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Solving Systems - By Substitution

Solve the following systems of equations by substitution:

1. $y = x + 10$
$4x + 5y = -13$

$4x + 5(x + 10) = -13$

$4x + 5x + 50 = -13$

$9x + 50 = -13$

$-50 \quad -50$

$\frac{9x}{9} = \frac{-63}{9}$

$\boxed{x = -7}$

$y = (-7) + 10$

$\boxed{y = 3}$

$\boxed{(-7,\ 3)}$

2. $c = 1 - d$
$3d - 2c = -17$

$3d - 2(1 - d) = -17$

$3d - 2 + 2d = -17$

$5d - 2 = -17$

$+2 \quad +2$

$\frac{5d}{5} = \frac{-15}{5}$

$\boxed{d = -3}$

$c = 1 - (-3)$

$\boxed{c = 4}$

$\boxed{(4,\ -3)}$

3. $m - n = -10$
$n = 3m + 20$

$m - (3m + 20) = -10$

$m - 3m - 20 = -10$

$-2m - 20 = -10$

$+20 \quad +20$

$\frac{-2m}{-2} = \frac{10}{-2}$

$\boxed{m = -5}$

$n = 3(-5) + 20$

$n = -15 + 20$

$\boxed{n = 5}$

$\boxed{(-5,\ 5)}$

4. $x - 2y = 0$
$5x + 6y = 16$

$x - 2y = 0$

$+2y \quad +2y$

$x = 2y$

$5(2y) + 6y = 16$

$10y + 6y = 16$

$\frac{16y}{16} = \frac{16}{16}$

$\boxed{y = 1}$

$x = 2(1)$

$\boxed{x = 2}$

$\boxed{(2,\ 1)}$

5. $a + b = -7$
$5a - 2b = 7$

$a + b = -7$
$\underline{-b \quad -b}$
$a = -b - 7$

$5(-b - 7) - 2b = 7$
$-5b - 35 - 2b = 7$
$-7b - 35 = 7$
$\underline{+35 \quad +35}$
$\frac{-7b}{-7} = \frac{42}{-7}$

$\boxed{b = -6}$

$a = -(-6) - 7$
$a = 6 - 7$
$\boxed{a = -1}$

$\boxed{(-1, \ -6)}$

6. $5p - 3q = 9$
$8p + q = -3$

$\underline{-8p \qquad -8p}$
$q = -8p - 3$

$5p - 3(-8p - 3) = 9$
$5p + 24p + 9 = 9$
$29p + 9 = 9$
$\underline{-9 \quad -9}$
$\frac{29p}{29} = \frac{0}{29}$

$\boxed{p = 0}$

$q = -8(0) - 3$
$q = 0 - 3$
$\boxed{q = -3}$

$\boxed{(0, \ -3)}$

7. $2x = y - 1$
$2y = 1 + 4x$

$2x = y - 1$
$\underline{+1 \qquad +1}$
$2x + 1 = y$

$2(2x + 1) = 1 + 4x$
$4x + 2 = 1 + 4x$
$\underline{-4x \qquad -4x}$
$2 \neq 1$

$\boxed{\varnothing}$

8. $-j + 3k = 14$
$2j - 9k = -40$

$-j + 3k = 14$
$\underline{-3k \quad -3k}$
$\frac{-j}{-1} = \frac{-3k + 14}{-1}$

$j = 3k - 14$

$2(3k - 14) - 9k = -40$
$6k - 28 - 9k = -40$
$-3k - 28 = -40$
$\underline{+28 \quad +28}$
$\frac{-3k}{-3} = \frac{-12}{-3}$

$\boxed{k = 4}$

$j = 3(4) - 14$
$j = 12 - 14$
$\boxed{j = -2}$

$\boxed{(-2, \ 4)}$

9. $7g - 5h = 1$

$5 - h = -4g$

$-5 \qquad -5$

$$\frac{-h}{-1} = \frac{-4g - 5}{-1}$$

$$h = 4g + 5$$

$$7g - 5(4g + 5) = 1$$

$$7g - 20g - 25 = 1$$

$$-13g - 25 = 1$$

$+25 \qquad +25$

$$\frac{-13g}{-13} = \frac{26}{-13}$$

$$\boxed{g = -2}$$

$$h = 4(-2) + 5$$

$$h = -8 + 5$$

$$\boxed{h = -3}$$

$$\boxed{(-2, \ -3)}$$

10. $6x - y = 2$

$2y + 4 = 12x$

$6x - y = 2$

$-6x \qquad -6x$

$$\frac{-y}{-1} = \frac{-6x + 2}{-1}$$

$$y = 6x - 2$$

$$2(6x - 2) + 4 = 12x$$

$$12x - 4 + 4 = 12x$$

$$\frac{12x}{12} = \frac{12x}{12}$$

$$x = x$$

$$\boxed{\{(x, \ y): \ 6x - y = 2\}}$$