Lab 9

Optimization, Newton's Method, Antiderivatives, and Area

1. Find the dimensions of the rectangle of maximum area that can be inscribed in a circle of radius 4.

2. A box of volume 72 m^3 with square bottom and no top is constructed out of two different materials. The cost of the bottom is \$40/m^2 and the cost of the sides is \$30/m^2. Find the dimensions of the box that minimize total cost.

3. A box with no top is to be constructed from a piece of cardboard of sides A and B by cutting out squares of length h from the corners and folding up the sides. Find the value of h that maximizes the volume of the box if $A = 15$ and $B = 24$. What are the dimensions of this box?

4. Use Newton's Method to estimate $\sqrt[3]{25}$ to four decimal places.

5. Calculate the indefinite integral.

   (a) $\int (4x^3 - 2x^2)\, dx$

   (b) $\int \sin(4x - 9)\, dx$

   (c) $\int e^{-4x}\, dx$

   (d) $\int 4x^{-1}\, dx$

   (e) $\int \dfrac{x^3 + 3x - 4}{x^2}\, dx$

   (f) $\int 25 \sec^2(3z + 1)\, dz$

6. Solve the differential equation with the given initial conditions.

   (a) $\dfrac{dy}{dt} = 3t^2 + \cos t, y(0) = 12$

   (b) $\dfrac{dy}{dx} = e^{-x}, y(0) = 3$

   (c) $\dfrac{dy}{dx} = x^{-1/2}, y(1) = 1$

7. Find $f(t)$ if $f''(t) = 1 - 2t, f(0) = 2$ and $f'(0) = -1$.

8. A car traveling with velocity 24 m/s begins to slow down at time $t = 0$ with a constant deceleration of $a = -6$ m/s^2. Find the velocity $v(t)$ at time t.

9. Calculate R_5, M_5 and L_5 for $f(x) = (x^2 + 1)^{-1}$ on the interval $[0, 1]$.

10. Let A be the area under the graph of $f(x) = 2x^2 - x + 3$ over $[2, 4]$. Find a formula for R_N and compute A as a limit.