

ON THE FRONT OF YOUR BLUEBOOK write: (1) your name, (2) your student ID number, (3) lecture section (4) your instructor's name, and (5) a grading table. You must work all of the problems on the exam. Show ALL of your work in your bluebook and **BOX IN YOUR FINAL ANSWERS**. A correct answer with no relevant work may receive no credit, while an incorrect answer accompanied by some correct work may receive partial credit. Only the provided formula sheet is permitted (no textbooks, classnotes, crib sheets, or calculators).

1. (28 points) For each of the following functions, compute the derivative with respect to the appropriate variable. Simplify your answers whenever possible.

a. $y = 1 + e^{2\ln(\tan x)}$

b. $y = \tan^{-1}(\cot \theta)$

c. $y = \frac{x\sqrt{x^2 + 1}}{(x + 1)^{2/3}}$

d. $y = \log_2(\sinh z)$

2. (21 points) Evaluate the following integrals. Simplify your answers whenever possible.

a. $\int_0^{\pi/2} 2^{\cos x} \sin x \, dx$

b. $\int \frac{x^2}{x^2 + 1} \, dx$

c. $\int_{\pi/2}^{\pi} \sqrt{1 + \cos(2t)} \, dt$

3. (21 points) Solve the following limits. If a limit does not exist, write “DNE” for your answer.

a. $\lim_{x \rightarrow 0} \frac{e^x - \cos x}{x + \sin x}$

b. $\lim_{x \rightarrow 0^+} \frac{1}{x} - \frac{1}{\sin x}$

c. $\lim_{x \rightarrow \infty} \frac{e^x - e^{-x}}{e^x + e^{-x}}$

4. (30 points)

a. Solve the differential equation

$$\frac{dy}{dx} = e^{x-y}.$$

b. Solve the initial value problem

$$(x+1)\frac{dy}{dx} - 2(x^2+x)y = \frac{e^{x^2}}{x+1}, \quad x > -1, \quad \text{when } y(0) = 5.$$