Section 2.3
Equations: Two or More Steps

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

Example: $3x - 12 = 6$

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 says. A typical inverse rule says addition is undone with subtraction, subtraction with addition, multiplication with division, and division with multiplication.

The objective of "solving for x" is to have "x" isolated (alone) to the left of the equal sign. This way, when we finally solve for "x", the value of "x" is read: "x is equal to...". Isolating "x" involves removing (undoing) every value (number or letter) to the other side of the equation using the inverse rules. Removal is done one number at a time, starting with the most convenient number.

Therefore, because in the above equation 12 is being subtracted and 3 is being multiplied, the equation above is solved by adding 12 and dividing by 3, on both sides:

$3x - 12 + 12 = 6 + 12$ add 12 to both sides (it's more "convenient" to add 12 first)

$3x = 18$

$\frac{3x}{3} = \frac{18}{3}$ divide by 3 (because 3 is closer to "x", it's more convenient to do 3 last)

$x = 6$

Notice that by undoing (adding) 12 on the left with another 12, we are forced to add another 12 on the right side of the equation to keep the equation balanced (equal). After the addition, $3x = 18$ is then undone by dividing both sides by 3. The value of x is then exposed as $\frac{18}{3} = 6$.

Example: $2x + 10 = 6$

$2x + 10 - 10 = 6 - 10$ subtract 10 (both sides)

$2x = -4$

$\frac{2x}{2} = -\frac{4}{2}$ divide both sides by 2

$x = -2$

Example: $24 = -9 - 3y$

$24 + 9 = -9 + 9 - 3y$ add 9 to both sides

$33 = -3y$

$\frac{33}{-3} = \frac{-3y}{-3}$ divide both sides by –3

$-11 = y$

$y = -11$

Example: $5x + 9 = 2x - 27$

$5x - 2x + 9 - 9 = 2x - 2x - 27 - 9$ subtract $2x$ and 9

$3x = -36$

$\frac{3x}{3} = -\frac{36}{3}$ divide by 3

$x = -12$

Practice

Solve.

1. $2x - 7 = 13$
2. $12 + 3y = 18$
3. $-3y + 12 = -12$
4. $21 = 4c - 7$
5. $-14 - 2x = -20$
6. $7x - 12 = 3x + 18$
7. $10 + 5v = -8 + 2v$
8. $\frac{x}{3} + 14 = 7$
9. $4x - 34 = 30$
10. $70 + 10y = 40$
11. $-6y + 24 = -18$
12. $42 = 8c - 22$
13. $-24 - 4x = -40$
14. $14x - 24 = 6x + 36$
15. $24 + 10k = -18 + 4k$
16. $28 + \frac{a}{6} = 8$
17. $6x - 18 = 18$
18. $36 + 12y = 60$
19. $-9y + 108 = -36$
20. $15 = 5c - 70$
21. $-42 - 7x = -28$
22. $5x - 81 = 9x + 9$
23. $44 + 8b = -36 + 4b$
24. $4 = \frac{x}{5} + 19$
25. $0.5x - 7 = 9$
26. $6 + 13y = -26$
27. $-5y + 6 = -24$
28. $24 = 2c - 8$
29. $-24 - 6x = -48$
30. $3x - 15 = -x + 17$
31. $9 + 3f = -12 + 10f$
32. $\frac{y}{8} + 5 = 23$
33. $11x - 11 = 22$
34. $27 + 9y = 54$
35. $-6y + 24 = -24$
36. $41 = 6c - 13$
37. $-14 - 2x = -20$
38. $12x - 36 = 6x + 54$
39. $62 + 8g = -10 - 4g$
40. $\frac{x}{7} + 20 = 9$
41. $11x - 16 = 50$
42. $-14 + 13y = 12$
43. $-9y + 20 = -34$
44. $60 = 7d - 3$
45. $33 - 5x = -22$
46. $13x - 49 = 7x + 21$
47. $18 + 2u = -54 - 2u$
48. $\frac{x}{4} - 15 = 9$
49. $18x - 27 = 45$
50. $17 + 6y = 13$
51. $-y + 41 = +38$
52. $67 = 12c + 19$
53. $17 - 9x = -73$
54. $8x - 42 = 11x + 84$
55. $23 + 7p = -17 + 2p$
56. $\frac{x}{13} + 14 = 24$
57. $10x - 17 = 33$
58. $49 + 7y = 28$
59. $-31y + 8 = -54$
60. $59 = 21c - 25$
61. $-35 - 10x = -5$
62. $-2x - 3 = 6x + 5$
63. $8 + 12v = -19 + 3v$
64. $\frac{x}{8} - 9 = 4$
65. $27x - 18 = 36$
66. $-12 + 9y = -93$
67. $-6y - 13 = 26$
68. $52 = 5c - 13$
69. $-14 - 15x = -44$
70. $3x - 6 = 2x + 9$
71. $12 + 13h = -42 + 7h$
72. $\frac{x}{6} + 18 = 5$
73. $7x - 5 = 51$
74. $-7 + 4y = 21$
75. $-5y + 45 = -75$
76. $23 = 12c - 37$
77. $-13 - 8x = -45$
78. $9x - 45 = 7x + 3$
79. $12 + 10r = -14 + 12r$
80. $\frac{x}{9} + 35 = 9$
81. $44 = 14c - 26$
82. $-66 - 3x = -223$
83. $9x - 54 = 5x + 77$
84. $120 + 6v = -8 + 3v$
85. $\frac{x}{5} + 48 = 12$
86. $57x - 76 = 38$
87. $140 + 7y = 42$
88. $-8y + 6.4 = -2.8$
89. $8.8 = 1.2c - 5.6$
90. $-310 - 41x = -480$
91. $12x - 2.4 = 4x + 2.8$
92. $89 + 8k = -180 + 12k$
93. $-1 + \frac{a}{3} = 128$
94. $2x - 4.2 = 5.6$
95. $340 + 18y = 448$
96. $-1.4y + 3.2 = -5.8$
97. $15.7 = 8c - 4.5$
98. $-7.4 - 5x = -3.45$
99. $0.9x - 14.7 = 1.8x + 48.3$
100. $3.8 + 5b = -7.8 + 11b$
101. $24.8 = \frac{x}{4} + 27$
102. $0.3x - 0.7 = 4.9$
103. $36 + 12y = -444$
104. $-8y + 160 = -350$
105. $7 = 10c - 93$
106. $-23 - 9x = -46$