Name: _____

Write all of your responses on these exam pages, use the back if necessary. Show all your work, answers without supporting justification will not receive credit.

1. Optimization (*20 Points*): A rectangular storage container without a lid is to have a volume of 10 m^3. The length of its base is twice the width. Material for the base costs \$10 per square meter. Material for the sides costs \$6 per square meter. Find the dimensions of the box that minimizes the cost of materials to create the container.

2. Newton's Method (*20 Points*): Set up the Newton's Method iteration equation for finding all solutions to the equation $2^x = 2 - x^2$. Do not find the solutions.

3. The Definite Integral by Definition (*20 Points*): Using the Definition of a Definite Integral with the right hand endpoint as the test value find the following integral.

$$\int_0^1 (x^3 - 3x^2)\, dx$$

Remember that

$$\sum_{i=1}^{n} 1 = n \qquad \sum_{i=1}^{n} i = \frac{n(n+1)}{2} \qquad \sum_{i=1}^{n} i^2 = \frac{n(n+1)(2n+1)}{6} \qquad \sum_{i=1}^{n} i^3 = \left(\frac{n(n+1)}{2}\right)^2$$

4. The Fundamental Theorem of Calculus (*50 Points*): Find the following,

   (a) Given that $y = \int_1^{3x+2} \frac{t}{1+t^3}\, dt$, find $\frac{dy}{dx}$.

(b) Evaluate $\displaystyle\int_1^3 \left(2x + \frac{1}{x}\right)\, dx.$

(c) Find the general indefinite integral, $\displaystyle\int \frac{1+\sqrt{x}+x}{x}\,dx$.

(d) Evaluate $\displaystyle\int_{\pi/6}^{\pi/3} 4\sec^2(x)\,dx$.

(e) Find the general indefinite integral, $\int \cos^3(x)\sin(x)\,dx$.