No calculators, books, notes, etc. are permitted. Because calculators are not allowed, we expect answers left in a form such as $\sqrt{93}\ln(6) - 100^{1/3}$. Show all your work for partial credit.

(15) 1. Use Simpson's rule with $n = 4$ intervals to approximate $\displaystyle\int_1^3 \frac{1}{\sqrt{1+x^2}}\,dx$.

(40) 2. Evaluate each of the following.

(a) If $f(x) = \arctan(2 + \ln(x))$, find $f'(x)$ (6 pts)

(b) $\displaystyle\int \frac{e^{2x}}{1+(e^{2x})^2}\,dx$ (5 pts)

(c) $\displaystyle\int \cos(4x)\sin(3x)\,dx$ (7 pts)

(d) If $f(x) = (2 + \sec(x))^{\sin(x)}$, find $f'(x)$ (6 pts)

(e) $\displaystyle\int xe^{-5x}\,dx$ (10 pts)

(f) $\displaystyle\int \sec^2(x)10^{2\tan(x)}\,dx$ (6 pts)

(60) 3. Evaluate

(a) $\displaystyle\int \frac{-x^3+2x^2-4x+4}{x^2(x^2+4)}\,dx$ (12 pts)

(b) If $f(x) = \log_6(1 + e^x)$, find $f'(x)$. (7 pts)

(c) $\displaystyle\int \frac{\sqrt{x^2-4}}{x}\,dx$ (12 pts)

(d) Does the improper integral $\displaystyle\int_0^1 \ln(x)\,dx$ converge? If so, find the value. (7 pts)

(e) $\displaystyle\lim_{x\to 0}\frac{x\cos(2x)}{\sin(3x)}$ (8 pts)

(f) $\displaystyle\lim_{t\to\infty}\left(1-\frac{1}{t}\right)^{2t}$. (7 pts)

(g) $\displaystyle\int_0^1 \arctan(x)\,dx$. (7 pts)

(20) 4. Use the shell method to find the volume of the solid generated by revolving the region bounded by $y = x - x^2, y = 0, 0 \le x \le 1$ about the axis $x = -2$.

(20) 5. Use the disc method to find the volume of the solid obtained by revolving the region bounded by the lines $x = 0, x = \pi/2$, the line $y = -1$, and the graph of $y = \cos(x)$ about the axis $y = -1$.

(15) 6. Find the length of the curve $y = 2x^{3/2}, 1 \le x \le 3$.

(15) 7. I found a bank that compounds interest continuously; that is, if $A(t)$ is the amount of money I have in the account at time $t$, then the rate of change is equal to $kA(t)$. Last year, I deposited \$1000; this year I have \$1500. If I keep the money in the bank, when will I have \$5,000?

(15) 8. (a) Find the Taylor series approximation (without remainder) for $f(x) = \sin(2x)$ where $a = \pi/2$ and $n = 4$. (10 pts)

(b) Use this series to find an approximate value for $\sin(\pi/2 + 0.2)$. (5 pts)