Solving linear systems using elimination with addition

Solving systems Find values that make every equation true.

Today Find the same pair (x, y) that makes BOTH linear equations true. The pair locates a point on a two-dimensional plane.

Why we can add equations

These are two equations. Each has equal weights on its two sides.

Box	=	3 bricks
+ Bag	=	+ 2 bricks
Box + Bag	=	5 bricks

We just added two equations!

We added left sides and right sides. Equal weights give equal totals, so the new equation is true.

Now find new unknown weights

Find ONE box's weight and ONE bag's weight in bricks. These weights are new.

x	weight of 1 box	y	weight of 1 bag
2x	weight of 2 boxes	2y	weight of 2 bags
5x	weight of 5 boxes	3y	weight of 3 bags
7x	weight of 7 boxes		

1x means x; 1y means y.

All boxes weigh the same. All bags weigh the same.

Two boxes and three bags weigh 17 bricks:

$$2x + 3y = 17$$

Five boxes weigh 11 bricks more than three bags:

$$5x - 3y = 11$$

In the next column, Section A continues these same equations. The same three bags' weight is added (+3y) and subtracted (−3y).

A The same story in symbols

1 Add both left sides and both right sides.

$$\begin{array}{rrcr} & 2x & +3y & = & 17 \\ + & 5x & -3y & = & 11 \\ \hline & 7x & +0 & = & 28 \end{array}$$

This is elimination: 3y − 3y = 0.

$$\frac{7x}{7} = \frac{28}{7}$$
$$x = 4$$

We found one unknown!

Adding canceled the y terms, leaving only x to solve. ONE box weighs 4 bricks.

2 Use x = 4 to find y, ONE bag's weight. Either original works; we use the first.

$$\begin{aligned} 2(4) + 3y &= 17 \\ 8 + 3y &= 17 \\ 8 + 3y - 8 &= 17 - 8 \\ 3y &= 9 \\ \frac{3y}{3} &= \frac{9}{3} \\ y &= 3 \end{aligned}$$

ONE bag weighs 3 bricks.

Solution: (4, 3). Write x first, y second.

3 Check the pair in BOTH originals.

$$\begin{aligned} 2(4) + 3(3) &= 17 \\ 17 &= 17 \\ 5(4) - 3(3) &= 11 \\ 11 &= 11 \end{aligned}$$

B A new system to prepare

$$\begin{aligned} 3x + 6y &= 6 \\ 7x + 6y &= 22 \end{aligned}$$

Both y terms are +6y, so adding gives 12y. We need one −6y to cancel y.

Make opposite terms, then add!

In the second equation, multiply BOTH sides by −1. Distribute to every term.

$$-1(7x + 6y) = -1(22)$$

$$\begin{array}{rrcr} & 3x & +6y & = & 6 \\ + & -7x & -6y & = & -22 \\ \hline & -4x & +0 & = & -16 \end{array}$$

$$\frac{-4x}{-4} = \frac{-16}{-4}$$
$$x = 4$$

Now find y. Use x = 4 in the first original.

$$\begin{aligned} 3(4) + 6y &= 6 \\ 12 + 6y &= 6 \\ 12 + 6y - 12 &= 6 - 12 \\ 6y &= -6 \\ \frac{6y}{6} &= \frac{-6}{6} \\ y &= -1 \end{aligned}$$

Solution: (4, −1). Check BOTH originals.

$$\begin{aligned} 3(4) + 6(-1) &= 6 \\ 6 &= 6 \\ 7(4) + 6(-1) &= 22 \\ 22 &= 22 \end{aligned}$$

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Solve and show how you know

Find both values. Use either original equation to find the second value; check the complete pair in BOTH originals.

Use the printed equations; you do not need to recopy them. Work vertically. Show each operation on both sides.

(a) A starting cue

$$-8x + 3y = 3$$
$$13x - 3y = -18$$

The +3y and −3y cancel. Add to find one value, then use it to find the other.

Find both values

Solution (x, y): (_____ , _____)

Check both originals

(b) Fewer cues

$$6x + 7y = 4$$
$$6x + 9y = 12$$

Which terms could become opposites? Multiply BOTH sides of one equation by −1.

Find both values

Solution (x, y): (_____ , _____)

Check both originals

(c) On your own

$$3x + 5y = 5$$
$$7x + 5y = 25$$

Solve independently. Show each new equation and the operation on both sides.

Find both values

Solution (x, y): (_____ , _____)

Check both originals

Check and correct your work. Then move to your assigned Topic 28 ALEKS problems and keep your reasoning on paper.

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