Calculus: Homework 13

December 27th, 2007

1. Show that the error of the Simpson rule when applied to a polynomial of degree at most 3 is zero.

2. Find the length of the curve

$$f(x) = \frac{1}{2}x\sqrt{x^2-1} - \frac{1}{2}\ln\left(x + \sqrt{x^2-1}\right),$$

with x from 1 to 2.

3. A mouse which at time 0 is at the origin of the coordinate system is moving upwards along the positive y-axis. A cat which at time 0 is at position $(1, 0)$ moves along the line

$$f(x) = \frac{1}{3}\left(x^{3/2} - 3x^{1/2} + 2\right)$$

and eventually catches the mouse. Show that the distance moved by the cat is twice the distance moved by the mouse.

4. Find the surface area of the solid of revolution obtained by rotating the region below $f(x) = \cosh x, x \in [0, \ln 2]$ and above the x-axis around the x-axis.

5. Consider the parametric curve given by

$$x = \frac{1-t^2}{1+t^2}, \qquad y = \frac{t(1-t^2)}{1+t^2}, \qquad t \in \mathbb{R}.$$

Find the equations of the tangent lines at the origin. Also, find all points where the tangent line is horizontal.