§3-1 LINEAR EQUATIONS

Definition

Linear equations in one variable are equations which can be written in the form $ax + b = 0$ where a and b are real numbers.

Property

The Addition Property of Equations
If $a = b$ and c is a real number then $a + c = b + c$.

Property

The Multiplication Property of Equations
If $a = b$ and c is a real number then $ac = bc$.

Example 1 Solve the equation for x: $5x + 15 = 0$.

Solution

$$\begin{aligned} 5x + 15 &= 0 \\ 5x + 15 - 15 &= 0 - 15 \\ 5x &= -15 \\ \frac{5x}{5} &= \frac{-15}{5} \\ x &= -3 \end{aligned}$$

Example 2 Solve the equation for x: $4x + 5 = 6$.

Solution

$$\begin{aligned} 4x + 5 &= 6 \\ 4x + 5 - 5 &= 6 - 5 \\ 4x &= 1 \\ \frac{4x}{4} &= \frac{1}{4} \\ x &= \frac{1}{4} \end{aligned}$$

Example 3 Solve the equation for x: $3x - 5 = x + 1$.

Solution

$$\begin{aligned} 3x - 5 &= x + 1 \\ 3x - 5 - x &= x + 1 - x \\ 2x - 5 &= 1 \\ 2x - 5 + 5 &= 1 + 5 \\ 2x &= 6 \\ \frac{2x}{2} &= \frac{6}{2} \\ x &= 3 \end{aligned}$$

Example 4 Solve the equation for x: $ax + b = c$.

Solution

$$\begin{aligned} ax + b &= c \\ ax + b - b &= c - b \\ ax &= c - b \\ \frac{ax}{a} &= \frac{c-b}{a} \\ x &= \frac{c-b}{a} \end{aligned}$$

Example 5 Solve the equation for x: $\frac{1}{2}x-\frac{1}{3}=\frac{5}{6}x+1$.

Solution

$$\begin{aligned}
\frac{1}{2}x-\frac{1}{3}+\frac{1}{3} &= \frac{5}{6}x+1+\frac{1}{3}\\
\frac{1}{2}x &= \frac{5}{6}x+\frac{4}{3}\\
\frac{3}{6}x-\frac{5}{6}x &= \frac{5}{6}x+\frac{4}{3}-\frac{5}{6}x\\
-\frac{2}{6}x &= \frac{4}{3}\\
-\frac{1}{3}x &= \frac{4}{3}\\
(-3)\left(-\frac{1}{3}x\right) &= \frac{4}{3}\cdot(-3)\\
x &= -4
\end{aligned}$$

Example 6 Solve the equation for x: $-16x + 7 = 2x - 2$.

Solution

$$\begin{aligned}
-16x+7 &= 2x-2\\
-16x+7-7 &= 2x-2-7\\
-16x &= 2x-9\\
-16x+7-2x &= 2x-2-2x\\
-18x &= 9\\
\frac{-18x}{-18} &= \frac{-9}{-18}\\
x &= \frac{1}{2}
\end{aligned}$$

Example 7 Solve the equation for x: $(x-3)^2 = x^2+3$.

Solution

$$\begin{aligned}
(x-3)^2 &= x^2+3\\
x^2-6x+9 &= x^2+3\\
x^2-6x+9-x^2 &= x^2+3-x^2\\
-6x+9 &= 3\\
-6x+9-9 &= 3-9\\
-6x &= -6\\
\frac{-6x}{-6} &= \frac{-6}{-6}\\
x &= 1
\end{aligned}$$

Example 8 Three more than twice a number x is equal to y. Solve the equation for x.

Solution

$$\begin{aligned}
2x+3 &= y\\
2x+3-3 &= y-3\\
2x &= y-3\\
\frac{2x}{2} &= \frac{y-3}{2}\\
x &= \frac{y-3}{2}
\end{aligned}$$

§3-1 PROBLEM SET

Solve each equation.

1. $4x = 36$ **2**. $x + 12 = 64$ **3**. $x - 6 = 43$

4. $\frac{x}{4} = 8$ **5**. $\frac{2x}{3} = 6$ **6**. $\frac{x}{9} - 5 = 40$

7. $\frac{5x}{2} = 10$ **8**. $13x + 57 = 182$ **9**. $14 = 3x - 4$

10. $5(b - 3) = 7$ **11**. $4 + 6(r + 2) = 9$ **12**. $12x - 3 = 8x - 9$

13. $6s + 8 = 8 - 5s$ **14**. $\frac{2 + 9x}{6} = 12$ **15**. $\frac{7 - 2s}{3} = 2$

16. $\frac{x}{3} + 1 = 22$ **17**. $\frac{3y}{4} + 7 = 10$ **18**. $\frac{3t}{2} - 10 = 6$

19. $0.3c + 1.5 = 0.8c$ **20**. $0.1(v - 8) = 10$ **21**. $\frac{3w}{2} - \frac{5}{6} = \frac{w}{3}$

22. $41.7x - 13.2 = 91.8$ **23**. $\frac{2}{3}t + 8 = \frac{5}{4}t$ **24**. $6(k + 10) = 5(k + 14)$

25. $3t - 7 = 8t + 5$ **26**. $1.83 = 7x - 4.19$ **27**. $r + \frac{1}{3} = \frac{2}{3}r + \frac{5}{6}$

28. $8 - 9a = 9a - 8$ **29**. $\frac{3}{5}(2t - 4) = \frac{1}{5}t$ **30**. $4(1 - b) = 2(b + 14)$

31. $\frac{5x}{2} + 2 = 3x - 1$ **32**. $3a + 2 = \frac{a}{5} - 4$ **33**. $5 - x = \frac{2x}{3} - 6$

34. $\frac{x}{2} - \frac{2}{3} = \frac{1}{4}$ **35**. $\frac{2x}{3} - \frac{1}{2} = \frac{1}{4}$ **36**. $\frac{2x}{3} - 2 = \frac{1}{5}$

Solve for x.

37. $ax + cd = h$ **38**. $a(b + x) = d$ **39**. $2r + 3x = 6$

40. $5x - 6 = 3q + 4$ **41**. $8 - 3x = 2r - 7$ **42**. $5(x + 2s) = 2x$

Write an equation that represents each word statement. Solve the equation for x.

43. Two more than three times a number x is equal to 7.

44. Two more than three times a number x is equal to –3.

45. Three less than four times a number x is equal to y.

§3-1 PROBLEM SOLUTIONS

1.	9	**2**.	52	**3**.	49	**4**.	32	**5**.	9
6.	5	**7**.	4	**8**.	$\frac{125}{13}$	**9**.	6	**10**.	$\frac{22}{5}$
11.	$-\frac{7}{6}$	**12**.	$-\frac{3}{2}$	**13**.	0	**14**.	$\frac{70}{9}$	**15**.	$\frac{1}{2}$
16.	63	**17**.	4	**18**.	$\frac{32}{3}$	**19**.	3	**20**.	108
21.	$\frac{5}{7}$	**22**.	$\frac{350}{139}$	**23**.	$\frac{96}{7}$	**24**.	10	**25**.	$-\frac{12}{5}$
26.	0.86	**27**.	$\frac{3}{2}$	**28**.	$\frac{8}{9}$	**29**.	$\frac{12}{5}$	**30**.	-4
31.	6	**32**.	$-\frac{15}{7}$	**33**.	$\frac{33}{5}$	**34**.	$\frac{11}{6}$	**35**.	$\frac{9}{8}$
36.	$\frac{33}{10}$	**37**.	$\frac{h-cd}{a}$	**38**.	$\frac{d-ab}{a}$	**39**.	$\frac{6-2r}{3}$	**40**.	$\frac{3q+10}{5}$
41.	$\frac{15-2r}{3}$	**42**.	$-\frac{10s}{3}$	**43**.	$3x + 2 = 7;\ x = \frac{5}{3}$				
44.	$3x + 2 = -3;\ x = -\frac{5}{3}$			**45**.	$4x - 3 = y;\ x = \frac{y+3}{4}$				