INSTRUCTIONS: **Simplify** and **box** all your answers. Write neatly and **show all work**. A correct answer with incorrect or no supporting work may receive no credit. Books, notes, electronic devices (such as calculator or other unauthorized electronic resources) are not permitted. **Give all answers in exact form.**

Potentially useful formulas:

$$\frac{d}{dx}\arctan(x) = \frac{1}{1+x^2}$$

$$\frac{d}{dx}\arcsin(x) = \frac{1}{\sqrt{1-x^2}}$$

$$\frac{d}{dx}\arccos(x) = -\frac{1}{\sqrt{1-x^2}}$$

$$\int \frac{1}{1+x^2}\,dx = \arctan x$$

$$\int \frac{1}{\sqrt{1-x^2}}\,dx = \arcsin x$$

$$\frac{d}{dx}\cosh(x) = \sinh(x)$$

$$\frac{d}{dx}\sinh(x) = \cosh(x)$$

$$\frac{d}{dx}\tanh(x) = \sec^2 h(x)$$

$$\cosh^2(x) - \sinh^2(x) = 1$$

NOTE: YOU MAY TEAR OFF THIS FIRST PAGE AND USE (FRONT AND BACK) AS SCRATCH PAPER.

i. DO NOT START UNTIL INSTRUCTED BY ME.

ii. THE EXAM IS ON BOTH SIDES OF EACH FOLLOWING EXAM PAGE

iii. WRITE YOUR NAME ON THE NEXT PAGE.

iv. WHEN YOU FINISH (IF BEFORE THE EXAM END TIME) PLEASE QUIETLY SCAN AND UPLOAD IT ON GRADESCOPE.

Name: ____

1. (10 pts) Find the minimum vertical distance between the functions $f(x) = e^{2x}$ and $g(x) = x$

2. Differentiate the following with respect to x

   (a) (10 pts) $y = \left(x + e^{\arctan(x)}\right)^2$

   (b) (10 pts) $y = x^{\cosh x}$

3. (10 pts) Find the range of the following function by finding its inverse

$$f(x) = \frac{2x + 5}{3x - 1}$$

4. Evaluate the following limits

   (a) (10 pts) $\lim_{x\to\infty} e^{-x}x^2$

   (b) (10 pts) $\lim_{n\to\infty} \left(1 + \frac{2}{n}\right)^n$

5. Evaluate the following integrals

(a) (10 pts) $\displaystyle\int \ln(\cosh x)\tanh x\,dx$

(b) (10 pts) $\displaystyle\int \frac{e^x}{\sqrt{1-e^{2x}}}\,dx$

6. Consider the following function

$$y = \frac{e^x}{e^x - 2}$$

(a) (12 pts) Find the Vertical and Horizontal asymptote(s) by using the limit definitions

(b) (8 pts) Sketch the graph of the function, which should reflect the results of part(a) as well as any intercept(s).

END OF THE EXAM. HAVE A WONDERFUL BREAK :)