A Variable on Both Sides

Example 1. Solve $2x + 8 = -5x$.

Notice that the unknown appears on both sides of the equation. This is not a problem; we can still use the principle of doing the same operation to both sides in order to isolate the unknown on one side. In this case, we can either subtract $2x$ from both sides or add $5x$ to both sides. See both options below.

First subtract 2x:

$$\begin{aligned} 2x + 8 &= -5x && \mid -2x \\ 8 &= -7x && \text{(Switch sides.)} \\ -7x &= 8 && \mid \div -7 \\ x &= -8/7 \end{aligned}$$

First add 5x:

$$\begin{aligned} 2x + 8 &= -5x && \mid +5x \\ 7x + 8 &= 0 && \mid -8 \\ 7x &= -8 && \mid \div 7 \\ x &= -8/7 \end{aligned}$$

Check:

$$\begin{aligned} 2 \cdot (-8/7) + 8 &\stackrel{?}{=} -5 \cdot (-8/7) \\ -16/7 + 8 &\stackrel{?}{=} 40/7 \\ -2\ 2/7 + 8 &\stackrel{?}{=} 5\ 5/7 \\ 5\ 5/7 &= 5\ 5/7 \quad \checkmark \end{aligned}$$

1. Solve the equation in two ways, as instructed.

First add 2s:

$$10 - 2s = 4s + 9 \quad \mid +2s$$

First subtract 4s:

$$10 - 2s = 4s + 9 \quad \mid -4s$$

2. Solve. Check your solutions (as always!).

a. $3x + 2 = 2x - 7$

b. $9y - 2 = 7y + 5$

3. A common student error is to add or subtract "across the sides," instead of carefully adding or subtracting the same quantity to/from both sides.

   Here is an example of it: the student added $7w$ and $2w$, and wrote $9w$ on the next line. Correct the error and solve the equation.

$$7w + 8 = 2w - 5$$
$$9w + 8 = -5$$

4. Solve. Check your solutions (as always!).

a. $-2y - 6 = 20 + 6y$	**b.** $8x - 12 = -1 - 3x$	**c.** $6z - 5 = 9 - 2z$

5. Fred is contemplating two different job offers. In one, he gets paid \$19.50 per hour plus he will receive a bonus based on the sales he brings in, which he estimates to be about \$150 per week. In another job, he will earn \$21 per hour (no bonuses).

   a. Write an expression for the weekly earnings in each job, for m hours of work.

   Job 1: Job 2:

   b. In which job would he earn more, if he worked 20 hours per week?

   c. For what amount of work hours would both jobs provide him the same wages?