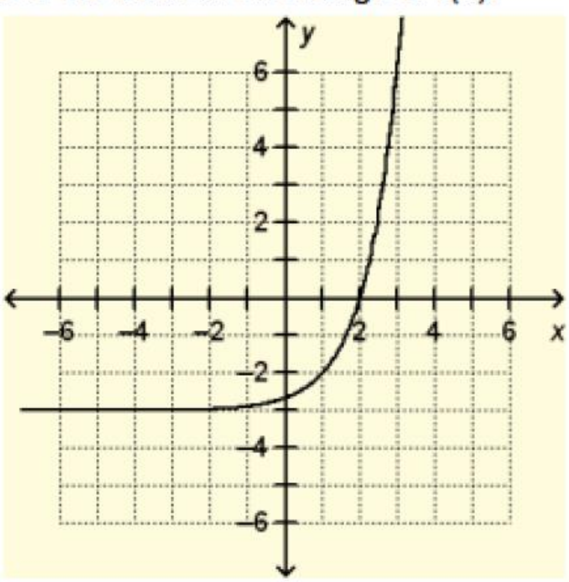
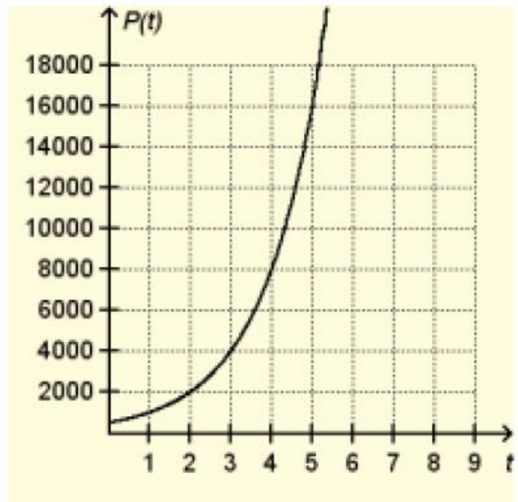
An exponential function $y = f(x)$ is graphed below. The graph has a horizontal asymptote at $y = -3$. What are the domain and range of $f(x)$?




The growth of a population of bacteria can be modeled by an exponential function. The graph models the population of the bacteria colony $P(t)$ as a function of the time $t$, in weeks, that has passed. The initial population of the bacteria colony was 500. What is the domain of the function? What does the domain represent in this context?



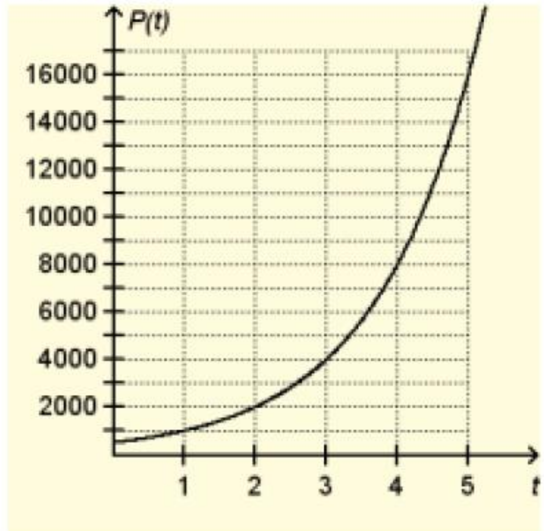

Ⓐ The domain is the real numbers greater than 500. The domain represents the time, in weeks, that has passed.

Ⓑ The domain is the real numbers greater than 500. The domain represents the population of the colony after a given number of weeks.

Ⓒ The domain is the nonnegative real numbers. The domain represents the time, in weeks, that has passed.

Ⓓ The domain is the nonnegative real numbers. The domain represents the population of the colony after a given number of weeks.

The graph models the population $P(t)$ of a bacteria colony as a function of time $t$, in weeks.




a. Determine the average growth rate between weeks 2 and 3.

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b. Determine the average growth rate between weeks 3 and 4.

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c. Determine the average growth rate between weeks 4 and 5.

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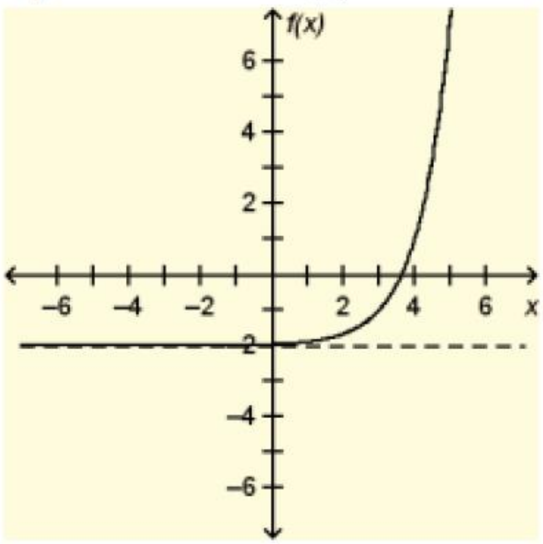
What are the domain and range of the exponential function $f(x)$?



b. Determine the average growth rate between weeks 3 and 4.

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c. Determine the average growth rate between weeks 4 and 5.

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d. What is happening to the average growth rate as each week passes? Justify your answer.

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e. What do you think the average growth rate will be between weeks 5 and 6 if the pattern continues?

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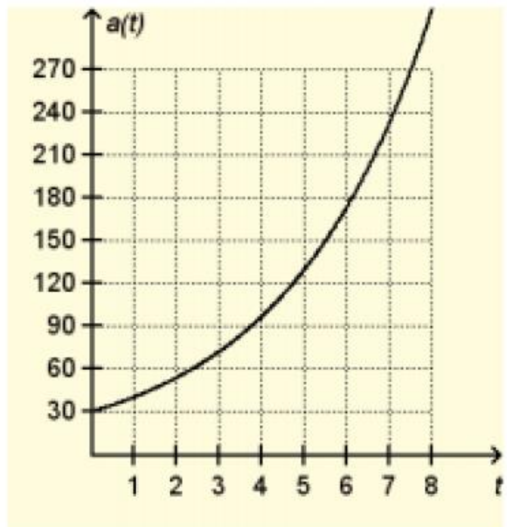
A website allows its users to submit and edit content in an online encyclopedia. The graph shows the number of articles $a(t)$ in the encyclopedia $t$ months after the website goes live. How many articles were in the encyclopedia when it went live?



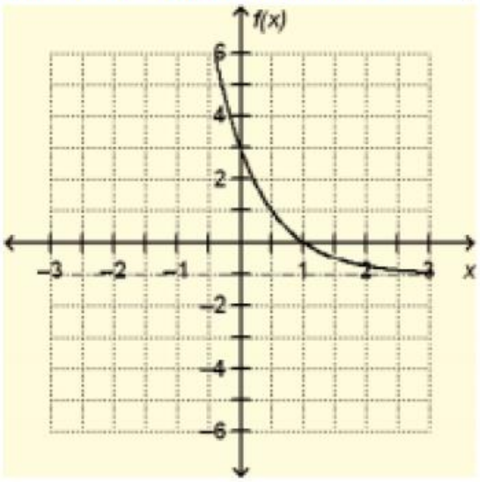

Ⓐ 0

Ⓑ 30

Ⓒ 60

Ⓓ 180

Which statements are true about the graph of the exponential function $f(x)$?




Ⓐ The domain is all real numbers.

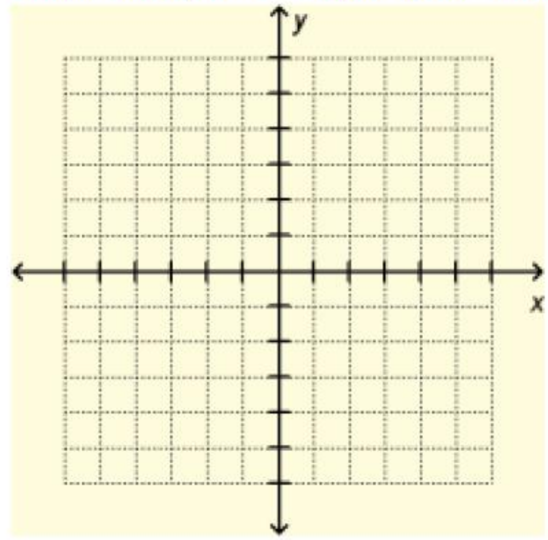
Ⓑ The range is all real numbers.

Ⓒ The $f(x)$-intercept is 3.

Ⓓ The $x$-intercept is −1.

Ⓔ As $x$ increases without bound, $f(x)$ approaches, but never reaches, −1.

Suppose an exponential function has a domain of all real numbers and a range that is bounded by an integer. How many $x$-intercepts could such a function have? Graph examples to support your answer.

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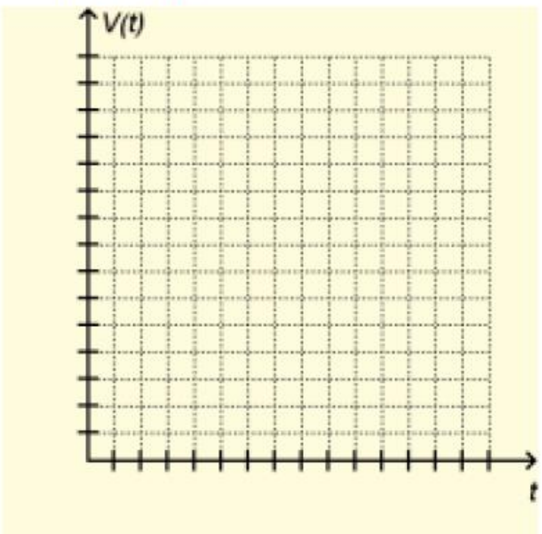
The value of an object decreases from its purchase price over time. This change in value can be modeled using an exponential function. A new copy machine purchased by a school for \$1200 has an estimated useful life span of 12 years. After 12 years, the copier is worth \$250. The value $V(t)$ of the copier after $t$ years is approximated by the function $V(t) = 1200(0.88)^t$.

a. Graph the function on the domain $0 \le t \le 12$.




b. Estimate and interpret the $V(t)$-intercept.

The balance $B$, in dollars, after $t$ years of an investment that earns interest compounded annually is given by the function $B(t) = 1500(1.045)^t$. To the nearest hundredth of a percent, what is the monthly interest rate for the investment?

(A) 0.37%
(B) 3.67%
(C) 4.50%
(D) 69.59%

Which of these functions describe exponential growth?

(A) $f(t) = 1.25^t$
(B) $f(t) = 2(0.93)^{0.5t}$
(C) $f(t) = 3(1.07)^{3t}$
(D) $f(t) = 18(0.85)^t$
(E) $f(t) = 0.5(1.05)^t$
(F) $f(t) = 3(1.71)^{5t}$
(G) $f(t) = 0.68^{2t}$
(H) $f(t) = 8(1.56)^{1.4t}$

After $t$ days, the mass $m$, in grams, of 100 grams of a certain radioactive element is given by the function $m(t) = 100(0.97)^t$. To the nearest percent, what is the weekly decay rate of the element?

(A) 3%
(B) 19%
(C) 21%
(D) 81%

How do the function values of $g(x) = 200(4^{x-1})$ compare to the corresponding function values of $f(x) = 200(4^x)$? Explain using a transformation of $g(x)$.

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The population of a certain town is 3500 people in 2000. The population of the town $P$ is modeled by the function $P(t) = 3500(0.97)^t$, where $t$ is the number of years after 2000.

a. By what factor did the population change between 2000 and 2001? Between 2001 and 2002? Round your answers to the nearest hundredth. Show your work. What do you notice?

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b. By what factor did the population change between 2000 and 2002? Between 2001 and 2003? Round your answers to the nearest hundredth. Show your work. What do you notice?

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For some exponential function $f(x)$, $f(0) = 12$, $f(1) = 18$, and $f(2) = 27$. How does $f(x)$ change when $x$ increases by 1?

(A) $f(x)$ grows by a factor of $\frac{2}{3}$.

(B) $f(x)$ grows by a factor of $\frac{3}{2}$.

(C) $f(x)$ increases by 6.

(D) $f(x)$ increases by 9.

For which of these functions does the function value change at a constant rate per unit change in $x$? Explain.

| $x$ | $f(x)$ | $g(x)$ | $h(x)$ |
|---|---|---|---|
| 1 | 6 | 1 | 31 |
| 2 | 12 | 2 | 25 |
| 3 | 20 | 4 | 19 |
| 4 | 30 | 8 | 13 |
| 5 | 42 | 16 | 7 |

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In one year, a population of endangered turtles laid 8000 nests. Each year, the number of nests is half as many as the number of nests in the previous year. Does the number of nests change by a constant percent per unit change in a year? Explain.

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Two competing companies redesigned their websites during the same month. The table shows the number of visits each website receives per month after the redesigns. Jeff thinks that the number of visits for both websites grows by a constant percent per month.

| Month | Company A | Company B |
|---|---|---|
| 0 | 120,000 | 150,000 |
| 1 | 126,000 | 153,000 |
| 2 | 132,300 | 157,590 |
| 3 | 138,915 | 159,166 |

a. Is Jeff correct about company A? Justify your answer.

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b. Is Jeff correct about company B? Justify your answer.

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Carol inherited three antiques one year. The value, in dollars, of each antique for the first few years after she inherited the antiques is shown in the table.

| Time (years) | Antique toy | Antique vase | Antique chair |
|---|---|---|---|
| 0 | $70.00 | $25.00 | $100.00 |
| 1 | $77.00 | $30.00 | $108.00 |
| 2 | $84.70 | $37.50 | $116.64 |
| 3 | $93.17 | $47.50 | $125.97 |

Which antiques have a value that grows by a constant factor relative to time? Of those antiques, which antique increases its value at a faster rate? Explain your answers.

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The value of a stock over time is shown in the table. Write an exponential function that models the value $V$, in dollars, after $t$ years. Show your work.

| Time, in years | Value, in dollars |
|---|---|
| 0 | 18.00 |
| 1 | 16.20 |
| 2 | 14.58 |
| 3 | 13.12 |
| 4 | 11.81 |
| 5 | 10.63 |

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The value $V_A$ of stock A $t$ months after it is purchased is modeled by the function $V_A(t) = t^2 + 1.50$. The value $V_B$ of stock B $t$ months after it is purchased is modeled by the function $V_B(t) = 10(1.25)^t$. Based on the model, for which $t$-values is the value of stock B greater than the value of stock A?

(A) $t = 5$

(B) $t = 6$

(C) $t = 7$

(D) $t = 11$

(E) $t = 12$

As $x$ increases without bound, which of the following eventually has greater function values than all the others for the same values of $x$?

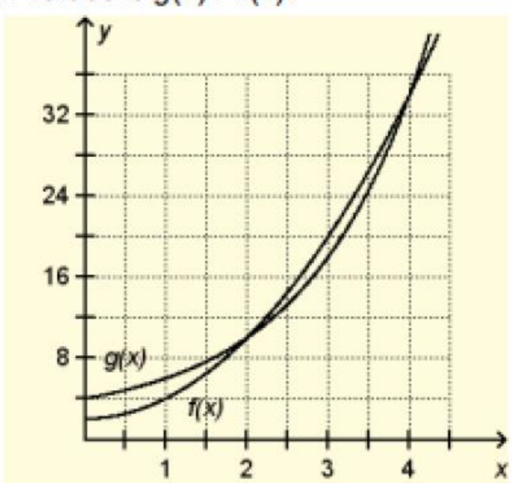
(A) $f(x) = 3x^2$

(B) $f(x) = 2x^3$

(C) $f(x) = 3(2^x)$

(D) $f(x) = 3x + 2$

$f(x) = 2x^2 + 2$ and $g(x) = 2^{x+1} + 2$ are graphed on the grid below. For what $x$-values is $g(x) > f(x)$?



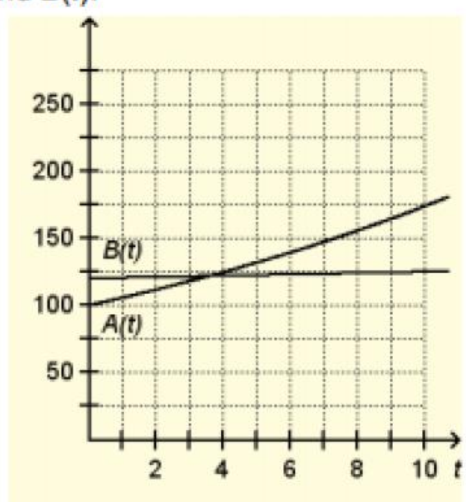

(A) $x > 4$

(B) $x > 2$

(C) $0 < x < 2$ and $x > 4$

(D) $2 < x < 4$

Two websites launched at the beginning of the year. The number of visits $A(t)$ to website A is given by some exponential function, where $t$ is the time in months after the website is launched. The number of visits $B(t)$ to website B is given by some quadratic function. The graph of each function is shown below. For each of the given $t$-values, compare $A(t)$ and $B(t)$.




| | | |
|---|---|---|
| a. $t = 2$ | ○ $A(t) < B(t)$ | ○ $A(t) > B(t)$ |
| b. $t = 3$ | ○ $A(t) < B(t)$ | ○ $A(t) > B(t)$ |
| c. $t = 4$ | ○ $A(t) < B(t)$ | ○ $A(t) > B(t)$ |
| d. $t = 5$ | ○ $A(t) < B(t)$ | ○ $A(t) > B(t)$ |
| e. $t > 12$ | ○ $A(t) < B(t)$ | ○ $A(t) > B(t)$ |

The population $A$ of town A and the population $B$ of town B $t$ years after 2000 is described in the table.

| **Time, $t$ (years)** | **Town A population, $A(t)$** | **Town B population, $B(t)$** |
|---|---|---|
| 0 | 1500 | 1500 |
| 1 | 1800 | 1725 |
| 2 | 2100 | 1984 |
| 3 | 2400 | 2281 |
| 4 | 2700 | 2624 |
| 5 | 3000 | 3017 |
| 6 | 3300 | 3470 |
| 7 | | |
| 8 | | |

a. Write functions for $A(t)$ and $B(t)$.

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b. Use your functions from part a to complete the table, rounding to the nearest person.

c. If the populations continue to increase in the same way, how do the populations compare for every year after 2008? Explain how you can tell without calculating the populations for every year.

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The function $a(t) = 44{,}000(1.045)^t$ models Johanna's annual earnings $a$, in dollars, $t$ years after she starts her job. Which of the following statements are true about Johanna's salary?

(A) Johanna initially earns \$44,000 per year.

(B) Johanna initially earns \$45,980 per year.

(C) Johanna's salary increases by 1.045% per year.

(D) Johanna's salary increases by 4.5% per year.

(E) Johanna's salary increases by 104.5% per year.

A census from the government determines the official population of jurisdictions. The census is taken once every decade. The function $A(c) = 50{,}600(1.08)^c$ models the official value for the population of city A, where $c$ is the number of censuses taken since the first census. Similarly, $B(c) = 75{,}850(1.069)^c$ models the official value for the population of city B.

a. Which city had a larger population in the first census? Explain.

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b. Which city's official value for its population is growing at a faster rate between the censuses? Explain.

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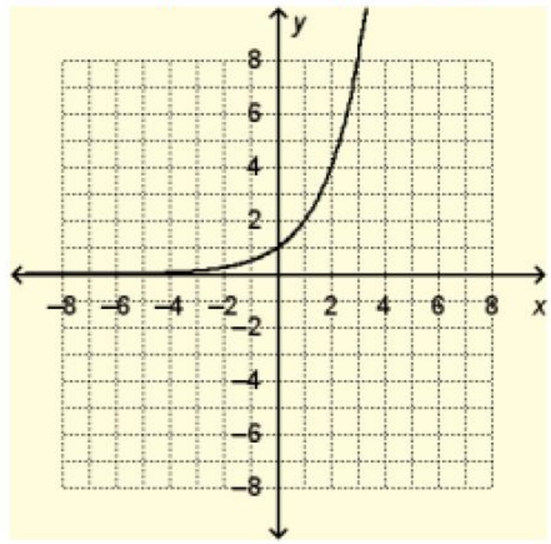
. Which of the following are solutions of the equation represented by the graph?




(A) (−4, 1)

(B) (−1, 2)

(C) (0, 1)

(D) (1, 0)

(E) (2, 4)

(F) (3, 8)

Which of the following equations represents the amount $A$ in a bank account that pays 1.2% interest compounded annually $t$ years after $2000 is deposited into the account?

(A) $A = 2000 + 1.2t$

(B) $A = 2000 + 1.012t$

(C) $A = 2000(1.2)^t$

(D) $A = 2000(1.012)^t$