MATH 1101, Section 2
Midterm 2
November 11, 10:10-11:25am

Name: ________________________________
UNI: ________________________________
Section: _____________________________

DO NOT OPEN THIS EXAM YET

(1) Fill in your name, UNI and section number.
(2) This exam is closed-book and closed-notes; no calculators, no phones.
(3) Please write legibly to receive credit. Circle or box your final answers. If your solution to a problem does not fit on the page on which the problem is stated, please indicate on that page where in the exam to find (the rest of) your solution.
(4) You may continue your solutions on additional sheets of paper provided by the proctor. If you do so, please write your name and UNI at the top of each of them and staple them to the back of the exam (stapler available); otherwise, these sheets may get lost.
(5) Anything handed in will be graded; incorrect statements will be penalized even if they are in addition to complete and correct solutions. If you do not want something graded, please erase it or cross it out.
(6) Show your work; correct answers only will receive only partial credit (unless noted otherwise).
(7) Be careful to avoid making grievous errors that are subject to heavy penalties.
(8) If you need more blank paper, ask a proctor.

Out of fairness to others, please stop working and close the exam as soon as the time is called. A significant number of points will be taken off your exam score if you continue working after the time is called. You will be given a two-minute warning before the end.

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1. (10 points) Find the derivatives of the functions:

a) (5 points)
\[ f(x) = \sin \left( x^2 + \frac{1}{x} \right) \]

b) (5 points)
\[ f(x) = \frac{\ln(3x + 2)}{(1 + 2x)^3} \]
2. (5 points) Find the maximal and the minimal values of the function

\[ f(x) = x^3 - x^2 - x - 1 \]

on the interval \([-1, 2]\).

3. (5 points) Use L'Hôpital's rule to find the limit

\[ \lim_{x \to 0} \frac{\sin x - x}{x^3}. \]
4. (10 points) For a function

\[ f(x) = \frac{x^2}{1 - x^2} \]

determine:
   a) Intervals where it is increasing/decreasing, points of local maximum/minimum
   b) Intervals where it is concave up/down, inflection points
   c) Limits at \( \pm \infty \), vertical and horizontal asymptotes
   d) Sketch the graph of \( f(x) \).
5. (5 points) Find the maximal value of the function $x^{1/x}$.

*Hint: present the function in a different form using exponent and logarithm*