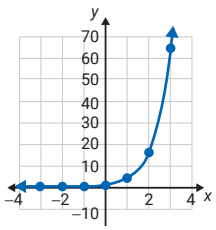
7. You may leave the `FreqList:` and the "`StoreREqEQ:`" fields blank.
8. Press ENTER or the down arrow until "`Calculate`" is highlighted.
9. Press ENTER.
10. The calculator will display the exponential regression in the form $y = ab^x$ and identify the values for $a$ and $b$.

We can see that the exponential regression model computed for the number of downloads is $y = 3.99(1.25)^x$.

***Now work margin exercise 6.***

***Margin Exercise Answers***

**1. a.** exponential; $f(x) = 4^x$ **b.** $f(x) = 10x + 50$ **2.**




**3.** 12,150 people **4.** \$360.45 **5.** \$20,650.35

**6.** $y = 2.76(1.47)^x$

# 4.3 Exercises

## Concept Check

**Fill-in-the-Blank.** Complete the sentences using information found in this section.

1. Equations that model a _____ rate of change are linear equations.
2. In an exponential function, the _____ can take on the value of any real number.
3. The _____ of an exponential function cannot equal one.
4. With exponential growth, the value of the function _____ as the value of the exponent _____.
5. With exponential decay, the value of the function _____ as the value of the exponent _____.
6. The value $e$ is called the _____ base.

**True/False.** Determine whether each statement is true or false. If a statement is false, explain how it can be changed so the statement will be true. (**Note:** There may be more than one acceptable change.)

7. Exponential functions increase quickly at first and then grow very slowly.
8. For all exponential functions $f(x) = b^x, b < 0$.
9. The function $f(x) = 5^x$ is an examples of exponential growth.
10. Continuously compounding interest compounds once a month.

## Practice

Determine whether the given situation is best described by a linear model or an exponential model. Create a function for the situation. See Example 1.

**1.** A petri dish contains 100 bacteria at the beginning of an experiment (hour zero). The population triples every hour.

**2.** A farmer has 50 sheep at the beginning of the year (month zero). Every month, she adds 3 more sheep to her flock.

3. An investor deposits 100 dollars in a bank account that pays 4 dollars in interest every month.

**4.** An investor puts 100 dollars in an account that pays 4% interest on the previous amount.

**5.** The number of people who signed for a social media platform is 100,000 and it doubles every year for 6 consecutive years.

**6.** The number of people signed up for a club on campus is 47 and it decreases by 3 member per year for 6 consecutive years.

Create a table of 6 values for each function and then sketch the graph. See Example 2.

**7.** $f(x)=3^x$

**8.** $f(x)=16^x$

**9.** $f(x)=\left(\frac{1}{2}\right)^x$

**10.** $f(x)=\left(\frac{1}{4}\right)^x$

**11.** $f(x)=2^{x-1}$

**12.** $f(x)=4^x+1$

**13.** $f(x)=\left(\frac{1}{2}\right)^x-1$

**14.** $f(x)=\left(\frac{1}{4}\right)^{x+1}$

**15.** $f(x)=0.5\left(16^{x-0.5}\right)$

**16.** $f(x)=0.5\left(4^x+2\right)$

For the following problems, use the first column as the independent variable *x* and the second column as the dependent variable *y*, use a TI-84 Plus graphing calculator to compute the exponential model of the data. See Example 6.

**17.** A biologist has measured the number of bacteria in a petri dish every hour and recorded the data in the table below.

| Time (hours) | Number of Bacteria (in Thousands) |
|---|---|
| 1 | 10.10 |
| 2.5 | 12.25 |
| 4 | 10.40 |
| 5 | 10.51 |

**18.** An accountant recorded the balance in an investment account.

| Time (in Months) | Dollars |
|---|---|
| 1 | 1515.07 |
| 2 | 1530.30 |
| 3 | 1545.68 |
| 4 | 1561.21 |

**19.** A maintenance manager recorded the volume of water in a pool that is being filled.

| Time (in Hours) | Volume (in Gallons) |
|---|---|
| 4 | 10406.04 |
| 5 | 10510.1 |
| 6 | 10615.2 |

**20.** Researcher estimated population of wild African elephants.

| Years Since 1979 | Number of Elephants (in Thousands) |
|---|---|
| 0 | 1300 |
| 10 | 600 |
| 37 | 460 |

**21.** The number of hours a student spends working on math homework.

| Time (in Weeks Since the Start of Semester) | Weekly Number of Study Hours. |
|---|---|
| 1 | 10 |
| 2 | 12.5 |
| 3 | 15.625 |

**22.** The number of hours a student sleeps per night as finals week approach.

| Number of weeks until final | Number of hours slept per nigh |
|---|---|
| 1 | 5.6 |
| 2 | 6.25 |
| 3 | 7.00 |
| 4 | 7.85 |
| 5 | 8.85 |

## Applications

Solve.

**23.** A biologist knows that in the laboratory, bacteria in a culture grow according to the function $y = y_0 \cdot 3^{2t}$, where $y_0$ is the initial number of bacteria present and $t$ is time, measured in hours. How many bacteria will be present in a culture at the end of 5 hours if there were 250 bacteria present initially?

**24.** In Exercise 23, how many bacteria were present initially if at the end of 5 hours there were 2,500,000 bacteria present? Round to the nearest number of bacteria.

**25.** The balance (in dollars) of an investment account, $t$ months after an initial deposit, is given by $P(t) = 1000(1.005)^t$. Determine the balance after 6 months. Round your answer to the nearest cent.

**26.** The population of pigeons at a city park, $t$ weeks after the beginning of the summer, is given approximately by $P(t) = 55(1.02)^t$. Determine the number of pigeons at the park after 3 weeks. Round your answer to the nearest integer.

**27.** The population of bacteria in a petri dish, $t$ minutes after the start of an experiment, is given by $P(t) = P_0(1.02)^t$. Knowing that the population after 3 minutes is equal to 1061, determine the value of the initial population to the nearest whole number. In other words, knowing that $P(3) = 1061$, find $P_0$.

**28.** A balloon has an initial volume of 1 liter. Air is slowly pumped into the balloon so that its volume increases by 5% every hour. Write a function that represents the volume of the balloon in liters, $t$ hours after the beginning of the pumping process. Determine the volume of the balloon 5 hours into the process.

**29.** A car loses approximately 20% of its value every year after the initial purchase. The value of a 10,000-dollar car $t$ years after its initial purchase is then given by $V(t) = 10{,}000(0.8)^t$. Determine the value of the car after 4 years.

**30.** A pool is full of water when a leak develops. The volume of water in the pool (in thousands of gallons) $t$ minutes after the development of the leak is given by $V(t) = 10(0.99)^t$. Determine the volume of the pool 10 hours after the leak.

**31.** Consider that the amount of caffeine in the human body in milligrams is given by $V(t) = V_0(0.5)^{\frac{t}{6}}$ where $V_0$ is the initial ingested amount and $t$ is the number of hours since it was ingested. Determine the amount of caffeine in the human body after 8 hours if the initial ingested amount is 95 milligrams (the equivalent to about one cup of coffee).

**32.** The blood concentration, in milligrams per liter (mg/L), of a particular antibiotic is given by $V(t) = V_0(0.5)^{\frac{t}{8}}$ where $t$ is the number of hours since the patient ingested the initial dose of $V_0$ milligrams. Determine the blood concentration 8 hours after the patient has ingested 500 mg of the antibiotic.

**33.** The mass of radioactive Carbon-14 in a sample (measured in milligrams) $t$ years after the beginning of an experiment is given by $M(t) = M_0 \cdot (0.5)^{\frac{t}{5730}}$ where $M_0$ is the initial mass. Determine the mass of Carbon-14 50,000 years for an initial amount on 200 milligrams.

**34.** The blood stream concentration, in milligrams per liter (mg/L), of a particular medicine is given by $V(t) = 250(0.5)^{\frac{t}{8}}$ where $t$ is the number of hours since the initial dose. This particular medicine is only effective when the blood stream concentration is at least 150 mg/L. Determine if the medicine is being effective 4 hours after the initial dose has been administered.

**35.** Find the amount A repaid on a loan if \$2000 is borrowed at 6.25% compounded continuously for six years. Use $e = 2.71828$ or the $e$-button on your calculator. Round your answer to the nearest cent. Do not round until the final answer.

**36.** Find the amount $A$ repaid on a loan if \$2675 is borrowed at 4.725% compounded continuously for three years. Use $e = 2.71828$ or the $e$-button on your calculator. Round your answer to the nearest cent. Do not round until the final answer.

**37.** Find the amount $P$ initially invested if an account contains \$4500 at the end of four years at an interest rate of 6.25% compounded continuously. Use $e = 2.71828$ or the $e$-button on your calculator. Round your answer to the nearest cent. Do not round until the final answer.

**38.** Find the amount $P$ initially invested if an account contains \$10,000 at the end of ten years at an interest rate of 1.07% compounded continuously. Use $e = 2.71828$ or the $e$-button on your calculator. Round your answer to the nearest cent. Do not round until the final answer.

**39.** Assume that the number of salmon caught in 2019 was equal to 2.1 million and that the number is supposed to decrease by 37% every year after that.

**a.** Write an exponential model $f(x) = ab^x$, where $x$ is the number of years since 2019 and $f(x)$ is the number salmon caught in millions of units.

**b.** Use your model to predict how many salmon will be caught in 2022.