What is Calculus?

By the end of the semester you’ll be able to do all of the following problems:

1. Suppose that a patient is given a dose of $D$ milligrams of a drug. The change in a patient’s temperature $T$ in response to the drug is given by

$$T = D^2 \left( \frac{k}{2} - \frac{D}{3} \right),$$

where $k$ is a positive constant. What dose will maximize the temperature change?

2. A particle moves along a coordinate line with acceleration $a(t) = 2 - 6\sqrt{t}$ units/sec$^2$. At time $t = 1$ second, the object is at the origin and is moving with velocity 4 units/sec. Find the position of the particle as a function of time $t$.

3. Graph the function $f(x) = \frac{x^2(x + 1)^3}{(x - 2)^2(x - 4)^4}$.

4. Graph the function $f(x) = \frac{e^x}{x^2 - 9}$.

5. A stone is dropped into a still pond and sends out a circular ripple whose radius increases at a constant rate of 3 ft/sec. How fast is the area enclosed by the ripple increasing when the radius of the ripple is 8 feet?

6. A rocket that is launched vertically is tracked by a camera located on the ground 4 miles from the rocket launching pad. How fast is distance between the rocket and the television camera changing at the instant that the rocket is 3 miles above the ground and rising at a speed of 600 mph?

7. A liquid form of penicillin manufactured by a pharmaceutical firm is sold in bulk at a price of $200 per unit. The total monthly production cost for $x$ units of penicillin is

$$C(x) = 500,000 + 80x + .003x^2$$

dollars.

Suppose that the monthly production capacity of the firm is at most 30,000 units. How many units of penicillin should the firm manufacture and sell each month in order to maximize its profit?