System of Equations

Determine the nature of the solution to each system of linear equations. If the system has a solution, find it algebraically,

1. $\begin{cases} y = \frac{1}{2}x + \frac{5}{2} \\ x - 2y = 7 \end{cases}$

2. $\begin{cases} y = \dfrac{2}{3}x + 4 \\ 2y + \dfrac{1}{2}x = 2 \end{cases}$

3. $\begin{cases} y = 3x - 2 \\ -3x + y = -2 \end{cases}$

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1. $\begin{cases} y = \frac{1}{2}x + \frac{5}{2} \\ x - 2y = 7 \end{cases}$

The slopes of these two equations are the same, and the y-intercept points are different, which means they graph as parallel lines. Therefore, this system will have no solution.

2. $\begin{cases} y = \dfrac{2}{3}x + 4 \\ 2y + \dfrac{1}{2}x = 2 \end{cases}$

The slopes of these two equations are unique. That means they graph as distinct lines and will intersect at one point. Therefore, this system has one solution.

$$2\left(\frac{2}{3}x + 4\right) + \frac{1}{2}x = 2$$
$$\frac{4}{3}x + 8 + \frac{1}{2}x = 2$$
$$\frac{11}{6}x + 8 = 2$$
$$\frac{11}{6}x = -6$$
$$x = -\frac{36}{11}$$

$$y = \frac{2}{3}\left(-\frac{36}{11}\right) + 4$$
$$y = -\frac{24}{11} + 4$$
$$y = \frac{20}{11}$$

The solution is $\left(-\frac{36}{11}, \frac{20}{11}\right)$.

3. $\begin{cases} y = 3x - 2 \\ -3x + y = -2 \end{cases}$

These equations define the same line. Therefore, this system will have infinitely many solutions.