Work as many of the following problems as you can in one hour. To assure partial credit, show your work.

No calculators are permitted for this exam.

<table>
<thead>
<tr>
<th>page</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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(10) 1. Find the derivative of the function $F(x) = \int_{1}^{x} \ln(t)dt$ at the point $x = e^2$.

(10) 2. Find $g'(\pi)$, where $g(x)$ is the inverse function for $f(x) = x^3$. 
(10) 3. Use logarithmic differentiation to find $D_x \left( \sqrt[3]{\frac{x^2 - 1}{x^2 + 1}} \right)$.

(12) 4. An archeologist has found an ancient Sumerian basket, having 60% as much $^{14}C$ as a comparable basket woven today. It is known that the half-life of $^{14}C$ is 5730 years. How old is the basket? (Express your answer in terms of $\ln(0.5)$ and $\ln(0.6)$.)
5. Evaluate the integrals given below.

(a) \[ \int \frac{dx}{\sqrt{9 - 4x^2}} \]

(b) \[ \int \frac{dx}{8x - x^2} \]

(c) \[ \int \sinh t e^{\cosh t} \, dt \]
(d) \[ \int x \sec^2 x \, dx \]

(e) \[ \int_0^1 (3^4 - 4^3) \, dx \]

(10) 6. Solve the differential equation \( y' t = y \ln t \). (That is, obtain a relationship between \( y \) and \( t \) that does not involve \( y' \).)
(8) 7. Very roughly, just so as to give the general idea, sketch the graphs of \( y = e^x \), \( y = e^{-x} \), and \( y = \ln x \), all in the space provided below. (Label which graph is which, please.)