Algebra 1 Advanced Workbook

17 lessons · printable · answer key at the back

Name _____ Date _____

Contents

1-1

Evaluating Expressions

WORKED EXAMPLE

$x = 5$ $4x - 13 =$ 7

$4x - 13$ with $x = 5$
$4 \times 5 = 20$
$20 - 13 = 7$
$4x - 13 = 7$

1. Evaluate expressions

Put the number in place of the letter, then work each one out.

1 $x = 9$ $2x + 15 =$ ___

2 $x = 12$ $4x - 8 =$ ___

3 $a = 3, b = 6$ $5a + b =$ ___

4 $x = 6$ $x^2 + 6 =$ ___

5 $x = 8$ $2x + 10 =$ ___

6 $x = 11$ $4x - 1 =$ ___

7 $x = 12$ $2x + 14 =$ ___

8 $x = 8$ $3x + 10 =$ ___

9 $x = 11$ $4x - 5 =$ ___

10 $x = 8$ $6x - 8 =$ ___

11 $x = 6$ $4x + 8 =$ ___

12 $x = 5$ $5x + 14 =$ ___

1. Evaluate expressions (continued)

Put the number in place of the letter, then work each one out.

13 $x = 4$ $x^2 + 10 =$ ___

14 $a = 4, b = 6$ $2a + b =$ ___

15 $x = 11$ $3x + 8 =$ ___

16 $x = 12$ $4x =$ ___

17 $x = 2$ $9x + 9 =$ ___

18 $x = 10$ $3x + 15 =$ ___

19 $x = 4$ $x^2 + 1 =$ ___

20 $a = 4, b = 8$ $2a + b =$ ___

21 $a = 10, b = 3$ $3a + b =$ ___

22 $x = 3$ $8x + 20 =$ ___

23 $x = 8$ $4x + 7 =$ ___

24 $x = 9$ $4x - 11 =$ ___

Combining Like Terms

WORKED EXAMPLE

2 + 5x + 7 + 7x

5 + 7 = 12

2 + 7 = 9

12x + 9

2. Collect like terms

Collect the like terms.

1 **9 + 5x + 8 + 5x**

2 **8x + 13 − x − 7**

3 **6 + 6x + 10 + 4x**

4 **10x + 18 − 4x − 7**

5 **10x + 12 − 3x − 11**

6 **4x + 11 − 2x − 2**

7 **11x + 19 − 6x − 13**

8 **9x + 20 − 8x**

9 **10x + 18 − 6x − 11**

10 **12x + 16 − 8x − 8**

11 **8x + 15 − 3x**

12 **7x + 14 − 5x − 1**

13 **10x + 7 − 3x − 1**

14 **4x + 14 − 3x − 8**

15 **9x + 18 − 3x − 12**

16 **10x + 20 − 3x − 11**

17 **8x + 7 − 5x − 6**

18 **12x + 11 − 4x − 1**

19 **10x + 17 − 5x − 7**

20 **8x + 18 − 5x**

21 **11x + 13 − 4x − 7**

22 **12x + 20 − 11x − 1**

23 **11x + 16 − 4x − 2**

24 **4x + 14 − x − 9**

The Distributive Property

WORKED EXAMPLE

2(5 + 2x)

2 × 5 = 10
2 × 2x = 4x
4x + 10

3. Multiply out brackets

Multiply out each bracket.

1 **6(7x + 3)**
2 **3(12 + 5x)**
3 **2(11 + 5x)**
4 **5(8 + 5x)**
5 **4(3x − 6)**
6 **7(3 + 4x)**
7 **3(8x − 11)**
8 **8(x + 6)**
9 **4(9 + 4x)**
10 **7(6x + 4)**
11 **7(2x + 7)**
12 **5(7x + 8)**
13 **9(5 + 2x)**
14 **2(9 + 5x)**
15 **8(3x − 4)**
16 **4(9x − 8)**
17 **3(5 + 4x)**
18 **5(5 + 5x)**
19 **5(6x − 8)**
20 **4(10 + x)**
21 **5(4x − 8)**
22 **4(9x − 7)**
23 **9(3 + 4x)**
24 **2(5 + 9x)**

Absolute Value

WORKED EXAMPLE

$|2 - 10| = 8$

4. Absolute value

Work out each one. The bars ask how far the number is from zero.

1. $|-4| + |2| =$ ___
2. How far apart are −12 and 1 on the number line? ___
3. $|-3| + |8| =$ ___
4. $|11| + |-8| =$ ___
5. $|-5| + |7| =$ ___
6. $|-6| + |10| =$ ___
7. $|10| + |-10| =$ ___
8. $|11| + |-2| =$ ___
9. How far apart are −7 and 6 on the number line? ___
10. $|-5| + |11| =$ ___
11. $|2| + |-3| =$ ___
12. How far apart are −6 and 3 on the number line? ___
13. $|7| + |-12| =$ ___
14. $|3| + |-11| =$ ___
15. How far apart are −5 and 4 on the number line? ___
16. How far apart are −6 and 5 on the number line? ___
17. $|3| + |-8| =$ ___
18. $|11| + |-4| =$ ___
19. $|-7| + |9| =$ ___
20. $|-6| + |3| =$ ___
21. $|4| + |-11| =$ ___
22. How far apart are −11 and 3 on the number line? ___
23. $|-5| + |10| =$ ___
24. $|3| + |-5| =$ ___

5. Evaluate expressions

Put the number in place of the letter, then work each one out.

25 $a = 2, b = 7$ **$3a + b =$** ___

26 $x = 6$ **$7x - 4 =$** ___

27 $x = 7$ **$2x + 18 =$** ___

28 $x = 7$ **$5x + 4 =$** ___

29 $x = 11$ **$4x - 14 =$** ___

30 $a = 5, b = 8$ **$4a + b =$** ___

31 $x = 12$ **$4x - 6 =$** ___

32 $a = 5, b = 5$ **$3a + b =$** ___

33 $x = 8$ **$4x + 15 =$** ___

34 $x = 11$ **$2x + 19 =$** ___

Absolute Value Equations

WORKED EXAMPLE

|x + 6| = 7

x + 6 = 7 or x + 6 = −7
x + 6 = 7 → x = 1
x + 6 = −7 → x = −13
x = −13 or x = 1

6. Absolute value equations

Solve each equation. Each has two answers.

1 **|x − 4| = 5**

2 **|x − 6| = 9**

3 **|x + 1| = 7**

4 **|x − 6| = 8**

5 **|x − 1| = 6**

6 **|x + 5| = 8**

7 **|x − 5| = 9**

8 **|x − 5| = 7**

9 **|x + 2| = 8**

10 **|x − 2| = 8**

11 **|x + 5| = 5**

12 **|x − 1| = 9**

13 **|x + 4| = 8**

14 **|x − 6| = 6**

15 **|x + 3| = 8**

6. Absolute value equations (continued)

Solve each equation. Each has two answers.

16 $|x - 4| = 9$

17 $|x - 2| = 5$

18 $|x - 1| = 8$

19 $|x| = 8$

20 $|x| = 6$

7. Collect like terms

Collect the like terms.

21 $9x + 13 - x - 12$

22 $10x + 13 - 3x - 5$

23 $4x + 15 - 2x - 8$

24 $6x + 19 - 3x - 1$

25 $10x + 11 - 4x - 8$

26 $9x + 12 - 2x - 7$

27 $12x + 17 - 11x - 3$

28 $5x + 16 - 3x - 10$

29 $10x + 15 - 6x - 4$

30 $11x + 20 - 2x - 13$

Solving Inequalities

WORKED EXAMPLE

$x + 11 \leq 25 \quad x \boxed{\leq} \quad 14$

$25 - 11 = 14$

$x \leq 14$

8. Inequalities

Solve each one, then write >, <, ≥ or ≤ in the box.

1 $3x + 2 < -79 \quad x \boxed{} -27$

2 $x + 8 \geq 65 \quad x \boxed{} 57$

3 $2x > 64 \quad x \boxed{} 32$

4 $x + 4 < 91 \quad x \boxed{} 87$

5 $-4x + 12 > 44 \quad x \boxed{} -8$

6 $-2x > 66 \quad x \boxed{} -33$

7 $-4x < 80 \quad x \boxed{} -20$

8 $-3x \leq -30 \quad x \boxed{} 10$

9 $x + 9 \geq 71 \quad x \boxed{} 62$

10 $-3x + 2 \leq -49 \quad x \boxed{} 17$

11 $3x + 7 \geq -86 \quad x \boxed{} -31$

12 $-2x > -74 \quad x \boxed{} 37$

13 $x + 7 < 59 \quad x \boxed{} 52$

14 $-6x \leq 48 \quad x \boxed{} -8$

15 $x - 1 < 55 \quad x \boxed{} 56$

16 $-2x < 48 \quad x \boxed{} -24$

17 $x - 5 \geq 36 \quad x \boxed{} 41$

18 $-5x + 7 \geq -83 \quad x \boxed{} 18$

19 $-6x \leq -90 \quad x \boxed{} 15$

20 $-5x + 11 \leq 46 \quad x \boxed{} -7$

9. Multiply out brackets

Multiply out each bracket.

21 $4(2 + 5x)$

22 $6(5 + 3x)$

23 $4(9x + 4)$

24 $7(5 + 4x)$

25 $3(7x - 11)$

26 $4(8 + 5x)$

27 $7(6 + 7x)$

28 $5(2 + 4x)$

29 $8(5 + 5x)$

30 $3(11 + 5x)$

Intercepts

WORKED EXAMPLE

$2x - 5y = 10$ **x =** 5

$2x - 5y = 10,\ y = 0$

$2x = 10$

$x = 5$

10. Intercepts of a line

Find the x-intercept of each line.

1 $x - 2y = -4$ **x =** ___

2 $9x - 4y = -36$ **x =** ___

3 $x - 7y = 7$ **x =** ___

4 $x - 9y = -9$ **x =** ___

5 $x + 2y = -2$ **x =** ___

6 $4x + 7y = -28$ **x =** ___

7 $7x + 9y = 63$ **x =** ___

8 $4x - 7y = 28$ **x =** ___

9 $7x - 8y = -56$ **x =** ___

10 $5x + 4y = -20$ **x =** ___

11 $3x + y = -6$ **x =** ___

12 $4x + 3y = -24$ **x =** ___

13 $x - 7y = -7$ **x =** ___

14 $4x - 9y = 36$ **x =** ___

15 $3x + 7y = -21$ **x =** ___

16 $4x + 9y = -36$ **x =** ___

11. Absolute value

Work out each one. The bars ask how far the number is from zero.

17 $|-9| + |5|$ = ___

18 **How far apart are −5 and 4 on the number line?** ___

19 $|2| + |-2|$ = ___

20 **How far apart are −2 and 12 on the number line?** ___

11. Absolute value (continued)

Work out each one. The bars ask how far the number is from zero.

21 **$|3| + |-10| =$ ___**

22 **How far apart are −5 and 6 on the number line? ___**

23 **How far apart are −1 and 12 on the number line? ___**

24 **How far apart are −3 and 3 on the number line? ___**

25 **How far apart are −11 and 9 on the number line? ___**

26 **$|-7| + |9| =$ ___**

Writing the Equation of a Line

WORKED EXAMPLE

through (2, 5) and (4, 11)

slope = (11 − 5) ÷ (4 − 2)
6 ÷ 2 = 3
b = 5 − (3)(2) = −1
y = 3x − 1

12. Write the equation of a line

Write the equation of each line through the two points.

1 **through (1, 2) and (3, 10)**

2 **through (−3, 7) and (−1, −1)**

3 **through (−3, −10) and (−1, −8)**

4 **through (−2, 12) and (1, 6)**

5 **through (1, 1) and (2, 5)**

6 **through (−3, 4) and (−1, −4)**

7 **through (−2, 0) and (1, −9)**

8 **through (1, 2) and (2, −1)**

9 **through (−1, 11) and (2, 5)**

10 **through (−1, 10) and (2, −2)**

11 **through (1, 5) and (2, 4)**

12 **through (2, −12) and (4, −20)**

12. Write the equation of a line (continued)

Write the equation of each line through the two points.

13 **through (−1, −6) and (2, −9)**

14 **through (1, −4) and (3, −10)**

15 **through (−1, −12) and (2, 0)**

16 **through (−1, −5) and (2, −14)**

13. Absolute value equations

Solve each equation. Each has two answers.

17 $|x - 2| = 5$

18 $|x - 4| = 8$

19 $|x - 2| = 6$

20 $|x + 1| = 9$

21 $|x - 3| = 5$

22 $|x - 5| = 8$

23 $|x - 4| = 9$

24 $|x + 4| = 5$

25 $|x + 4| = 9$

26 $|x + 5| = 9$

Function Notation

WORKED EXAMPLE

$f(x) = x + 3$ $f(3) =$ 6

14. Function notation and composition

Work out the value each function asks for.

1 $f(x) = -x - 16$ $f(7) =$ ____

2 $f(x) = 7x + 10$ $f(5) =$ ____

3 $f(x) = -2x + 10$ $f(-3) =$ ____

4 $f(x) = -6x + 7$ $f(9) =$ ____

5 $f(x) = 7x + 7$ $f(-3) =$ ____

6 $f(x) = 7x + 2$ $f(8) =$ ____

7 $f(x) = 9x + 18$ $f(9) =$ ____

8 $f(x) = 4x + 11$ $f(3) =$ ____

9 $f(x) = 4x + 7$ $f(10) =$ ____

10 $f(x) = -3x + 15$ $f(-5) =$ ____

11 $f(x) = -2x - 12$ $f(6) =$ ____

12 $f(x) = -8x - 9$ $f(-5) =$ ____

13 $f(x) = 4x + 15$ $f(12) =$ ____

14 $f(x) = -6x + 11$ $f(-2) =$ ____

15 $f(x) = -7x + 4$ $f(7) =$ ____

16 $f(x) = 5x - 9$ $f(-6) =$ ____

17 $f(x) = -x - 16$ $f(11) =$ ____

18 $f(x) = 8x + 7$ $f(-4) =$ ____

19 $f(x) = 9x + 8$ $f(11) =$ ____

20 $f(x) = 5x + 15$ $f(2) =$ ____

15. Inequalities

Solve each one, then write >, <, ≥ or ≤ in the box.

21 $-7x < 28$ x ☐ -4

22 $-5x > 75$ x ☐ -15

23 $2x \geq -96$ x ☐ -48

24 $-2x + 8 \geq 68$ x ☐ -30

25 $x - 8 > 33$ x ☐ 41

26 $x + 7 > 99$ x ☐ 92

27 $-5x \leq 60$ x ☐ -12

28 $x - 9 \geq 22$ x ☐ 31

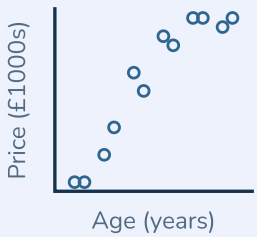
29 $-2x < -62$ x ☐ 31

30 $-2x + 7 < -79$ x ☐ 43

Scatter Plots and Trend Lines

WORKED EXAMPLE

Age and price of a used car



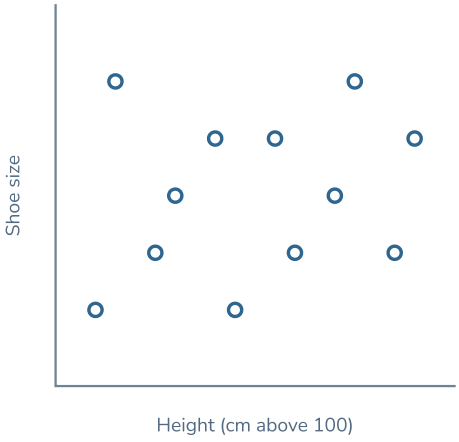
Is the association positive, negative or none?

(positive) negative none

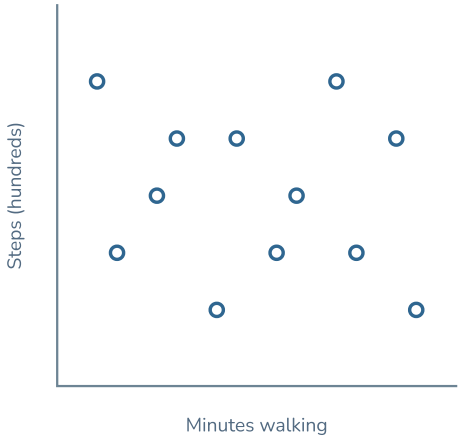
16. Scatter plots

Read each scatter plot and circle the answer.

Height and shoe size



Walking and steps taken



1 **Is there a point well away from the rest?**

yes no

2 **Do the points cluster along a line, or spread out?**

along a line spread out

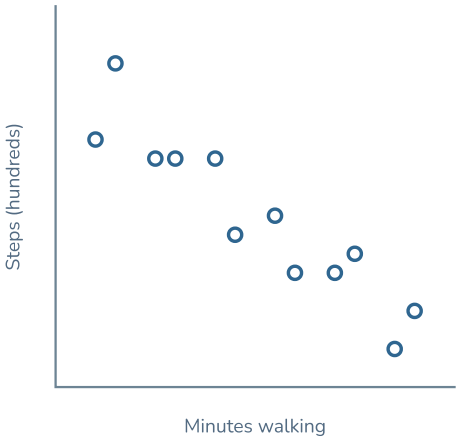
3 **Is the association positive, negative or none?**

positive negative none

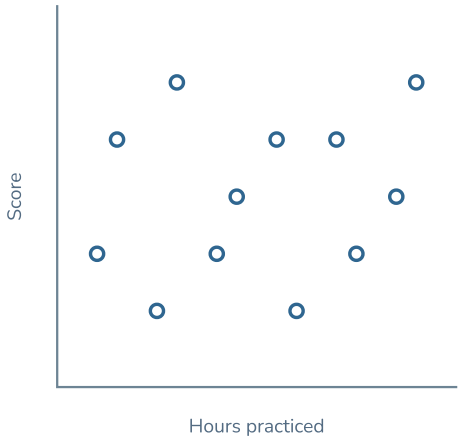
16. Scatter plots (continued)

Read each scatter plot and circle the answer.

Walking and steps taken



Practice and test scores



4 **Is there a point well away from the rest?**

yes no

5 **Do the points cluster along a line, or spread out?**

along a line spread out

6 **Is the association positive, negative or none?**

positive negative none

17. Intercepts of a line

Find the x-intercept of each line.

7 $7x + 8y = 56$ **x =** ___

8 $2x + 3y = -12$ **x =** ___

9 $5x - 6y = 30$ **x =** ___

10 $7x + 8y = -56$ **x =** ___

11 $8x - 7y = 56$ **x =** ___

12 $x + y = -7$ **x =** ___

Factoring Out the GCF

WORKED EXAMPLE

48x + 12

GCF = 12

12(4x + 1)

18. Taking out a common factor

Take out the greatest common factor. Fill in every number.

1 **253x + 276**

2 **95x + 114**

3 **60x + 10**

4 **23x + 138**

5 **48x + 80**

6 **40x + 20**

7 **3x + 27**

8 **276x + 115**

9 **240x + 100**

10 **14x + 16**

11 **20x + 80**

12 **136x + 153**

13 **56x + 77**

14 **220x + 154**

15 **18x + 12**

16 **143x + 13**

17 **24x + 72**

18 **33x + 3**

19 **14x + 70**

20 **130x + 91**

19. Write the equation of a line

Write the equation of each line through the two points.

21 **through (−3, −12) and (−1, −6)**

22 **through (2, −2) and (4, 4)**

23 **through (−1, 6) and (2, 0)**

24 **through (2, −13) and (4, −17)**

25 **through (−1, 5) and (2, 14)**

26 **through (2, −16) and (4, −24)**

19. Write the equation of a line (continued)

Write the equation of each line through the two points.

27 **through (2, −10) and (4, −18)**

28 **through (1, 5) and (3, 3)**

29 **through (1, 3) and (2, 0)**

30 **through (−2, 2) and (1, −7)**

Difference of Two Squares

20. Difference of two squares

Each one is a difference of two squares. Factor it.

1 $x^2 - 484$

2 $x^2 - 1089$

3 $x^2 - 400$

4 $x^2 - 1444$

5 $x^2 - 784$

6 $x^2 - 841$

7 $x^2 - 961$

8 $x^2 - 576$

9 $x^2 - 1156$

10 $x^2 - 1369$

11 $x^2 - 529$

12 $x^2 - 1296$

13 $x^2 - 1225$

14 $x^2 - 625$

15 $x^2 - 1600$

16 $x^2 - 1521$

17 $x^2 - 289$

18 $x^2 - 1024$

19 $x^2 - 900$

20 $x^2 - 324$

21. Function notation and composition

Work out the value each function asks for.

21 $f(x) = 3x - 4$ $f(-3) =$ _____

22 $f(x) = 5x - 9$ $f(-6) =$ _____

23 $f(x) = 8x - 10$ $f(4) =$ _____

24 $f(x) = 9x + 2$ $f(4) =$ _____

25 $f(x) = -6x - 17$ $f(-5) =$ _____

26 $f(x) = 7x - 2$ $f(11) =$ _____

27 $f(x) = -6x - 12$ $f(6) =$ _____

28 $f(x) = 6x - 9$ $f(5) =$ _____

29 $f(x) = 5x - 18$ $f(11) =$ _____

30 $f(x) = 7x + 2$ $f(8) =$ _____

Factoring Quadratics

WORKED EXAMPLE

$x^2 + 18x + 32$

multiply to 32 · add to 18
16 and 2
= (x + 16)(x + 2)

22. Factoring $x^2 + bx + c$

Factor each one.

1 $x^2 + 23x + 112$

2 $x^2 + 26x + 120$

3 $x^2 + 18x + 65$

4 $x^2 + 29x + 154$

5 $x^2 + 21x + 108$

6 $x^2 + 35x + 304$

7 $x^2 + 38x + 361$

8 $x^2 + 32x + 231$

9 $x^2 + 11x + 24$

10 $x^2 + 24x + 95$

11 $x^2 + 24x + 108$

12 $x^2 + 37x + 336$

13 $x^2 + 13x + 22$

14 $x^2 + 36x + 288$

15 $x^2 + 28x + 147$

16 $x^2 + 17x + 66$

17 $x^2 + 29x + 100$

18 $x^2 + 21x + 20$

19 $x^2 + 21x + 90$

20 $x^2 + 34x + 288$

23. Evaluate expressions

Put the number in place of the letter, then work each one out.

21 $x = 7$ $5x - 9 =$ ___

22 $a = 7, b = 5$ $6a + b =$ ___

23 $x = 7$ $3x + 7 =$ ___

24 $a = 10, b = 6$ $4a + b =$ ___

25 $x = 10$ $5x - 17 =$ ___

26 $x = 12$ $4x - 13 =$ ___

27 $x = 4$ $8x + 7 =$ ___

28 $x = 6$ $8x - 20 =$ ___

29 $a = 6, b = 9$ $6a + b =$ ___

30 $x = 4$ $x^2 + 4 =$ ___

Solving Quadratics by Factoring

WORKED EXAMPLE

$(x - 8)(x - 9) = 0$

$x - 8 = 0$ or $x - 9 = 0$

$x - 8 = 0 \rightarrow x = 8$

$x - 9 = 0 \rightarrow x = 9$

$x = 8$ or $x = 9$

24. Solving $x^2 + bx + c = 0$

Each product is zero. Write the two values of x.

1 $(x + 13)(x + 19) = 0$

2 $(x - 20)(x - 2) = 0$

3 $(x + 12)(x - 20) = 0$

4 $(x - 20)(x - 16) = 0$

5 $(x - 14)(x + 18) = 0$

6 $(x - 3)(x + 3) = 0$

7 $(x + 13)(x - 18) = 0$

8 $(x + 10)(x - 19) = 0$

9 $(x - 11)(x - 15) = 0$

10 $(x + 13)(x - 15) = 0$

11 $(x - 18)(x + 14) = 0$

12 $(x - 20)(x + 1) = 0$

13 $(x - 14)(x - 18) = 0$

14 $(x - 14)(x + 17) = 0$

15 $(x - 17)(x + 9) = 0$

16 $(x - 8)(x + 20) = 0$

25. Taking out a common factor

Take out the greatest common factor. Fill in every number.

17 **105x + 15**

18 **14x + 154**

19 **70x + 10**

20 **42x + 105**

21 **126x + 72**

22 **144x + 32**

23 **48x + 12**

24 **52x + 143**

25 **165x + 75**

26 **7x + 42**

Solving with Square Roots

WORKED EXAMPLE

$(x - 3)^2 = 25$

$x - 3 = \pm 5$

$x = 3 \pm 5$

$x = 8$ or $x = -2$

26. Solve quadratics by square roots

Solve each equation by taking square roots.

1 $(x + 5)^2 = 9$

2 $(x - 9)^2 = 36$

3 $(x - 4)^2 = 9$

4 $(x - 3)^2 = 100$

5 $(x + 3)^2 = 25$

6 $(x - 7)^2 = 64$

7 $(x - 9)^2 = 64$

8 $7x^2 = 252$

9 $(x - 9)^2 = 49$

10 $(x - 6)^2 = 64$

11 $(x - 8)^2 = 4$

12 $(x + 9)^2 = 16$

13 $(x + 6)^2 = 100$

14 $(x + 3)^2 = 16$

15 $(x + 9)^2 = 64$

16 $(x - 8)^2 = 81$

27. Difference of two squares

Each one is a difference of two squares. Factor it.

17 $x^2 - 784$

18 $x^2 - 1296$

19 $x^2 - 529$

20 $x^2 - 1024$

21 $x^2 - 400$

22 $x^2 - 900$

23 $x^2 - 1444$

24 $x^2 - 361$

25 $x^2 - 1156$

26 $x^2 - 1225$

How Many Solutions?

WORKED EXAMPLE

10x − 31 = 10x − 27

x is gone
−31 = −27 is false
no solution

28. How many solutions?

How many solutions does each equation have? Show how you know.

1 **−14x + 35 = −14x + 34**

2 **11x + 49 = 11x + 55**

3 **−15x − 23 = −23 − 15x**

4 **x − 44 = −44 + x**

5 **15x − 37 = −12x + 4**

6 **−12x + 49 = −12x + 51**

7 **20x + 25 = 20x + 28**

8 **2x − 24 = −7x + 1**

9 **17x + 25 = 25 + 17x**

10 **−2x + 12 = −2x + 14**

11 **5x − 15 = 11x**

12 **18x − 27 = −2x + 45**

13 **7x + 40 = 40 + 7x**

14 **16x + 23 = −6x + 55**

15 **5x − 50 = 12x + 24**

16 **12x + 58 = 58 + 12x**

17 **−16x + 26 = 8x + 54**

18 **7x − 49 = −10x − 44**

19 **−9x = −9x + 5**

20 **17x + 7 = 14x + 10**

29. Factoring $x^2 + bx + c$

Factor each one.

21 $x^2 + 25x + 150$

22 $x^2 + 36x + 315$

23 $x^2 + 28x + 171$

24 $x^2 + 41x + 414$

25 $x^2 + 39x + 360$

26 $x^2 + 26x + 105$

27 $x^2 + 24x + 63$

28 $x^2 + 27x + 162$

29 $x^2 + 45x + 506$

30 $x^2 + 24x + 23$

Check the Expansion

30. Check the expansion

Read each line of working and choose the answer that is correct.

1 **On Sam's paper: $(x + 6)^2 - 36 = 2x - 24$. Which line should replace it?**

$x^2 + 12x + 36$ | $2x - 24$ | $x^2 + 12x$ | $x^2 + 6x$

Why? .....

2 **Theo wrote $(x + 12)^2 - 144 = 2x - 120$. Which is correct?**

$2x - 120$ | $x^2 + 24x + 144$ | $x^2 + 24x$ | $x^2 + 12x$

Why? .....

3 **Imani says $(x + 10)^2 - 100$ comes to $x^2 + 10x$. Which is correct?**

$x^2 + 20x$ | x^2 | $x^2 + 10x$ | $x^2 + 20x + 100$

Why? .....

4 **Sam says $(x + 3)^2 - 9$ comes to $x^2 + 6x$. Which is correct?**

$x^2 + 6x$ | $x^2 + 6x + 9$ | $x^2 + 3x$ | x^2

Why? .....

5 **Ana wrote $(x + 5)^2 - 25 = x^2 + 10x + 25$. Which is correct?**

$x^2 + 10x + 25$ | x^2 | $x^2 + 5x$ | $x^2 + 10x$

Why? .....

6 **Noor says $(x + 7)^2 - 49$ comes to $x^2 + 14x$. Which is correct?**

$x^2 + 14x$ | x^2 | $x^2 + 7x$ | $x^2 + 14x + 49$

Why? .....

7 **Check this line: $(x + 8)^2 - 64 = x^2 + 8x$. Which is correct?**

x^2 | $x^2 + 16x + 64$ | $x^2 + 8x$ | $x^2 + 16x$

Why? .....

8 **$(x + 11)^2 - 121 = x^2 + 22x + 121$ is wrong. Which is right?**

$x^2 + 22x + 121$ | x^2 | $x^2 + 11x$ | $x^2 + 22x$

Why? .....

Answer Key (1 of 6)

Evaluating Expressions

Evaluate expressions

1. $2x + 15$ ($x = 9$) → 33
2. $4x - 8$ ($x = 12$) → 40
3. $5a + b$ ($a = 3$, $b = 6$) → 21
4. $x^2 + 6$ ($x = 6$) → 42
5. $2x + 10$ ($x = 8$) → 26
6. $4x - 1$ ($x = 11$) → 43
7. $2x + 14$ ($x = 12$) → 38
8. $3x + 10$ ($x = 8$) → 34
9. $4x - 5$ ($x = 11$) → 39
10. $6x - 8$ ($x = 8$) → 40
11. $4x + 8$ ($x = 6$) → 32
12. $5x + 14$ ($x = 5$) → 39
13. $x^2 + 10$ ($x = 4$) → 26
14. $2a + b$ ($a = 4$, $b = 6$) → 14
15. $3x + 8$ ($x = 11$) → 41
16. $4x$ ($x = 12$) → 48
17. $9x + 9$ ($x = 2$) → 27
18. $3x + 15$ ($x = 10$) → 45
19. $x^2 + 1$ ($x = 4$) → 17
20. $2a + b$ ($a = 4$, $b = 8$) → 16
21. $3a + b$ ($a = 10$, $b = 3$) → 33
22. $8x + 20$ ($x = 3$) → 44
23. $4x + 7$ ($x = 8$) → 39
24. $4x - 11$ ($x = 9$) → 25

Combining Like Terms

Collect like terms

1. $9 + 5x + 8 + 5x$ → $10x + 17$
2. $8x + 13 - x - 7$ → $7x + 6$
3. $6 + 6x + 10 + 4x$ → $10x + 16$
4. $10x + 18 - 4x - 7$ → $6x + 11$
5. $10x + 12 - 3x - 11$ → $7x + 1$
6. $4x + 11 - 2x - 2$ → $2x + 9$
7. $11x + 19 - 6x - 13$ → $5x + 6$
8. $9x + 20 - 8x$ → $1x + 20$
9. $10x + 18 - 6x - 11$ → $4x + 7$
10. $12x + 16 - 8x - 8$ → $4x + 8$
11. $8x + 15 - 3x$ → $5x + 15$
12. $7x + 14 - 5x - 1$ → $2x + 13$
13. $10x + 7 - 3x - 1$ → $7x + 6$
14. $4x + 14 - 3x - 8$ → $1x + 6$
15. $9x + 18 - 3x - 12$ → $6x + 6$
16. $10x + 20 - 3x - 11$ → $7x + 9$
17. $8x + 7 - 5x - 6$ → $3x + 1$
18. $12x + 11 - 4x - 1$ → $8x + 10$
19. $10x + 17 - 5x - 7$ → $5x + 10$
20. $8x + 18 - 5x$ → $3x + 18$

Combining Like Terms (continued)

Collect like terms (continued)

21. $11x + 13 - 4x - 7$ → $7x + 6$
22. $12x + 20 - 11x - 1$ → $1x + 19$
23. $11x + 16 - 4x - 2$ → $7x + 14$
24. $4x + 14 - x - 9$ → $3x + 5$

The Distributive Property

Multiply out brackets

1. $6(7x + 3)$ → $42x + 18$
2. $3(12 + 5x)$ → $15x + 36$
3. $2(11 + 5x)$ → $10x + 22$
4. $5(8 + 5x)$ → $25x + 40$
5. $4(3x - 6)$ → $12x - 24$
6. $7(3 + 4x)$ → $28x + 21$
7. $3(8x - 11)$ → $24x - 33$
8. $8(x + 6)$ → $8x + 48$
9. $4(9 + 4x)$ → $16x + 36$
10. $7(6x + 4)$ → $42x + 28$
11. $7(2x + 7)$ → $14x + 49$
12. $5(7x + 8)$ → $35x + 40$
13. $9(5 + 2x)$ → $18x + 45$
14. $2(9 + 5x)$ → $10x + 18$
15. $8(3x - 4)$ → $24x - 32$
16. $4(9x - 8)$ → $36x - 32$
17. $3(5 + 4x)$ → $12x + 15$
18. $5(5 + 5x)$ → $25x + 25$
19. $5(6x - 8)$ → $30x - 40$
20. $4(10 + x)$ → $4x + 40$
21. $5(4x - 8)$ → $20x - 40$
22. $4(9x - 7)$ → $36x - 28$
23. $9(3 + 4x)$ → $36x + 27$
24. $2(5 + 9x)$ → $18x + 10$

Absolute Value

Absolute value

1. $|-4| + |2|$ → 6
2. How far apart are −12 and 1 on the number line? → 13
3. $|-3| + |8|$ → 11
4. $|11| + |-8|$ → 19
5. $|-5| + |7|$ → 12
6. $|-6| + |10|$ → 16
7. $|10| + |-10|$ → 20
8. $|11| + |-2|$ → 13
9. How far apart are −7 and 6 on the number line? → 13
10. $|-5| + |11|$ → 16
11. $|2| + |-3|$ → 5
12. How far apart are −6 and 3 on the number line? → 9
13. $|7| + |-12|$ → 19

Answer Key (2 of 6)

Absolute Value (continued)

Absolute value (continued)

14. $|3| + |-11| \rightarrow 14$
15. How far apart are −5 and 4 on the number line? → 9
16. How far apart are −6 and 5 on the number line? → 11
17. $|3| + |-8| \rightarrow 11$
18. $|11| + |-4| \rightarrow 15$
19. $|-7| + |9| \rightarrow 16$
20. $|-6| + |3| \rightarrow 9$
21. $|4| + |-11| \rightarrow 15$
22. How far apart are −11 and 3 on the number line? → 14
23. $|-5| + |10| \rightarrow 15$
24. $|3| + |-5| \rightarrow 8$

Evaluate expressions

25. $3a + b$ $(a = 2, b = 7) \rightarrow 13$
26. $7x - 4$ $(x = 6) \rightarrow 38$
27. $2x + 18$ $(x = 7) \rightarrow 32$
28. $5x + 4$ $(x = 7) \rightarrow 39$
29. $4x - 14$ $(x = 11) \rightarrow 30$
30. $4a + b$ $(a = 5, b = 8) \rightarrow 28$
31. $4x - 6$ $(x = 12) \rightarrow 42$
32. $3a + b$ $(a = 5, b = 5) \rightarrow 20$
33. $4x + 15$ $(x = 8) \rightarrow 47$
34. $2x + 19$ $(x = 11) \rightarrow 41$

Absolute Value Equations

Absolute value equations

1. $|x - 4| = 5 \rightarrow x = -1$ or $x = 9$
2. $|x - 6| = 9 \rightarrow x = -3$ or $x = 15$
3. $|x + 1| = 7 \rightarrow x = -8$ or $x = 6$
4. $|x - 6| = 8 \rightarrow x = -2$ or $x = 14$
5. $|x - 1| = 6 \rightarrow x = -5$ or $x = 7$
6. $|x + 5| = 8 \rightarrow x = -13$ or $x = 3$
7. $|x - 5| = 9 \rightarrow x = -4$ or $x = 14$
8. $|x - 5| = 7 \rightarrow x = -2$ or $x = 12$
9. $|x + 2| = 8 \rightarrow x = -10$ or $x = 6$
10. $|x - 2| = 8 \rightarrow x = -6$ or $x = 10$
11. $|x + 5| = 5 \rightarrow x = -10$ or $x = 0$
12. $|x - 1| = 9 \rightarrow x = -8$ or $x = 10$
13. $|x + 4| = 8 \rightarrow x = -12$ or $x = 4$
14. $|x - 6| = 6 \rightarrow x = 0$ or $x = 12$
15. $|x + 3| = 8 \rightarrow x = -11$ or $x = 5$
16. $|x - 4| = 9 \rightarrow x = -5$ or $x = 13$
17. $|x - 2| = 5 \rightarrow x = -3$ or $x = 7$
18. $|x - 1| = 8 \rightarrow x = -7$ or $x = 9$
19. $|x| = 8 \rightarrow x = -8$ or $x = 8$
20. $|x| = 6 \rightarrow x = -6$ or $x = 6$

Collect like terms

21. $9x + 13 - x - 12 \rightarrow 8x + 1$

Absolute Value Equations (continued)

Collect like terms (continued)

22. $10x + 13 - 3x - 5 \rightarrow 7x + 8$
23. $4x + 15 - 2x - 8 \rightarrow 2x + 7$
24. $6x + 19 - 3x - 1 \rightarrow 3x + 18$
25. $10x + 11 - 4x - 8 \rightarrow 6x + 3$
26. $9x + 12 - 2x - 7 \rightarrow 7x + 5$
27. $12x + 17 - 11x - 3 \rightarrow 1x + 14$
28. $5x + 16 - 3x - 10 \rightarrow 2x + 6$
29. $10x + 15 - 6x - 4 \rightarrow 4x + 11$
30. $11x + 20 - 2x - 13 \rightarrow 9x + 7$

Solving Inequalities

Inequalities

1. $3x + 2 < -79 \rightarrow x < -27$
2. $x + 8 \geq 65 \rightarrow x \geq 57$
3. $2x > 64 \rightarrow x > 32$
4. $x + 4 < 91 \rightarrow x < 87$
5. $-4x + 12 > 44 \rightarrow x < -8$
6. $-2x > 66 \rightarrow x < -33$
7. $-4x < 80 \rightarrow x > -20$
8. $-3x \leq -30 \rightarrow x \geq 10$
9. $x + 9 \geq 71 \rightarrow x \geq 62$
10. $-3x + 2 \leq -49 \rightarrow x \geq 17$
11. $3x + 7 \geq -86 \rightarrow x \geq -31$
12. $-2x > -74 \rightarrow x < 37$
13. $x + 7 < 59 \rightarrow x < 52$
14. $-6x \leq 48 \rightarrow x \geq -8$
15. $x - 1 < 55 \rightarrow x < 56$
16. $-2x < 48 \rightarrow x > -24$
17. $x - 5 \geq 36 \rightarrow x \geq 41$
18. $-5x + 7 \geq -83 \rightarrow x \leq 18$
19. $-6x \leq -90 \rightarrow x \geq 15$
20. $-5x + 11 \leq 46 \rightarrow x \geq -7$

Multiply out brackets

21. $4(2 + 5x) \rightarrow 20x + 8$
22. $6(5 + 3x) \rightarrow 18x + 30$
23. $4(9x + 4) \rightarrow 36x + 16$
24. $7(5 + 4x) \rightarrow 28x + 35$
25. $3(7x - 11) \rightarrow 21x - 33$
26. $4(8 + 5x) \rightarrow 20x + 32$
27. $7(6 + 7x) \rightarrow 49x + 42$
28. $5(2 + 4x) \rightarrow 20x + 10$
29. $8(5 + 5x) \rightarrow 40x + 40$
30. $3(11 + 5x) \rightarrow 15x + 33$

Intercepts

Intercepts of a line

1. $x - 2y = -4$ the x-intercept = −4

Answer Key (3 of 6)

Intercepts (continued)

Intercepts of a line (continued)

2. 9x − 4y = −36 the x-intercept = −4
3. x − 7y = 7 the x-intercept = 7
4. x − 9y = −9 the x-intercept = −9
5. x + 2y = −2 the x-intercept = −2
6. 4x + 7y = −28 the x-intercept = −7
7. 7x + 9y = 63 the x-intercept = 9
8. 4x − 7y = 28 the x-intercept = 7
9. 7x − 8y = −56 the x-intercept = −8
10. 5x + 4y = −20 the x-intercept = −4
11. 3x + y = −6 the x-intercept = −2
12. 4x + 3y = −24 the x-intercept = −6
13. x − 7y = −7 the x-intercept = −7
14. 4x − 9y = 36 the x-intercept = 9
15. 3x + 7y = −21 the x-intercept = −7
16. 4x + 9y = −36 the x-intercept = −9

Absolute value

17. |−9| + |5| → 14
18. How far apart are −5 and 4 on the number line? → 9
19. |2| + |−2| → 4
20. How far apart are −2 and 12 on the number line? → 14
21. |3| + |−10| → 13
22. How far apart are −5 and 6 on the number line? → 11
23. How far apart are −1 and 12 on the number line? → 13
24. How far apart are −3 and 3 on the number line? → 6
25. How far apart are −11 and 9 on the number line? → 20
26. |−7| + |9| → 16

Writing the Equation of a Line

Write the equation of a line

1. through (1, 2) and (3, 10) → y = 4x − 2
2. through (−3, 7) and (−1, −1) → y = −4x − 5
3. through (−3, −10) and (−1, −8) → y = x − 7
4. through (−2, 12) and (1, 6) → y = −2x + 8
5. through (1, 1) and (2, 5) → y = 4x − 3
6. through (−3, 4) and (−1, −4) → y = −4x − 8
7. through (−2, 0) and (1, −9) → y = −3x − 6
8. through (1, 2) and (2, −1) → y = −3x + 5
9. through (−1, 11) and (2, 5) → y = −2x + 9
10. through (−1, 10) and (2, −2) → y = −4x + 6
11. through (1, 5) and (2, 4) → y = −x + 6
12. through (2, −12) and (4, −20) → y = −4x − 4
13. through (−1, −6) and (2, −9) → y = −x − 7
14. through (1, −4) and (3, −10) → y = −3x − 1
15. through (−1, −12) and (2, 0) → y = 4x − 8
16. through (−1, −5) and (2, −14) → y = −3x − 8

Absolute value equations

17. |x − 2| = 5 → x = −3 or x = 7

Writing the Equation of a Line (continued)

Absolute value equations (continued)

18. |x − 4| = 8 → x = −4 or x = 12
19. |x − 2| = 6 → x = −4 or x = 8
20. |x + 1| = 9 → x = −10 or x = 8
21. |x − 3| = 5 → x = −2 or x = 8
22. |x − 5| = 8 → x = −3 or x = 13
23. |x − 4| = 9 → x = −5 or x = 13
24. |x + 4| = 5 → x = −9 or x = 1
25. |x + 4| = 9 → x = −13 or x = 5
26. |x + 5| = 9 → x = −14 or x = 4

Function Notation

Function notation and composition

1. f(x) = −x − 16 f(7) = −23
2. f(x) = 7x + 10 f(5) = 45
3. f(x) = −2x + 10 f(−3) = 16
4. f(x) = −6x + 7 f(9) = −47
5. f(x) = 7x + 7 f(−3) = −14
6. f(x) = 7x + 2 f(8) = 58
7. f(x) = 9x + 18 f(9) = 99
8. f(x) = 4x + 11 f(3) = 23
9. f(x) = 4x + 7 f(10) = 47
10. f(x) = −3x + 15 f(−5) = 30
11. f(x) = −2x − 12 f(6) = −24
12. f(x) = −8x − 9 f(−5) = 31
13. f(x) = 4x + 15 f(12) = 63
14. f(x) = −6x + 11 f(−2) = 23
15. f(x) = −7x + 4 f(7) = −45
16. f(x) = 5x − 9 f(−6) = −39
17. f(x) = −x − 16 f(11) = −27
18. f(x) = 8x + 7 f(−4) = −25
19. f(x) = 9x + 8 f(11) = 107
20. f(x) = 5x + 15 f(2) = 25

Inequalities

21. −7x < 28 → x > −4
22. −5x > 75 → x < −15
23. 2x ≥ −96 → x ≥ −48
24. −2x + 8 ≥ 68 → x ≤ −30
25. x − 8 > 33 → x > 41
26. x + 7 > 99 → x > 92
27. −5x ≤ 60 → x ≥ −12
28. x − 9 ≥ 22 → x ≥ 31
29. −2x < −62 → x > 31
30. −2x + 7 < −79 → x > 43

Answer Key (4 of 6)

Scatter Plots and Trend Lines

Scatter plots

1. Shoe size against Height (cm above 100) — Is there a point well away from the rest? no
2. Shoe size against Height (cm above 100) — Do the points cluster along a line, or spread out? spread out
3. Steps (hundreds) against Minutes walking — Is the association positive, negative or none? none
4. Steps (hundreds) against Minutes walking — Is there a point well away from the rest? no
5. Steps (hundreds) against Minutes walking — Do the points cluster along a line, or spread out? along a line
6. Score against Hours practiced — Is the association positive, negative or none? none

Intercepts of a line

7. $7x + 8y = 56$ the x-intercept = 8
8. $2x + 3y = -12$ the x-intercept = −6
9. $5x - 6y = 30$ the x-intercept = 6
10. $7x + 8y = -56$ the x-intercept = −8
11. $8x - 7y = 56$ the x-intercept = 7
12. $x + y = -7$ the x-intercept = −7

Factoring Out the GCF

Taking out a common factor

1. $253x + 276 = 23(11x + 12)$ (253 ÷ 23 = 11, 276 ÷ 23 = 12)
2. $95x + 114 = 19(5x + 6)$ (95 ÷ 19 = 5, 114 ÷ 19 = 6)
3. $60x + 10 = 10(6x + 1)$ (60 ÷ 10 = 6, 10 ÷ 10 = 1)
4. $23x + 138 = 23(x + 6)$ (23 ÷ 23 = 1, 138 ÷ 23 = 6)
5. $48x + 80 = 16(3x + 5)$ (48 ÷ 16 = 3, 80 ÷ 16 = 5)
6. $40x + 20 = 20(2x + 1)$ (40 ÷ 20 = 2, 20 ÷ 20 = 1)
7. $3x + 27 = 3(x + 9)$ (3 ÷ 3 = 1, 27 ÷ 3 = 9)
8. $276x + 115 = 23(12x + 5)$ (276 ÷ 23 = 12, 115 ÷ 23 = 5)
9. $240x + 100 = 20(12x + 5)$ (240 ÷ 20 = 12, 100 ÷ 20 = 5)
10. $14x + 16 = 2(7x + 8)$ (14 ÷ 2 = 7, 16 ÷ 2 = 8)
11. $20x + 80 = 20(x + 4)$ (20 ÷ 20 = 1, 80 ÷ 20 = 4)
12. $136x + 153 = 17(8x + 9)$ (136 ÷ 17 = 8, 153 ÷ 17 = 9)
13. $56x + 77 = 7(8x + 11)$ (56 ÷ 7 = 8, 77 ÷ 7 = 11)
14. $220x + 154 = 22(10x + 7)$ (220 ÷ 22 = 10, 154 ÷ 22 = 7)
15. $18x + 12 = 6(3x + 2)$ (18 ÷ 6 = 3, 12 ÷ 6 = 2)
16. $143x + 13 = 13(11x + 1)$ (143 ÷ 13 = 11, 13 ÷ 13 = 1)
17. $24x + 72 = 24(x + 3)$ (24 ÷ 24 = 1, 72 ÷ 24 = 3)
18. $33x + 3 = 3(11x + 1)$ (33 ÷ 3 = 11, 3 ÷ 3 = 1)
19. $14x + 70 = 14(x + 5)$ (14 ÷ 14 = 1, 70 ÷ 14 = 5)
20. $130x + 91 = 13(10x + 7)$ (130 ÷ 13 = 10, 91 ÷ 13 = 7)

Write the equation of a line

21. through (−3, −12) and (−1, −6) → $y = 3x - 3$
22. through (2, −2) and (4, 4) → $y = 3x - 8$
23. through (−1, 6) and (2, 0) → $y = -2x + 4$
24. through (2, −13) and (4, −17) → $y = -2x - 9$
25. through (−1, 5) and (2, 14) → $y = 3x + 8$

Factoring Out the GCF (continued)

Write the equation of a line (continued)

26. through (2, −16) and (4, −24) → $y = -4x - 8$
27. through (2, −10) and (4, −18) → $y = -4x - 2$
28. through (1, 5) and (3, 3) → $y = -x + 6$
29. through (1, 3) and (2, 0) → $y = -3x + 6$
30. through (−2, 2) and (1, −7) → $y = -3x - 4$

Difference of Two Squares

Difference of two squares

1. $x^2 - 484 = (x + 22)(x - 22)$ (484 is 22 squared, so the two brackets are (x + 22) and (x − 22))
2. $x^2 - 1089 = (x + 33)(x - 33)$ (1089 is 33 squared, so the two brackets are (x + 33) and (x − 33))
3. $x^2 - 400 = (x + 20)(x - 20)$ (400 is 20 squared, so the two brackets are (x + 20) and (x − 20))
4. $x^2 - 1444 = (x + 38)(x - 38)$ (1444 is 38 squared, so the two brackets are (x + 38) and (x − 38))
5. $x^2 - 784 = (x + 28)(x - 28)$ (784 is 28 squared, so the two brackets are (x + 28) and (x − 28))
6. $x^2 - 841 = (x + 29)(x - 29)$ (841 is 29 squared, so the two brackets are (x + 29) and (x − 29))
7. $x^2 - 961 = (x + 31)(x - 31)$ (961 is 31 squared, so the two brackets are (x + 31) and (x − 31))
8. $x^2 - 576 = (x + 24)(x - 24)$ (576 is 24 squared, so the two brackets are (x + 24) and (x − 24))
9. $x^2 - 1156 = (x + 34)(x - 34)$ (1156 is 34 squared, so the two brackets are (x + 34) and (x − 34))
10. $x^2 - 1369 = (x + 37)(x - 37)$ (1369 is 37 squared, so the two brackets are (x + 37) and (x − 37))
11. $x^2 - 529 = (x + 23)(x - 23)$ (529 is 23 squared, so the two brackets are (x + 23) and (x − 23))
12. $x^2 - 1296 = (x + 36)(x - 36)$ (1296 is 36 squared, so the two brackets are (x + 36) and (x − 36))
13. $x^2 - 1225 = (x + 35)(x - 35)$ (1225 is 35 squared, so the two brackets are (x + 35) and (x − 35))
14. $x^2 - 625 = (x + 25)(x - 25)$ (625 is 25 squared, so the two brackets are (x + 25) and (x − 25))
15. $x^2 - 1600 = (x + 40)(x - 40)$ (1600 is 40 squared, so the two brackets are (x + 40) and (x − 40))
16. $x^2 - 1521 = (x + 39)(x - 39)$ (1521 is 39 squared, so the two brackets are (x + 39) and (x − 39))
17. $x^2 - 289 = (x + 17)(x - 17)$ (289 is 17 squared, so the two brackets are (x + 17) and (x − 17))
18. $x^2 - 1024 = (x + 32)(x - 32)$ (1024 is 32 squared, so the two brackets are (x + 32) and (x − 32))
19. $x^2 - 900 = (x + 30)(x - 30)$ (900 is 30 squared, so the two brackets are (x + 30) and (x − 30))
20. $x^2 - 324 = (x + 18)(x - 18)$ (324 is 18 squared, so the two brackets are (x + 18) and (x − 18))

Function notation and composition

21. $f(x) = 3x - 4$ $f(-3) = -13$

Answer Key (5 of 6)

Difference of Two Squares (continued)

Function notation and composition (continued)

22. f(x) = 5x − 9 f(−6) = −39
23. f(x) = 8x − 10 f(4) = 22
24. f(x) = 9x + 2 f(4) = 38
25. f(x) = −6x − 17 f(−5) = 13
26. f(x) = 7x − 2 f(11) = 75
27. f(x) = −6x − 12 f(6) = −48
28. f(x) = 6x − 9 f(5) = 21
29. f(x) = 5x − 18 f(11) = 37
30. f(x) = 7x + 2 f(8) = 58

Factoring Quadratics

Factoring $x^2 + bx + c$

1. $x^2 + 23x + 112 = (x + 7)(x + 16)$ (7 and 16)
2. $x^2 + 26x + 120 = (x + 20)(x + 6)$ (20 and 6)
3. $x^2 + 18x + 65 = (x + 13)(x + 5)$ (13 and 5)
4. $x^2 + 29x + 154 = (x + 7)(x + 22)$ (7 and 22)
5. $x^2 + 21x + 108 = (x + 9)(x + 12)$ (9 and 12)
6. $x^2 + 35x + 304 = (x + 16)(x + 19)$ (16 and 19)
7. $x^2 + 38x + 361 = (x + 19)(x + 19)$ (19 and 19)
8. $x^2 + 32x + 231 = (x + 21)(x + 11)$ (21 and 11)
9. $x^2 + 11x + 24 = (x + 3)(x + 8)$ (3 and 8)
10. $x^2 + 24x + 95 = (x + 5)(x + 19)$ (5 and 19)
11. $x^2 + 24x + 108 = (x + 18)(x + 6)$ (18 and 6)
12. $x^2 + 37x + 336 = (x + 16)(x + 21)$ (16 and 21)
13. $x^2 + 13x + 22 = (x + 11)(x + 2)$ (11 and 2)
14. $x^2 + 36x + 288 = (x + 24)(x + 12)$ (24 and 12)
15. $x^2 + 28x + 147 = (x + 21)(x + 7)$ (21 and 7)
16. $x^2 + 17x + 66 = (x + 11)(x + 6)$ (11 and 6)
17. $x^2 + 29x + 100 = (x + 25)(x + 4)$ (25 and 4)
18. $x^2 + 21x + 20 = (x + 20)(x + 1)$ (20 and 1)
19. $x^2 + 21x + 90 = (x + 6)(x + 15)$ (6 and 15)
20. $x^2 + 34x + 288 = (x + 18)(x + 16)$ (18 and 16)

Evaluate expressions

21. 5x − 9 (x = 7) → 26
22. 6a + b (a = 7, b = 5) → 47
23. 3x + 7 (x = 7) → 28
24. 4a + b (a = 10, b = 6) → 46
25. 5x − 17 (x = 10) → 33
26. 4x − 13 (x = 12) → 35
27. 8x + 7 (x = 4) → 39
28. 8x − 20 (x = 6) → 28
29. 6a + b (a = 6, b = 9) → 45
30. $x^2 + 4$ (x = 4) → 20

Solving Quadratics by Factoring

Solving $x^2 + bx + c = 0$

1. (x + 13)(x + 19) = 0 → (x + 13)(x + 19) = 0 → x = −13 or x = −19
2. (x − 20)(x − 2) = 0 → (x − 20)(x − 2) = 0 → x = 20 or x = 2
3. (x + 12)(x − 20) = 0 → (x + 12)(x − 20) = 0 → x = −12 or x = 20
4. (x − 20)(x − 16) = 0 → (x − 20)(x − 16) = 0 → x = 20 or x = 16
5. (x − 14)(x + 18) = 0 → (x − 14)(x + 18) = 0 → x = 14 or x = −18
6. (x − 3)(x + 3) = 0 → (x − 3)(x + 3) = 0 → x = 3 or x = −3
7. (x + 13)(x − 18) = 0 → (x + 13)(x − 18) = 0 → x = −13 or x = 18
8. (x + 10)(x − 19) = 0 → (x + 10)(x − 19) = 0 → x = −10 or x = 19
9. (x − 11)(x − 15) = 0 → (x − 11)(x − 15) = 0 → x = 11 or x = 15
10. (x + 13)(x − 15) = 0 → (x + 13)(x − 15) = 0 → x = −13 or x = 15
11. (x − 18)(x + 14) = 0 → (x − 18)(x + 14) = 0 → x = 18 or x = −14
12. (x − 20)(x + 1) = 0 → (x − 20)(x + 1) = 0 → x = 20 or x = −1
13. (x − 14)(x − 18) = 0 → (x − 14)(x − 18) = 0 → x = 14 or x = 18
14. (x − 14)(x + 17) = 0 → (x − 14)(x + 17) = 0 → x = 14 or x = −17
15. (x − 17)(x + 9) = 0 → (x − 17)(x + 9) = 0 → x = 17 or x = −9
16. (x − 8)(x + 20) = 0 → (x − 8)(x + 20) = 0 → x = 8 or x = −20

Taking out a common factor

17. 105x + 15 = 15(7x + 1) (105 ÷ 15 = 7, 15 ÷ 15 = 1)
18. 14x + 154 = 14(x + 11) (14 ÷ 14 = 1, 154 ÷ 14 = 11)
19. 70x + 10 = 10(7x + 1) (70 ÷ 10 = 7, 10 ÷ 10 = 1)
20. 42x + 105 = 21(2x + 5) (42 ÷ 21 = 2, 105 ÷ 21 = 5)
21. 126x + 72 = 18(7x + 4) (126 ÷ 18 = 7, 72 ÷ 18 = 4)
22. 144x + 32 = 16(9x + 2) (144 ÷ 16 = 9, 32 ÷ 16 = 2)
23. 48x + 12 = 12(4x + 1) (48 ÷ 12 = 4, 12 ÷ 12 = 1)
24. 52x + 143 = 13(4x + 11) (52 ÷ 13 = 4, 143 ÷ 13 = 11)
25. 165x + 75 = 15(11x + 5) (165 ÷ 15 = 11, 75 ÷ 15 = 5)
26. 7x + 42 = 7(x + 6) (7 ÷ 7 = 1, 42 ÷ 7 = 6)

Solving with Square Roots

Solve quadratics by square roots

1. $(x + 5)^2 = 9$ → x = −8 or x = −2
2. $(x − 9)^2 = 36$ → x = 3 or x = 15
3. $(x − 4)^2 = 9$ → x = 1 or x = 7
4. $(x − 3)^2 = 100$ → x = −7 or x = 13
5. $(x + 3)^2 = 25$ → x = −8 or x = 2
6. $(x − 7)^2 = 64$ → x = −1 or x = 15
7. $(x − 9)^2 = 64$ → x = 1 or x = 17
8. $7x^2 = 252$ → x = −6 or x = 6

Answer Key (6 of 6)

Solving with Square Roots (continued)

Solve quadratics by square roots (continued)

9. $(x - 9)^2 = 49 \rightarrow x = 2$ or $x = 16$
10. $(x - 6)^2 = 64 \rightarrow x = -2$ or $x = 14$
11. $(x - 8)^2 = 4 \rightarrow x = 6$ or $x = 10$
12. $(x + 9)^2 = 16 \rightarrow x = -13$ or $x = -5$
13. $(x + 6)^2 = 100 \rightarrow x = -16$ or $x = 4$
14. $(x + 3)^2 = 16 \rightarrow x = -7$ or $x = 1$
15. $(x + 9)^2 = 64 \rightarrow x = -17$ or $x = -1$
16. $(x - 8)^2 = 81 \rightarrow x = -1$ or $x = 17$

Difference of two squares

17. $x^2 - 784 = (x + 28)(x - 28)$ (784 is 28 squared, so the two brackets are $(x + 28)$ and $(x - 28)$)
18. $x^2 - 1296 = (x + 36)(x - 36)$ (1296 is 36 squared, so the two brackets are $(x + 36)$ and $(x - 36)$)
19. $x^2 - 529 = (x + 23)(x - 23)$ (529 is 23 squared, so the two brackets are $(x + 23)$ and $(x - 23)$)
20. $x^2 - 1024 = (x + 32)(x - 32)$ (1024 is 32 squared, so the two brackets are $(x + 32)$ and $(x - 32)$)
21. $x^2 - 400 = (x + 20)(x - 20)$ (400 is 20 squared, so the two brackets are $(x + 20)$ and $(x - 20)$)
22. $x^2 - 900 = (x + 30)(x - 30)$ (900 is 30 squared, so the two brackets are $(x + 30)$ and $(x - 30)$)
23. $x^2 - 1444 = (x + 38)(x - 38)$ (1444 is 38 squared, so the two brackets are $(x + 38)$ and $(x - 38)$)
24. $x^2 - 361 = (x + 19)(x - 19)$ (361 is 19 squared, so the two brackets are $(x + 19)$ and $(x - 19)$)
25. $x^2 - 1156 = (x + 34)(x - 34)$ (1156 is 34 squared, so the two brackets are $(x + 34)$ and $(x - 34)$)
26. $x^2 - 1225 = (x + 35)(x - 35)$ (1225 is 35 squared, so the two brackets are $(x + 35)$ and $(x - 35)$)

How Many Solutions?

How many solutions?

1. $-14x + 35 = -14x + 34$: no solution
2. $11x + 49 = 11x + 55$: no solution
3. $-15x - 23 = -23 - 15x$: infinitely many
4. $x - 44 = -44 + x$: infinitely many
5. $15x - 37 = -12x + 4$: one solution
6. $-12x + 49 = -12x + 51$: no solution
7. $20x + 25 = 20x + 28$: no solution
8. $2x - 24 = -7x + 1$: one solution
9. $17x + 25 = 25 + 17x$: infinitely many
10. $-2x + 12 = -2x + 14$: no solution
11. $5x - 15 = 11x$: one solution
12. $18x - 27 = -2x + 45$: one solution
13. $7x + 40 = 40 + 7x$: infinitely many
14. $16x + 23 = -6x + 55$: one solution
15. $5x - 50 = 12x + 24$: one solution

How Many Solutions? (continued)

How many solutions? (continued)

16. $12x + 58 = 58 + 12x$: infinitely many
17. $-16x + 26 = 8x + 54$: one solution
18. $7x - 49 = -10x - 44$: one solution
19. $-9x = -9x + 5$: no solution
20. $17x + 7 = 14x + 10$: one solution

Factoring $x^2 + bx + c$

21. $x^2 + 25x + 150 = (x + 15)(x + 10)$ (15 and 10)
22. $x^2 + 36x + 315 = (x + 21)(x + 15)$ (21 and 15)
23. $x^2 + 28x + 171 = (x + 19)(x + 9)$ (19 and 9)
24. $x^2 + 41x + 414 = (x + 18)(x + 23)$ (18 and 23)
25. $x^2 + 39x + 360 = (x + 24)(x + 15)$ (24 and 15)
26. $x^2 + 26x + 105 = (x + 5)(x + 21)$ (5 and 21)
27. $x^2 + 24x + 63 = (x + 21)(x + 3)$ (21 and 3)
28. $x^2 + 27x + 162 = (x + 9)(x + 18)$ (9 and 18)
29. $x^2 + 45x + 506 = (x + 23)(x + 22)$ (23 and 22)
30. $x^2 + 24x + 23 = (x + 1)(x + 23)$ (1 and 23)

Check the Expansion

Check the expansion

1. $(x + 6)^2 - 36 = x^2 + 12x$, not $2x - 24$ (the bracket was doubled instead of squared)
2. $(x + 12)^2 - 144 = x^2 + 24x$, not $2x - 120$ (the bracket was doubled instead of squared)
3. $(x + 10)^2 - 100 = x^2 + 20x$, not $x^2 + 10x$ (the middle term was not doubled when the bracket was squared)
4. $(x + 3)^2 - 9 = x^2 + 6x$, which is what was written — this line is correct
5. $(x + 5)^2 - 25 = x^2 + 10x$, not $x^2 + 10x + 25$ (the squared constant was never taken away again)
6. $(x + 7)^2 - 49 = x^2 + 14x$, which is what was written — this line is correct
7. $(x + 8)^2 - 64 = x^2 + 16x$, not $x^2 + 8x$ (the middle term was not doubled when the bracket was squared)
8. $(x + 11)^2 - 121 = x^2 + 22x$, not $x^2 + 22x + 121$ (the squared constant was never taken away again)

Solutions (1 of 16)

Evaluating Expressions

Evaluate expressions

1. $x = 9$ **$2x + 15 =$ ___**

$2x + 15$ with **$x = 9$**

$2 \times 9 = 18$

$18 + 15 = 33$

$2x + 15 = 33$

A letter is a number that has not been written down yet, and this question writes it down: x = 9. So put the value in where the letter is — in BRACKETS, which keeps whatever was being done to the letter being done to the number.

2x means 2 TIMES x, and multiplying happens before adding or taking away however the line is written. So this multiplication comes first: 2 × 9 = 18.

Now the last bit: 18 + 15 = 33. Doing it the other way round — adding first and multiplying after — gives 48, which is why the order is the whole of this question.

So 2x + 15 is 33 when x = 9.

2. $x = 12$ **$4x - 8 =$ ___**

$4x - 8$ with **$x = 12$**

$4 \times 12 = 48$

$48 - 8 = 40$

$4x - 8 = 40$

A letter is a number that has not been written down yet, and this question writes it down: x = 12. So put the value in where the letter is — in BRACKETS, which keeps whatever was being done to the letter being done to the number.

4x means 4 TIMES x, and multiplying happens before adding or taking away however the line is written. So this multiplication comes first: 4 × 12 = 48.

Now the last bit: 48 – 8 = 40. Doing it the other way round — taking away first and multiplying after — gives 16, which is why the order is the whole of this question.

So 4x – 8 is 40 when x = 12.

Solutions (2 of 16)

Combining Like Terms

Collect like terms

1. **9 + 5x + 8 + 5x**

9 + 5x + 8 + 5x

5 + 5 = **10**

9 + 8 = **17**

10x + **17**

There are two kinds of thing on this line and they cannot mix: the x terms, and the plain numbers. Sort them into two piles before adding anything — the x terms are 5x and 5x, and the numbers are 9 and 8.

Add up the x pile, keeping the signs: 5 + 5 = 10, so 10x.

Then the number pile, on its own: 9 + 8 = 17.

So it is 10x + 17 — and that is finished, even though it is still two things. Squashing them into 27x would be answering "10 whats and 17 whats?", and there is no answer to that until somebody says what x is.

2. **8x + 13 − x − 7**

8x + 13 − x − 7

8 − 1 = **7**

13 − 7 = **6**

7x + **6**

There are two kinds of thing on this line and they cannot mix: the x terms, and the plain numbers. Sort them into two piles before adding anything — the x terms are 8x and −x, and the numbers are 13 and −7.

Add up the x pile, keeping the signs: 8 − 1 = 7, so 7x.

Then the number pile, on its own: 13 − 7 = 6.

So it is 7x + 6 — and that is finished, even though it is still two things. Squashing them into 13x would be answering "7 whats and 6 whats?", and there is no answer to that until somebody says what x is.

Solutions (3 of 16)

The Distributive Property

Multiply out brackets

1. **6(7x + 3)**

6(7x + 3)

$6 \times 7x = 42x$

$6 \times 3 = 18$

$42x + 18$

The 6 outside multiplies EVERYTHING inside the bracket, not just the thing next to it. Draw an arrow from the 6 to each of the two terms before working anything out — that is what stops one of them being left behind.

First arrow: $6 \times 7x = 42x$.

Second arrow: $6 \times 3 = 18$.

Put the two together: $42x + 18$. Check it by putting a small number in for x on both forms — they should agree, because they are the same amount written two ways.

2. **3(12 + 5x)**

3(12 + 5x)

$3 \times 12 = 36$

$3 \times 5x = 15x$

$15x + 36$

The 3 outside multiplies EVERYTHING inside the bracket, not just the thing next to it. Draw an arrow from the 3 to each of the two terms before working anything out — that is what stops one of them being left behind.

First arrow: $3 \times 12 = 36$.

Second arrow: $3 \times 5x = 15x$.

Put the two together: $15x + 36$. Check it by putting a small number in for x on both forms — they should agree, because they are the same amount written two ways.

Solutions (4 of 16)

Absolute Value

Absolute value

1. $|-4| + |2| =$ ___

$|-4| + |2|$

$|-4| = 4$ $|2| = 2$

$4 + 2 = 6$

The two bars ask for a DISTANCE: how far the thing between them is from zero. A distance is never negative, and that is a fact about distance rather than a rule about minus signs.

There are two sets of bars here, and each one is finished before they meet: $|-4|$ is 4, and $|2|$ is 2.

Only then add them: $4 + 2 = 6$. Adding -4 and 2 FIRST would have given -2, which is the answer to a question nobody asked.

2. **How far apart are −12 and 1 on the number line?** ___

How far apart are −12 and 1 on the number line?

$12 + 1 = 13$

13

The two bars ask for a DISTANCE: how far the thing between them is from zero. A distance is never negative, and that is a fact about distance rather than a rule about minus signs.

These two are on opposite sides of zero, so count to zero and then on: −12 is 12 from zero, and 1 is 1 more.

So they are 13 apart. Written with bars that is $|-12 - 1|$, and the reason it is not 11 is that the gap crosses zero.

Absolute Value Equations

Absolute value equations

1. $|x - 4| = 5$

$x - 4 = 5$ or $x - 4 = -5$

$x - 4 = 5 \rightarrow x = 9$

$x - 4 = -5 \rightarrow x = -1$

$x = -1$ or $x = 9$

The bars mean the inside is 5 away from zero — so it is 5 OR it is −5. Split into two equations.

Solve the first, $x - 4 = 5$: add 4 to both sides: $x = 9$.

Solve the second, $x - 4 = -5$: add 4 to both sides: $x = -1$.

So $x = -1$ or $x = 9$ — both answers.

Solutions (5 of 16)

Absolute Value Equations (continued)

Absolute value equations (continued)

2. **$|x - 6| = 9$**

$x - 6 = 9$ or **$x - 6 = -9$**

$x - 6 = 9$ → **$x = 15$**

$x - 6 = -9$ → **$x = -3$**

$x = -3$ or **$x = 15$**

The bars mean the inside is 9 away from zero — so it is 9 OR it is −9. Split into two equations.

Solve the first, x − 6 = 9: add 6 to both sides: x = 15.

Solve the second, x − 6 = −9: add 6 to both sides: x = −3.

So x = −3 or x = 15 — both answers.

Solving Inequalities

Inequalities

1. **$3x + 2 < -79$** x ☐ -27

x **<** -27

An inequality comes apart exactly like an equation — the same moves, done to both sides. There is one extra rule and it arrives at the end, so start by ignoring the sign and solving for x.

2 was added last, so it comes off first — off BOTH sides: -79 − 2 = -81.

Now divide both sides by 3: -81 ÷ 3 = −27.

Nothing was divided by a negative here, so the sign has not moved: it is still <. That is the one thing to check on every one of these before writing the answer down.

So x < −27. That is a whole RANGE of numbers rather than one, which is what makes this different from an equation — and why the sign is half the answer.

Solutions (6 of 16)

Solving Inequalities (continued)

Inequalities (continued)

2. $x + 8 \geq 65$ x ☐ 57

$x \geq 57$

An inequality comes apart exactly like an equation — the same moves, done to both sides. There is one extra rule and it arrives at the end, so start by ignoring the sign and solving for x.

8 was added last, so it comes off first — off BOTH sides: 65 − 8 = 57.

Nothing was divided by a negative here, so the sign has not moved: it is still ≥. That is the one thing to check on every one of these before writing the answer down.

So x ≥ 57. That is a whole RANGE of numbers rather than one, which is what makes this different from an equation — and why the sign is half the answer.

Intercepts

Intercepts of a line

1. $x - 2y = -4$ **x =** ___

$x - 2y = -4$ **$y = 0$**

$x = -4$

$x = -4$

The x-intercept is where the line crosses the x-axis, and there y = 0. Put y = 0 into x − 2y = −4.

The y-term disappears, leaving x = −4.

So the x-intercept is −4.

2. $9x - 4y = -36$ **x =** ___

$9x - 4y = -36$ **$y = 0$**

$9x = -36$

$x = -4$

The x-intercept is where the line crosses the x-axis, and there y = 0. Put y = 0 into 9x − 4y = −36.

The y-term disappears, leaving 9x = −36.

Divide by 9: −36 ÷ 9 = −4 — so the x-intercept is −4.

Solutions (7 of 16)

Writing the Equation of a Line

Write the equation of a line

1. **through (1, 2) and (3, 10)**

$$\text{slope} = (10 - 2) \div (3 - 1)$$
$$8 \div 2 = 4$$
$$b = 2 - (4)(1) = -2$$
$$y = 4x - 2$$

Find the slope first: rise over run, $(10 - 2) \div (3 - 1) = 4$.

Put a point back in to find b: $b = y - mx = 2 - (4)(1) = -2$.

Write it as $y = mx + b$: $y = 4x - 2$.

2. **through (−3, 7) and (−1, −1)**

$$\text{slope} = (-1 - 7) \div (-1 - (-3))$$
$$-8 \div 2 = -4$$
$$b = 7 - (-4)(-3) = -5$$
$$y = -4x - 5$$

Find the slope first: rise over run, $(-1 - 7) \div (-1 - (-3)) = -4$.

Put a point back in to find b: $b = y - mx = 7 - (-4)(-3) = -5$.

Write it as $y = mx + b$: $y = -4x - 5$.

Function Notation

Function notation and composition

1. $f(x) = -x - 16$ **$f(7) =$** ____

$$f(x) = -x - 16 \text{ at } x = 7$$
$$-1 \times 7 = -7$$
$$-7 - 16 = -23$$
$$f(7) = -23$$

$f(7)$ is a name for the value of the rule when $x = 7$. Put 7 where the x is — it is not f times 7.

Multiply first, sign and all: $-1 \times 7 = -7$.

Then subtract 16: $-7 - 16 = -23$.

So $f(7) = -23$.

Solutions (8 of 16)

Function Notation (continued)

Function notation and composition (continued)

2. f(x) = 7x + 10 **f(5) = ___**

f(x) = 7x + 10 at **x = 5**

7 × 5 = **35**

35 + 10 = **45**

f(5) = **45**

f(5) is a name for the value of the rule when x = 5. Put 5 where the x is — it is not f times 5.

Multiply first, sign and all: 7 × 5 = 35.

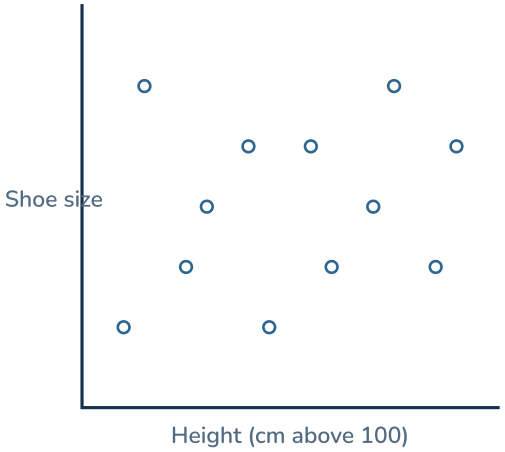
Then add 10: 35 + 10 = 45.

So f(5) = 45.

Scatter Plots and Trend Lines

Scatter plots

1. **Height and shoe size**



Is there a point well away from the rest?

yes no

no

A scatter plot puts two measurements against each other: Height (cm above 100) along the bottom, Shoe size up the side, and one dot for each thing measured. There is no single dot to read off — every question here is about what the whole cloud is doing.

An outlier is one point standing well away from all the others — not merely the highest or the lowest, which every set has, but one that has left the crowd.

Every point is part of the same crowd. The end ones are further along, but none of them has left it — so no, there is no outlier here.

So the answer is "no". Say what that means for the two things rather than for the graph — and remember it is not a claim that one CAUSES the other. Two measurements can move together for a reason that is nothing to do with either of them.

Solutions (9 of 16)

Scatter Plots and Trend Lines (continued)

Scatter plots (continued)

2.

Do the points cluster along a line, or spread out?

along a line spread out

spread out

A scatter plot puts two measurements against each other: Height (cm above 100) along the bottom, Shoe size up the side, and one dot for each thing measured. There is no single dot to read off — every question here is about what the whole cloud is doing.

This one is about how TIGHTLY the points hold to a line, which is a different question from which way they lean. A cloud can lean clearly and still be scattered wide.

They are scattered widely rather than hugging any line, so they SPREAD OUT.

So the answer is "spread out". Say what that means for the two things rather than for the graph — and remember it is not a claim that one CAUSES the other. Two measurements can move together for a reason that is nothing to do with either of them.

Solutions (10 of 16)

Factoring Out the GCF

Taking out a common factor

1. **253x + 276**

$253x + 276 = 23(11x + 12)$

Before anything else, look at whether every term shares a factor. The numbers here are 253, 276 — so the question is what the biggest number that divides ALL of them is.

List what divides each one and look for the biggest they all share. 253: 1, 11, 23, 253 276: 1, 2, 3, 4, 6, 12, 23, 46, 69, 92, 138, 276.

The biggest number in all of those lists is 23. Take it out in front and divide every term by it: 253 ÷ 23 = 11, 276 ÷ 23 = 12.

Check the bracket before you stop. 11x + 12 — those numbers share nothing but 1, so there is no more to take out and 23 really was the greatest. 253x + 276 = 23(11x + 12).

2. **95x + 114**

$95x + 114 = 19(5x + 6)$

Before anything else, look at whether every term shares a factor. The numbers here are 95, 114 — so the question is what the biggest number that divides ALL of them is.

List what divides each one and look for the biggest they all share. 95: 1, 5, 19, 95 114: 1, 2, 3, 6, 19, 38, 57, 114.

The biggest number in all of those lists is 19. Take it out in front and divide every term by it: 95 ÷ 19 = 5, 114 ÷ 19 = 6.

Check the bracket before you stop. 5x + 6 — those numbers share nothing but 1, so there is no more to take out and 19 really was the greatest. 95x + 114 = 19(5x + 6).

Solutions (11 of 16)

Difference of Two Squares

Difference of two squares

1. **$x^2 - 484$**

$$x^2 - 484 = (x + 22)(x - 22)$$

Before factoring anything, check the shape. There are two parts with a − between them, and each part has to be a perfect square: x^2 is x squared, and 484 is 22 squared. Both are, and it is a minus — so this is a difference of two squares.

That shape always factors the same way, and there is nothing to search for: it is the SUM times the DIFFERENCE of the two things being squared — $(x + 22)(x - 22)$.

So the missing number is 22: 484 is 22 squared, so the two brackets are $(x + 22)$ and $(x - 22)$.

2. **$x^2 - 1089$**

$$x^2 - 1089 = (x + 33)(x - 33)$$

Before factoring anything, check the shape. There are two parts with a − between them, and each part has to be a perfect square: x^2 is x squared, and 1089 is 33 squared. Both are, and it is a minus — so this is a difference of two squares.

That shape always factors the same way, and there is nothing to search for: it is the SUM times the DIFFERENCE of the two things being squared — $(x + 33)(x - 33)$.

So the missing number is 33: 1089 is 33 squared, so the two brackets are $(x + 33)$ and $(x - 33)$.

Solutions (12 of 16)

Factoring Quadratics

Factoring $x^2 + bx + c$

1. **$x^2 + 23x + 112$**

$$x^2 + 23x + 112 = (x + 7)(x + 16)$$

Factoring this means finding two numbers to put in $(x + \square)(x + \square)$. Two conditions decide them, and both have to hold: they MULTIPLY to 112, the last term, and they ADD to 23, the number in front of x.

Now list the pairs that multiply to 112. There are only 5, so this is a short search rather than a guess: 1 and 112, 2 and 56, 4 and 28, 7 and 16, 8 and 14.

Which of them adds to 23? $7 \times 16 = 112$ and $7 + 16 = 23$. So the two numbers are 7 and 16.

Put them in the brackets: $x^2 + 23x + 112 = (x + 7)(x + 16)$. Multiply it back out if you want to check — the x terms should add up to 23x again.

2. **$x^2 + 26x + 120$**

$$x^2 + 26x + 120 = (x + 20)(x + 6)$$

Factoring this means finding two numbers to put in $(x + \square)(x + \square)$. Two conditions decide them, and both have to hold: they MULTIPLY to 120, the last term, and they ADD to 26, the number in front of x.

Now list the pairs that multiply to 120. There are only 8, so this is a short search rather than a guess: 1 and 120, 2 and 60, 3 and 40, 4 and 30, 5 and 24, 6 and 20, 8 and 15, 10 and 12.

Which of them adds to 26? $20 \times 6 = 120$ and $20 + 6 = 26$. So the two numbers are 20 and 6.

Put them in the brackets: $x^2 + 26x + 120 = (x + 20)(x + 6)$. Multiply it back out if you want to check — the x terms should add up to 26x again.

Solutions (13 of 16)

Solving Quadratics by Factoring

Solving $x^2 + bx + c = 0$

1. **$(x + 13)(x + 19) = 0$**

$x = -13$ or $x = -19$

The left side is already a product of two brackets, and the right side is zero. That is the useful shape, so no factoring is needed here.

Now the step that gives the answers: a product is zero ONLY when one of the things being multiplied is zero. Two numbers that multiply to zero — one of them has to be zero. So either $(x + 13)$ is zero, or $(x + 19)$ is zero.

Solve each one. $x + 13 = 0$ gives $x = -13$, and $x + 19 = 0$ gives $x = -19$. Notice the sign turns over: a + in the bracket gives a NEGATIVE answer.

So $x = -13$ or $x = -19$. Either one makes the equation true, and it is "or" rather than "and" — x cannot be both at once.

2. **$(x - 20)(x - 2) = 0$**

$x = 20$ or $x = 2$

The left side is already a product of two brackets, and the right side is zero. That is the useful shape, so no factoring is needed here.

Now the step that gives the answers: a product is zero ONLY when one of the things being multiplied is zero. Two numbers that multiply to zero — one of them has to be zero. So either $(x - 20)$ is zero, or $(x - 2)$ is zero.

Solve each one. $x - 20 = 0$ gives $x = 20$, and $x - 2 = 0$ gives $x = 2$. Notice the sign turns over: a − in the bracket gives a POSITIVE answer.

So $x = 20$ or $x = 2$. Either one makes the equation true, and it is "or" rather than "and" — x cannot be both at once.

Solutions (14 of 16)

Solving with Square Roots

Solve quadratics by square roots

1. $(x + 5)^2 = 9$

$x + 5 = \pm 3$

$x = -5 \pm 3$

$x = -2$ or $x = -8$

Take the square root of both sides — both signs: $x + 5 = \pm\sqrt{9} = \pm 3$.

Then subtract 5 to both sides: $x = -5 \pm 3$.

So $x = -2$ or $x = -8$ — both roots.

2. $(x - 9)^2 = 36$

$x - 9 = \pm 6$

$x = 9 \pm 6$

$x = 15$ or $x = 3$

Take the square root of both sides — both signs: $x - 9 = \pm\sqrt{36} = \pm 6$.

Then add 9 to both sides: $x = 9 \pm 6$.

So $x = 15$ or $x = 3$ — both roots.

How Many Solutions?

How many solutions?

1. $-14x + 35 = -14x + 34$

$35 = 34$ is false

no solution

Do not start by hunting for x. Ask a smaller question first: what is left when the x terms are collected on one side?

Both sides have the SAME number of x, so taking it off both sides removes x completely. That is not a mistake — it is the answer arriving early.

What is left is 35 = 34, which is never true, whatever x is. So there is no solution.

Solutions (15 of 16)

How Many Solutions? (continued)

How many solutions? (continued)

2. **11x + 49 = 11x + 55**

49 = 55 **is false**

no solution

Do not start by hunting for x. Ask a smaller question first: what is left when the x terms are collected on one side?

Both sides have the SAME number of x, so taking it off both sides removes x completely. That is not a mistake — it is the answer arriving early.

What is left is 49 = 55, which is never true, whatever x is. So there is no solution.

Check the Expansion

Check the expansion

1. **On Sam's paper: $(x + 6)^2 - 36 = 2x - 24$. Which line should replace it?**

$x^2 + 12x + 36$ | $2x - 24$ | $x^2 + 12x$ | $x^2 + 6x$

Why?

$(x + 6)^2 - 36$ = **$x^2 + 12x$**

they wrote: **$2x - 24$**

Do not check by reading their line. Somebody else's working is the most persuasive thing on the page, and rereading it is how you end up agreeing with it — do the step yourself first, then compare.

On your own, and writing the step nobody writes down: $(x + 6)^2 - 36$ becomes $x^2 + 12x + 36 - 36$.

Tidy that up and it is $x^2 + 12x$.

Now compare. They wrote $2x - 24$, and the bracket was doubled instead of squared — so the correct answer is $x^2 + 12x$.

Solutions (16 of 16)

Check the Expansion (continued)

Check the expansion (continued)

2. **Theo wrote $(x + 12)^2 - 144 = 2x - 120$. Which is correct?**

$2x - 120$ | $x^2 + 24x + 144$ | $x^2 + 24x$ | $x^2 + 12x$

Why?

$(x + 12)^2 - 144$ = **$x^2 + 24x$**

they wrote: **$2x - 120$**

Do not check by reading their line. Somebody else's working is the most persuasive thing on the page, and rereading it is how you end up agreeing with it — do the step yourself first, then compare.

On your own, and writing the step nobody writes down: $(x + 12)^2 - 144$ becomes $x^2 + 24x + 144 - 144$.

Tidy that up and it is $x^2 + 24x$.

Now compare. They wrote $2x - 120$, and the bracket was doubled instead of squared — so the correct answer is $x^2 + 24x$.