**Name:** —————————————————————————                                   —————— / 25

**Circle one:    Rhodes (F01)** | **Bueler (F02)**

25 points possible. No aids (book, calculator, etc.) are permitted. You need not simplify, but show all work and use proper notation for full credit.

1. **[6 points]** An invasive plant species is introduced in the middle of a large flat region, and spreads outward over time in a circular pattern with the radius growing at a rate of 3 *km/year*. How fast is the plant-covered area growing when the radius is 40 *km*? Indicate appropriate units.

2. **[7 points]**

   **a**. Give a linear approximation to the function $f(x) = \sqrt{x}$ for $x$ near 16.

   **b**. Use your approximation to estimate $\sqrt{15}$.

3. **[6 points]** A population of 3 thousand cells of algae is introduced into a large vat of growing medium. After 2 days, the population has grown to 20 thousand cells. Assuming the population grows at a rate proportional to the size of the population, give a formula for the size of the population after $t$ days. (Your answer may involve exponentials or logarithms but should have no unspecified constants.)

4. **[6 points]** A rocket is launched vertically upward, and tracked by a ground observer located 4 km from the launch pad. If the rocket is traveling 450 *km/hour* when it has reached an altitude of 3 *km*, at what rate is its distance to the observer changing at that moment? Indicate appropriate units.