Malthus believed that populations increase exponentially while food production increases linearly. The last example explains his gloomy predictions: Malthus believed that any population eventually outstrips its food supply, leading to famine and war.

Exercises and Problems for Section 4.2

Skill Refresher

In Exercises S1–S4, write each of the following with single positive exponents.

S1. $b^4 \cdot b^6$

S2. $8g^3 \cdot (-4g)^2$

S3. $\dfrac{18a^{10}b^6}{6a^3b^{-4}}$

S4. $\dfrac{(2a^3b^2)^3}{(4ab^{-4})^2}$

In Exercises S5–S6, evaluate the functions for $t = 0$ and $t = 3$.

S5. $f(t) = 5.6(1.043)^t$

S6. $g(t) = 12{,}837(0.84)^t$

In Exercises S7–S10, solve for x.

S7. $4x^3 = 20$

S8. $\dfrac{5x^3}{x^5} = 125$

S9. $\dfrac{4x^8}{3x^3} = 7$

S10. $\sqrt{4x^3} = 5$

Exercises

1. Write a formula for the price p of a gallon of gas in t days if the price is \$2.50 on day $t = 0$ and the price is:

- **(a)** Increasing by \$0.03 per day.
- **(b)** Decreasing by \$0.07 per day.
- **(c)** Increasing by 2% per day.
- **(d)** Decreasing by 4% per day.

2. A population has size 5000 at time $t = 0$, with t in years.

- **(a)** If the population decreases by 100 people per year, find a formula for the population, P, at time t.
- **(b)** If the population decreases by 8% per year, find a formula for the population, P, at time t.

3. The following formulas give the populations (in 1000s) of four different cities, A, B, C, and D, where t is in years. Which are changing exponentially? Describe in words how each of these populations is changing over time. Graph those that are exponential.

$$P_A = 200 + 1.3t, \quad P_B = 270(1.021)^t,$$

$$P_C = 150(1.045)^t, \quad P_D = 600(0.978)^t.$$

4. In an environment with unlimited resources and no predators, a population tends to grow by the same percentage each year. Should a linear or exponential function be used to model such a population? Why?

5. Find $g(t) = ab^t$ if $g(10) = 50$ and $g(30) = 25$.

6. Find a formula for $f(x)$, an exponential function such that $f(-8) = 200$ and $f(30) = 580$.

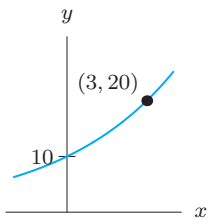
7. Suppose that $f(x)$ is exponential and that $f(-3) = 54$ and $f(2) = \frac{2}{9}$. Find a formula for $f(x)$.

8. Find a formula for $f(x)$, an exponential function such that $f(2) = 1/27$ and $f(-1) = 27$.

9. Find the equation of an exponential curve through the points $(-1, 2)$, $(1, 0.3)$.

For Exercises 10–15, find a formula for the exponential function.

10.



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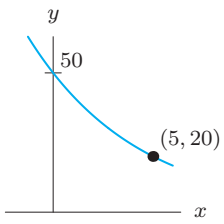

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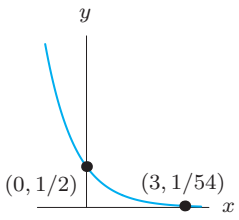

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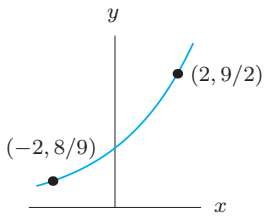

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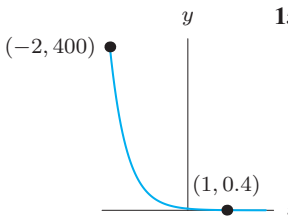

15.