Written Homework 4
Due 11-2-05

1. Cell Traction Force (5 points)

In a matrix of cells, the cell traction force per unit mass is given by $T(n)=\frac{an}{1+bn^2}$

where n is the number of cells, a is the measure of the traction force generated by a cell, and b measures how force is reduced due to neighboring cells. Find and interpret $T'(n)$.

2. Calcium Kinetics (5 points)

A function used to describe the kinetics of calcium in the cytogel (the gel of cell cytoplasm in the epithelium, an external tissue of epidermal cells) is given by $R(c)=\frac{ac^2}{1+bc^2}-kc$,

where $R(c)$ measures the release of calcium, c is the amount of free calcium outside the vesicles in which it is stored, and a, b, and k are positive constants. Find and interpret $R'(c)$.

3. Cellular Chemistry (5 points)

The release of a chemical neurotransmitter as a function of the amount C of intracellular calcium is given by $L(C)=\frac{aC^n}{k+C^n}$,

where n measures the degree of cooperativity, k measures saturation, and a is the maximum of the process. Find and interpret $L'(C)$.

4. Uniform Load on a Bridge (20 points)

The equation which describes the vertical displacement, v, at a point, x, on a bridge under a uniformly distributed load is determined by the following equation involving its second derivative: $EIv''(x)=\frac{qLx}{2}-\frac{qx^2}{2}$

where E is the modulus of elasticity (a property related to the stiffness of the material)
I is the second moment of the area (a geometric property of the cross-section)
q is the force per unit length along the bridge
L is the length of the bridge.

Determine the maximum deflection, δ, of the bridge and the angle of deflection, θ, at the ends of the bridge. Hint: Use the fact that the vertical displacement at both ends is zero and that the bridge will be flat at the midpoint (where the maximum deflection occurs)