

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

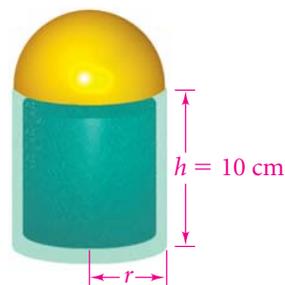
B Apply Your Skills

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. $\frac{3x^5 + 4x}{6}$ |

-  **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.



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.



- 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.

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



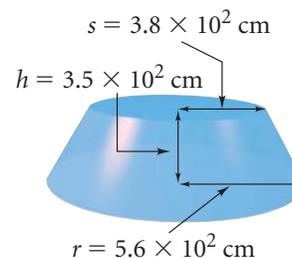
- 59.** The table shows U.S. energy production for a number of years.
- Find a linear model, a cubic model, and a quartic model for the data set. Let 0 represent 1960.
 - Graph each model. Compare the three models to determine which fits best.
 - Use your answer to part (b) to estimate U.S. energy production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

- | | | |
|-----|---|---|
| 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 $x^3 + 5x^2 - 3$ |



Take It to the NET

Online lesson quiz at www.PHSchool.com

Web Code: agk-0601

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. $\begin{bmatrix} 1 & 2 & 1 & 2 \\ -1 & -1 & -2 & -2 \end{bmatrix}$