1. Two farmers, husband and wife, wish to purchase a field in which to grow yams. The field is rectangular in shape and lies in a valley between a riverbed and a hillside. The Farmers estimate that land located \( x \) feet from the edge of the field nearest the river has value \( 250 - 0.15x \) dollars per square foot. The edge of the field nearest the river is 1000 feet long while the edge perpendicular to the river is 1500 feet long.

Use the information above to set up an integral for the total value of the field. A clear diagram of the field as viewed from above should be helpful to you. Do not bother to evaluate your integral.

2. Mr Farmer has recently purchased a Pivot Master irrigation sprinkler for watering the yam field. The sprinkler delivers \( \frac{1}{\sqrt{1+r^2}} \) gallons of water per hour per square foot of field at distance \( r \) feet from the sprinkler head.

Use the information above to set up an integral for the total amount of water delivered in one hour to a circular region centered on the sprinkler and having radius 100 feet. A clear diagram of the circle as viewed from above should be helpful to you. Do not bother to evaluate your integral.

3. The Farmers specialize in growing cone-shaped yams. When harvest time comes, work must be done in order to transfer the yams from the ground into the back of the Farmers' flatbed truck. Here is the relevant information for this problem:

The average yam sits in the ground with its pointed end downward, much like a carrot. The yam is 0.5 feet long, with a radius of 0.1 feet at the top. The distance from the top of the yam to the bed of the truck is 4 feet. The density of the yam is 72 pounds per cubic foot.

Use the information above to set up an integral for the total amount of work done by Mrs Farmer in lifting an average size yam onto the truck. A clear diagram of the yam should be helpful to you. Do not bother to evaluate your integral.
4. When Mr Farmer removes hot yams from the oven they obey Newton’s Law of Cooling. The initial temperature of the yams is 200°, the temperature of the kitchen is 70° and the temperature of the yams after 10 minutes is 110°.

Use the information above to find the value of the proportionality constant for cooling in the farmers’ kitchen. You may leave your answer in terms of logarithms.

5. While eating their yams, the farmers consider the population of yam pests (tiny bugs related to potato beetles) in their field. “Suppose,” says Mrs Farmer, “that the yam pest population \( P \) at time \( t \) satisfies the differential equation below. What would that mean for us in the long term?”

The differential equation is

\[
\frac{dP}{dt} = k P (P - 1000) (P - 2000),
\]

where \( k \) is a positive constant.

On a graph with axes labeled \( t \) and \( P \), locate the equilibrium solutions for the differential equation above. Identify each equilibrium solution you find as stable or unstable, indicating clearly how you made your determination.

**BONUS.** Do you prefer your yams with or without marshmallows?

_____ with.
_____ without.
_____ I hate yams.
_____ I would eat them with a cow, I would eat them anyhow!