**INSTRUCTIONS:** Books, notes, and electronic devices are not permitted. Write your (1) name, (2) instructor's name, and (3) when your lecture meets on the front of your bluebook. Also make a scoring table, with places for 6 problems, plus a total score. This exam has 6 problems. **Work all problems. Start each problem on a new page.** Box your answers. A correct answer with incorrect or no supporting work may receive no credit, while an incorrect answer with relevant work may receive partial credit. **SHOW ALL WORK.**

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1. (20 points)

   (a) Find $y(x)$, given $\ln(y^2-1) - \ln(y+1) = \ln(\sin(x))$.

   (b) State the *Mean Value Theorem for Definite Integrals*. Be sure to include the hypothesis of the theorem in your answer.

   (c) Suppose $f(x) = e^{-x} - 3x - \sin(x)$, is $f(x)$ invertible? Justify your answer.

2. (10 points)

   (a) Estimate $\displaystyle\int_1^4 \frac{1}{x^2+1}\,dx$ using a *Riemann Sum* with 3 equal subintervals and left-hand endpoints.

   (b) Is the estimate calculated in part (a) above an underestimate or an overestimate? Justify your answer.

3. (20 points)

   (a) Evaluate $\displaystyle\int_2^4 \frac{dx}{x(\ln(x))^2}$

   (b) Evaluate $\displaystyle\int e^t \sin(e^t - 2)\,dt$

   (c) Given $\displaystyle\int_3^{-1} \big[1 + f(x)\big]\,dx = -1,$ and $\displaystyle\int_{-1}^5 \big[2f(x) - \frac{1}{6}\big]\,dx = 11$ find $\displaystyle\int_3^5 f(x)\,dx.$

4. (20 points) Let $g(x) = 3 + \displaystyle\int_1^{x^2} [1 + \ln(t)]\,dt.$

   (a) Find the *linearization* of $g(x)$ at $x = -1$.

   (b) Find $g''(-1)$.

5. (15 points) Find a curve $y = f(x)$ with the following two properties:

   i) $\dfrac{d^2y}{dx^2} = 6x$

   ii) Its graph passes through the point $(0, 1)$ and has a horizontal tangent there.

6. (15 points) Find the *total area* bounded by the curve $y = x^2 - 3x + 2$ and the $x$-axis in the interval $[-1, 2]$.

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