Math 1030 **Final Exam – Section 103** **December 15^{th}, 2008**

PART I. ANSWER KEY

1. (10 points) Given $f(x)$, compute the derivative $f'(x)$.

(a) $f(x) = x^3 \ln(x) + \dfrac{1}{\sqrt{x}} + 7x - 15$ so that $f(x) = x^3 \ln(x) + x^{-1/2} + 7x - 15$

(Use the product rule on the first term.)
$f'(x) = 3x^2 \ln(x) + x^3 \cdot \dfrac{1}{x} - \dfrac{1}{2} x^{-3/2} + 7$

(b) $f(x) = \ln(e^x + 1) + (x^2 + 5)^{100}$

(Use the chain rule on both terms.)
$f'(x) = \dfrac{1}{e^x + 1} e^x + 100(x^2 + 5)^{99}(2x)$

2. (10 points) Compute the following indefinite integrals.

(a) $\displaystyle\int 1 + \sqrt{x} + \frac{1}{x^3}\, dx$

$= \displaystyle\int 1 + x^{1/2} + x^{-3}\, dx = x + \frac{x^{3/2}}{3/2} + \frac{x^{-2}}{-2} + C$ (where C is an arbitrary constant.)

(b) $\displaystyle\int e^{4x}\, dx$

Use the u-substitution: $u = 4x$ so that $du = 4dx$ and thus $1/4\, du = dx$.
Therefore, $\displaystyle\int e^{4x}\, dx = \int e^u \left(\frac{1}{4}\right) du = \frac{1}{4} e^u + C = \frac{1}{4} e^{4x} + C$ (where C is an arbitrary constant.)

(c) $\displaystyle\int \frac{3x^2 + 2}{x^3 + 2x - 5}\, dx$

Use the u-substitution: $u = x^3 + 2x - 5$ so that $du = (3x^2 + 2)dx$.
Therefore, $\displaystyle\int \frac{3x^2 + 2}{x^3 + 2x - 5}\, dx = \int \frac{1}{u}\, du = \ln|u| + C = \ln|x^3 + 2x - 5| + C$ (where C is an arbitrary constant.)