Section 2.2
Equations: Multiplication and Division

An equation is an open statement that has one or more unknowns, also called variables.

Example: \(4x = 12\)  
or  
\(\frac{x}{3} = 8\)

Equations are solved by the use of inverse rules (see page 16). The value of the unknown is found because inverse rules undo what the equation states. A typical inverse rule says multiplications are undone by divisions and divisions by multiplications. Therefore, the first equation above is:

\[
\frac{4x}{4} = \frac{12}{4}
\]

Where the multiplication \(4x\) was undone by division

\[x = 3\]

Notice that by undoing (dividing) 4 on the left with another 4, we are forced to divide by 4 on the right side of the equation to keep the equation balanced (equal). The value of \(x\) is then exposed as \(\frac{12}{4} = 3\).

In the second equation above, the variable \(x\) is being divided by 3, therefore, to undo it, both the left and right-hand of the equation must be multiplied by 3.

\[
\frac{x}{3} (3) = 8 (3)
\]

The result is that the 3s on the left cancel and the answer is \(8(3) = 24\)

Example:

\[
\begin{align*}
5x &= 35 \\
\frac{5x}{5} &= \frac{35}{5} \\
x &= 7
\end{align*}
\]

Example:

\[
\begin{align*}
\frac{54}{-6} &= -9 \\
-9 &= y
\end{align*}
\]

Example:

\[
\begin{align*}
12a &= -48 \\
-12 &= -12 \\
a &= 4
\end{align*}
\]

From page 28

1. Remove double signs and all parentheses, leaving only numbers and one sign between numbers.
   - If the signs are the same, turn both signs into one positive sign.
   - If the signs are different, turn both signs into one negative sign.

2. Find answer by moving right and left on the number line.

The example in page 27 becomes: \(-12 + 9 + 14 - 7 - 11 - 8 + 5 + 16 - 2 = 4\)

**Multiplication and Division**

Multiplication is noted with an \(\times\), dot \((2 \cdot 3)\), or parenthesis, like in \(3(4) = 12\). Division is noted with a slash (/), fraction line (–), or ÷.

1. \(9 \times 8 = 72\) 
   same signs, answer positive
2. \(12 \div 3 = -36\) 
   different signs, answer negative
3. \(-4(-7) = 28\) 
   same signs, answer positive
4. \((8) - 5 = -40\) 
   different signs, answer negative
5. \(-12 \div 4 = -3\) 
   different signs, answer negative
6. \(-\frac{24}{-8} = 0.3\) 
   same signs, answer positive
7. \(84 \div (-12) = -7\) 
   different signs, answer negative
8. \(\frac{52}{13} = 4\) 
   same signs, answer positive

If you look carefully at the answers of the eight multiplication and division examples above, one conclusion seems clear: **Answers are positive when the signs of both numbers are the same, and negative when they are not.**

*Chorus from Signs. © 1970, 2002 Five Man Electrical Band*
Practice:
Solve.

1. \(4x = 16\)
2. \(8y = 48\)
3. \(-2a = 22\)
4. \(21 = -7b\)
5. \(-4x = -32\)
6. \(\frac{x}{4} = 3\)
7. \(\frac{x}{12} = -5\)
8. \(-6 = \frac{x}{8}\)
9. \(\frac{a}{-9} = 13\)
10. \(\frac{b}{-15} = -7\)
11. \(8x = 64\)
12. \(7y = 98\)
13. \(-7a = 42\)
14. \(140 = -70b\)
15. \(-6x = -72\)
16. \(\frac{x}{7} = 6\)
17. \(\frac{x}{3} = -341\)
18. \(-4 = \frac{x}{23}\)
19. \(\frac{a}{-8} = 5\)
20. \(\frac{b}{-11} = -1\)
21. \(8x = 56\)
22. \(12y = 132\)
23. \(-3a = 321\)
24. \(438 = -219b\)
25. \(-13x = -65\)
26. \(\frac{x}{17} = 34\)
27. \(\frac{x}{14} = -6\)
28. \(-5 = \frac{x}{7}\)
29. \(\frac{a}{-12} = 24\)
30. \(\frac{b}{-22} = -9\)
31. \(24x = 168\)
32. \(24y = 480\)
33. \(-3a = 105\)
34. \(135 = -45b\)
35. \(-16x = -320\)
36. \(\frac{x}{7} = 30\)
37. \(\frac{x}{17} = -8\)
38. \(-2 = \frac{x}{84}\)
39. \(\frac{a}{-11} = 33\)
40. \(\frac{b}{-33} = -17\)
41. \(6x = 45\)
42. \(82y = 148\)
43. \(-9a = 351\)
44. \(222 = -22b\)
45. \(-15x = -750\)
46. \(\frac{x}{14} = 2\)
47. \(\frac{x}{9} = -55\)
48. \(-4 = \frac{x}{19}\)
49. \(\frac{a}{-13} = 8\)
50. \(\frac{b}{-8} = -71\)
51. \(33x = 165\)
52. \(5y = 435\)
53. \(-a = 88\)
54. \(15 = -85b\)
55. \(-33x = -66\)
56. \(\frac{x}{5} = 315\)
57. \(\frac{x}{13} = -52\)
58. \(-10 = \frac{x}{32}\)
59. \(\frac{a}{-8} = 67\)
60. \(\frac{b}{-6} = -27\)
61. \(17x = 51\)
62. \(23y = 92\)
63. \(-3a = 102\)
64. \(240 = -20b\)
65. \(-9x = -153\)
66. \(\frac{x}{6} = 44\)
67. \(\frac{x}{3} = -71\)
68. \(-18 = \frac{x}{20}\)
69. \(\frac{a}{-7} = 11\)
70. \(\frac{b}{-6} = -27\)
71. \(\frac{b}{-3} = 13\)
72. \(\frac{b}{-6} = -28\)
73. \(31x = 124\)
74. \(52y = 130\)
75. \(-13a = 26\)
76. \(425 = -85b\)
77. \(-5x = -50\)
78. \(\frac{x}{15} = 26\)
79. \(\frac{x}{7} = -54\)