Print your name here: __________________________

Please circle your section:

(1) T 1:30    Gilman 17    Ariturk, Sina
(2) T 3:00    Hodson 210    Tran, Timothy
(3) Th 1:30   Maryland 309   Ravit, Jason
(4) Th 3:00   Hodson 316    Tran, Timothy

Write out and SIGN the pledge:
I attest that I have completed this exam without unauthorized assistance from any person, materials, or device.

Grading

1

2

3

4

Total:

__________________________________________

Signature:______________________Date:______________________

This is a 50 minutes in-class closed book exam. No notes, books, or calculators are allowed.

This examination booklet contains 4 problems, on 6 sheets of paper including the front cover. Please detach the last page, which is intended for use as scrap paper.

Show all work. Don’t use any techniques that haven’t been covered in class yet. The correct answer is worth no points without any argumentation.
1 (30 pts.) Find the derivatives $f'(x)$ of the following functions $y = f(x)$.

a) $f(x) = \frac{x^2 + \sin x}{\cos x}$

b) $f(x) = \ln(\sqrt{x^2 + 1})$

c) $f(x) = (\sin x)^x$ ($x \in (0, \pi)$)
2 (20 pts.) Evaluate the following limits.

a) \( \lim_{x \to \infty} \frac{\ln x}{\sqrt{x}} \)

b) \( \lim_{x \to \infty} \left( \frac{2x-1}{2x+2} \right)^{x+1} \)
3 (20 pts.)

The volume of a cylinder of radius $r$ and height $h$ is $\pi r^2 h$. The diagonal $L$ of the cylinder satisfies Pythagoras relation $L^2 = h^2 + (2r)^2$.

**Question.** Of all cylinders of given diagonal length $L$, determine the height and radius of the one that has maximum volume. Argue your answer thoroughly.
4 (30 pts.) Consider the function $f(x) = x^4 - 4x^3$.

a) Determine the intervals where $f$ is increasing or decreasing.

b) Determine the intervals where (the graph of) $f$ is concave up(CU) or concave down(CD).

c) Determine local maxima and minima.

d) Determine the points where the graph of $f$ intersects the x-axis.

e) Use the information from above to sketch the graph of $f(x)$ over the interval $[-1, 5]$.

[To receive full credit you must exhibit the features from a)-d)]
This page is intended for use as scrap paper.