3. [15 points] A scientist is observing two different ant colonies under different experimental conditions. From her data, it looks like

- Colony A's population increases by 10% every two hours.
- Colony B's population decreases by 7% every hour.

a. [1 point] By what factor is Colony A's population multiplied each hour? *Give your answer in exact form or rounded to two decimal places.*

a factor of: _____

b. [2 points] What is the *continuous* decay rate of Colony B per hour as a percentage? *Give your answer in exact form or rounded to two decimal places.*

_____ %

c. [2 points] How long will it take for Colony B to reach 25% of its original size? *Show all work. Give your answer in exact form or rounded to two decimal places.*

_____ hours

d. [4 points] If Colony A starts with 1000 ants and Colony B starts with 10,000 ants, after how many hours will the colonies have equal populations? *Show all work. Give your answer in exact form or rounded to two decimal places.*

_____ hours

(Problem continues on the next page.)

The scientist now observes two additional different ant colonies. From her data, it looks like

- Colony C's population doubles for the first time after 2.5 hours; doubles again 1.5 hours after that; then doubles a third time 1 hour after that.
- Colony D's population is given by $P = D(t) = 1200 - 300e^{-0.11t}$, where P is the number of ants and t is measured in hours since the experiment started.

e. [2 points] Is Colony C growing exponentially? Circle your answer below. If YES, find its growth factor. If NO, explain why not.

YES NO

Explanation or Growth Factor:

f. [4 points] Find a general formula $D^{-1}(P)$ and explain what that function means. *Show all work.*

$D^{-1}(P) =$_____

Meaning of $D^{-1}(P)$: