10$ on the interval $0 \leq x \leq 9$.

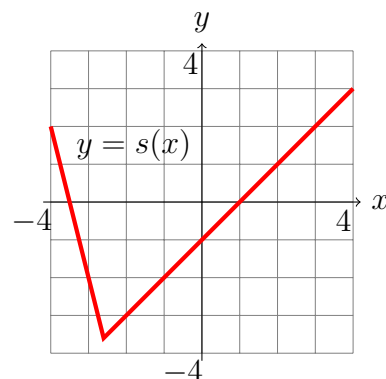
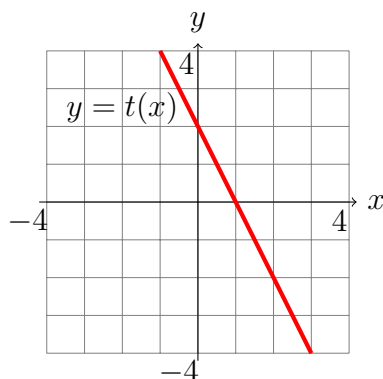
Question 9. (15 points)

Sketch a possible graph of $y = f(x)$ on the axes below, using the given information about the derivatives $y' = f'(x)$ and $y'' = f''(x)$.



Question 10.

The graphs of the functions $t(x)$ and $s(x)$ are given below.

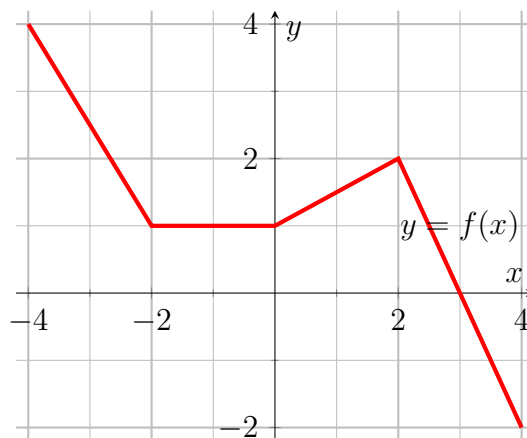


Determine the following:

- (5) (a) $t'(0.5)$
- (5) (b) $h'(2)$ if $h(x) = s(t(x))$
- (5) (c) $g'(-3.5)$ if $g(x) = s(x) + x^2$

Question 11. (20 points)

The graph of a function $y = f(x)$ is given below.



Complete the table below of values of $F(x)$, which is an antiderivative of $f(x)$; in other words $F'(x) = f(x)$. You should show your work for how you found $F(2)$, but you do not need to show work for the other entries in the table.

x	-4	-2	0	2	4
$F(x)$			7		