

Skill Check Answers

1. a. 8:27 a.m. b. $\frac{1}{16}$ full
2. One half step up is F# and one half step down is E.
3. $f(23) \approx 2.262$
4. About 63 times stronger.

5.7 Exercises

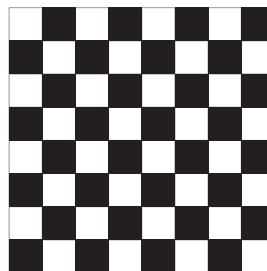
✓ CONCEPT CHECK

1. An exponential function has the form _____.
2. The expanded form of an exponential function has the form _____.
3. _____ is the sound of a number of energy wave cycles completed in one second.
4. A logarithm has the form _____.
5. A logarithm has a base of ___ is referred to as a common logarithm.

👤 APPLICATIONS

6. Bacteria in a bottle are quadrupling every minute. If the number of bacteria in the bottle at noon is 1, how many bacteria are in the bottle at 12:10 p.m.?
7. The population of Greene Hills is decreasing at a rate of 2% per year. If the population is 20,000 today, what will the population be in 10 years?
8. The price of a gallon of milk is increasing at a rate of 1% per year. If a gallon of milk costs \$3.50 in 2014, how much will a gallon of milk cost in 2017?
9. The current population of a town in California is modeled by the function where x is the number of years since January 1, 2022 .
 - a. What was the initial population on January 1, 2022?
 - b. What will the population be on January 1, 2025?
 - c. What will the population be on January 1, 2030?

10. A checkerboard has 64 squares that alternate black and white. A grain of rice weighs 0.03 grams. Assume 1 grain of rice is placed on the first square, 2 grains are placed on the second square, 4 grains are placed on the third square, and so on.



- How many grains will be placed on the 14th square?
- How many grains will be placed on the 25th square?
- How much does the rice on the 20th square weigh?
- How much does the rice on the 30th square weigh?

Use the given information and logarithmic equation to answer each question.

$\text{pH} = -\log[\text{H}^+]$ where $[\text{H}^+]$ is the hydrogen ion concentration, measured in moles per liter. Solutions with a pH-value of less than 7 are acidic; solutions with a pH-value of greater than 7 are basic; solutions with a pH-value of 7 (such as pure water) are neutral.

- Suppose that you test apple juice and find that the hydrogen ion concentration is $[\text{H}^+] = 0.0003$. Find the pH value and determine whether the juice is basic or acidic. Round your answer to the nearest hundredth.
- You test some ammonia and determine the hydrogen ion concentration to be $[\text{H}^+] = 1.3 \times 10^{-9}$. Find the pH value and determine whether the ammonia is basic or acidic. Round your answer to the nearest hundredth.
- An orange has a pH of about 3. Find the concentration of hydrogen ions in an orange.
- An antacid tablet has a pH of 11. Find the concentration of hydrogen ions in the tablet.
- Acid rain has a pH of 4 and normal rain has a pH of 6. Compare the pH of each and determine how much more acidic acid rain is than normal rain.

Solve each problem. Round your answer to the nearest thousandth, if necessary. Assume middle C has a frequency of 261 Hz.

- If a note has a frequency of 27.5 Hz, find the frequencies of the notes one, two, three, four, and five octaves higher.
- If a note has a frequency of 220 Hz, find the frequencies of the notes one, two, and three octaves higher.

18. If a note has a frequency of 4176 Hz, how many octaves higher is the note than middle C?
19. If a note has a frequency of 1044 Hz, how many octaves higher is the note than middle C?
20. What is the frequency of the note that is nine half steps below middle C?
21. What is the frequency of the note that is nine half steps above middle C?
22. Two podcasts, one on psychology and one on medicine, were both launched about a year ago. By now, the psychological podcast has 23,000 subscribers, and the medical one has 34,000 subscribers. Both podcasts estimate their future growth. The psychology podcast projects an increase of 45% in the number of subscribers each year, while the medical podcast plans to increase its coverage by 28,000 subscribers per year.
 - a. Create a function model for the projected growth over time for both podcasts.
 - b. How many subscribers is each podcast predicted to have in 5 years?
 - c. Approximately how many years would it take for the two podcasts to have the same number of subscribers?
 - d. How many years would it take the psychology podcast to reach 1 million of subscribers?
23. Suppose you want to borrow \$50 from either your brother or your sister for a week. They each offer you a different condition for borrowing money. Your brother asks for an additional \$5 for each day that you are late paying back the money. Your sister says she will increase the total amount you owe her by 10% per day for each day you are late returning the money. Your brother and sister both want the full amount paid back all at once.
 - a. Create function models for the money you need to return to both siblings based on the number of days you are late paying back the money.
 - b. How much money do you need to return in both cases if are 3 days late in paying back the money?
 - c. Assuming you are unable to pay the money back on time, after how many days would you owe equal amounts to your siblings?
 - d. If you knew that you would be at least 2 days late paying back the money, who would you borrow money from?

Use the given information and logarithmic equation to answer each question. Round your answer to the nearest whole number, if necessary.

Sound intensity, given in decibels, is measured by the formula

$$db = 10 \log \left(\frac{I}{I_0} \right). \quad I \text{ is the intensity of the sound in question relative to the reference value } I_0 \text{ which has the value } I_0 = 1.$$

24. A dog bark is 400 times as intense as the reference value I_0 . How many decibels is a dog bark? Round your answer to the nearest whole decibel.
25. A jet engine is about 155 decibels. What is the intensity level of the jet engine? Round your answer to the nearest whole number.
26. The threshold of hearing loss is about 125 decibels. If a gunshot has an intensity of 5.012×10^{12} , should you wear ear protection to prevent hearing loss?

Use the given information and logarithmic equation to answer each question. Round your answer to the nearest hundredth, if necessary.

The magnitude of an earthquake on the Richter scale is measured by

$$R = \log \left(\frac{I}{I_0} \right)$$

27. What is the magnitude of an earthquake that is 5×10^8 times as intense as a zero-level quake?
28. A dump truck has an intensity of about 975. If a seismograph will register a quake of anything larger than a magnitude of 3, will the dump truck cause a small earthquake on the seismograph?

WRITING & THINKING

29. In a given 30-day month, would you rather get a penny on day 1, two pennies on day 2, and continue to double that amount each day from the previous day, or start with a quarter on day 1, 2 quarters on day 4, 4 quarters on day 7 and continue to double the amount from the previous amount every 3rd day? Explain your reasoning.

5.7 PROJECT

USING NEWTON'S LAW OF COOLING TO AVOID COFFEE BURNS

Newton's Law of Cooling gives the temperature of an object (such as a pan or a cup of liquid) as it cools over time to the temperature of its surrounding environment (such as the air in a room). The law can be described with the following function.

$$T(t) = T_e + (T_0 - T_e)e^{-kt}$$