Growth!

1. (a) possible growth function:
   \[ \frac{dT}{dt} = T e^{-T} \]

* there are much simpler cases!

2. we have (i) the # of proliferating cell is proportional to the volume: \( T = kV \) or \( V = R^2T \) \( (R = \frac{1}{k}) \)
   (ii) the # of proliferating cells, \( P \) is proportional to the surface area of the sphere:
   \[ V = \frac{4}{3} \pi r^3(t) \Rightarrow \left( \frac{2V}{\pi} \right)^{1/2} = r(t) \]
   \[ SA = 4 \pi r^2(t) \]
   \[ P = k_2 SA = k_2 \left( 4 \pi r^2(t) \right) \]
   \[ = k_2 \left( 4 \pi \left( \frac{2V}{\pi} \right)^{2/3} \right) \]
   \[ = k_3 T^{2/3} \text{ where } k_3 = k_2 \cdot 4 \pi \cdot \left( \frac{3V}{\pi} \right)^{2/3} \]
   \[ \frac{dT}{dt} = k_3 T^{2/3} \]

3. In case (A)
   - if \( x(0) = 1 \), \( x(t) \) increases until it reaches 2
   - if \( x(0) = -1 \), \( x(t) \) still increases until it reaches 2
   - if \( x(0) = 3 \), for example, \( x(t) \) decreases until it reaches 2

In case (B)
   - if \( x(0) = 1 \), \( x(t) \) decreases until it reaches -2
   - if \( x(0) = -1 \), \( x(t) \) increases until it reaches -2
   - if \( x(0) = 4 \), for example, \( x(t) \) increases indefinitely