5. [8 points] Remember to show your work carefully throughout this problem.
Algie and Cal go on a picnic, arriving at 12:00 noon.

a. [5 points] Five minutes after they arrive, they notice that 5 ants have joined their picnic. More ants soon appear, and after careful study, they determine that the number of ants appears to be increasing by 20% every minute. Find a formula for a function \( A(t) \) modeling the number of ants present at the picnic \( t \) minutes past noon for \( t \geq 5 \).

**Solution:** Since this is an exponential function, there are constants \( c \) and \( b \) such that \( A(t) = cb^t \). We can see immediately that \( b = 1.2 \). We can then use the fact that we know that \( A(5) = 5 \) to find \( c \): \( c(1.2)^5 = 5 \), so \( c = 5/(1.2)^5 \), which is approximately 2.01. Alternatively, we can use a horizontal shift to say that this is \( 5(1.2)^{t-5} \).

**Answer:** \( A(t) = 5(1.2)^{(t-5)} \)

b. [3 points] Algie and Cal notice that their food is, unfortunately, also attracting flies. The number of flies at their picnic \( t \) minutes after noon can be modeled by the function \( g(t) = 1.8(1.25)^t \). Algie and Cal decide they will end their picnic when there are at least 1000 flies. How long will their picnic last? Include units.

**Solution:** We wish to find \( t \) such that \( 1.8(1.25)^t = 1000 \). Then
\[
1.8(1.25)^t = 1000
\]
\[
\ln(1.8(1.25)^t) = \ln(1000)
\]
\[
\ln(1.8) + t \ln(1.25) = \ln(1000)
\]
\[
t \ln(1.25) = \ln(1000) - \ln(1.8)
\]
\[
t = \ln(1000/1.8)/\ln(1.25) \approx 28.3.
\]
So they end their picnic about 28.3 minutes after noon (when it started).

**Answer:** About 28.3 minutes

6. [6 points] Consider the function
\[
R(w) = 2 + (\ln(w))^{\cos(w)}.
\]
Use the limit definition of the derivative to write an explicit expression for \( R'(\pi) \). Your answer should not involve the letter \( R \). Do not attempt to evaluate or simplify the limit. Please write your final answer in the answer box provided below.

**Answer:** \( R'(\pi) = \lim_{h \to 0} \frac{2 + (\ln(\pi + h))^{\cos(\pi + h)} - (2 + (\ln(\pi))^{\cos(\pi)})}{h} \)