APPM 1350 **Final Exam** **Summer 2019**

On the front of your bluebook, please write: a grading key, your name, lecture number, and instructor name. This exam is worth 150 points and has 4 questions.

- Make sure all of your work is in your bluebook. Nothing on this exam sheet will be graded. Please begin each problem on a new page.
- **Show all work and simplify your answers!** Name any theorem that you use. Answers with no justification will receive no points unless the problem explicitly states otherwise.
- Notes, papers, calculators, cell phones, and other electronic devices are not permitted.

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1. (43 pts total)

   (a) Evaluate the following integrals:

   i. (9 pts) $\displaystyle\int \frac{(1+e^x)^2}{e^x}dx$ ii. (10 pts) $\displaystyle\int_0^{\frac{\pi}{2}} \frac{\sin(x)}{1+\cos(x)}\,dx$

   (b) Evaluate the following limits:

   i. (8 pts) $\displaystyle\lim_{x\to-\infty} \tanh(2x)$ ii. (8 pts) $\displaystyle\lim_{x\to 0} x^2\cos\left(\frac{1}{\sqrt{x}}\right)$ iii. (8 pts) $\displaystyle\lim_{x\to 0^-} e^{3/x}$

2. (22 pts total) Find the area of the largest rectangle inscribed in a right triangle with leg lengths 3 and 4 if two sides of the rectangle lie along the legs.

3. (40 pts total) The following problems are unrelated.

   (a) (11 pts) Calculate y' if $y = \tan(xy)$.

   (b) (13 pts) Find the equation of the tangent line to the curve of the function $f(x) = (\ln(x))^x$ at the point $(e, 1)$. Write your answer in the form $y = mx + b$. Use this linearization to estimate $\ln(3)^3$.

   (c) (16 pts) Let $f(x) = \ln(2 + \ln(x))$. Determine the domain of f and f^{-1}, and find a formula for $f^{-1}(x)$.

4. (45 pts total) Let $g(x) = \displaystyle\int_{-x^3}^{8} e^{t^2}\,dt$.

   (a) (12 pts) Calculate $g(-2)$ and $g'(-2)$.

   (b) (15 pts) Find the intervals on which the graph of $g(x)$ is concave up/down.

   (c) (10 pts) Demonstrate that g is one-to-one.

   (d) (8 pts) Calculate $(g^{-1})'(0)$.
