

# Key

Review- 9.1-9.10

## 9.1-9.3- Exponential and Continuous Growth and Decay

1. Give the basic equation for exponential growth.

$$y = a(1+r)^x \leftarrow \text{growth} \quad \text{decay} \rightarrow y = a(1-r)^x$$

2. What does a, b, and x stand for?

$$a = \text{start w/} \quad b = 1 \pm \text{rate} \quad x = \text{time (t=future, -=past)}$$

3. How do I know if it is growth or decay?

the words

4. How do I know if it is going forward in time or backwards?

ago = past in # years = future

5. Give the basic equation for continuous growth or decay.

$$A = Pe^{rt}$$

6. What do the variables mean?

$$P = \text{amount start w/} \quad r = \text{rate} \quad t = \text{time} \quad e = 2.7182818 \dots$$

7. How do I know if it is growth or decay?

8. How do I know if time goes forward or backwards?

same as #4

9. Your toenails grow 20% longer every 2 days. Now it is 3 inches long. How long will it be in 8 days? How long will they have been 16 days ago?

in 8 days:

$$y = 3(1 + 0.20)^{8/2}$$

$$y = 6.2 \text{ inches}$$

16 days ago:

$$y = 3(1 + 0.20)^{-16/2}$$

$$y = 0.70 \text{ inches}$$

10. The half life of water is 3 hours. If there are 100 pounds in a cup right now, then how much will there be in 12 hours? How much was there 9 hours ago?

in 12 hours:

$$y = 100(.5)^{12/3} = 6.25$$

9 hours ago:

$$y = 100(.5)^{-9/3} = 800$$

11. Your car is worth \$20,000 right now, and loses 10% of its value every month. How much was it worth 4 months ago? How much will it be worth in 12 months?

$$20,000(1 - 0.10)^{-4} \\ = \$30,483.16$$

$$20,000(1 - 0.10)^{12} \\ = \$5,648.59$$

12. A certain bacteria decays continuously at an annual rate of 10%. If there are 2000 bacteria right now, how many will there be in 3 years? How many were there 10 years ago?

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13. Your money is in a bank that grows continuously at an annual rate of 8%. If you have \$5,000 right now, how much will you have in 20 years?

$$5000e^{.08 \times 20} = \$24,765.16$$

9.5 and 9.7- LOG of various bases- Think Circle of Life- Remember we raise to powers, not multiply.

14. If you see, log, what is the base?

15. Write the basic log definition.

$$\log_b x = y \Rightarrow b^y = x$$

16. What does the circle of life tell you?

How to manipulate from log to exponential form

Find the following logs. Try not to use a calculator. For some you cannot use a calculator.

17.  $\log_9 9$

$$9^? = 9 \Rightarrow ? = 1$$

18. log base 9 of  $\frac{1}{81}$

$$9^? = \frac{1}{81} \Rightarrow 9^? = 9^{-2} \Rightarrow ? = -2$$

19.  $\log 1,000$

$$10^? = 1000 \Rightarrow ? = 3$$

20.  $\log_4 4^{18}$

$$4^? = 4^{18} \Rightarrow ? = 18$$

21.  $\log_4 16^2$

$$4^? = 16^2 \Rightarrow 4^? = 256 \Rightarrow ? = 4$$

22. log base 5 of  $(1/125)$

$$5^? = \frac{1}{125} = \frac{1}{5^3} \Rightarrow 5^? = 5^{-3} \Rightarrow ? = -3$$

23.  $\log 5 + \log 20$

$$\log(5 \cdot 20) = \log 100 \Rightarrow 10^? = 100 \Rightarrow ? = 2$$

24.  $\log_6 216 - \log_6 36$

$$\log_6 \frac{216}{36} = \log_6 6 \Rightarrow 6^? = 6 \Rightarrow ? = 1$$

25.  $\log_{33} 1$

$$33^? = 1 \Rightarrow ? = 0$$

26.  $\log_3 27 - \log 100$  (THINK)

$$3^? = 27 \Rightarrow 3^3 = 27 \Rightarrow 3 - 2 = 1$$

27.  $\ln e^{12}$

$$e^? = e^{12} \Rightarrow ? = 12$$

28.  $4 \cdot \ln e^5$

$$4 \cdot 5 = 20$$

9-10- When do you use log vs. ln?

everytime except when "e" is present

Solve:

29.  $8^x = 12$

$$\begin{aligned} \textcircled{52} \log 8^x &= \log 12 \\ \textcircled{53} x \cdot \log 8 &= \log 12 \\ \textcircled{54} \frac{\log 12}{\log 8} &= \frac{\log 12}{\log 8} \\ x &= 1.19 \end{aligned}$$

30.  $8^{x-2} = 50$

$$\begin{aligned} \textcircled{52} \log 8^{x-2} &= \log 50 \\ \textcircled{53} (x-2) \log 8 &= \log 50 \\ \textcircled{54} x-2 &= \frac{\log 50}{\log 8} + 2 \\ x &= 3.88 \end{aligned}$$

31.  $6^{4x} = 18$

$$\begin{aligned} \textcircled{52} \log 6^{4x} &= \log 18 \\ \textcircled{53} 4x \cdot \log 6 &= \log 18 \\ \textcircled{54} \frac{\log 18}{\log 6} &= \frac{\log 18}{\log 6} \\ 4x &= 1.16 \\ x &= .40 \end{aligned}$$

32.  $7^x = 81$

$$\begin{aligned} \log 7^x &= \log 81 \\ x \cdot \log 7 &= \log 81 \\ \frac{\log 81}{\log 7} &= \frac{\log 81}{\log 7} \\ x &= 2.26 \end{aligned}$$

33. Sue Aimi wants to invest \$2500 in a certificate of deposit paying interest at 5.8% compounded continuously. How long will it take the money to double?

$$A = Pe^{rt} \Rightarrow 2P = 2500e^{.058t}$$

$$\frac{2P}{P} = \frac{Pe^{.058t}}{P} \Rightarrow 2 = e^{.058t}$$

$$\begin{aligned} \ln 2 &= \ln e^{.058t} \\ \ln 2 &= .058t \cdot \ln e \\ \frac{\ln 2}{.058} &= \frac{.058t}{.058} \end{aligned}$$

$$t = 11.95 \approx 12 \text{ years}$$