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MTH 130, section J01, Fall 2023

Exam 2 Fall 2023 (Exam)

INSTRUCTOR

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SUNY Farmingdale State College

Current Score		Due Date
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<div> Instructions</div> <div>^</div>		Assignment Submission & Scoring
<div>Please enter your answer according to the rules below.</div> <div>Rule 1. No decimal point in answers if there is no decimal point in a question, unless otherwise noted.</div> <div>Rule 2. An exact answer is expected, unless otherwise noted.</div> <div>Rule 3. When rounding instructions are given, do NOT round any number in the intermediate steps.</div> <div>Rule 4. Expressions must be simplified, unless otherwise noted.</div> <div>If you have any WA technical issues, please contact</div>		<div>Assignment Submission</div> <div>For this assignment, you submit answers by question parts. The number of submissions remaining for each question part only changes if you submit or change the answer.</div> <div>Assignment Scoring</div> <div>Your last submission is used for your score.</div>

Cengage Technical Support immediately by calling 1-800-354-9706 and keep your case number for your records.

1.

DETAILS

MY NOTES

ASK YOUR TEACHER

Let  $f$  be the function defined as follows.

$$y = f(x) = 5x^2 - 6x + 6$$

(a) Find the differential of  $f$ .

$$dy =$$

$$10x - 6 dx$$

(b) Use your result from part (a) to find the approximate change in  $y$  if  $x$  changes from 2 to 1.81. (Round your answer to four decimal places, if necessary.)

$$dy = 2.66$$

(c) Find the actual change in  $y$  if  $x$  changes from 2 to 1.81. (Round your answer to four decimal places, if necessary.)

$$\Delta y = 2.4795$$

(d) Compare your result in part (c) with that obtained in part (b) by calculating the absolute value of their difference.

$$|dy - \Delta y| = .1805$$

2.

DETAILS

MY NOTES

ASK YOUR TEACHER

Use differentials to approximate the quantity. (Round your answer to four decimal places.)

$$\sqrt[3]{215}$$

Please explain how you obtained the above approximation by answering the following questions.

- a) In order to use the differential, we need a function. What is the most appropriate function for this

$$y = f(x) =$$

$$\sqrt[3]{x}$$

problem?

$$dy =$$

$$\frac{1}{3}x^{-2/3}$$

- b) What is the differential of this function?

- c) What is the most appropriate value for  $x$ ?  (Enter an integer.)

- d) What is the corresponding value of  $dx$ ?

- e) What is the corresponding value of  $dy$ ?  (Round your answer to four decimal places.)

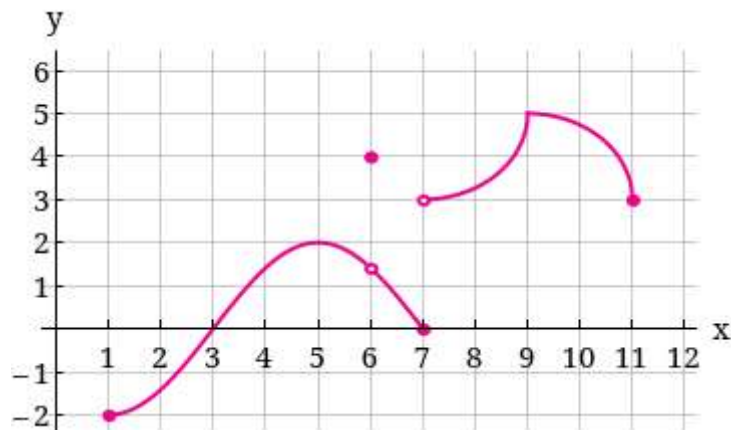
3.

DETAILS

MY NOTES

ASK YOUR TEACHER

The entire graph of the function  $f$  is given below. Round your answer to the nearest integer, if necessary.



- (a) Find the relative maximum and relative minimum values, if any, of the function. (Enter your answers as a comma-separated list. If an answer does not exist, enter DNE.)

Relative maximum value(s): \$\$3

Relative minimum value(s): \$\$0

- (b) Find the absolute maximum and absolute minimum values, if any, of the function. (If an answer does not exist, enter DNE.)

Absolute maximum value: \$\$5

Absolute minimum value: \$\$-2

- (c) Find the critical numbers, if any, of the function in the interval  $(1, 11)$ . (Enter your answers as a comma-separated list. If an answer does not exist, enter DNE.)

$x =$

\$\$5,9

4.

DETAILS

MY NOTES

ASK YOUR TEACHER

This question has several parts that must be completed sequentially. If you skip a part of the question, you will not receive any points for the skipped part, and you will not be able to come back to the skipped part.

**Exercise**

- (a) Find the critical numbers of the function  $f(x) = x^2(x - 4)^8$ .  
 (b) What does the Second Derivative Test tell you about the behavior of  $f$  at these critical numbers?  
 (c) What does the First Derivative Test tell you about the behavior of  $f$  at these critical numbers?

**Part 1 of 3**

- (a) Find the critical numbers of the function  $f(x) = x^2(x - 4)^8$ . (Enter your answers as a comma-separated list. If an answer does not exist, enter DNE.)

 $x =$  $0, 4$ 

 $0, \frac{4}{5}, 4$  $f'(x) =$  $2x(x-4)^7(5x-4)$ 

 $2(x-4)^7x(5x-4)$ 

Enter the derivative of the function.

(Factor your answer

completely.)

**Part 2 of 3**

- (b) What does the Second Derivative Test tell you about the behavior of  $f$  at these critical numbers?

From Part (a), we have three critical numbers:  $x = 0$ ,  $x = 4/5$ , and  $x = 4$ .

At  $x = 0$ ,  $f$  may or may not have a relative extremum value



has a relative minimum value

because  $f''(0) = 0$  or DNE

 $f''(0)$  is positive.

At  $x = 4/5$ ,  $f$  has a relative maximum value



has a relative maximum value

because

 $f''$ 

changes sign from + to - at  $x = 4/5$

 $f''(4/5)$  is negative.

At  $x = 4$ ,  $f$  has a relative minimum value



may or may not have a relative extremum value

because  $f''$  changes sign from - to + at  $x = 4$

 $f''(4) = 0$  or DNE.**Part 3 of 3**

- (c) What does the First Derivative Test tell you about the behavior of  $f$  at these critical numbers?

At  $x = 0$ ,  $f$  does not have a relative extremum value



has a relative minimum value

because

$f'$  does not change sign at  $x = 0$

 $f'$  changes sign from - to + at  $x = 0$ .

At  $x = 4/5$ ,  $f$  has a relative maximum value



has a relative maximum value

because

 $f'$

changes sign from + to - at  $x = 4/5$  $f'$  changes sign from + to - at  $x = 4/5$ .At  $x = 4$ ,  $f$  has a relative minimum value

has a relative minimum value

because  $f'$  changessign from - to + at  $x = 4$  $f'$  changes sign from - to + at  $x = 4$ .

You have now completed the exercise.

5.

DETAILS

MY NOTES

ASK YOUR TEACHER

Determine where the function is concave upward and where it is concave downward. (Round your answers to three decimal places, if necessary. Enter your answer using interval notation. If an answer does not exist, enter DNE.)

$$f(x) = 10x^2 + 3x^{1/2} + 15$$

 $[[0, .112) \cup (.112, \infty)$ 

Concave upward:

 $DNE$ 

Concave downward:

Complete the following parts.

(a) The domain of the function  $f$  is
 $[0, \infty)$ 


. (Enter your answer using interval notation.)

(b) To determine the concavity of the function  $f$ , we use the Concavity Test (CT).(c) To determine the concavity of the function  $f$ , we need the critical numbers of  $f'$ .(d) To find these critical numbers, we need to find  $f''(x) =$ 
 $20 - 34x(32)$ 


(e) These critical numbers are as follows. (Round your answer(s) to three decimal places, if necessary. Enter your answers as a comma-separated list. If an answer does not exist, enter DNE.)

 $x =$ 
 $0.112$ 

(f) Then, we use these critical numbers to construct the sign diagram for  $f''$ .

6.

DETAILS

MY NOTES

ASK YOUR TEACHER

Use calculus to find the absolute maximum value and the absolute minimum value, if any, of the function. (If an answer does not exist, enter DNE.)

$$f(x) = \frac{1}{x^2 - 6x + 38} \quad \text{on} \quad [-1, 6]$$

Absolute maximum value:  $\frac{1}{29}$  at  $x =$

\$\$\$3

(Enter your answers as a comma-separated list if there are multiple x-values.)

Absolute minimum value:  $\frac{1}{45}$  at  $x =$

\$\$-1

(Enter your answers as a comma-separated list if there are multiple x-values.)

Complete the following parts.

(a) The domain of the function  $f$  is

\$\$[-1,6]

. (Enter your answer using interval notation.)

(b) To determine the absolute extreme values of the function  $f$ , we need the critical numbers of  $f$ .

(c) To find these critical numbers, we need to find  $f'(x) =$

\$\$-2x-6(x^2-6x+38)^{-2}

. (Express your answer as a single fraction. Use positive exponents only.)

(d) These critical numbers are as follows. (If a critical number is an endpoint of the domain, do NOT include it in your answer. Enter your answers as a comma-separated list. If an answer does not exist, enter DNE.)

$x =$   
\$\$\$3

(e) The Closed Interval Optimal Test  $\text{can}$  be used to find the absolute maximum value and the absolute minimum value of the function.

7.

DETAILS

MY NOTES

ASK YOUR TEACHER

The price per square foot in dollars of prime space in a big city from 2004 through 2009 is approximated by the function

$$R(t) = 0.549t^3 - 4.43t^2 + 7.379t + 236.5 \quad (0 \leq t \leq 5)$$

where  $t$  is measured in years, with  $t = 0$  corresponding to 2004.

(a) When was the office space rent lowest? Round your answer to two decimal places, if necessary.

$t =$   years after 2004

(b) What was the lowest office space rent during the period in question? Round your answer to two decimal places, if necessary.

dollars per square foot

Complete the following parts.

(1) The domain of the function  $R$  is

$[0, 5]$

. (Enter your answer using interval notation.)

(2) To answer the above questions, we need the critical numbers of  $R$ .

(3) To find these critical numbers, we need to find  $R'(t) =$

$1.647t^2 - 8.86t + 7.379$

(4) These critical numbers are as follows. (Round your answer(s) to two decimal places. If a critical number is an endpoint of the domain, do NOT include it in your answer. Enter your answers as a comma-separated list. If an answer does not exist, enter DNE.)

$t =$   
 $1.32, 3.26$

(5) The Closed Interval Optimal Test  be used to find the absolute extrema of the function.



8.

DETAILS

MY NOTES

ASK YOUR TEACHER

A rectangular storage container with an open top is to have a capacity of  $119 \text{ in.}^3$ . The length of this base is 3 times the width. What should the dimensions of the container be to minimize the construction cost?

Let  $x$  be the width (in in.) of the base of the container, and  $h$  be the height (in in.) of the container.  $x = \boxed{3.10}$  in. (Round your answer to two decimal places, if necessary.)

Complete the following parts.

- (a) Give a function  $f$  in the variable  $x$  for the quantity to be optimized.

$$f(x) =$$

$$3x^2h$$


- (b) State the domain of this function. (Enter your answer using interval notation.)

$$(0, \infty)$$

- (c) Give the formula for  $h$  in terms of  $x$ .

$$h =$$

$$\frac{119}{3x^2}$$


- (d) To determine the optimal value of the function  $f$ , we need the critical numbers of  $f$ .

- (e) To find these critical numbers, we need to find  $f'(x) =$

$$-6hx$$

- (f) These critical numbers are as follows. (Round your answer(s) to two decimal places, if necessary. If a critical number is an endpoint of the domain, do NOT include it in your answer. Enter your answers as a comma-separated list. If an answer does not exist, enter DNE.)

$$x =$$

$$3.10$$

9.

[DETAILS](#)[MY NOTES](#)[ASK YOUR TEACHER](#)**Exam Confirmation**

Please complete this question only after you have answered and submitted all of the above questions.

(a) As stated in Exam Instructions posted in Brightspace, "The authorized resources are the textbook, lecture material inside Brightspace and WebAssign, your own class notes, homework assignments, and calculators. Unauthorized resources are outside resources including other people and other resources available on the internet."

☒ I confirm that I do not give or receive any unauthorized assistance during this exam.

(b) I understand that I must generate a pdf file of my exam submission record (as I did it for Practice for exam pdf submission) after completing the exam, or generate a pdf file of the screen where the timer says "time is up 0:00:00" if my exam is locked due to the timer expiring. Then submit the pdf file with the file name "Exam 2 Your Last Name" (for example, Exam 2 Yang) to the [Exam 2 pdf submission](#) folder in Brightspace's Assignments within fifteen (15) minutes of completing the exam.

☒ I will generate the required pdf file and submit it within fifteen (15) minutes of completing the exam.

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