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 \( D^{-1}(P) \):**