

Balance Scales

A GUIDE

Crack the secret of the mystery bag — and you'll be solving real equations without even noticing.

The Mystery Bag

Picture an old-fashioned balance scale: two pans hanging from a bar. When both pans hold the same weight, the bar sits perfectly level. Put something heavier on one side and that pan drops.

Now imagine a sealed bag on the left pan. You can't peek inside, but you can see the scale is balanced. That means whatever is in the bag, plus anything sitting next to it, weighs exactly the same as the stuff on the right pan.

Here's the fun part: a balanced scale is really an equation in disguise. The bag is the unknown — call it X — and 'balanced' means 'equals'. Your job is to figure out what X weighs without ever opening the bag.

$X + 3$	=	8
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The Golden Move

Look at the picture above: one bag and a 3-gram weight on the left balance an 8-gram weight on the right. How do you get the bag all by itself? You take that 3 away — but wait. If you only remove weight from the left, the left pan shoots up and the balance is ruined.

So here is the golden move: whatever you take off one pan, take the SAME amount off the other pan. Remove 3 from the left and 3 from the right, and the scale stays level. Now the bag sits alone on the left, facing 5 grams on the right. The bag must weigh 5.

That's the whole secret of solving equations. You're never guessing — you're just carefully un-burying the bag while keeping both sides fair.

Worked example A bag and a 7-gram weight on the left balance a 15-gram weight on the right ($X + 7 = 15$). What does the bag weigh?

1. The bag is hidden under an extra 7 grams, so take 7 off the left pan.
2. To keep the balance, take 7 off the right pan too: $15 - 7 = 8$.
3. Now the bag alone balances 8 grams, so the bag weighs 8.

Answer: $X = 8$

More Bags, Same Trick

What if the left pan holds two identical mystery bags and a 5-gram weight, balancing 17 grams on the right? Start exactly the same way: clear the plain weights first. Take 5 off both pans, and now two bags balance 12 grams.

Two identical bags weighing 12 grams together means each bag gets an equal share: $12 \div 2 = 6$. Each bag weighs 6 grams. So the recipe is: first subtract to sweep the loose weights away, then divide to share what's left among the bags.

$X + X + 5$	=	17
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Worked example Three identical bags and a 4-gram weight balance a 19-gram weight ($3X + 4 = 19$). Find the weight of one bag.

1. Take 4 grams off both pans: $19 - 4 = 15$, so three bags balance 15 grams.
2. Share 15 equally among the 3 bags: $15 \div 3 = 5$.

3. Check: $3 \times 5 + 4 = 19$ — balanced!

Answer: $X = 5$

Bags on Both Sides

Ready for the boss level? Sometimes bags sit on BOTH pans. In the picture, four bags and 2 grams on the left balance one bag and 11 grams on the right. It looks tangled, but the golden move still works — and it works on bags too.

Lift one bag off each pan. The balance holds, because you removed the same mystery amount from both sides. Now three bags and 2 grams face 11 grams. That's a puzzle you already know how to solve: take 2 off both pans (three bags balance 9), then share: $9 \div 3 = 3$. Each bag weighs 3 grams.

Notice the order: clear the bags from one side first, then the loose weights, then divide. Three calm moves, and even the messiest scale gives up its secret.

$$X + X + X + X + 2$$

=

$$X + 11$$

Worked example Five bags and 3 grams on the left balance two bags and 18 grams on the right ($5X + 3 = 2X + 18$). What does one bag weigh?

1. Remove 2 bags from each pan: 3 bags and 3 grams now balance 18 grams.
2. Remove 3 grams from each pan: 3 bags balance 15 grams.
3. Share equally: $15 \div 3 = 5$, so each bag weighs 5.
4. Check: $5 \times 5 + 3 = 28$ and $2 \times 5 + 18 = 28$ — balanced!

Answer: $X = 5$

Remember

- ★ Whatever you do to one pan, do the exact same thing to the other — that's the one rule that keeps the balance true.
- ★ Clear the loose weights first, then share what's left equally among the bags.
- ★ When bags appear on both sides, remove the same number of bags from each pan before touching any weights.
- ★ Always check your answer by putting it back on the scale — if both pans add up the same, you've got it.

Now you try

1) A scale is balanced. The left pan holds one mystery bag and a 4-gram weight. The right pan holds a 10-gram weight. What does the bag weigh?

Answer: _____

2) One bag and a 9-gram weight on the left balance a 20-gram weight on the right. Solve $X + 9 = 20$.

Answer: _____

3) Three identical bags on the left balance a 21-gram weight on the right. What does one bag weigh?

Answer: _____

4) Two identical bags and a 3-gram weight balance a 13-gram weight. Solve $2X + 3 = 13$.

Answer: _____

5) Four identical bags and a 6-gram weight balance a 30-gram weight. What does one bag weigh?

Answer: _____

6) Three bags and 2 grams on the left balance one bag and 10 grams on the right. Solve $3X + 2 = X + 10$.

Answer: _____

7) Five bags and 4 grams on the left balance two bags and 19 grams on the right. What does one bag weigh?

Answer: _____

8) Six bags and 2 grams on the left balance two bags and 26 grams on the right. First remove bags, then weights — what does one bag weigh?

Answer: _____

Answers — check yourself

1. $X = 6$
2. $X = 11$
3. $X = 7$
4. $X = 5$
5. $X = 6$
6. $X = 4$
7. $X = 5$
8. $X = 6$