
On the front of your bluebook, please write: a grading key, your name, student ID, your lecture number, and instructor. This exam is worth 100 points and has 5 questions on both sides of this paper.

- Submit this exam sheet with your bluebook. However, nothing on this exam sheet will be graded. Make sure all of your work is in your bluebook.
 - **Show all work and simplify your answers!** Answers with no justification will receive no points.
 - Please begin each problem on a new page.
 - No notes or papers, calculators, cell phones, or electronic devices are permitted.
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1. (21 points, 7 points each) Find $\frac{dy}{dx}$ for the following:

a.) $y = x \sec(\sqrt{x})$

b.) $4 \cos(x) \sin(y^2) = 1$

c.) $y = \sqrt{\frac{x^2 + 1}{x^2 + 4}}$

2. (15 points) A particle is moving along the line $y = 3x$. When $x = 4\text{cm}$, the x -coordinate of the particle's position is increasing at a rate of 2cm/min . At this moment, what is the rate of change of the particle's distance from the origin? Be sure to include all units in your answer.

Problems #3,4,5 continued on back side!

3. (30 points) Given $f(x) = \frac{-x^2 + x - 1}{x - 1}$, $f'(x) = \frac{x(2 - x)}{(x - 1)^2}$, $f''(x) = \frac{-2}{(x - 1)^3}$,

- a.) (1 point) Find the y -intercept of $f(x)$. Note that $f(x)$ does not have any x -intercepts.
 - b.) (5 points) Find any vertical and horizontal asymptotes of $f(x)$.
 - c.) (8 points) State the intervals of increase and decrease of $f(x)$ using interval notation. Find the x and y values of any local extrema.
 - d.) (6 points) On what intervals (using interval notation) is $f(x)$ concave up? Concave down? State the x and y values of any inflection points.
 - e.) (10 points) Sketch $f(x)$
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4. (22 points) The following are unrelated:

- a.) (10 points) State the definition of a critical point for a function $f(x)$ and find all critical points of the function $f(x) = |x + 2| - 1$
 - b.) (12 points) If $f(x) = \frac{5}{\sqrt{x + 2}}$, does the mean value theorem guarantee the existence of a c in $(2, 7)$ such that $f'(c) = -1/6$?
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5. (12 points)

- a.) (9 points) Use the linearization of $f(x) = \sqrt[3]{x}$ about $x = 27$ to estimate $\sqrt[3]{24}$
 - b.) (3 points) Based on your answer above, if $\sqrt[3]{24} \approx 2.8845$, what is the absolute error of your estimate?
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