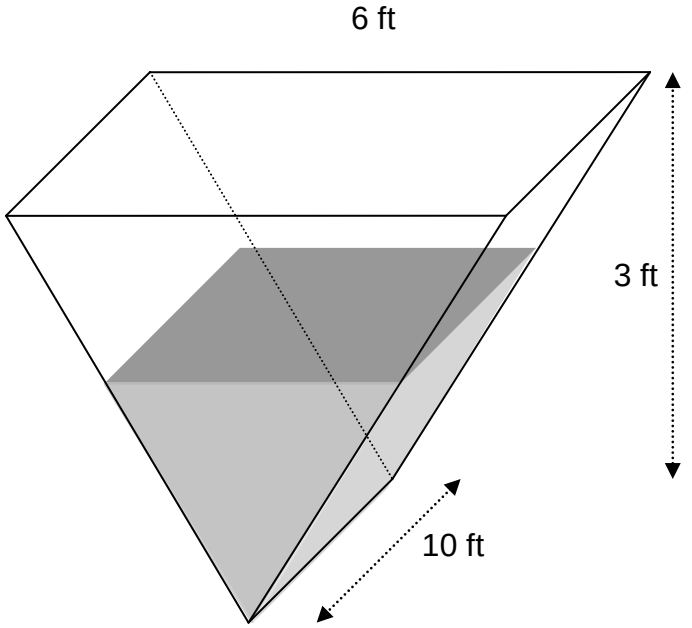
Math 31 More Applications to First Order Differential Equations July 3, 2017

1. A culture of bacteria is subjected to a controlled environment in order to test a new growth inhibitor. Data from these tests provides a growth model for this bacteria in this particular environment suggesting that the rate of growth is proportional to the tangent function evaluated on the amount of bacteria present at time *t*, but only until the population reaches 1.5 mg. After the population reaches 1.5 mg, it maintains that value. If $\pi/6$ milligrams of this bacteria that is placed in this special environment grows to $\pi/3$ milligrams in 1 hour, then write an appropriate differential equation and solve it. In addition, sketch two graphs: $\frac{dP}{dt}$ against *P* and another with *P* against *t* (using technology for this latter graph is fine). When will $\frac{dP}{dt}$ become zero?

2. The rate at which a population grows is proportional to the square root of the number of people. If $P(0)=100$ and $P(1)=121$, then find a model for this population.

3. Membership to the political party of *Algebranian Anarchists* grows at a rate which is jointly proportional to the cube of the number of members and the reciprocal of the natural logarithm of the number of members. If the initial number of members is 1 hundred and the number after 1 year is *e* hundred, then write and solve a differential equation to determine the population, measured in 100's, after *t* years.

4. Consider a body of water in a tank. The rate at which the water evaporates is proportional to the exposed surface area. A particular tank has a cross section that is in the shape of an isosceles triangle, with dimensions as depicted in the following picture.



Initially, the tank is full. But after one minute, the height decreases by 0.1 ft. Write an appropriate differential equation and solve it to determine the volume, V, of the resulting body of water as a function in time, t.