• This is a closed-book examination. No books, notes, calculators, cell phones, communication devices of any sort, webpages, or other aids are permitted.

• Simplify numerical answers such as $\sin\left(\dfrac{\pi}{6}\right)$, $\ln e^3$, $e^{2\ln 3}$ and $4^{\frac{3}{2}}$.

• Please *show* all of your work and *justify* all of your answers. (You may use the backs of pages for additional work space.)

1. [30 Points] Compute each of the following derivatives.

(a) y' where $y = \ln\left(\dfrac{(\sin^2 x)\ \sqrt{1 + \sec\sqrt{x}}}{(5 - x^7)^{\frac{3}{7}}\ e^{-\cos x}}\right)$ Do not simplify your final answer here.

(b) $\dfrac{d}{dx}\ (\tan x)^{\sqrt{x}}$

(c) $\dfrac{dy}{dx}$ where $xe^{x+y} + \cos x = \ln(e + 5) + y\ln y + x^2$

2. [10 Points] Find the equation of the tangent line to the curve

$$y = \ln(1 + \cos x) + \cos(\ln(1 + x)) - e^{\sin x} + \frac{e}{1 + \ln(x+1)} + e^{x+1}\cdot\cos(e^x - 1) - \ln 2$$

at the point where $x = 0$.

3. [60 Points] Evaluate each of the following integrals. Simplify.

(a) $\displaystyle\int_0^{\ln 2} \left(e^x + \frac{1}{e^x} \right) \left(1 + \frac{1}{e^{2x}} \right) \, dx$

(b) $\displaystyle\int_1^{\sqrt{3}} \frac{w}{4 - w^2} \, dw$

(c) $\displaystyle\int_1^{e^3} \frac{\sqrt{4 - \ln x}}{x} \, dx$

(d) $\displaystyle\int \frac{1}{x e^{\ln x}} \, dx$

(e) $\displaystyle\int \frac{\left(x^{\frac{3}{4}} - 1 \right) \left(x^3 - x^{\frac{5}{4}} \right)}{x^3} \, dx$

(f) $\displaystyle\int_1^4 \frac{1}{\sqrt{x} \, e^{1 + \sqrt{x}}} \, dx$

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OPTIONAL BONUS

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

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OPTIONAL BONUS #1   Compute $\displaystyle\int e^{(e^{x+e^x} + x + e^x)} (1 + e^x) \, dx$