

3. [13 points] A wedge of cheese in Zack's refrigerator has become home to a colony of bacteria. Let $A(t)$ be the surface area of the colony (in cm^2) t days after the expiration date of the cheese.
- a. [4 points] For the first 20 days after the expiration date, the surface area of the colony grows exponentially. During this time, it takes the colony 5 days to double. Write a formula for $A(t)$ on the domain $0 \leq t \leq 20$. (Your formula may involve an unknown constant, but be sure to specify what this constant means in terms of bacteria.)
- b. [3 points] How many days does it take for the surface area of the colony to triple? (Your answer does not need to be a whole number.)
- c. [3 points] Twenty days after the expiration date, the bacteria mysteriously begin to die off. The surface area of the colony on the cheese decreases linearly at a rate of $0.3 \text{ cm}^2/\text{day}$ starting at $t = 20$, and by $t = 22$ the surface area has fallen to 9 cm^2 . Given that $A(t)$ is a continuous function, what was the surface area of the colony on the expiration date of the cheese?
- d. [3 points] What is $A'(20)$, or is it undefined? Justify your answer with a rough sketch of $A(t)$.