

### HW 3.3.1: Exponential Growth and Decay

In exercises 1 – 4, write an exponential model function of the form  $f(t) = a \cdot b^{kt}$  to model each situation, where  $k$  is a constant that describes the situation and  $t$  is time.

1. A population numbers 8,000 organisms initially and grows by 4.5% every two years.
2. A car is currently worth \$10,000 and has been decreasing in value by 17.2% every four years.
3. The property value of a home purchased in 2001 for \$87,000 increases by 0.15% every year.
4. The value of a \$1500 stainless steel refrigerator depreciates by 10% every five years.

In exercises 5 – 13, write an exponential function,  $f(t) = a \cdot b^t$  passing through the given points. Sketch a graph of your function.

5.  $(0,6), (3,750)$

6.  $(0,3), (2,75)$

7.  $(0,2000), (2,20)$

8.  $\left(-1, \frac{3}{2}\right), (3,24)$

9.  $\left(-1, \frac{2}{5}\right), (1,10)$

10.  $(3,1), (5,4)$

11.  $\left(\frac{1}{2}, \frac{4}{3}\right), \left(3, \frac{128}{3}\right)$

12.  $\left(-1, \frac{5}{3}\right), (2,45)$

13.  $(-4,12), \left(3, \frac{3}{32}\right)$

In exercises 14-20 give both the exact (without calculator) and approximate (with calculator) answers.

14. A radioactive substance decays exponentially. A scientist begins with 150 milligrams of a radioactive substance. After 40 hours, 75 mg of the substance remains. How many milligrams will remain after 60 hours?
  
15. A vehicle was valued at \$36,000 in the year 2011. The value depreciated to \$12,000 by the year 2015. Assume that the car value continues to drop at a constant rate. How long will it take for the car to be valued at \$800?
  
16. A house was valued at \$190,000 in the year 1988. The value appreciated to \$250,000 by the year 2003. What was the annual growth rate between 1988 and 2003? Assume that the house value continues to grow at the same rate. What is the value of the house in the year 2010?
  
17. A car purchased for \$25,700 depreciates at a constant rate of 3% each year. How long will it take for the car to be worth \$10,000?
  
18. A new homeowner purchases furniture worth \$10,000, which depreciates at a constant rate of 7% every 2 years. How many years will it take for the furniture to be valued at \$6,000?
  
19. A population of 20,000 rabbits has a growth rate of 25% every three years. Determine the population after 8 years.
  
20. Longhorn High School opens its door in 2005 with 800 students. The school grows 20% every four years. How long will it take for the school to reach 3000 students?



In exercises 21-26, do the following:

1. Sketch a graph of the function
2. Identify the function as growth or decay
3. Identify key coordinate points that the graph passes through
4. Identify any asymptotes

21.  $y = 2(3)^x$

22.  $y = 3(2)^{x-1}$

23.  $y = 4(2)^x + 1$

24.  $y = 2\left(\frac{2}{3}\right)^x$

25.  $y = \left(\frac{1}{2}\right)^{x+1}$

26.  $y = 3\left(\frac{1}{2}\right)^x - 4$

Selected Answers:

1.  $f(t) = 8,000(1.045)^{\frac{t}{2}}$

3.  $f(t) = 87,000(1.0015)^t$

5.  $f(t) = 6(5)^t$

7.  $f(t) = 2000\left(\frac{1}{10}\right)^t$

9.  $f(t) = 2(5)^t$

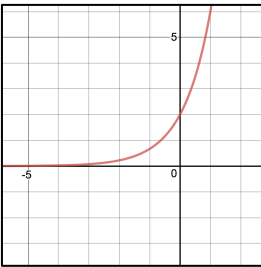
11.  $f(t) = \frac{2}{3}(4)^t$

13.  $f(t) = \frac{3}{4}\left(\frac{1}{2}\right)^t$

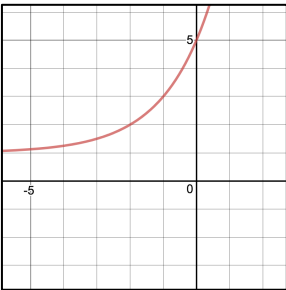
15.  $t = (4) \left( \frac{\log \frac{1}{45}}{\log \frac{1}{3}} \right)$

17.  $t = \frac{\log\left(\frac{100}{257}\right)}{\log\left(\frac{97}{100}\right)}$

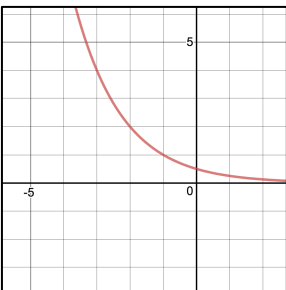
19.  $f(8) = 20000(1.25)^{\frac{8}{3}}$



21. growth; y-intercept (0,2) horizontal asymptote at  $y = 0$



23. growth; y-intercept (0,5); horizontal asymptote at  $y=1$



25. decay; y-intercept (1,1/2); horizontal asymptote at  $y=0$