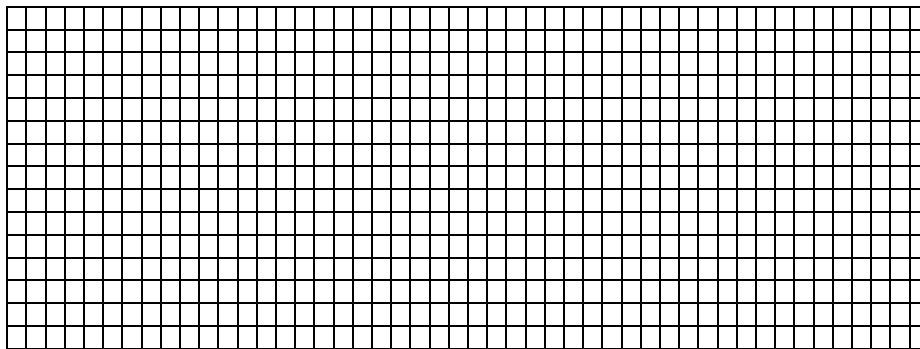


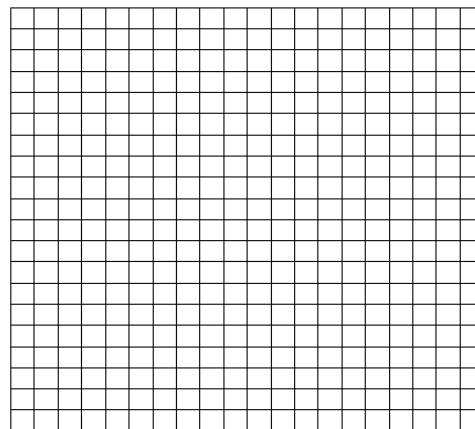
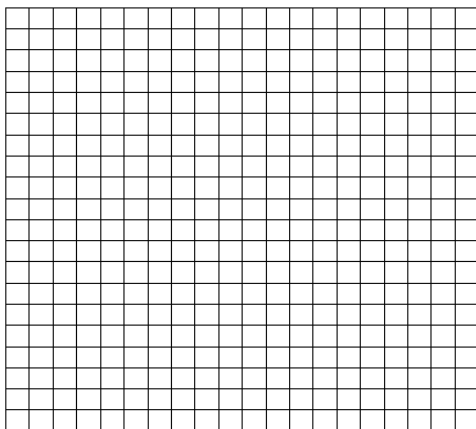
1. The Patuxent Research Refuge (located off of 295N) is charged with the mission of conserving and protecting the nation's wildlife and habitat through research and wildlife management techniques. Last summer they asked volunteers to come in and help eradicate an annual invasive grass species known as *Phragmites australis*. *Phragmites* has spread excessively in ponds where migratory birds frequent perennial reed *Typha latifolia* (Common Cattail) stands.

Phragmites has a growth function of $I(t) = 2.3t^{0.5}e^{-.02t}$ where $I(t)$ is the amount of biomass (in kilograms per squared kilometer) accumulated over time (in months) in *Phragmites* stands, and time starts at the beginning of this year's growing season in early Summer 2011. The native cattail is represented by $N(t) = 2.0\sin\left(\frac{\pi}{6}t - 1.5\right) + 2.5$ with the same units.

- a. Graph the two functions described over a period of 2 years with 8 points each. Be sure to label your axes, scale, and units. (2pts)



- b. Graph the rate of change of biomass accumulation over time for both *Phragmites* and Cattail over the same domain as the original functions. (2pts)



- c. Using the first derivative test, find the relative maximums and minimums for each plant species for the expressed domain. (2pts)
- d. Using the graphs for the first derivative, determine which seasons would be best for a large volunteer force to go and remove *Phragmites* stands. Why? (2pts)
- e. What do the graphs tell us about the pond's plant composition for Summer 2013? (1pt)
- f. What are some reasons **not** to manage *Phragmites* at Patuxent? (1pt)