

EXERCISES

For more practice, see *Extra Practice*.

Practice and Problem Solving

A Practice by Example

Example 1 (page 301)

Write each polynomial in standard form. Then classify it by degree and by number of terms.

- | | | |
|--------------------------|----------------------|------------------------|
| 1. $7x + 3x + 5$ | 2. $5 - 3x$ | 3. $2m^2 - 3 + 7m$ |
| 4. $-x^3 + x^4 + x$ | 5. $-4p + 3p + 2p^2$ | 6. $5a^2 + 3a^3 + 1$ |
| 7. $-x^5$ | 8. $3 + 12x^4$ | 9. $6x^3 - x^3$ |
| 10. $7x^3 - 10x^3 + x^3$ | 11. $4x + 5x^2 + 8$ | 12. $x^2 - x^4 + 2x^2$ |

Example 2 (page 302)



Find a cubic model for each set of values.

13. $(-2, -7), (-1, 0), (0, 1), (1, 2), (2, 9)$ 14. $(0, -12), (1, 10), (2, 4), (3, 42)$
 15. $(-1, 2.5), (0, 1), (1, 1.5), (2, 13)$ 16. $(-3, 91), (-2, 84), (-1, 93), (0, 100)$

17. **Vital Statistics** The data at the right indicate that the life expectancy for residents of the United States has been increasing. Recall that in Chapter 3 you found a linear model for this data set.
- Find a quadratic model for the data set.
 - Find a cubic model for the data set.
 - Graph each model. Compare the quadratic and cubic models to determine which one is a better fit.

Life Expectancy (years)

Year of Birth	Males	Females
1970	67.1	74.7
1980	70.0	77.4
1990	71.8	78.8
2000	73.2	80.2
2010	74.5	81.3

SOURCE: U.S. Bureau of the Census.
Go to www.PHSchool.com for a data update.
Web Code: agg-2041

Example 3 (pages 302–303)



Find a cubic model for each function. Then use your model to estimate the value of y when $x = 17$.

18. $(-1, -3), (0, 0), (1, -1), (2, 0)$ 19. $(10, 0), (11, 121), (12, 288), (13, 507)$
 20. $(10, 500), (14, 588), (16, 512), (20, 0)$ 21. $(1, 91), (10, 95), (20, 260), (30, 365)$

22.

x	0	3	5	6	9	11	12	14	16	18	20
y	42	31	26	21	17	15	19	22	28	30	29

23.

x	0	2	3	6	8	10	12	14	16	18	20
y	4.1	6	15.7	21.1	23.6	23.1	24.7	24.9	23.9	25.2	29.5

B Apply Your Skills

24. **Open-Ended** Write a third-degree polynomial function. Make a table of values and a graph. Find the x - and y -intercepts.

Write each polynomial in standard form. Then classify it by degree and by number of terms.

- | | | |
|---------------------|------------------------|---------------------------|
| 25. $8x - 4x + x^3$ | 26. $a^2 + a^3 - 4a^4$ | 27. 7 |
| 28. $2x(3x)$ | 29. $x^3(2 + x)$ | 30. $\frac{3x^5 + 4x}{6}$ |



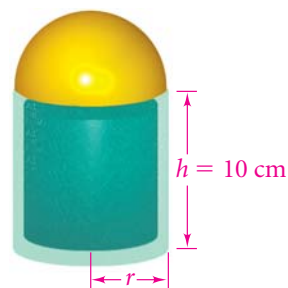
Reading Math

To interpolate means to estimate a value inside the range of known values. To extrapolate means to estimate a value outside the range of known values.



31. Packaging Design The diagram at the right shows a cologne bottle that consists of a cylindrical base and a hemispherical top.

- Write an expression for the cylinder's volume.
- Write an expression for the volume of the hemispherical top.
- Write a polynomial to represent the total volume.



32. Writing Explain why cubic functions are useful for interpolating between known data points. Why are they often not reliable for extrapolating data?

Simplify. Classify each result by number of terms.

- $(2c^2 + 9) - (3c^2 - 7)$
- $(7x^2 + 8x - 5) + (9x^2 - 9x)$
- $(3a - 2b) + (6b - 2a)$
- $(3x^2 - 6y - 1) + (5x^2 + 1)$
- $(7x^3 + 9x^2 - 8x + 11) - (5x^3 - 13x - 16)$
- $(-12x^3 + 5x - 23) - (4x^4 + 31 - 9x^3)$
- $(30x^3 - 49x^2 + 7x) + (50x^3 - 75 - 60x^2)$
- $(-3x^3 + 7x^2 - 8) - (-5x^3 + 9x^2 - 8x + 19)$
- $(3a^2 - ab - 7) + (5a^2 + ab + 8) - (-2a^2 + 3ab - 9)$
- $(-8d^3 - 7) + (-d^3 - 6)$
- $(5x^3 - 6x + 8) - (3x^3 - 9)$
- $(4x - 5y) - (4x + 7y)$
- $(-a^2 - 3) - (3a - a^2 - 5)$

Find each product. Classify the result by number of terms.

- $x(2x)(4x + 1)$
- $b(b - 3)^2$
- $(2x + 5)^3 + 1$
- $(s + 3)(4s - 1)(3s + 7)$
- $(2c - 3)(2c + 4)(2c - 1)$
- $5x^2(6x - 2)$
- $(x - 2)^3$
- $(a - b)^2(a + b)$
- $(x + 1)(x - 1)(x + 2)$
- $(s + t)(s - t)(s + t)(s - t)$
- $(2a - 5)(a^2 - 1)$
- $(x^2 + 1)^2$
- $(a - 1)^4$




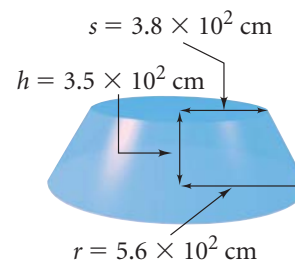
- 59.** The table shows U.S. energy production for a number of years.
- Find a linear model, a cubic model, and a quartic model for the data set. Let 0 represent 1960.
 - Graph each model. Compare the three models to determine which fits best.
 - Use your answer to part (b) to estimate U.S. energy production in 1997.


U.S. Energy Production

Year	1960	1965	1970	1975	1980	1985	1990	1995	1999
Production ($\times 10^{15}$ Btu)	41.5	49.3	62.1	59.9	64.8	64.9	70.8	71.0	72.5

SOURCE: *The World Almanac*

- C Challenge**  **60. Geometry** Use the formula $V = \frac{\pi h}{3}(r^2 + rs + s^2)$ to find the volume of the truncated cone. Express your answer in scientific notation with the appropriate number of significant digits.



-  **61. Critical Thinking** Recall that each family of functions has a simplest function called the parent function.
- Compare the graphs of $y = x^3$ and $y = x^3 + 4$. Describe how the graph of $y = x^3 + 4$ relates to the graph of $y = x^3$.
 - Compare the graphs of $y = x^3$ and $y = 4x^3$. Describe how the graph of $y = 4x^3$ relates to the graph of $y = x^3$.
 - Identify the parent function among the functions in parts (a) and (b).



Standardized Test Prep

Quantitative Comparison

Compare the boxed quantity in Column A with the boxed quantity in Column B. Choose the best answer.

- The quantity in Column A is greater.
- The quantity in Column B is greater.
- The two quantities are equal.
- The relationship cannot be determined from the information given.

Column A

Column B



Take It to the NET

Online lesson quiz at
www.PHSchool.com

Web Code: agk-0601

- | | | |
|-----|-------------------------------------------------------------|-----------------------------------------------------------------|
| 62. | the degree of the quadratic term of a polynomial | the degree of the cubic term of a polynomial |
| 63. | the degree of $-5x^2 + 1 + 2x^2$, written in standard form | the degree of $x^2 - 2x^2 + x^2 + 4$, written in standard form |
| 64. | the leading coefficient of $3x + 1$ | the constant term of $x^3 + 5x^2 - 3$ |

Short Response

65. Why is finding the degree of a polynomial simplified when the polynomial is written in standard form?

Mixed Review

Lesson 5-8

Use the discriminant to find the number of real solutions.

66. $3x^2 + x - 6 = 0$ 67. $5x^2 - 9 = 0$ 68. $-x^2 + 2x - 8 = 0$

Lesson 5-3

69. Graph $f(x) = 3x^2 - 1$. Translate the graph right five units and down two units. What is the vertex of the new graph?

Lesson 4-4

Each matrix represents the vertices of a polygon. Translate each figure 3 units left and 2 units down. Express your answer as a matrix.

70. $\begin{bmatrix} 4 & 0 & 4 & 8 \\ -6 & -1 & 2 & -1 \end{bmatrix}$ 71. $\begin{bmatrix} 5 & 0 & -3 \\ 7 & 0 & 2 \end{bmatrix}$ 72. $\begin{bmatrix} 1 & 2 & 1 & 2 \\ -1 & -1 & -2 & -2 \end{bmatrix}$