Variables on Both Sides of an Equation

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1. $3x = 16 - 5x$; $3x + 5x = 16 - 5x + 5x$; $8x = 16$;
$\frac{8x}{8} = \frac{16}{8}$; $x = 2$

2. $4y - 3 = 5y + 2$; $4y - 3 - 4y = 5y + 2 - 4y$;
$-3 = y + 2$; $-3 - 2 = y + 2 - 2$; $-5 = y$

3. $6m + 3 = \frac{2m - 4}{2}$; $2(6m + 3) = 2\left(\frac{2m - 4}{2}\right)$;
$12m + 6 = 2m - 4$; $12m + 6 - 2m = 2m - 4 - 2m$;
$10m + 6 = -4$; $10m + 6 - 6 = -4 - 6$; $10m = -10$;
$\frac{10m}{10} = \frac{-10}{10}$; $m = -1$

4. $5(a - 1) - 15 = 3(a + 2) + 4$;
$5a - 5 - 15 = 3a + 6 + 4$;
$5a - 20 = 3a + 10$; $5a - 20 - 3a = 3a + 10 - 3a$;
$2a - 20 = 10$; $2a - 20 + 20 = 10 + 20$;
$2a = 30$; $\frac{2a}{2} = \frac{30}{2}$; $a = 15$

5. $3(p - 2) + 7 = 32 - 4(2p + 5)$;
$3p - 6 + 7 = 32 - 8p - 20$;
$3p + 1 = 12 - 8p$; $3p + 1 + 8p = 12 - 8p + 8p$;
$11p + 1 = 12$; $11p + 1 - 1 = 12 - 1$;
$11p = 11$; $\frac{11p}{11} = \frac{11}{11}$; $p = 1$

6. $7(w + 1) = 5(2w - 3) + 1$; $7w + 7 = 10w - 15 + 1$;
$7w + 7 = 10w - 14$; $7w + 7 - 7w = 10w - 14 - 7w$;
$7 = 3w - 14$; $7 + 14 = 3w - 14 + 14$; $21 = 3w$;
$\frac{21}{3} = \frac{3w}{3}$; $7 = w$

7. $14 - x = 3x - 2$; $14 - x + x = 3x - 2 + x$;
$14 = 4x - 2$; $14 + 2 = 4x - 2 + 2$; $16 = 4x$;
$\frac{16}{4} = \frac{4x}{4}$; $4 = x$

8. $\frac{5x - 3}{2} = 3x + 8$; $2 \cdot \frac{5x - 3}{2} = 2(3x + 8)$;
$5x - 3 = 6x + 16$; $5x - 3 - 5x = 6x + 16 - 5x$;
$-3 = x + 16$; $-3 - 16 = x + 16 - 16$; $-19 = x$

9. $a - 8 = \frac{6 + 5a}{3}$; $3(a - 8) = 3 \cdot \frac{6 + 5a}{3}$;
$3a - 24 = 6 + 5a$; $3a - 24 - 3a = 6 + 5a - 3a$;
$-24 = 6 + 2a$; $-24 - 6 = 6 + 2a - 6$; $-30 = 2a$;
$\frac{-30}{2} = \frac{2a}{2}$; $-15 = a$

10. $6n = 4n + 3$; $6n - 4n = 4n + 3 - 4n$; $2n = 3$;
$\frac{2n}{2} = \frac{3}{2}$; $n = \frac{3}{2}$

11. $4(3 - y) = 6 - 2(1 - 3y)$; $12 - 4y = 6 - 2 + 6y$;
$12 - 4y = 4 + 6y$; $12 - 4y + 4y = 4 + 6y + 4y$;
$12 = 4 + 10y$; $12 - 4 = 4 + 10y - 4$; $8 = 10y$;
$\frac{8}{10} = \frac{10y}{10}$; $\frac{4}{5} = y$

12. $7b - 20 = 3b + 12$; $7b - 20 - 3b = 3b + 12 - 3b$;
$4b - 20 = 12$; $4b - 20 + 20 = 12 + 20$; $4b = 32$;
$\frac{4b}{4} = \frac{32}{4}$; $b = 8$

13. $7y + 2 = 3y - 10$; $7y + 2 - 3y = 3y - 10 - 3y$;
$4y + 2 = -10$; $4y + 2 - 2 = -10 - 2$; $4y = -12$;
$\frac{4y}{4} = \frac{-12}{4}$; $y = -3$

14. $\frac{2(2b + 1)}{3} = 3(b - 2)$; $\frac{4b + 2}{3} = 3b - 6$;
$3\left(\frac{4b + 2}{3}\right) = 3(3b - 6)$; $4b + 2 = 9b - 18$;
$4b + 2 + 18 = 9b - 18 + 18$; $4b + 20 = 9b$;
$4b + 20 - 4b = 9b - 4b$; $20 = 5b$; $\frac{20}{5} = \frac{5b}{5}$; $4 = b$

15. $3x + 10 = -2x$; $3x + 10 - 10 = -2x - 10$;
$3x = -2x - 10$; $3x + 2x = -2x - 10 + 2x$; $5x = -10$;
$\frac{5x}{5} = \frac{-10}{5}$; $x = -2$

16. $\frac{3t}{2} + 7 = 4t - 3$; $\frac{3t}{2} + 7 - 7 = 4t - 3 - 7$;
$\frac{3t}{2} = 4t - 10$; $2 \cdot \frac{3t}{2} = 2(4t - 10)$; $3t = 8t - 20$;
$3t - 8t = 8t - 20 - 8t$; $-5t = -20$; $\frac{-5t}{-5} = \frac{-20}{-5}$;
$t = 4$

17. $18 - 2(3m - 1) = \frac{6 + 2(m + 3)}{2}$;
$18 - 6m + 2 = \frac{6 + 2m + 6}{2}$;
$20 - 6m = \frac{12 + 2m}{2}$; $2(20 - 6m) = 2\left(\frac{12 + 2m}{2}\right)$;
$40 - 12m = 12 + 2m$; $40 - 12m - 12 = 12 + 2m - 12$;
$28 - 12m = 2m$; $28 - 12m + 12m = 2m + 12m$;
$28 = 14m$; $\frac{28}{14} = \frac{14m}{14}$; $2 = m$

18. **(a)** $3n = 2n - 6$

(b) $3n = 2n - 6; 3n - 2n = 2n - 6 - 2n; n = -6$

19. **(a)** $4n + 3 = 3n - 7$

(b) $4n + 3 = 3n - 7; 4n + 3 - 3n = 3n - 7 - 3n;$
$n + 3 = -7; n + 3 - 3 = -7 - 3; n = -10$

20. **(a)** $2n + 3 = n$

(b) $2n + 3 = n; 2n + 3 - 3 = n - 3; 2n = n - 3;$
$2n - n = n - 3 - n; n = -3$

21. **(a)** $2n + 5 = n - 4$

(b) $2n + 5 = n - 4; 2n + 5 - n = n - 4 - n;$
$n + 5 = -4; n + 5 - 5 = -4 - 5; n = -9$

22. **(a)** $2n - 5 = n + 3$

(b) $2n - 5 = n + 3; 2n - 5 - n = n + 3 - n;$
$n - 5 = 3; n - 5 + 5 = 3 + 5; n = 8$

23. **(a)** $\frac{n}{2} - 5 = 3n - 25$

(b) $\frac{n}{2} - 5 = 3n - 25; \frac{n}{2} - 5 + 5 = 3n - 25 + 5;$

$\frac{n}{2} = 3n - 20; 2 \cdot \frac{n}{2} = 2(3n - 20); n = 6n - 40;$

$n - 6n = 6n - 40 - 6n; -5n = -40;$

$\frac{-5n}{-5} = \frac{-40}{-5}; n = 8$

24. **(a)** $\frac{2}{5}n + 7 = \frac{3}{4}n - 7$

(b) $\frac{2}{5}n + 7 = \frac{3}{4}n - 7; \frac{2}{5}n + 7 + 7 = \frac{3}{4}n - 7 + 7;$

$\frac{2}{5}n + 14 = \frac{3}{4}n; \frac{2}{5}n + 14 - \frac{2}{5}n = \frac{3}{4}n - \frac{2}{5}n;$

$14 = \frac{15}{20}n - \frac{8}{20}n; 14 = \frac{7}{20}n; 20 \cdot 14 = 20 \cdot \frac{7}{20}n;$

$280 = 7n; \frac{280}{7} = \frac{7n}{7}; 40 = n$