2. A tree farm has become infested with a beetle that is killing healthy trees. The region of dead trees is expanding in a circular pattern. The radius, r, (measured in meters) of this circular region has been observed to be growing over time, t, (measured in days) and the relationship is given by the function: $r(t) = \sqrt{50t + 100}$ meters. The owner of the farm wants to spray the trees along the **circumference** of the circular region to stop the advance of the infestation. Recall that the circumference of a circle is a function of the radius of the circle: $C = 2\pi r$.

(a) (10 points) The owner needs to know the **circumference** of the circle at the point in **time** when he will be ready to begin the spraying operation. Using the concept of **composition of functions**, determine the **circumference, C, of the circular region of dead trees as a function of time t.** (Indicate exactly how you are using the functions C and $r(t)$ to get your answer.) Note that the function you determine, $C(t)$, will allow you to determine the circumference of the circular region directly from a value of time. Leave your final answer in terms of π.

(b) (8 points) The farmer can only order enough of the tree spray to cover a circumference of 300 meters. Using the function in part (a), determine the **time** at which the circumference of the circular region will be 300 meters. **Round your answer to one decimal place.**

3. Two years ago, the publisher of a national business weekly magazine began offering incentives for subscribers who renew their subscriptions. Since then, they have been tracking the number, N, of their subscribers who **do not** renew their subscriptions. Based on their data, they have derived a function to predict the number of subscribers who **do not** renew their subscriptions as a function of the number of months, x, from the present time ($t = 0$):

$$N(x) = \frac{10{,}000}{x+1} \; ; \; 0 \leq x \leq 24.$$

(a) (10 points) Determine the inverse function $N^{-1}(x)$.

(b) (4 points) What is the **range** of the inverse function $N^{-1}(x)$ determined in part (a)?

(c) (4 points) <u>Using the result from **part (a)**,</u> after how many **months** will the number of subscribers who **do not** renew their subscription each month be equal to 1600? Round your answer to **2 decimal places**.

4. A patient is going to be given a drug after surgery using a continuous IV infusion. The concentration, C, (measured in milligrams per liter) of the drug at time t hours after the start of the infusion is modeled by the function: $C(t) = \frac{100t}{2t+4}$; $t \geq 0$. (Note: This is a **rational function**.)

(a) (4 points) According to this function, what is the initial concentration of the drug at time $t = 0$?

(b) (8 points) According to this function, at what time will the concentration of the drug be equal to 40 mg. per liter? REMEMBER TO SHOW YOUR WORK. Round your answer to **1 decimal place.**

(c) (6 points) In the "long run" (mathematically, as $t \to \infty$), what value will the **concentration** of the drug approach? **Indicate exactly how you reached your answer; that is, JUSTIFY your answer with computations and a mathematically appropriate explanation.** NOTE: Plugging numbers into the function will NOT justify your result.