

SOLUTIONS MANUAL



Exercise Solutions



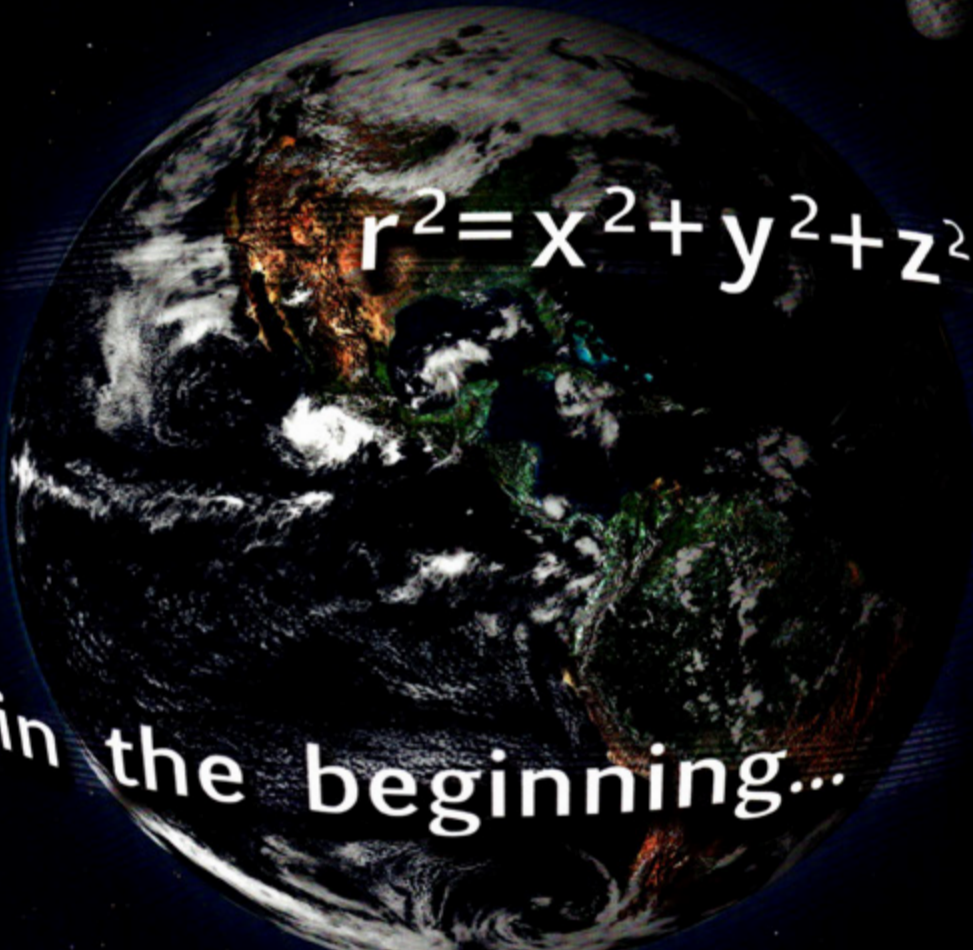
Answer Keys

High School

Algebra I

ELEMENTARY ALGEBRA

HAROLD R. JACOBS


$$r^2 = x^2 + y^2 + z^2$$

in the beginning...



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ELEMENTARY ALGEBRA

HAROLD R. JACOBS



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Introductory Comments

The exercises for each lesson in Elementary Algebra are arranged in four sets. Those in Set I review ideas from preceding lessons, affording continual practice with material considered earlier in the course. Sets II and III enable the student to apply the concepts of the new lesson. Because both sets have the same content, you will probably prefer to work one set or the other. Answers to all of the Set II exercises are given at the back of the textbook. Those answers, together with those to Sets I, III, and IV, are also included in this book.

Solutions to many of the exercises appear in brackets following the answers. These solutions vary in detail according to the complexity of the exercise. For those exercises that can be solved in a variety of ways, just one example solution is given.

Most of the Set IV exercises are intended to challenge the better students, although some are simple enough that everyone can be successful with them. They should be considered optional and counted as extra credit.

Detailed lesson plans for the course are available in the *Teacher's Guide to Elementary Algebra*.

I am grateful to Dale Callahan and Cassidy Cash for their help in preparing this solutions manual.

Harold R. Jacobs

ANSWERS TO EXERCISES

Introduction (pp. 3–4)

1. a)
 Think of a number: 1 2 3 4 5
 Double it: 2 4 6 8 10
 Add six: 8 10 12 14 16
 Divide by two: 4 5 6 7 8
 Subtract the number
 you first thought of: 3 3 3 3 3

b) No.

c)

- Think of a number:
 Double it:
 Add six:
 Divide by two:
 Subtract the number
 you first thought of:

d) Yes.

2. a) Think of a number.
 b) Multiply it by four.
 c) Add eight.
 d) Divide by four.
 e) Add three.
 f) Subtract the number that
 you first thought of.
3. a) 2.
 b) The result at the end is 4 instead of 2.
 c) The result at the end is 1.
 d) The result at the end now depends on the
 number first thought of.
4. (One of many possible answers.)
 Think of a number.
 Triple it.
 Add twelve.
 Divide by three.
 Subtract the number that
 you first thought of.
 The result is four.

5. 1,370.
 6. 1,370.
 7. 4.664.
 8. 10.631.
 9. 2.8.
 10. 1.605.

Set II (pages 8–9)

11. a) $10 + 7$ or 17.
 b) $x + 7$.
 c) $10 + y$.
 d) $x + y$.
 e) $4 + 8$ or 12.
 f) $4 + z$.
 g) $2 + 5 + 1$ or 8.
 h) $x + 5 + 1$ or $x + 6$.
 i) $2 + y + 1$ or $y + 3$.
 j) $x + y + 1$.
12. a) $9 + 4$.
 b) 13.
 c) $x + 5$.
 d) 7.
 e) 9.
13. a) $11 + 4 + 5$ or 20.
 b) $x + 6$.
 c) $x + y$.
 d) $5 + 3 + x$ or $8 + x$.
 e) $x + 1 + y + 1$ or $x + y + 2$.
 f) $x + y + z$.
14. a) and
 b) and
 c) and
15. a) $8 + y + 2$ or $y + 10$.
 b) $9 + y + 2$ or $y + 11$.
 c) $x + 3 + 2$ or $x + 5$.
 d) $x + 0 + 2$ or $x + 2$.
 e) $6 + 2 + 2$ or 10.
16. a) 44.
 b) $39 + x$.
 c) $39 + x + 6$ or $x + 45$.
 d) $x + 5$.
 e) $x + y$.
 f) $x + y + z$.

Set III

17. a) $3 + 11$ or 14.
 b) $3 + x$.

Chapter 1, Lesson 1

Set I (page 8)

1. 1,776.
 2. 1,107.
 3. 1.984.
 4. 20.202.

17. a) $3 + 11$ or 14.
 b) $3 + x$.

- c) $y + 11$.
 d) $y + x$.
 e) $7 + 2$ or 9 .
 f) $7 + x$.
 g) $9 + 1 + 4$ or 14 .
 h) $x + 1 + 4$ or $x + 5$.
 i) $9 + y + 4$ or $y + 13$.
 j) $x + y + 4$.
18. a) $8 + 3$.
 b) 11 .
 c) $x + 6$.
 d) 7 .
 e) 11 .
19. a) 17 .
 b) $x + 14$.
 c) $x + y + 16$.
 d) $x + x + x$.
 e) $x + y + x + y$.
20. a) $\circ\circ\square$ and $\square\circ\circ$
 b) $\circ\circ\circ\circ\circ\circ\circ\square\circ$ and $\square\circ\circ\circ\circ\circ\circ\circ$
 c) $\square\square\circ\circ\circ$ and $\square\circ\circ\circ\square$
21. a) $2 + 1 + y$ or $3 + y$.
 b) $0 + 1 + y$ or $1 + y$.
 c) $x + 1 + 6$ or $x + 7$.
 d) $x + 1 + 9$ or $x + 10$.
 e) $3 + 1 + 7$ or 11 .
22. a) 19 miles.
 b) $x + 1$ miles.
 c) $y + 3$ miles.
 d) $y + z$ miles.

Set IV (page 10)

It would happen with any four numbers because:

a	b	$a + b$
x	y	$x + y$
$a + x$	$b + y$	$a + b + x + y$ $= a + x + b + y$

Chapter 1, Lesson 2**Set I** (page 12)

1. 20,222.
 2. 589.
 3. 877.

4. 3.321.
 5. 4.221.
 6. 0.
 7. 0.1.
 8. 0.01.
 9. 1,793.88.
 10. 179.388.

Set II (pages 13–14)

11. a) $10 - 7$ or 3 .
 b) $6 - x$.
 c) $x - 6$.
 d) $11 - 3$ or 8 .
 e) $x - 1$.
 f) $x - y$.
 g) $4 - x$.
 h) $x - 4$.
12. a) $12 - 7$ or 5 .
 b) $14 - x$.
 c) $x - 3$.
 d) $y - x$.
 e) $9 - 2 - 3$ or 4 .
 f) $x - y - 1$.
13. a) 2.
 b) 3.
 c) 10.
 d) The value of $x - 4$ gets larger.
 e) 12.
 f) 11.
 g) 5.
 h) The value of $15 - x$ gets smaller.
14. a) 8.
 b) 10.
 c) 8.
 d) 10.
 e) Each expression is $x + y - 3$.
15. a) 4.
 b) $7 - x$.
 c) 6.
 d) $14 - y$.
16. a) $7,000 - x$ pounds.
 b) $7,000 + y$ pounds.
17. a) 24 cents.
 b) $y - x$ cents.
 c) $x + 30$ cents.

- d) $95 - y$ cents.

Set III

18. a) $9 - 3$ or 6.
 b) $x - 5$.
 c) $5 - x$.
 d) $20 - 8$ or 12.
 e) $x - 2$.
 f) $y - x$.
 g) $7 - x$.
 h) $x - 7$.
19. a) 5.
 b) $y - 7$.
 c) 3.
 d) $10 - y$.
 e) $y - 15$.
 f) $z - y - 21$.
20. a) 7.
 b) 8.
 c) 18.
 d) The value of $x - 2$ gets larger.
 e) 7.
 f) 6.
 g) 0.
 h) The value of $8 - x$ gets smaller.
21. a) 11.
 b) 14.
 c) 11.
 d) 14.
 e) Each expression is $x + 7 - y$.
22. a) $12 - x$ feet.
 b) $x + y$ feet.
 c) $x - y$ feet.
23. a) $2 - x$ dollars.
 b) $2 + y$ dollars.
 c) $z - 2$ dollars.
24. a) $100 - x$.
 b) $100 + y$.
 c) $100 + y - z$.

Set IV (page 14)





The clerk is giving a customer the change for an \$8.47 purchase: $\$20 - \$8.47 = \$11.53$. The problem is being solved by addition.

Chapter 1, Lesson 3

Set I (page 17)




- 36,000.
- 714,285.
- 77,777.
- 1.
- 12.345.
- 12.345.
- 1.001.
- 10.01.
- 100.1.
- 10,000.

Set II (pages 17–18)

11. a)  for $4 \cdot 3$ and  for $3 \cdot 4$.
- b) 
- c) 
12. a) $5 \cdot 6$ or 30.
 b) $5 + 6$ or 11.
 c) $5x$.
 d) $5 + x$.
 e) xy .
 f) $x + y$.
 g) xx .
 h) $8x$.
 i) $x - 8$.
 j) $2 + 7 + x$ or $9 + x$.
 k) $2 \cdot 7 \cdot x$ or $14x$.
 l) $10 + y + 3$ or $y + 13$.
 m) $10 \cdot y \cdot 3$ or $30y$.
 n) $4 + x + y$.
 o) $4xy$.
13. a) $6 \cdot 2$.
 b) $2 \cdot 6$.
 c) $5x$.
 d) $11 \cdot 7$.
 e) $x \cdot 7$ or $7x$.
 f) xy .
 g) $17 + 17 + 17$.
 h) $x + x + x + x$.
 i) $2 + 2 + \dots + 2$ (y of them).
 j) $z + z + \dots + z$ (y of them).
14. a) $7 \cdot 8$ or 56.
 b) $10x$.
 c) xy .

- d) xx .
15. a) 140.
b) $354x$.
16. a) $7x$.
b) $24x$.
c) 1,440.
d) $1,440x$.
e) 10,080.
f) $100x$.
g) $1,200x$.
17. a) 165.
b) $11x$.

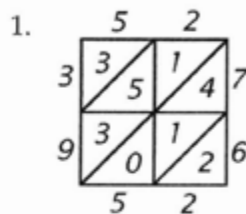
Set III

18. a) 
b) 
c) 

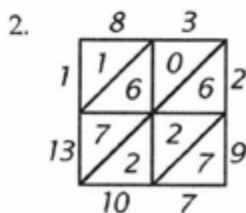
19. a) 21.
b) 10.
c) $7x$.
d) $7 + x$.
e) xy .
f) $x + y$.
g) yy .
h) $5x$.
i) $x - 5$.
j) $10 + x$.
k) $24x$.
l) $y + 17$.
m) $60y$.
n) $x + y + 2$.
o) $2xy$.
20. a) $3 \cdot 10$.
b) $10 \cdot 3$.
c) $3x$.
d) $15 \cdot 4$.
e) $4x$.
f) xy .
g) $19 + 19$.
h) $x + x + x + x + x$.
i) $3 + 3 + \dots + 3$ (y of them).
j) $x + x + \dots + x$ (x of them).
21. a) 72.

- b) $16x$.
c) $7xy$.
d) xxx .
22. a) 48.
b) $4x$.
c) $48y$.
23. a) $20x$.
b) xx .
24. a) 1,000.
b) $1,000x$.
c) 3,000.
d) $1,000y$.
e) 100,000.
f) $100,000y$.
g) $1,000,000y$.

Set IV (page 19)



Yes: 3952 is correct.



Yes. If we "carry" from each slanting column to the next going clockwise, we get 2407.

Chapter 1, Lesson 4

Set I (page 21)

- 50.
- 0.02.
- 1234.
- 3003.
- 1.6.
- 16.
- 0.625.
- 0.0625.

Set II (pages 21–22)

9. a) $\frac{12}{3}$ or 4.
b) $12 - 3$ or 9.

- c) $\frac{7}{x}$.
- d) $\frac{x}{7}$.
- e) $\frac{x}{2}$.
- f) $x \cdot 2$ or $2x$.
- g) $\frac{10}{x}$.
- h) $10 - x$.
- i) $\frac{x}{y}$.
- j) xy .
10. a) $\frac{12}{3} = 4$ and $\frac{12}{4} = 3$.
- b) $\frac{16}{4} = 4$.
- c) $\frac{18}{3} = 6$ and $\frac{18}{6} = 3$.
11. a) $5 \cdot 3 = 15$.
- b) $23 \cdot 4 = 92$.
- c) $12 \cdot 0 = 0$.
- d) $(7.5)(1) = 7.5$.
- e) $10 \cdot 7 = x$.
- f) $x \cdot 12 = 36$.
- g) $4x = 20$.
- h) $y \cdot 2 = x$.
12. a) 45. [$9 \cdot 5$.]
- b) 63. [$9 \cdot 7$.]
- c) 108. [$9 \cdot 12$.]
- d) The value of $9x$ gets larger.
- e) 1. [$\frac{4}{4}$.]
- f) 5. [$\frac{20}{4}$.]
- g) 25. [$\frac{100}{4}$.]
- h) The value of $\frac{x}{4}$ gets larger.
- i) 15. [$\frac{30}{2}$.]
- j) 6. [$\frac{30}{5}$.]
- k) 0.5. [$\frac{30}{60}$.]
- l) The value of $\frac{30}{x}$ gets smaller.
13. a) 20. [$\frac{300}{15}$.]
- b) $\frac{300}{x}$.
14. a) $170x$ dollars.
- b) 600. [$\frac{102,000}{170}$.]
- c) $\frac{x}{170}$.
15. a) $12x$ inches or x feet.
- b) 50. [$\frac{600}{12}$.]
- c) $\frac{x}{12}$.
16. a) 10.6. [$\frac{159}{15}$.]
- b) $\frac{159}{x}$.

Set III

17. a) $\frac{8}{2}$ or 4.
- b) $8 - 2$ or 6.
- c) $\frac{x}{5}$.
- d) $\frac{5}{x}$.
- e) $\frac{3}{x}$.
- f) $3x$.
- g) $\frac{x}{12}$.
- h) $x - 12$.

- i) $\frac{y}{x}$.
- j) yx .
18. a) 21.
b) 42.
c) 77.
d) The value of $7x$ gets larger.
e) 0.
f) 4.
g) 17.
h) The value of $\frac{x}{3}$ gets larger.
i) 2.
j) 1.8.
k) 0.4.
l) The value of $\frac{18}{x}$ gets smaller.
19. a) 7. [$\frac{63}{9}$.]
b) 8. [$\frac{8x}{x}$.]
c) $\frac{15}{x}$.
d) $\frac{x}{4}$.
e) $\frac{x}{y}$.
20. a)
$$\begin{array}{r} 966 \\ -840 \\ \hline 126 \\ -126 \\ \hline 0 \end{array}$$
 40 twenty-ones
6 more twenty-ones
46 twenty-ones subtracted
- b)
$$\begin{array}{r} 125 \\ 7\overline{)875} \\ -700 \\ \hline 175 \\ -140 \\ \hline 35 \\ -35 \\ \hline 0 \end{array}$$
 875
100 sevens
20 more sevens
5 more sevens
125 sevens subtracted
21. a) 20 minutes. [$\frac{2,000}{100}$.]
b) $\frac{2000}{x}$ minutes.

22. a) xy .
b) $\frac{80}{x}$.
c) $\frac{x}{8}$.
23. a) 150 square inches. [$6 \cdot 25$.]
b) $6x$ square inches.
c) 16 square inches. [$\frac{96}{6}$.]
d) $\frac{y}{6}$ square inches.
24. a) 1.08 dollars. [$\frac{10.80}{10}$.]
b) 0.09 dollars. [$\frac{10.80}{120}$.]
c) $\frac{x}{10}$ dollars.
d) $\frac{x}{120}$ dollars.

Set IV (page 23)

There were twelve loaves of bread altogether. In sharing them equally, the three travelers each got four loaves. This means that the third traveler got three loaves from the pilgrim who had seven loaves and one loaf from the pilgrim who had five loaves.

Because $\frac{3}{3+1} = \frac{3}{4}$ of the traveler's bread came from the first pilgrim, he should

receive $\frac{3}{4}$ of the twelve coins:

$$\frac{3}{4} \text{ of } 12 \text{ coins} = 9 \text{ coins.}$$

Chapter 1, Lesson 5**Set I** (page 25)

- 25.
- 32.
- 1,000.
- 10,000,000.
- 1.
- 1.
- 1.69.
- 9.61.

9. 0.064.
10. 0.004096.

Set II (pages 26–27)

11. a) “ x squared” and “ x to the second power.”
b) An exponent.
12. a) 3^2 .
b) 5^2 .
c) x^2 .
d) 4^3 .
e) x^3 .
13. a) 7^2 .
b) 2^6 .
c) x^3 .
d) x^8 .
e) 3^x .
f) x^y .
14. a) 7^4 .
b) 4^7 .
c) x^6 .
d) 2^{12} .
e) 2^x .
f) x^y .
g) $8 \cdot 8 \cdot 8 \cdot 8 \cdot 8$.
h) $x \cdot x \cdot x$.
i) $3 \cdot 3 \cdot \dots \cdot 3$ (x of them).
j) $y \cdot y \cdot \dots \cdot y$ (x of them).
15. a) 2,401.
b) 49^2 .
16. a) 3^6 .
b) 2^6 .
c) 4^3 .
d) 8^2 .
e) 10^4 .
f) 10^9 .
g) Because all powers of 1 are equal to 1.
17. a) 512. [$2 \cdot 256$.]
b) 14,641. [$11 \cdot 1,331$.]
c) 2,187. [$3 \cdot 3 \cdot 243$.]
d) 390,625. [$5 \cdot 5 \cdot 5 \cdot 3,125$.]
e) x .
f) x^2 .

Set III

18. a) “ x cubed” and “ x to the third power.”
b) An exponent.
19. a) 6^2 .
b) 4^2 .
c) y^2 .
d) 5^3 .
e) y^3 .
20. a) 2^3 .
b) 5^{10} .
c) x^2 .
d) x^4 .
e) 9^y .
f) y^x .
21. a) 6^5 .
b) 11^3 .
c) y^7 .
d) 3^{10} .
e) 3^x .
f) x^y .
g) $1 \cdot 1 \cdot 1 \cdot 1$.
h) $x \cdot x \cdot x \cdot x \cdot x$.
i) $5 \cdot 5 \cdot \dots \cdot 5$ (x of them).
j) $x \cdot x \cdot \dots \cdot x$ (y of them).
22. a) 7^3 .
b) 81^2 .
c) 9^4 .
d) 3^8 .
e) 10^3 .
f) 10^7 .
g) Because all powers of 1 are equal to 1.
23. a) The last digit of 6^{100} is 6.
b) $5^2 = 25$
 $5^3 = 125$
 $5^4 = 625$
 $5^5 = 3,125$
 $5^6 = 15,625$
c) The last two digits of 5^{100} are 25.
d) The last digit of 9^{100} is 1.

Set IV (page 27)

This table shows Ollie's study times:

Week	Minutes
1	1
2	2
3	$2 \cdot 2 = 2^2$
4	$2 \cdot 2 \cdot 2 = 2^3$
5	$2 \cdot 2 \cdot 2 \cdot 2 = 2^4$
6	$2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 2^5$
\vdots	\vdots
20	2^{19}

According to Ollie's plan, he would study 2^{19} minutes in the last week, but $2^{19} = 524,288$ minutes. Altogether there are $7 \cdot 24 \cdot 60 = 10,080$ minutes in a week, so Ollie wouldn't be able to do it!

Chapter 1, Lesson 6

Set I (page 30)

- - 88
 - 888888
 - 80
 - o
 - o
- $3x$.
 - $3 + x$.
 - $3 - x$.
 - $\frac{3}{x}$.
 - x^3 .
 - 3^x .
- $2a$.
 - $b + b + b + b + b$.
 - c^3 .
 - $d \cdot d \cdot d \cdot d$.
 - xe .
 - f^j .

Set II (pages 30–31)

- The sum of a number and zero is the number.
 - The difference between a number and zero is the number.

- The product of a number and zero is zero.
- The product of a number and one is the number.
- The quotient of zero and a nonzero number is zero.
- The quotient of a number and zero is not defined.
- The quotient of a number and one is the number.

- 45.
 - 0.
 - 11.
 - 1.
- $1^2 = 1$ because 1 times 1 is 1.
 - 1.
 - 1.
- 0.
 - 10 has a "higher value" than 1.
- x .
 - 0.
 - x .
 - $x + 1$ cannot be simplified.
 - x .
 - 0.
 - $\frac{x}{0}$ is not defined.
 - x .
- $x + y$.
 - x .
 - y .
 - 0.
 - $x + y$.
 - 0.
 - x .
 - y .
- 1.
 - 0.
 - Even.

Set III

- 1.
 - 0.
 - 1.
 - 1.
 - $\frac{0}{0}$ is meaningless.

- f) 0.
g) x .
h) 0.
12. a) The product $2 \cdot 5$ would have two rows.
b) The product $1 \cdot 5$ would have one row.
c) No; $0 \cdot 5$ would have no rows.
13. a) 0 because zero times zero is zero.
b) 0.
c) 0.
14. a) x .
b) $y - x$.
c) y .
d) 0.
e) $y + x$.
f) 0.
g) y .
h) x .
15. a) 45
 $\frac{-5}{40}$
b) The answer is 4 tens and 0 ones.
16. a) $x + 1$.
b) $x - 1$.
c) 1.
17. a) If $\frac{7}{0}$ were equal to 0, then $0 \cdot 0$ would be equal to 7.
b) No. If $\frac{7}{0}$ were equal to 7, then $0 \cdot 7$ would be equal to 7.
c) $\frac{0}{7} = 0$ because $7 \cdot 0 = 0$.
d) No; because we could also say $\frac{0}{0} = a$ for any number a .
18. a) No, because no matter how many times zero is subtracted from 12, the result is always 12.
b) The calculator endlessly subtracts zero from zero without getting any answer. [This is the way that electrically driven calculators work. An electronic calculator will give an error message.]

Set IV (page 31)

If x is not equal to 0, then $x^0 = 1$. If x is equal to 0, it would seem that $0^0 = 0$.

Chapter 1, Lesson 7**Set I** (page 35)

1. a) 5^3 .
b) Not possible.
c) 2^6 .
2. a) $x + 1$.
b) $17 - x$.
c) $x + 26$.
3. a) $7x$.
b) $\frac{1000}{x}$ days.
c) $15,000 + 10x$.

Set II (pages 35–36)

4. a) Figure 4.
b) Figure 5.
c) Figure 2.
d) Figure 6.
e) Figure 3.
f) Figure 4.
g) Figure 1.
5. a) 50. [10 + 40 = 50.]
b) 32. [2 + 20 + 10 = 32.]
c) 48. [3 · 16 = 48.]
d) 19. [3 + 16 = 19.]
e) 9. [25 - 16 = 9.]
f) 400. [25 · 16 = 400.]
g) 57. [42 - 12 + 27 = 57.]
h) 57. [42 + 27 - 12 = 57.]
i) 27. [42 - 27 + 12 = 27.]
j) 27. [42 + 12 - 27 = 27.]
k) 18. [$\frac{16}{8} + \frac{64}{4} = 2 + 16 = 18$.]
l) 12. [$\frac{16}{4} + \frac{64}{8} = 4 + 8 = 12$.]
m) 18. [$\frac{64}{4} + \frac{16}{8} = 16 + 2 = 18$.]
n) 19. [11 - 6 + 14 = 19.]
o) 52. [11 - 8 + 49 = 52.]
p) 39. [11 · 8 - 49 = 88 - 49 = 39.]
q) 531. [11 · 49 - 8 = 539 - 8 = 531.]

6. a) $x^2 + y^2$.
 b) $10 - 5x$.
 c) $\frac{x}{5} - 10$.
 d) $8x^3$.
 e) $y^4 - y$.
 f) $\frac{12}{x} + 2$.
 g) $x + xy$.
7. a) 2. [$1^2 + 3 \cdot 1 - 2 = 1 + 3 - 2 = 2$.]
 b) 26. [$4^2 + 3 \cdot 4 - 2 = 16 + 12 - 2 = 26$.]
 c) 128. [$10^2 + 3 \cdot 10 - 2 = 100 + 30 - 2 = 128$.]
 d) 458. [$20^2 + 3 \cdot 20 - 2 = 400 + 60 - 2 = 458$.]
8. a) 19. [$2 \cdot 6 + 7 = 12 + 7 = 19$.]
 b) 9. [$15 - 3 \cdot 2 = 15 - 6 = 9$.]
 c) 101.
 [$1 + 4 \cdot 5^2 = 1 + 4 \cdot 25 = 1 + 100 = 101$.]
 d) 900. [$10^3 - 10^2 = 1000 - 100 = 900$.]
 e) 84. [$3^4 + 3 = 81 + 3 = 84$.]
 f) 82. [$5 \cdot 4^2 - 4 + 6 = 5 \cdot 16 - 4 + 6 = 80 - 4 + 6 = 82$.]
9. a) 845 cents or \$8.45.
 [$7 \cdot 80 + 3 \cdot 95 = 560 + 285 = 845$.]
 b) $80x + 95y$ cents.

Set III

10. a) Figure 1.
 b) Figure 6.
 c) Figure 4.
 d) Figure 3.
 e) Figure 5.
 f) Figure 6.
 g) Figure 2.
11. a) 17. [$14 + 3 = 17$.]
 b) 2. [$20 - 18 = 2$.]
 c) 117. [$120 - 3 = 117$.]
 d) 17. [$45 - 28 = 17$.]
 e) 34. [$5 + 36 - 7 = 34$.]
 f) 66. [$2 + 64 = 66$.]
 g) 128. [$2 \cdot 64 = 128$.]
 h) 48. [$16 \cdot 3 = 48$.]
 i) 25. [$26 + 24 - 25 = 25$.]
 j) 25. [$26 - 25 + 24 = 25$.]
 k) 27. [$26 - 24 + 25 = 27$.]
 l) 27. [$26 + 25 - 24 = 27$.]

m) 20. [$\frac{64}{2} - \frac{36}{3} = 32 - 12 = 20$.]

n) 0.5. [$\frac{8}{4} - \frac{9}{6} = 2 - 1.5 = 0.5$.]

o) 6. [$36 - 30 = 6$.]

p) 147. $3 \cdot 81 - 3 \cdot 32 = 243 - 96 = 147$.]

q) 147. $81 \cdot 3 - 32 \cdot 3 = 243 - 96 = 147$.]

12. a) $7x + 1$.

b) $x^3 - y^3$.

c) $3x - 3y$.

d) $12 + \frac{x}{6}$.

e) $5x^2$.

f) $x + y^5$.

g) $\frac{1}{xy}$.

13. a) 4. [$0^3 - 2 \cdot 0 + 4 = 0 - 0 + 4 = 4$.]

b) 8. [$2^3 - 2 \cdot 2 + 4 = 8 - 4 + 4 = 8$.]

c) 119. [$5^3 - 2 \cdot 5 + 4 = 125 - 10 + 4 = 119$.]

d) 333. [$7^3 - 2 \cdot 7 + 4 = 343 - 14 + 4 = 333$.]

14. a) 44. [$5 \cdot 8 + 4 = 40 + 4 = 44$.]

b) 11. [$(17 - 2 \cdot 3 = 17 - 6 = 11)$.]

c) 49. [$1 + 3 \cdot 4^2 = 1 + 3 \cdot 16 = 1 + 48 = 49$.]

d) 1,100. [$10^2 + 10^3 = 100 + 1,000 = 1,100$.]

e) 620. [$5^4 - 5 = 625 - 5 = 620$.]

f) 5. [$6 \cdot 1^2 + 1 - 2 = 6 + 1 - 2 = 5$.]

15. a) 51 square centimeters.

[$10^2 - 7^2 = 100 - 49 = 51$.]

b) $y^2 - x^2$ square centimeters.

Set IV (page 37)

1. 72. [$60 - 2 + 14 = 72$.]

2. 40. [$12 \cdot 5 = 60$; $60 - 8 = 52$; $52 + 4 = 13$;
 $13 + 7 = 20$; $20 \cdot 2 = 40$.]

3. The calculator would do the operations in order from left to right.

4. Write down some of the intermediate steps.

Chapter 1, Lesson 8**Set I** (page 40)

1. a) 0.
 b) 100.
 c) 0.
 d) Not possible.
 e) 0.01.

- f) 100.
2. a) 7. $[\frac{35}{5}.]$
 b) 6. $[\frac{6x}{x}.]$
 c) x. $[\frac{x^2}{x}.]$
 d) $\frac{20}{x}$.
 e) x. $[\frac{x}{1}.]$
 f) $\frac{y}{x}$
3. a) 5. $[\frac{50}{10}.]$
 b) $\frac{x}{10}$.

Set II (pages 41-42)

4. a) Yes. $[16 + 2 = 18; 11 + 7 = 18.]$
 b) No. $[6 - 2 = 4; 11 - 3 = 8.]$
 c) Yes. $[16 - 2 = 14; 11 + 3 = 14.]$
 d) No. $[6 + 2 = 8; 11 - 7 = 4.]$
 e) Yes. $[72 \cdot 3 = 216; 12 \cdot 18 = 216.]$
 f) Yes. $[12 + 18 = 30; 12 + 18 = 30.]$
 g) No. $[12 + 18 = 30; 18 \cdot 3 = 54.]$
 h) Yes. $[\frac{18}{3} = 6; \frac{18}{3} = 6.]$
5. a) 63. $[7 \cdot 9 = 63.]$
 b) 441. $[21^2 = 441.]$
 c) 15. $[4 + 6 + 5 = 15.]$
 d) 23. $[6 \cdot 3 + 5 = 18 + 5 = 23.]$
 e) 20. $[4 + 2 \cdot 8 = 4 + 16 = 20.]$
 f) 48. $[6 \cdot 8 = 48.]$
 g) 1. $[15 - 12 - 2 = 1.]$
 h) 24. $[12 \cdot 2 = 24.]$
 i) 5. $[15 - (12 - 2) = 15 - 10 = 5.]$
 j) 9. $[15 - 3 \cdot 2 = 15 - 6 = 9.]$
 k) 6. $[3 + 3 = 6.]$
 l) 3. $[\frac{36}{12} = 3.]$
 m) 9. $[3 \cdot 3 = 9.]$
 n) 9. $[\frac{180}{20} = 9.]$
 o) 5. $[25 - 5 \cdot 4 = 25 - 20 = 5.]$
 p) 80. $[(25 - 5) \cdot 4 = 20 \cdot 4 = 80.]$
 q) 225. $[(25 - 10)^2 = 15^2 = 225.]$
6. a) Figure 2.
 b) Figure 3.
 c) Figure 1.
 d) Figure 5.
 e) Figure 4.
 f) Figure 6.
 g) Figure 1.
 h) Figure 6.
7. a) $(x - 5)^3$.
 b) $x \cdot 6 + y$ or $6x + y$.
 c) $(y + 6)x$.
 d) $\frac{10}{x} - y$.
 e) $\frac{10 - y}{x}$.
 f) $(x + 2)(x + 7)$.
 g) $\frac{x - y}{2x}$.
 h) $11 - (3x)^2$.
 i) $(11 - 3x)^2$.
 j) $(x^3 + y^3)8$ or $8(x^3 + y^3)$.
8. a) 0. $(3^2 + 2 \cdot 3 - 15 = 9 + 6 - 15 = 0.)$
 b) 9. $(4^2 + 2 \cdot 4 - 15 = 16 + 8 - 15 = 9.)$
 c) 105.
 $[10^2 + 2 \cdot 10 - 15 = 100 + 20 - 15 = 105.]$
 d) 2,585. $[50^2 + 2 \cdot 50 - 15 = 2,500 + 100 - 15 = 2,585.]$
 e) 0. $[0 \cdot 8 = 0.]$
 f) 9. $[1 \cdot 9 = 9.]$
 g) 105. $[7 \cdot 15 = 105.]$
 h) 2,585. $[47 \cdot 55 = 2,585.]$

Set III

9. a) Yes. $[20 + 1 = 21; 14 + 7 = 21.]$
 b) Yes. $[20 - 1 = 19; 14 + 5 = 19.]$
 c) No. $[8 - 1 = 7; 14 - 5 = 9.]$
 d) No. $[8 + 1 = 9; 14 - 7 = 7.]$
 e) Yes. $[20 \cdot 4 = 80; 10 \cdot 8 = 80.]$
 f) No. $[10 + 8 = 18; 12 \cdot 4 = 48.]$
 g) Yes. $[(10 + 8 = 18; 10 + 8 = 18.)$
 h) Yes. $[\frac{8}{4} = 2; \frac{8}{4} = 2.]$
10. a) 48. $[3 \cdot 16 = 48.]$
 b) 144. $[12^2 = 144.]$
 c) 29. $[8 + 24 - 3 = 29.]$

- d) 85. [$11 \cdot 8 - 3 = 88 - 3 = 85.$]
 e) 23. [$8 + 3 \cdot 5 = 8 + 15 = 23.$]
 f) 55. [$11 \cdot 5 = 55.$]
 g) 1. [$12 - 10 - 1 = 1.$]
 h) 40. [$10 \cdot 4 = 40.$]
 i) 3. [$12 - (10 - 1) = 12 - 9 = 3.$]
 j) 4. [$12 - 2 \cdot 4 = 12 - 8 = 4.$]
 k) 6. [$8 - 2 = 6.$]
 l) 14. [$\frac{28}{2} = 14.$]
 m) 16. [$8 \cdot 2 = 16.$]
 n) 16. [$\frac{128}{8} = 16.$]
 o) 13. [$49 - 9 \cdot 4 = 49 - 36 = 13.$]
 p) 160. [$(49 - 9) \cdot 4 = 40 \cdot 4 = 160.$]
 q) 961. [$(49 - 18)^2 = 31^2 = 961.$]
11. a) Figure 1.
 b) Figure 3.
 c) Figure 2.
 d) Figure 5.
 e) Figure 4.
 f) Figure 6.
 g) Figure 2.
 h) Figure 6.
12. a) $(x + 11)y$.
 b) $11y + x$.
 c) $\frac{x}{3} - 1$.
 d) $\frac{x-1}{3}$.
 e) $(x + y)^2$.
 f) $x^2 + y^2$.
 g) $(x - y)x$.
 h) $9 - (2x)^3$.
 i) $(9 - 2x)^3$.
 j) $\frac{x+y}{5y}$.
13. a) 0. [$2^2 + 4 \cdot 2 - 12 = 4 + 8 - 12 = 0.$]
 b) 20. [$4^2 + 4 \cdot 4 - 12 = 16 + 16 - 12 = 20.$]
 c) 128.
 [$10^2 + 4 \cdot 10 - 12 = 100 + 40 - 12 = 128.$]
 d) 273.
 [$15^2 + 4 \cdot 15 - 12 = 225 + 60 - 12 = 273.$]
 e) 0. [$8 \cdot 0 - 0.$]
 f) 20. [$10 \cdot 2 = 20.$]
 g) 128. [$16 \cdot 8 = 128.$]

h) 273. [$21 \cdot 13 = 273.$]

Set IV (page 42)

- All multiplication signs except for the first one which should be an addition sign:
 $1 + 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7 \cdot 8 \cdot 9 \cdot 10.$
- 3,628,801.
- Use the same symbols of operation as before, but put parentheses around the 1 + 2: $(1 + 2) \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7 \cdot 8 \cdot 9 \cdot 10.$
- 5,443,200.

Chapter 1, Lesson 9**Set I** (page 45)

- a) $5a$.
 b) b^3 .
 c) $a + b$.
 d) 0.
- a) $20 + x$.
 b) $5x$.
 c) $\frac{y}{20}$ minutes.
- a) $1000 - x$ pounds.
 b) $\frac{1000}{y}$ pounds.
 c) $1000 - 10z$ pounds.

Set II (pages 45-46)

- a) $3(6 + 2) = 3(6) + 3(2).$
 b) $4(7 - 3) = 4(7) - 4(3).$
 c) $5(1 + 8) = 5(1) + 5(8).$
 d) $6(5 - 1) = 6(5) - 6(1).$
- a) $4x^3$.
 b) $7(2x)$.
 c) $3(x + 1)$.
 d) $9(x + y)$.
 e) $x^4 + x^4$.
 f) $3x + 3x + 3x + 3x + 3x$.
 g) $(x + 7) + (x + 7) + (x + 7) + (x + 7)$.
- a) $3(x + 5) = (x + 5) + (x + 5) + (x + 5) = x + x + x + 5 + 5 + 5 = 3x + 15.$
 b) $2(x + y) = (x + y) + (x + y) = x + x + y + y = 2x + 2y.$

- c) $4(x^2 + 1) =$
 $(x^2 + 1) + (x^2 + 1) + (x^2 + 1) + (x^2 + 1) =$
 $x^2 + x^2 + x^2 + x^2 + 1 + 1 + 1 + 1 =$
 $4x^2 + 4.$
7. a) $8x + 24.$
 b) $5y - 10.$
 c) $x^2 + x.$
 d) $xy - y^2.$
 e) $2x + 18.$
 f) $4y + xy.$
 g) $7y - 7x.$
 h) $x^2 - 6x.$
 i) $10x^2 + 40.$
 j) $x^4 - x.$
8. a) 72
 $\times 43$
 $\hline 216$
 2880
 $\hline 3096$
- b) $43 \cdot 72 = (40 + 3)72$
 $= 40 \cdot 72 + 3 \cdot 72$
 $= 2880 + 216$
 $= 3096$
- c) 43
 $\times 72$
 $\hline 86$
 3010
 $\hline 3096$
- d) $72 \cdot 43 = (70 + 2)43$
 $= 70 \cdot 43 + 2 \cdot 43$
 $= 3010 + 86$
 $= 3096$
9. a) $4(x + 5)$ and $4x + 20.$
 b) $x(10 + x)$ and $10x + x^2.$
 c) $3(x + y + 3)$ and $3x + 3y + 9.$
 d) $x(x^2 + x + 1)$ and $x^3 + x^2 + x.$
10. a) $x + y.$
 b) $2(x + y).$
 c) $2x.$
 d) $2y.$
 e) $2x + 2y.$
11. a) $2(5 + 4) = 2(5) + 2(4).$
 b) $7(3 + 1) = 7(3) + 7(1).$
 c) $4(8 - 5) = 4(8) - 4(5).$
 d) $5(4 - 1) = 5(4) - 5(1).$
12. a) $7x^2.$
 b) $3(5x)$ or $15x.$
 c) $2(x + 7).$
 d) $10(x + y).$
 e) $x^3 + x^3 + x^3 + x^3.$
 f) $7x + 7x.$
 g) $(x + 8) + (x + 8) + (x + 8).$
13. a) $2(x + 6) = (x + 6) + (x + 6) =$
 $x + x + 6 + 6 = 2x + 12.$
 b) $4(x + y) =$
 $(x + y) + (x + y) + (x + y) + (x + y) =$
 $x + x + x + x + y + y + y + y = 4x + 4y.$
 c) $3(x^2 + 2) = (x^2 + 2) + (x^2 + 2) + (x^2 + 2) =$
 $x^2 + x^2 + x^2 + 2 + 2 + 2 = 3x^2 + 6.$
14. a) $2x + 10.$
 b) $4y - 28.$
 c) $3x + x^2.$
 d) $y^2 - y.$
 e) $10x + 80.$
 f) $6x + x^2.$
 g) $5y - 20.$
 h) $xy - y^2.$
 i) $3x^2 + 27.$
 j) $x^3 - 2x^2.$
15. a) 84
 $\times 21$
 $\hline 84$
 1680
 $\hline 1764$
- b) $21 \cdot 84 = (20 + 1)84$
 $= 20 \cdot 84 + 1 \cdot 84$
 $= 1680 + 84$
 $= 1764$
- c) 21
 $\times 84$
 $\hline 21$
 1680
 $\hline 1764$
- d) $84 \cdot 21 = (80 + 4)21$
 $= 80 \cdot 21 + 4 \cdot 21$
 $= 1680 + 84$
 $= 1764$

Set III

11. a) $2(5 + 4) = 2(5) + 2(4).$
 b) $7(3 + 1) = 7(3) + 7(1).$
 c) $4(8 - 5) = 4(8) - 4(5).$
 d) $5(4 - 1) = 5(4) - 5(1).$
16. a) $3(x + 7)$ and $3x + 21.$
 b) $y(2 + y)$ and $2y + y^2.$
 c) $4(x + y + 6)$ and $4x + 4y + 24.$
 d) $x(y^2 + y + 1)$ and $xy^2 + xy + x.$

17. a) $x + y$.
 b) $3.50(x + y)$ dollars.
 c) $3.50x$ dollars.
 d) $3.50y$ dollars.
 e) $3.50x + 3.50y$ dollars.

Set IV (page 47)

1. a) 4. $[(2 + 0)^2 = 2^2 = 4.]$
 b) 36. $[(0 + 6)^2 = 6^2 = 36.]$
 c) 49. $[(3 + 4)^2 = 7^2 = 49.]$
 d) 100. $[(9 + 1)^2 = 10^2 = 100.]$
 e) 4. $[2^2 + 0^2 = 4 + 0 = 4.]$
 f) 36. $[0^2 + 6^2 = 0 + 36 = 36.]$
 g) 25. $[3^2 + 4^2 = 9 + 16 = 25.]$
 h) 82. $[9^2 + 1^2 = 81 + 1 = 82.]$
2. $(x + y)^2$ and $x^2 + y^2$ are sometimes equal and sometimes not equal.

Chapter 1, Review**Set I** (pages 50–51)

1. a) $4 \cdot 7$.
 b) 7^4 .
 c) $x + x$.
 d) $y \cdot y \cdot y \cdot y \cdot y \cdot y$.
2. a) w^2 .
 b) $3x$.
 c) $17 - y$.
 d) z^5 .
3. a) Think of a number:
 Multiply by five:
 Add eight:
 Subtract three:
 Divide by five:
 Subtract the number
 you first thought of:
- b) The number 1.
 c) Steps 3 and 4.
 d) Add 5.
4. a) Figure 3.
 b) Figure 1.
 c) Figure 2.
5. a) $4^2 = 16$
 $4^3 = 64$
 $4^4 = 256$
 $4^5 = 1,024$
 $4^6 = 4,096$

- b) The last digit of 4^{100} is 6.
6. a) 64.
 b) 8^2 .
7. a) Perimeter, 22; area, 28.
 b) Perimeter, $2x + 6$; area, $3x$.
 c) Perimeter, $4y$; area, y^2 .
8. a) 14. $[21 - 7 = 14.]$
 b) 28. $[30 - 2 = 28.]$
 c) 65. $[1 + 64 = 65.]$
 d) 125. $[5^3 = 125.]$
9. a) $x + 151$. $[9 + x + 142.]$
 b) $160 - x - y$ or $160 - (x + y)$.
10. a) If $\frac{2}{0} = a$, then $0 \cdot a = 2$. But $0 \cdot a = 0$.
 b) No.
11. a) $600x$.
 b) $\frac{10,000}{x}$.
12. a) $5x + 1$.
 b) $(x + 3)^2$.
 c) $x^6 - 7$.
13. a) $7a + 14$.
 b) $b - b^2$.
 c) $5c + 45$.
14. a) $3x$ carbon atoms and $8x$ hydrogen atoms.
 b) $3x + 5x$.
 c) 11.
 d) $11x$.

Set II (pages 51–52)

1. a) $3 \cdot 11$.
 b) 2^7 .
 c) $x + x + x + x + x$.
 d) $y \cdot y \cdot y \cdot y$.
2. Step 1. Think of a number.
 Step 2. Add 1.
 Step 3. Multiply by 4.
 Step 4. Add 8.
 Step 5. Divide by 4.
 Step 6. Subtract the number that you first thought of.

3. a) $a - 5$.
b) b^3 .
c) $2 + c$.
d) $\frac{1}{d}$.
4. a) 2^5 .
[$2^1 = 2, 2^2 = 4, 2^3 = 8, 2^4 = 16, 2^5 = 32$.]
b) It is impossible to express 3 as a power of 1. [$1^1 = 1, 1^2 = 1, 1^3 = 1, \dots$]
c) 10^6 . [$10^1 = 10, 10^2 = 100, 10^3 = 1,000, 10^4 = 10,000, 10^5 = 100,000, 10^6 = 1,000,000$.]
5. a) $x - 3$.
b) $x + 5$.
6. a) 9. [$\frac{72}{8}$.]
b) $\frac{20}{x}$.
c) $\frac{x}{y}$.
7. a) $72 + x$.
b) $72 - y$.
c) $3 + x$. [$75 + x - 72$.]
8. a) 600. [$6 \cdot 100 = 600$.]
b) 3,600. [$60^2 = 3,600$.]
c) 45. [$9 \cdot 5 = 45$.]
d) 55. [$2 + 56 - 3 = 55$.]
9. a) $3^2 - 1^2 = 8 = 2^3$
 $6^2 - 3^2 = 27 = 3^3$
 $10^2 - 6^2 = 64 = 4^3$
 $15^2 - 10^2 = 125 = 5^3$
b) $21^2 - 15^2 = 216 = 6^3$.
10. a) $(x - 6)2$ or $2(x - 6)$.
b) $\frac{x}{8} + 4$.
c) $150 - x^3$.
11. a) $8v + 88$.
b) $3w - 18$.
c) $xy + xz$.
12. a) $3(x + 4) = 3x + 12$.
b) $(6 + x)x = 6x + x^2$.
c) $y(x + 1) = yx + y$.
13. a) $3x$.
b) $200 - 3x$ kilograms.
c) $\frac{x}{3}$.
14. a) 0. [$2^2 + 5 \cdot 2 - 14 = 4 + 10 - 14 = 0$.]
b) 10. [$3^2 + 5 \cdot 3 - 14 = 9 + 15 - 14 = 10$.]
c) 136.
[$10^2 + 5 \cdot 10 - 14 = 100 + 50 - 14 = 136$.]
d) 0. [$9 \cdot 0 = 0$.]
e) 10. [$10 \cdot 1 = 10$.]
f) 136. [$17 \cdot 8 = 136$.]

Chapter 2, Lesson 1

Set I (pages 55–56)

- 3 . [$12 - 9 = 3$.]
 - 81 . [$9^2 = 81$.]
 - 9 . [$1 + 8 = 9$.]
 - 27 . [$3^3 = 27$.]
- 0 .
 - 1 .
 - 0 .
- $100x$.
 - $400 - x$.

Set II (pages 56–57)

- | | | | | | |
|-----|---|---|---|---|---|
| x | 0 | 1 | 2 | 3 | 4 |
| y | 5 | 6 | 7 | 8 | 9 |
 - | | | | | | |
|-----|---|---|----|----|----|
| x | 0 | 2 | 4 | 6 | 8 |
| y | 0 | 8 | 16 | 24 | 32 |
 - | | | | | | |
|-----|---|---|---|---|----|
| x | 0 | 1 | 2 | 3 | 4 |
| y | 3 | 5 | 7 | 9 | 11 |
 - | | | | | | |
|-----|---|---|---|----|----|
| x | 1 | 2 | 3 | 4 | 5 |
| y | 1 | 4 | 9 | 16 | 25 |
 - | | | | | | |
|-----|---|---|---|-----|-----|
| x | 2 | 4 | 6 | 8 | 10 |
| y | 6 | 3 | 2 | 1.5 | 1.2 |
- | | | | | |
|-----|----|----|----|----|
| x | 2 | 3 | 4 | 5 |
| y | 13 | 28 | 49 | 76 |
 - | | | | | |
|-----|----|----|-----|-----|
| x | 2 | 3 | 4 | 5 |
| y | 12 | 45 | 112 | 225 |
- $y = 6x$.
 - $y = x + 7$.
 - $y = x - 4$.
 - $y = x^2$.
 - $y = x^2 + 1$.
 - $y = 6x - 1$.
 - $y = 10x + 3$.
 - $y = 11x$.
 - $y = 12 - x$.
 - $y = \frac{20}{x}$.
- 40 . [$4 \cdot 10 = 40$.]
 - $p = 4s$.
 - 100 . [$10^2 = 100$.]
 - $a = s^2$.

- 11 meters per second.
[$\frac{165 \text{ meters}}{15 \text{ seconds}} = 11 \text{ meters per second.}$]
 - $m = 11s$.
 - 770 meters. [$11 \cdot 70 = 770$.]
- The population is increasing.
 - No.

Set III

- | | | | | | |
|-----|---|---|----|----|----|
| x | 0 | 1 | 2 | 3 | 4 |
| y | 0 | 5 | 10 | 15 | 20 |
 - | | | | | | |
|-----|---|---|---|---|---|
| x | 3 | 4 | 5 | 6 | 7 |
| y | 0 | 1 | 2 | 3 | 4 |
 - | | | | | | |
|-----|----|----|----|----|----|
| x | 1 | 2 | 3 | 4 | 5 |
| y | 11 | 21 | 31 | 41 | 51 |
 - | | | | | | |
|-----|---|---|----|----|-----|
| x | 1 | 2 | 3 | 4 | 5 |
| y | 1 | 8 | 27 | 64 | 125 |
 - | | | | | | |
|-----|---|---|---|----|----|
| x | 0 | 1 | 2 | 3 | 4 |
| y | 0 | 2 | 6 | 12 | 20 |
- | | | | | |
|-----|---|---|----|-----|
| x | 0 | 1 | 2 | 3 |
| y | 2 | 6 | 34 | 110 |
 - | | | | | |
|-----|---|----|----|----|
| x | 2 | 3 | 4 | 5 |
| y | 6 | 24 | 52 | 90 |
- $y = x + 3$.
 - $y = 5x$.
 - $y = \frac{x}{2}$ (or $y = \frac{1}{2}x$).
 - $y = x - 6$.
 - $y = x^3$.
 - $y = 5x - 1$.
 - $y = x^3 + 2$.
 - $y = 10x + 4$.
 - $y = 11x$.
 - $y = 10 - x$.
- The longer the senator spoke, the fewer the people who were listening to him.
 - No.
- \$12.50.
[$\frac{100 \text{ dollars}}{8 \text{ hours}} = 12.50 \text{ dollars per hour.}$]
 - $d = 12.50h$.
 - 625 dollars. [$12.50 \cdot 50 = 625$.]
- 2.
 - 14.

c) $n = 2d$.

Set IV (page 58)

1. Taking first and second differences of the temperatures, we get

s	5	6	7	8	9	(10)				
t	11,250	16,200	22,050	28,800	36,450	(45,000)				
	4,950		5,850		6,750		7,650		(8,550)	
	900		900		900		(900)			

2. $45,000^\circ\text{C}$.**Chapter 2, Lesson 2****Set I** (pages 60–61)

1. a) $5n$.
 b) n^5 .
 c) $7 \cdot 7 \cdot 7 \cdot 7$.
 d) $4 + 4 + 4 + 4 + 4 + 4 + 4$.

2. a) 1. $[\frac{x}{x}]$

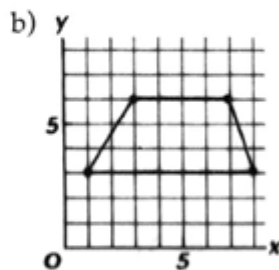
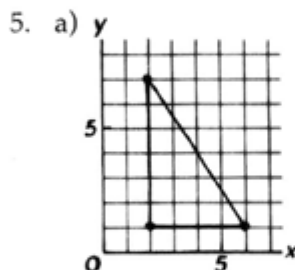
b) x . $[\frac{x^2}{x}]$

c) $\frac{x^2}{2}$.

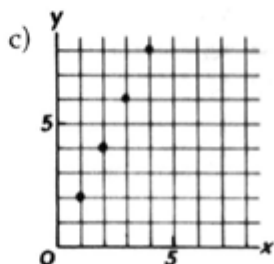
3. a) $4x - 9$.
 b) $(x - 9)4$ or $4(x - 9)$.
 c) $a^2 + b^2$.
 d) $(a + b)^2$.

Set II (pages 61–62)

4. O (0, 0); A (1, 10); B (6, 6); C (3, 7); D (7, 3);
 E (8, 0); F (0, 5).



6. a) $y = 2x$.
 b) Four.



d) They lie on a straight line.

7. a)

x	0	1	2	3	4
y	4	5	6	7	8

b) $y = x + 4$.

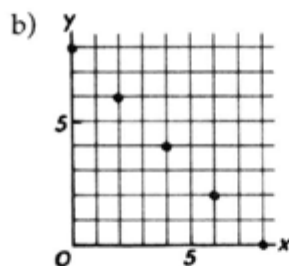
8. a)

x	0	1	2	3	4
y	7	6	5	4	3

b) $y = 7 - x$.

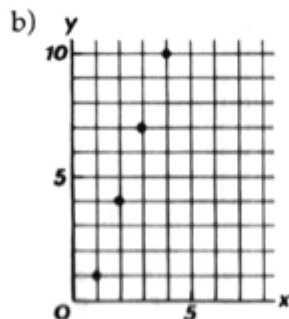
9. a)

x	0	2	4	6	8
y	8	6	4	2	0

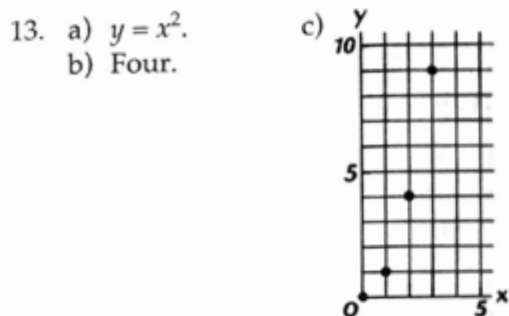
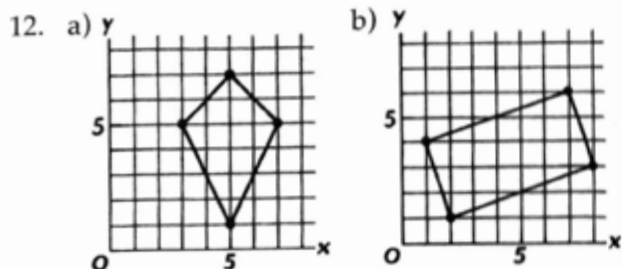


10. a)

x	1	2	3	4
y	1	4	7	10

**Set III**

11. A (1, 2); B (5, 0); C (8, 1); D (10, 5); E (9, 8);
 F (2, 9); G (0, 5); O (0, 0).



14. a)

x	1	2	3	4
y	0	1	2	3

b) $y = x - 1$.

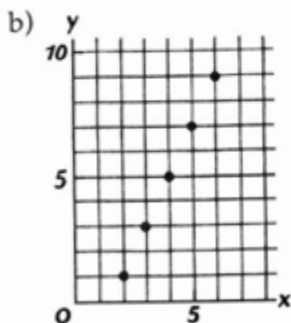
15. a)

x	0	1	2	3	4
y	5	4	3	2	1

b) $y = 5 - x$.

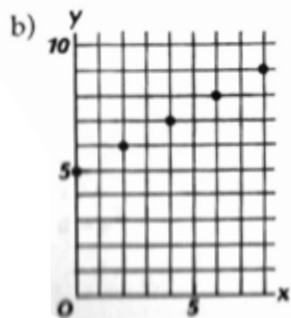
16. a)

x	2	3	4	5	6
y	1	3	5	7	9

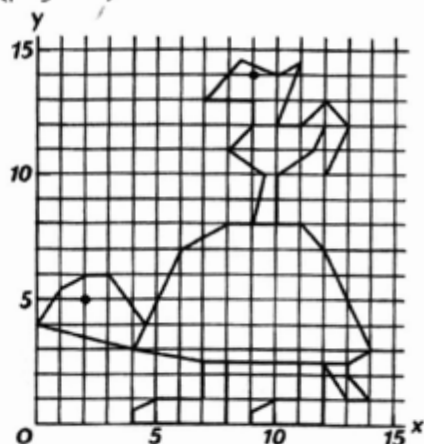


17. a)

x	0	2	4	6	8
y	5	6	7	8	9



Set IV (page 62)



Chapter 2, Lesson 3

Set I (page 65)

- Yes. [$13 + 3 = 16$; $9 + 7 = 16$.]
 - No. [$5 + 3 = 8$; $9 - 7 = 2$.]
 - Yes. [$13 - 3 = 10$; $9 + 1 = 10$.]
 - No. [$5 - 3 = 2$; $9 - 1 = 8$.]
- $3x + 3y$.
 - $5x - 35$.
 - $2x - x^2$.
 - $y^3 + y^2$.
- $6x$.
 - $24 - x$.

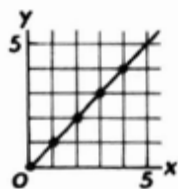
Set II (pages 65-66)

- | | | | | |
|---|---|---|---|---|
| x | 0 | 1 | 2 | 3 |
| y | 0 | 3 | 6 | 9 |
 - $y = 3x$.
- $x = 2$.
 - $y = 1$ and $y = 3$.
- Yes.
 - Yes.
 - No.
 - Yes.
 - Yes.
 - Yes.
 - No.
 - No.
 - Yes.
 - Yes.

7.

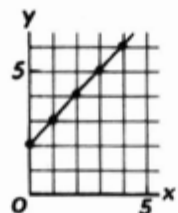
a)

x	0	1	2	3	4
y	0	1	2	3	4



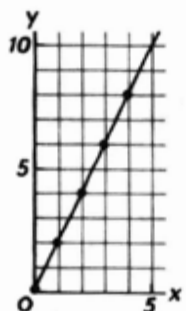
b)

x	0	1	2	3	4
y	2	3	4	5	6



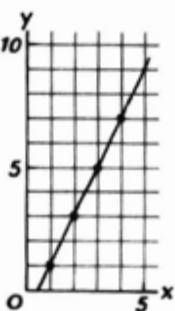
c)

x	0	1	2	3	4
y	0	2	4	6	8



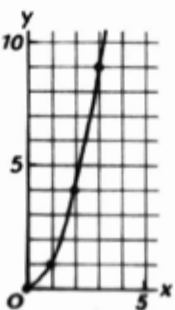
d)

x	1	2	3	4
y	1	3	5	7



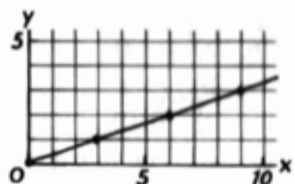
e)

x	0	1	2	3
y	0	1	4	9



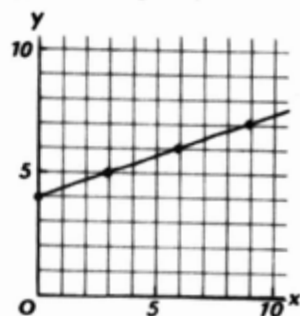
f)

x	0	3	6	9
y	0	1	2	3



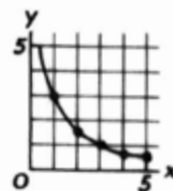
g)

x	0	3	6	9
y	4	5	6	7



h)

x	1	2	3	4	5
y	3	1.5	1	0.75	0.6



Set III

8. a)

x	1	2	3	4
y	3	4	5	6

b) $y = x + 2$.

9. a) $x = 3$.

b) $y = 2$ and $y = 4$.

10. a) Yes.

b) Yes.

c) No.

d) Yes.

e) Yes.

f) No.

g) Yes.

h) No.

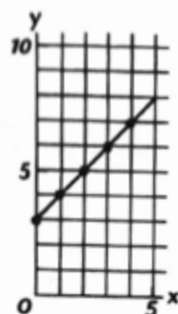
i) Yes.

j) No.

11.

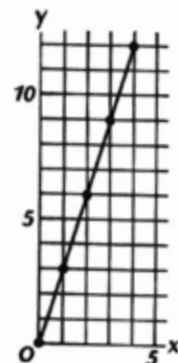
a)

x	0	1	2	3	4
y	3	4	5	6	7



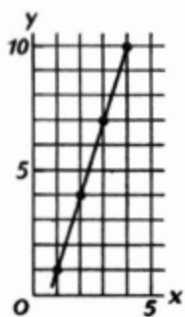
b)

x	0	1	2	3	4
y	0	3	6	9	12

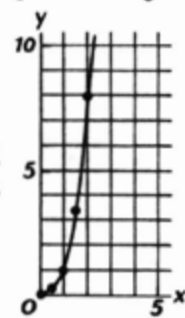


11.

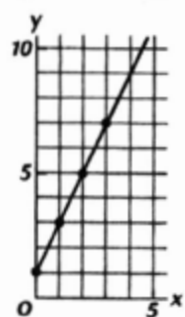
c)	x	1	2	3	4
	y	1	4	7	10



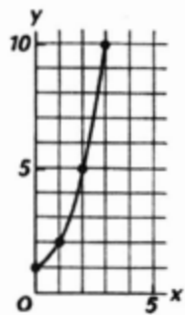
d)	x	0	0.5	1	1.5	2
	y	0	0.125	1	3.375	8



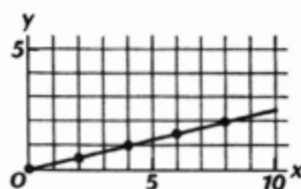
e)	x	0	1	2	3
	y	1	3	5	7



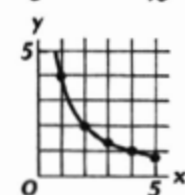
f)	x	0	1	2	3
	y	1	2	5	10



g)	x	0	2	4	6	8
	y	0	0.5	1	1.5	2

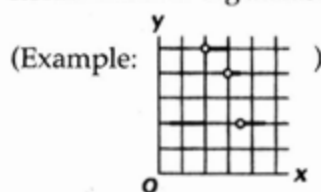


h)	x	1	2	3	4	5
	y	4	2	1.3	1	0.8



Set IV (page 67)

- There is more than one value of y corresponding to $x = 0.5$, $x = 2$, $x = 3$, $x = 3.5$, and $x = 4.5$.
- Remove the vertical line segments and either the right or left endpoints of the horizontal line segments.



Chapter 2, Lesson 4

Set I (page 70)

- Figure 3.
 - Figure 2.
 - Figure 4.
 - Figure 1.
- $y = 6 - x$.
 - $y = 10x + 1$.
 - $y = x^3$.
- $120x$ minutes.
 - $120 - y$.

Set II (pages 70-71)

- | | | | | |
|---|---|---|----|----|
| x | 0 | 1 | 2 | 3 |
| y | 0 | 5 | 10 | 15 |
 - y is tripled.
 - A direct variation.
 - $y = 5x$.
 35. [$y = 5 \cdot 7 = 35$.]
- | | | | | | |
|---|---|---|----|----|-----|
| x | 4 | 8 | 12 | 20 | 100 |
| y | 3 | 6 | 9 | 15 | 75 |
 - $\frac{3}{4}$.
 - $y = \frac{3}{4}x$.
- $y = 0$.
 - $y = a \cdot 0 = 0$.
 - $(0, 0)$.
 - The line goes through the origin.

7. a) Yes.
b) No.
c) Yes.
d) No.
e) No.

8. a)

x	0	1	2	3
y	0	2	4	6

b)

x	0	1	2	3
y	0	3	6	9

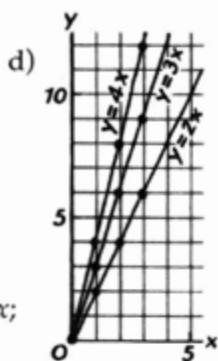
c)

x	0	1	2	3
y	0	4	8	12

e) 2 for $y = 2x$; 3 for $y = 3x$;
4 for $y = 4x$.

f) $y = 4x$.

g) The steepness increases as the constant of variation increases.



9. a) 75 centimeters. [$0.5 \cdot 150 = 75$.]
b) 240 centimeters. [$120 = 0.5 \cdot ?$]
c) The bounciness increases as the constant of variation increases.
d) No; in that case the ball would bounce higher and higher.
10. a) $y = 45x$.
b) A steep line going through the origin.

Set III

11. a)

x	0	1	2	3	4
y	0	3	6	9	12

b) y is doubled.

c) A direct variation.

d) $y = 3x$.

e) 30. [$y = 3 \cdot 10 = 30$.]

12. a)

x	2	4	6	12	18
y	7	14	21	42	63

b) $\frac{7}{2}$ or 3.5.

c) $y = \frac{7}{2}x$ or $y = 3.5x$.

13. a) Yes; the speed of light is the constant of variation.
b) No; after awhile the cat stops growing.
c) No; too many cooks and there is no soup.

d) Yes, if the bottles are uniform in size; the constant of variation is the refund per bottle.

14. a) Yes.
b) No.
c) No.
d) Yes.
e) No.
15. a) $y = 2x$.
b) $y = x$.
c) $y = 3x$.
d) $y = 2.5x$.
e) 2 for line 1; 1 for line 2; 3 for line 3; 2.5 for line 4.
f) Line 3.
g) The larger the constant of variation, the steeper the line.
16. a) 600 cubic centimeters.
[$y = 2 \cdot 300 = 600$.]
b) 250 degrees Kelvin. [$500 = 2 \cdot ?$]
c) The greater the constant of variation, the greater the size of the balloon.
17. a) $y = 19x$.
b) A straight line passing through the origin.

Set IV (page 72)

- The (changing) weights of the winner and first runner up.
- The winner weighs less than the runner up and ate 67 hot dogs, 3 more than the runner up.

Chapter 2, Lesson 5

Set I (page 75)

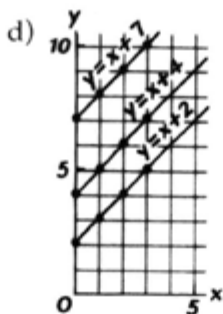
- $x - y$.
 - $2x + 3$. [$x + 3 + x = 2x + 3$.]
 - $y + 1$. [$x + y + 1 - x = y + 1$.]
- $2x$.
 - $4x$.
 - $8x$.
- $3^2 + 4^2 = 9 + 16 = 25$; $5^2 = 25$. True.
 - $3^3 + 4^3 + 5^3 = 27 + 64 + 125 = 216$; $6^3 = 216$. True.
 - $3^4 + 4^4 + 5^4 + 6^4 = 81 + 256 + 625 + 1,296 = 2,258$; $7^4 = 2,401$. False.

Set II (pages 75–76)

4. a) x 0 1 2 3
 y 2 3 4 5

b) x 0 1 2 3
 y 4 5 6 7

c) x 0 1 2 3
 y 7 8 9 10



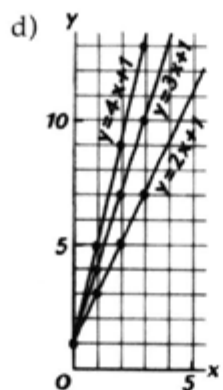
e) They are parallel.

f) $y = x + 2$ at $(0, 2)$; $y = x + 4$ at $(0, 4)$;
 $y = x + 7$ at $(0, 7)$.g) At $(0, 10)$.

5. a) x 0 1 2 3
 y 1 3 5 7

b) x 0 1 2 3
 y 1 4 7 10

c) x 0 1 2 3
 y 1 5 9 13

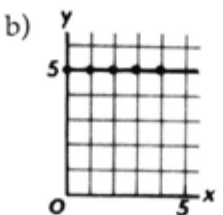


e) They all pass through the same point.

f) At $(0, 1)$.g) At $(0, 1)$.

6. a) x 0 1 2 3 4
 y 5 5 5 5 5

c) It is a horizontal line.

d) $y = 5$.7. a) It is the difference between successive values of y .b) It is the value of y corresponding to $x = 0$.c) $y = 2x + 8$.d) $y = 7x + 1$.e) $y = 4x + 6$.f) $y = 6x + 4$.8. a) $y = 2x + 6$. [$y = x + 3 + x + 3$.]

b) Linear.

c) No.

9. a) x 0 1 2 3 4
 y 20 20.5 21 21.5 22

b) 20 centimeters.

c) 0.5 centimeters.

d) 30 centimeters.

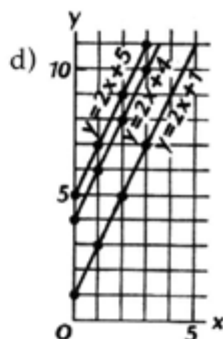
$[y = 0.5 \cdot 20 + 20 = 10 + 20 = 30.]$

Set III

10. a) x 0 1 2 3
 y 1 3 5 7

b) x 0 1 2 3
 y 4 6 8 10

c) x 0 1 2 3
 y 5 7 9 11



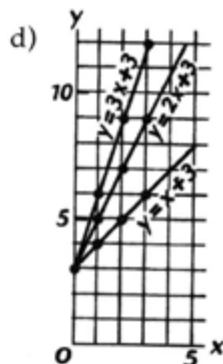
e) They are parallel.

f) $y = 2x + 1$ at $(0, 1)$; $y = 2x + 4$ at $(0, 4)$;
 $y = 2x + 5$ at $(0, 5)$.g) At $(0, 8)$.

11. a) x 0 1 2 3
 y 3 4 5 6

b) x 0 1 2 3
 y 3 5 7 9

c) x 0 1 2 3
 y 3 6 9 12

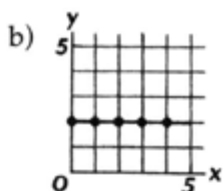


e) They all pass through the same point.

f) At $(0, 3)$.g) At $(0, 3)$.

12. a) x 0 1 2 3 4
 y 2 2 2 2 2

c) It is a horizontal line.

d) $y = 2$.13. a) It is the difference between successive values of y .b) It is the value of y corresponding to $x = 0$.c) $y = 6x + 2$.d) $y = 3x + 1$.e) $y = 5x + 9$.f) $y = 9x + 5$.14. a) $y = 2x + 5$. [$y = x + x + 5$.]

b) Linear.

c) No.

15. a) x 1 2 3 4 5
 y 300 300.5 301 301.5 302

b) $y = 300 + 0.5x$.

c) No.

d) \$325.00.

$[y = 300 + 0.5 \cdot 50 = 300 + 25 = 325.]$

Set IV (page 77)

1. $6x + 4$. [One way to figure this out is to extend the table to the left:
- | | | | | | | |
|-----|---|----|----|----|----|----|
| x | 0 | 1 | 2 | 3 | 4 | 5 |
| y | 4 | 10 | 16 | 22 | 28 | 34 |
- The number 6 is the difference between successive values of y . The number 4 is the value of y corresponding to $x = 0$.]
2. 4°C . [The ant stays home when its speed, x , is equal to 0. When $x = 0$, $y = 4$.]

Chapter 2, Lesson 6

Set I (page 80)

1. a) $x - 4$.
b) $2(x + 5)$.
c) $x^3 - 1$.
2. a) The axes.
b) The origin.
c) Coordinates.
3. a) Directly.
b) A straight line passing through the origin.

Set II (pages 80–81)

4. a)

x	1	2	3	4	5	6
y	12	6	4	3	2.4	2

b) y is divided by 3.
c) An inverse variation.
d) $y = \frac{12}{x}$.
e) 1.2. [$y = \frac{12}{10} = 1.2$.]
5. a)

x	2	4	6	12	20
y	30	15	10	5	3

b) 60.
c) $y = \frac{60}{x}$.
6. a) $y = a$.
b) 0.
c) We cannot divide by 0.
d) No. [Because there is no point for which $x = 0$.]
7. a) Yes.
b) No.
c) No.

d) Yes.

e) No.

8. a)

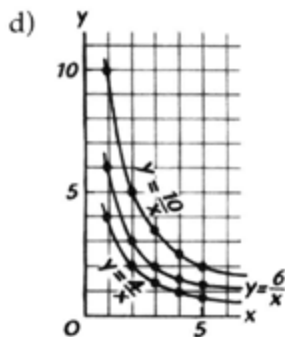
x	1	2	3	4	5
y	4	2	1.3	1	0.8

b)

x	1	2	3	4	5
y	6	3	2	1.5	1.2

c)

x	1	2	3	4	5
y	10	5	3.3	2.5	2

e) 4 for $y = \frac{4}{x}$; 6 for $y = \frac{6}{x}$; 10 for $y = \frac{10}{x}$.

f) The larger the constant of variation, the farther the curve is from the origin.

9. a) $y = \frac{24}{x}$.

b) 24.

c) Inversely.

10. a)

2	4	5	10
50	25	20	10

b) $s = \frac{100}{t}$.

c) It was approximately 10.4 meters per second. [$\frac{100 \text{ meters}}{9.57 \text{ seconds}} \approx 10.4 \text{ meters per second}$.]

Set III

11. a)

x	1	2	3	4	5
y	10	5	$3\frac{1}{3}$	$2\frac{1}{2}$	2

b) If x is doubled, y is halved.
c) An inverse variation.
d) $y = \frac{10}{x}$.
e) 0.5. [$y = \frac{10}{20} = 0.5$.]

12. a)

x	2	4	6	12	16
y	24	12	8	4	3

 b) 48.
 c) $y = \frac{48}{x}$.
13. a) No; if this were true, a baby would have a very long attention span.
 b) Yes; if someone swims twice as fast, the time required is cut in half.
 c) Yes; if the price is doubled, you can buy half as much.
 d) No; the more dogs, the faster the sled.
14. a) Yes.
 b) No.
 c) No.
 d) Yes.
 e) No.

15. a)

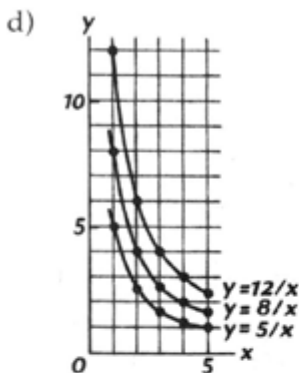
x	1	2	3	4	5
y	5	2.5	1.7	1.25	1

 b)

x	1	2	3	4	5
y	8	4	2.7	2	1.6

 c)

x	1	2	3	4	5
y	12	6	4	3	2.4



- e) 5 for $y = \frac{5}{x}$; 8 for $y = \frac{8}{x}$; 12 for $y = \frac{12}{x}$.
 f) The larger the constant of variation, the farther the curve is from the origin.
16. a) $y = \frac{36}{x}$.
 b) 36.
 c) Inversely.
17. a) $n = \frac{318}{d}$.
 b) 636. [$n = \frac{318}{0.5} = 636$.]

Set IV (page 82)

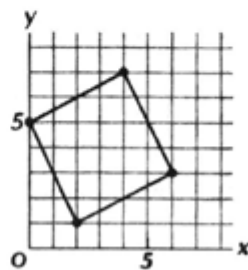
1. $f = \frac{600}{d}$. [Making this little table helps:

d	100
f	6

]
2. 7.5 kilograms. [$f = \frac{600}{80} = 7.5$.]

Chapter 2, Review**Set I** (pages 84–86)

1.



2. a)

x	1	2	3	4	5
y	6	5	4	3	2

 b)

x	0	1	2	3	4
y	1	2	9	28	65

 c)

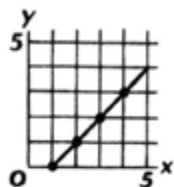
x	4	5	6	7	8
y	0	5	12	21	32
3. a) True.
 b) True.
 c) False. [The graphs of all linear functions do not intersect the origin.]
 d) True.
 e) False. [It is 1; $y = 1x$.]
4. a) $y = x - 5$.
 b) $y = 2x - 1$.
 c) $y = \frac{x}{3}$.
 d) $y = x^2 + 1$.
5. a)

x	0	2	4	6	8	10
y	0	1	2	3	4	5

 b) y is tripled.
 c) A direct variation.
 d) $y = \frac{x}{2}$.
 e) 15. [$y = \frac{30}{2} = 15$.]

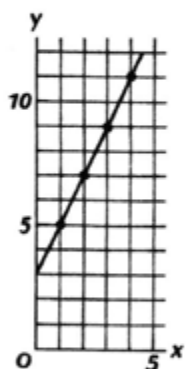
6. a)

x	1	2	3	4
y	0	1	2	3



b)

x	1	2	3	4
y	5	7	9	11



c)

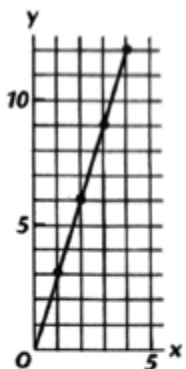
x	1	2	3	4
y	8	4	2.7	2



7. a)

x	1	2	3	4
y	3	6	9	12

b)

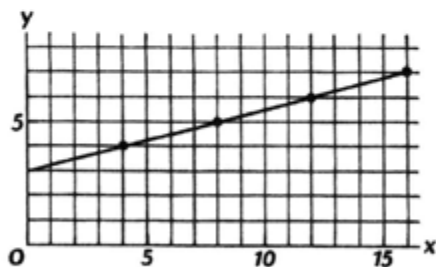


- c) A direct variation.
d) 7.5 seconds.
[$y = 3 \cdot 2.5 = 7.5$.]

8. a)

x	4	8	12	16
y	4	5	6	7

b)

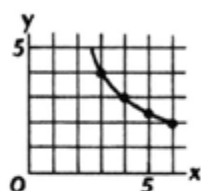


- c) No.
d) No; the graph does not pass through the origin.

9. a)

x	3	4	5	6
y	4	3	2.4	2

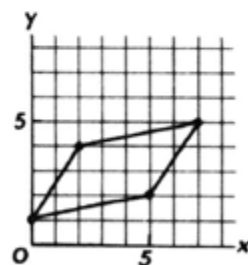
b)



- c) Inversely.
d) It becomes very small.

Set II (pages 86–88)

1.



2. a)

x	1	2	3	4	5
y	3	7	11	15	19

b)

x	0	1	2	3	4
y	0	4	10	18	28

c)

x	1	2	3	4	5
y	12	14	16	18	20

3. a) True.
b) False. [The graphs of direct variations intersect the origin.]
c) True.
d) True.
e) False. [Not all functions whose graphs are curved lines are inverse variations.]

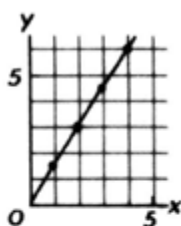
4. a) $y = 8 - x$.
b) $y = x^2$.
c) $y = 10x - 1$.
d) $y = \frac{3}{2}x$ or $y = 1.5x$

5. a)

x	0	1	2	3	4
y	3	5	7	9	11
- b) No.
c) A linear function.
d) $y = 2x + 3$.
e) 53. [$y = 2 \cdot 25 + 3 = 53$.]

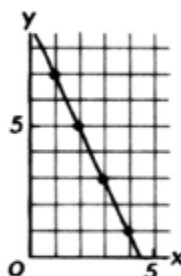
6. a)

x	1	2	3	4
y	1.5	3	4.5	6



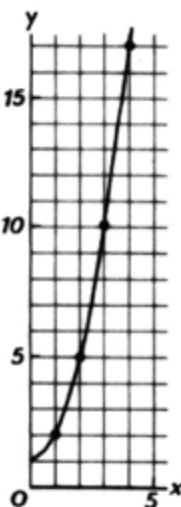
b)

x	1	2	3	4
y	7	5	3	1



c)

x	1	2	3	4
y	2	5	10	17



7. a) $y = \frac{x}{2}$.

b) Directly.

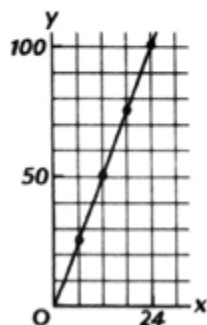
c) A straight line going through the origin.

8. a)

x	0	6	12	18	24
y	0	25	50	75	100

b) 24 karats.

c)

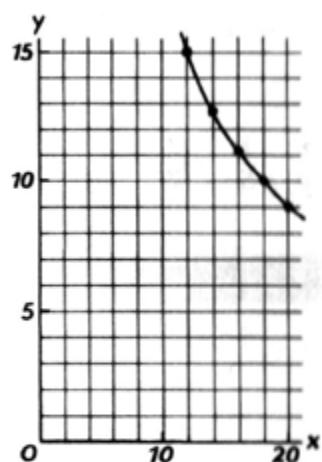


d) A direct variation.

9. a)

x	12	14	16	18	20
y	15	12.9	11.25	10	9

b)



c) Inversely.

d) It is impossible to divide by 0.

$$[y = \frac{180}{0} = \text{no number.}]$$

Chapter 3, Lesson 1

Set I (page 91)

- 2,592. [$32 \cdot 81 = 2,592.$]
 - The four digits are the same.
72. [$2 \cdot 3 \cdot 4 \cdot 3 = 72.$]
 120. [$3 \cdot 4 \cdot 5 \cdot 2 = 120.$]
 120. [$4 \cdot 5 \cdot 6 \cdot 1 = 120.$]
 0. [$5 \cdot 6 \cdot 7 \cdot 0 = 0.$]
- $\frac{x}{3}$.
 - 21y.
 - Direct.

Set II (page 92)

- 39 degrees below zero on the Celsius scale.
 - 29 meters below sea level.
 - 37 years after the birth of Christ.
 - 10 minutes ago.
- $+12 > -15.$
 - $-196^\circ < -78^\circ.$
 - $-3 < +3.$
 - $-22 > -24.$
- $4 > 1.$
 - $0 < 9.$
 - $7 > -7.$
 - $-3 < 0.$
 - $5 > -11.$
 - $-1 > -6.$
 - $-12 < 8.$
 - $-10 < -2.$
- +7.
 - 8.
 - 8, -6, -4, -2, +1, +3, +5, +7.
- 3.
 - 3.
 - 5.
 - 5.
 - 0.
 - 0.
 - 1.
 - 1.
- 5.
 - 5.
 - 8.

- 8.
- 6.
- 20.
- 7.
- 7.

- $x < 0.$
 - $x^2 > 5.$
 - $x + 1 < 10.$
 - $\frac{x}{2} > 8.$

Set III

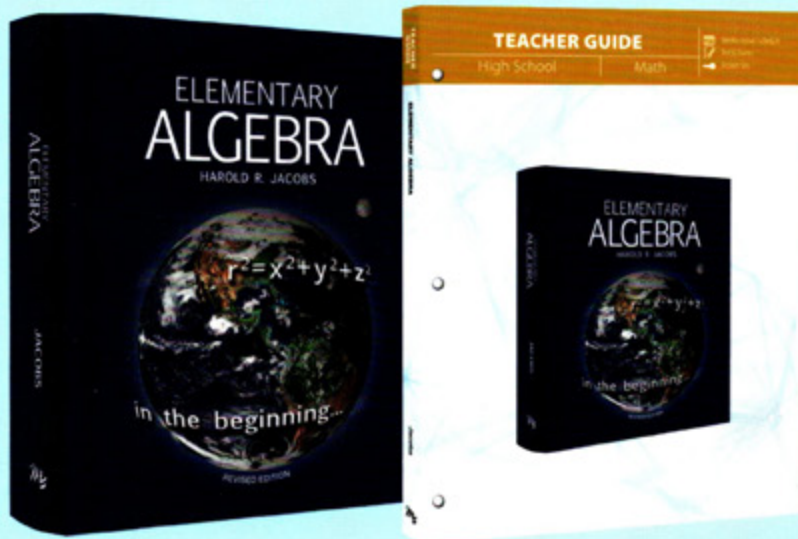
- 2,300 meters above sea level.
 - 212 years before the birth of Christ.
 - It went down 48 points.
 - He is 800 dollars in debt.
- $+15^\circ > -40^\circ.$
 - $-8 < 2.$
 - $12 > -12.$
 - $-60 < -50.$
- $2 < 8.$
 - $11 > 5.$
 - $0 > -6.$
 - $-4 < 4.$
 - $7 > -9.$
 - $-1 > -3.$
 - $-10 > 1.$
 - $-12 < -8.$
- 7.
 - +6.
 - 7, -5, -3, -1, 0, +2, +4, +6.
- 4.
 - 4.
 - 7.
 - 7.
 - 4.
 - 12.
 - 11.
 - 11.
- 4.
 - 4.
 - 5.
 - 5.
 - 0.
 - 0.
 - 1.
 - 1.

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