

Compact Version

- This is a closed-book examination. No books, notes, calculators, cell phones, communication devices of any sort, or other aids are permitted.
- You need *not* simplify algebraically complicated answers. However, numerical answers such as $\sin\left(\frac{\pi}{6}\right)$, $4^{\frac{3}{2}}$, $e^{\ln 4}$, $\ln(e^7)$, or $e^{3\ln 3}$ should be simplified.
- Please *show* all of your work and *justify* all of your answers. (You may use the backs of pages for additional work space.)

- 1.** [6 Points] Compute the **derivative** for the following function. Do not simplify your answer.

$$f(x) = \arctan(4x) \cdot \arcsin(3x)$$

- 2.** [24 Points] Evaluate each of the following **limits**. Please justify your answers. Be clear if the limit equals a value, $+\infty$ or $-\infty$, or Does Not Exist.

(a) $\lim_{x \rightarrow \infty} \frac{\arctan x}{\frac{1}{x} + 1}$

(b) $\lim_{x \rightarrow 0} \frac{\sin(3x)}{9 \cos x - 5x - 9}$

(c) $\lim_{x \rightarrow \infty} x \left(2e^{\frac{1}{x}} - 2\right)$

(d) $\lim_{x \rightarrow 0} (1 + 3x)^{\frac{2}{x}}$

- 3.** [25 Points] Compute each of the following **definite integrals**. Please simplify your answer.

(a) $\int_0^{\frac{1}{2}} \frac{1}{\sqrt{1-x^2}} dx$

(b) $\int_1^e \ln x dx$

(c) $\int_0^{\ln 3} \sinh x dx$

4. [45 Points] Compute each of the following **indefinite integrals**.

(a) $\int \frac{e^x}{1 + e^{2x}} dx$ [Hint: $e^{2x} = (e^x)^2$]

(b) $\int x^2 e^x dx$

(c) $\int \frac{1}{(4 - x^2)^{\frac{3}{2}}} dx$

(d) $\int \sin^3 x \cos^4 x dx$

(e) $\int x \arcsin x dx$

OPTIONAL BONUS

Do not attempt these unless you are completely done with the rest of the exam.

OPTIONAL BONUS #1 Compute the following **indefinite integral**.

1. $\int \frac{x^3}{1 - \sin(x^2)} dx$

OPTIONAL BONUS #2 Compute the following **indefinite integral**.

2. $\int \frac{1}{x^{\frac{3}{2}} (1 + x^{\frac{1}{3}})} dx$