MATH 102:107, CLASS 29 (WED NOV 15)

(1) In this question, we write down a differential equation to model the growth of a spherical cell. Let $r(t)$ be the radius of the cell at time t, and let $V(t)$ be the volume of the cell at time t. We assume that

$$\frac{dV}{dt} = \text{Nutrients absorbed} - \text{Nutrients consumed}$$

$$= aS - bV$$

where S is the surface area, V is the volume, and a and b are constants.

(a) By writing S and V in terms of the radius r, write down a differential equation for r.

(b) What happens to the size of the cell over time?

(2) A barrel initially contains 2 kg of salt dissolved in 20 L of water. Water flows in at a rate of 0.5 L per minute, and well-mixed salt water solution flows out at the same rate.

(a) Write down a differential equation for $S(t)$, the amount of salt in the barrel at time t.

(b) How many minutes will it take before there is only 1 kg of salt in the barrel?