

Name: \_\_\_\_\_

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Circle one: Rhodes (F01) | Bueller (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. [7 points]**

a. Give a linear approximation to the function  $f(x) = \sqrt{x}$  for  $x$  near 25.

b. Use your approximation to estimate  $\sqrt{24}$ .

**2. [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  $2 \text{ km/year}$ . How fast is the plant-covered area growing when the radius is  $30 \text{ km}$ ? Indicate appropriate units.

3. [6 points] A rocket is launched vertically upward, and tracked by a ground observer located 3 km from the launch pad. If the rocket is traveling  $350 \text{ km/hour}$  when it has reached an altitude of  $4 \text{ km}$ , at what rate is its distance to the observer changing at that moment? Indicate appropriate units.
4. [6 points] A population of 2 thousand cells of algae is introduced into a large vat of growing medium. After 3 days, the population has grown to 30 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.)