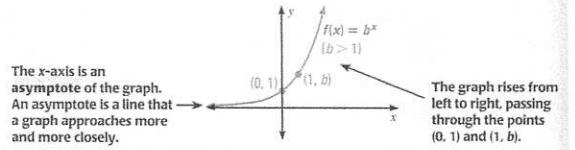
7.1 – Graph Exponential Growth Functions

KEY CONCEPT *For Your Notebook*

Parent Function for Exponential Growth Functions

The function $f(x) = b^x$, where $b > 1$, is the parent function for the family of exponential growth functions with base b. The general shape of the graph of $f(x) = b^x$ is shown below.

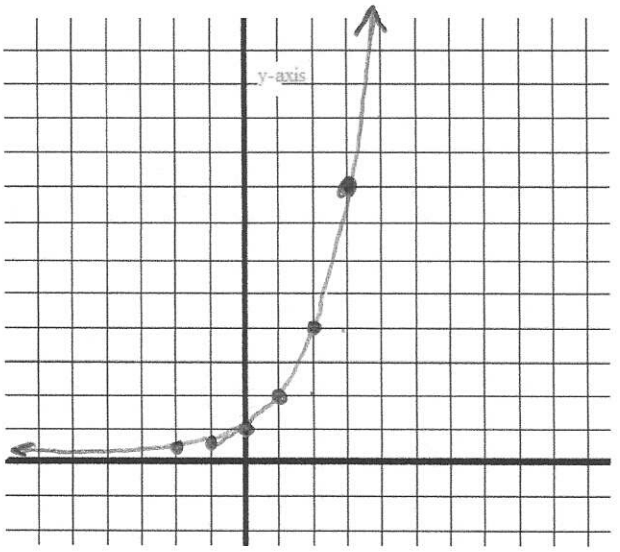


The domain of $f(x) = b^x$ is all real numbers. The range is $y > 0$.

Example 1 Graph $y = b^x$ for $b > 1$

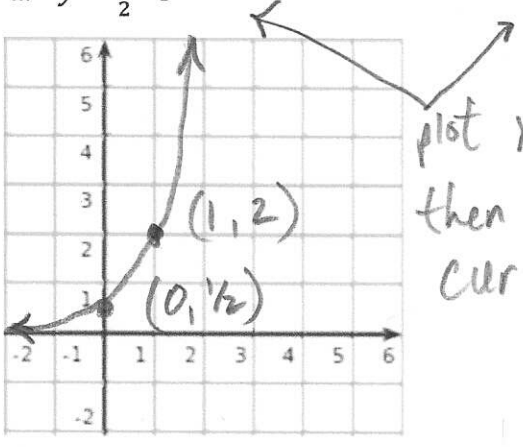
Graph $y = 2^x$

x	-2	-1	0	1	2	3
y	1/4	1/2	1	2	4	8



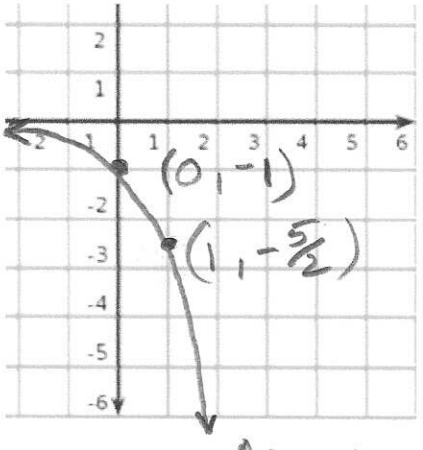
Example 2 Graph $y = ab^x$ for $b > 1$

a. $y = \frac{1}{2} \cdot 4^x$



plot $x=0$ & $x=1$ then sketch the curve

b. $y = -\left(\frac{5}{2}\right)^x$



Example 3 Graph $y = ab^{x-h} + k$ for $b > 1$

Graph $y = 4 \cdot 2^{x-1} - 3$

① plot $x=0$ & $x=1$ for $y = 4 \cdot 2^x$

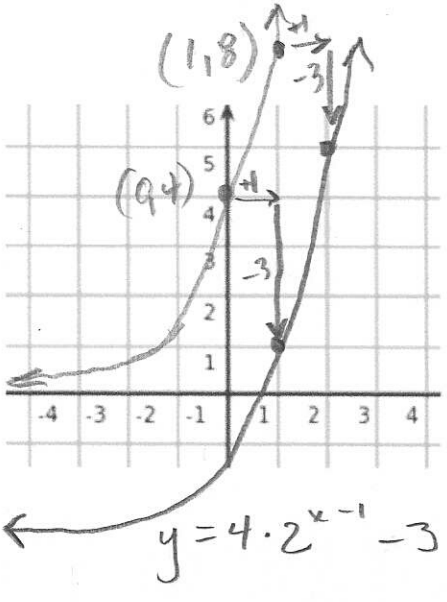
② translate these pts by (h, k)

① $(0,4)$ & $(1,8)$

② $h = 1$ $k = -3$

$(0,4) \to (1,1)$ & $(1,8) \Rightarrow (2,5)$

+1 −3 +1 −3



Exponential Growth Models $y = a(1 + r)^t$

a = initial amount

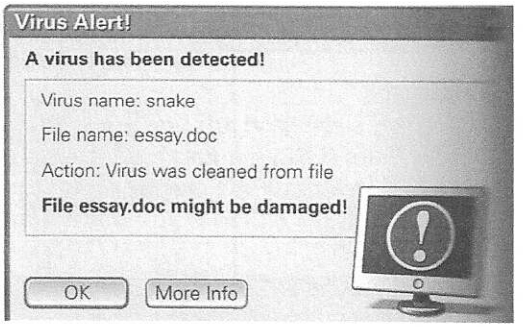
r = percent (as a decimal)

t = time (in years)

Example 4

COMPUTERS In 1996, there were 2573 computer viruses and other computer security incidents. During the next 7 years, the number of incidents increased by about 92% each year.

- Write an exponential growth model giving the number n of incidents t years after 1996. About how many incidents were there in 2003?



a

r

$n = 2573(1 + .92)^t$

$n = 2573(1.92)^t$

Compound Interest $A = P\left(1 + \frac{r}{n}\right)^{nt}$

You deposited $4000 in and account that pays 2.92% annual interest. Find the balance after 1 year if the interest is compounded with the given frequency.

a. Quarterly
b. Daily
c. Semi-annually

A = account balance
P = initial investment
r = interest rate (a percent as a decimal)
n = number of times interest is compounded
t = time in years

$P = 4000$
$r = .0292$
$t = 1$

a) $n = 4 \Rightarrow A = 4000\left(1 + \frac{.0292}{4}\right)^{4(1)}$

$A = \$4118.09$

b) $n = 365 \Rightarrow A = 4000\left(1 + \frac{.0292}{365}\right)^{365(1)}$

$A = \$4118.52$

c) $n = 2 \Rightarrow A = 4000\left(1 + \frac{.0292}{2}\right)^{2(1)}$

$A = \$4117.65$

HW: (3-8), (15-17), (28-30), (35-38)

EXAMPLES 1 and 2 on pp. 478–479 for Exs. 3–14

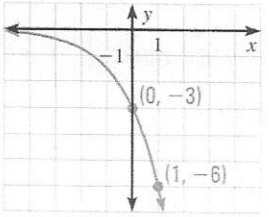
MATCHING GRAPHS **Match the function with its graph.**

3. $y = 3 \cdot 2^x$

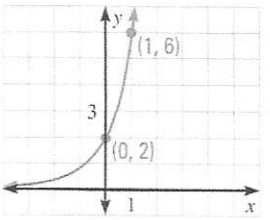
4. $y = -3 \cdot 2^x$

5. $y = 2 \cdot 3^x$

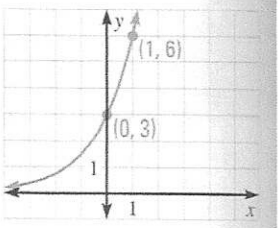
A.



B.



C.



GRAPHING FUNCTIONS **Graph the function.**

6. $y = 3^x$

7. $y = -2^x$

8. $f(x) = 5 \cdot 2^x$

9. $y = 5^x$

10. $y = 2 \cdot 4^x$

11. $g(x) = -(1.5)^x$

12. $y = 3\left(\frac{4}{3}\right)^x$

13. $y = \frac{1}{2} \cdot 3^x$

14. $h(x) = -2(2.5)^x$

EXAMPLE 3 on p. 479 for Exs. 15–24

TRANSLATING GRAPHS **Graph the function. State the domain and range.**

15. $y = -3 \cdot 2^{x+2}$

16. $y = 5 \cdot 4^x + 2$

17. $y = 2^{x+1} + 3$

18. $y = 3^{x-2} - 1$

19. $y = 2 \cdot 3^{x-2} - 1$

20. $y = -3 \cdot 4^{x-1} - 2$

21. $f(x) = 6 \cdot 2^{x-3} + 3$

22. $g(x) = 5 \cdot 3^{x+2} - 4$

23. $h(x) = -2 \cdot 5^{x-1} + 1$

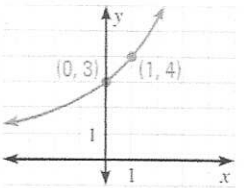
24. ★ **MULTIPLE CHOICE** The graph of which function is shown?

Ⓐ $f(x) = 2(1.5)^x - 1$

Ⓑ $f(x) = 2(1.5)^x + 1$

Ⓒ $f(x) = 3(1.5)^x - 1$

Ⓓ $f(x) = 3(1.5)^x + 1$



25. ★ **MULTIPLE CHOICE** The student enrollment E of a high school was 1310 in 1998 and has increased by 10% per year since then. Which exponential growth model gives the school's student enrollment in terms of t, where t is the number of years since 1998?

Ⓐ $E = 0.1(1310)^t$

Ⓑ $E = 1310(0.1)^t$

Ⓒ $E = 1.1(1310)^t$

Ⓓ $E = 1310(1.1)^t$

WRITING MODELS **In Exercises 28–30, write an exponential growth model that describes the situation.**

28. In 1992, 1219 monk parakeets were observed in the United States. For the next 11 years, about 12% more parakeets were observed each year.

29. You deposit $800 in an account that pays 2% annual interest compounded daily.

30. You purchase an antique table for $450. The value of the table increases by 6% per year.

EXAMPLE 4
on p. 480
for Exs. 35–36

35. DVD PLAYERS From 1997 to 2002, the number n (in millions) of DVD players sold in the United States can be modeled by $n = 0.42(2.47)^t$ where t is the number of years since 1997.

a. Identify the initial amount, the growth factor, and the annual percent increase.

b. Graph the function. Estimate the number of DVD players sold in 2001.

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36. INTERNET Each March from 1998 to 2003, a website recorded the number y of referrals it received from Internet search engines. The results can be modeled by $y = 2500(1.50)^t$ where t is the number of years since 1998.

a. Identify the initial amount, the growth factor, and the annual percent increase.

b. Graph the function and state the domain and range. Estimate the number of referrals the website received from Internet search engines in March of 2002.

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EXAMPLE 5
on p. 481
for Exs. 37–38

37. ACCOUNT BALANCE You deposit $2200 in a bank account. Find the balance after 4 years for each of the situations described below.

a. The account pays 3% annual interest compounded quarterly.

b. The account pays 2.25% annual interest compounded monthly.

c. The account pays 2% annual interest compounded daily.

38. DEPOSITING FUNDS You want to have $3000 in your savings account after 3 years. Find the amount you should deposit for each of the situations described below.

a. The account pays 2.25% annual interest compounded quarterly.

b. The account pays 3.5% annual interest compounded monthly.

c. The account pays 4% annual interest compounded yearly.