1. Find the following derivatives. (10%)

(a) $\frac{d}{dx}\ln\left(x^2+3^x\right)$, at x=1 (b) $D_x \sin e^{2x}$

2. Find the following integrals. (20%)

(a) $\int \frac{t}{\sqrt{1-t^4}}\,dt$ (b) $\int x^2 \ln x\,dx$

(c) $\int_0^\infty \frac{x+1}{e^{3x}}\,dx$ (d) $\int_1^4 \frac{e^{\sqrt{x}}}{\sqrt{x}}\,dx$

3. Test $\int_1^4 \frac{1}{(x-2)^2}\,dx$ for convergence. (10%)

4. Find the area between the curves $y=12-3x^2$ and $y=4x+5$ from x=0 to x=3. (10%)

5. Verify that $\int_1^{x^r} \frac{1}{t}\,dt = r\int_1^x \frac{1}{t}\,dt,\ \forall x>0$ (10%)

6. Beginning 1 month from now, each month \$ 250 will be deposited into an account where the interest is compounded continuously at the annual rate of 9 percent. Use a definite integral to approximate the amount of money in the account immediately after the 36^{th} deposit. (10%)

7. The present value of the continuous stream of income $C(t)$ dollars per year, where t is the number of years from now, for T years at continuous interest rate r is $\int_0^T C(t)e^{-rt}\,dt$. A business generates income at the rate of $2t$ million dollars per year, where t is the number of years from now. Find the present value of this continuous stream for the next five years at the continuous interest rate of 10%. (15%)

8. Suppose that you have saved \$ 5000, and that you expect to save an additional \$3000 during each year. If you deposit these savings in a bank paying 5% interest compounded continuously, find a formula for your bank balance after t years. (15%)