Differential Equations

While working in a group make sure you:

- Expect to make mistakes but be sure to reflect/learn from them!
- Are civil and are aware of your impact on others.
- Assume and engage with the strongest argument while assuming best intent.

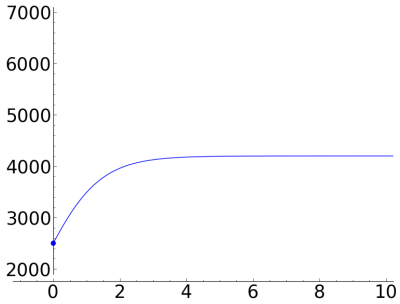
1. Consider $\dfrac{dP}{dt} = 1.2P\left(1 - \dfrac{P}{4200}\right)$
   where P denotes a non-negative population as a function of t.

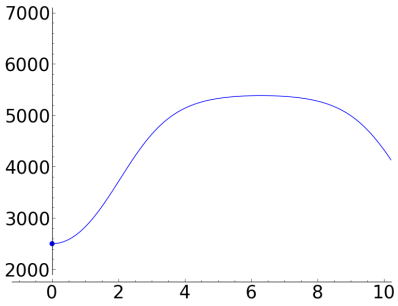
   (a) Is the above equation a differential equation?

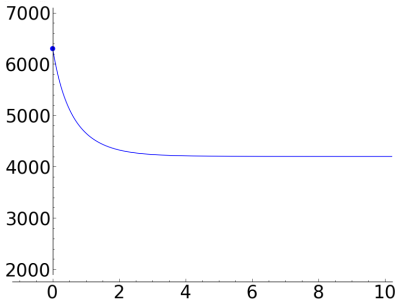
   (b) For what P values is the population increasing?

   (c) For what P values is the population decreasing?

   (d) Which of the below graphs could be a graph of P as a function of time?





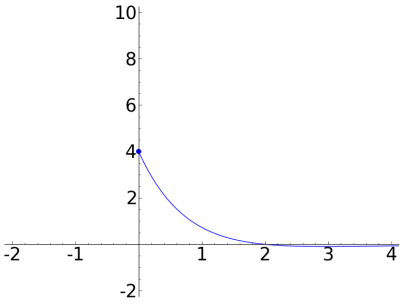


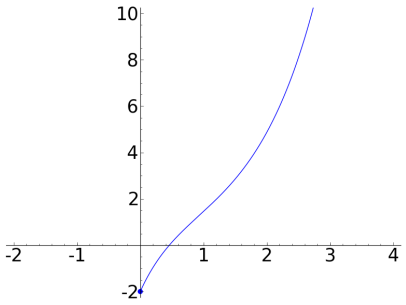
   (e) Are there any populations where the population seems to stabilize? (These are called *equilibrium solutions*.)

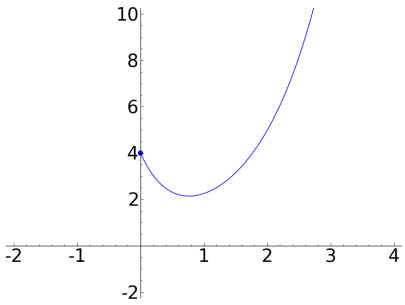
   (f) If you also knew that $P(0) = 2500$, which of the graphs above could be a solution to the initial value problem?

   Note, the solution to this differential equation is common/famous enough to have a name: a logistic equation.

2. Let $\dfrac{dy}{dx} = 2e^x - 2y$. Which of the graphs below could be a graph of y?







3. Match the differential equations with the solutions graphs labeled I-IV.

(a) $y' = 1 + x^2 + y^2$

(b) $y' = xe^{-x^2-y^2}$

(c) $y' = \dfrac{1}{1 + e^{x^2+y^2}}$

(d) $y' = \sin(xy)\cos(xy)$