MATHS FIELD GUIDE · GRADE 6

Equations express a balance of values

OPENING PROBLEM

Which change keeps both sides balanced?

$$x + 7 = 19$$
$$\downarrow$$
$$x = 19 - 7$$
$$\downarrow$$
$$x = 12$$

02 Keep the solution set intact
03 Rules and worked cases
04 Weigh the mystery parcel
05 Run the operation backwards
06 Check your reasoning

ILLUSTRATED PROBLEM SHEET

Keep the solution set intact

An operation used on both sides must be reversible on the allowed values.

1

$$x + 7 = 19$$
$$\downarrow$$
$$x = 19 - 7$$
$$\downarrow$$
$$x = 12$$

Which change keeps both sides balanced?

Subtract seven from each side. Substitution gives 12 + 7 = 19.

2

$$3x - 4 = 14$$
$$\downarrow$$
$$3x = 18$$
$$\downarrow$$
$$x = 6$$

Which step undoes multiplication?

Dividing both sides by three. Check: 18 – 4 = 14.

3

$$2(x + 3) = 2x + 6$$
$$\downarrow$$
$$2x + 6 = 2x + 6$$
$$\downarrow$$
$$0 = 0$$

What does this final equality mean?

Every allowed x satisfies the original equation.

4

$$2(x + 3) = 2x + 7$$
$$\downarrow$$
$$6 = 7$$

What if the variable disappears into a false statement?

There is no solution. Subtracting the same 2x did not lose one.

0x = 0
all real x fit.

0x = 4
no real x fits.

CHAPTER PROBLEM

Why must seven be removed from both sides of x + 7 = 15?

The two quantities must remain equal. Removing it from only one side breaks that equality.

MATHS REFERENCE · GRADE 6

Equations express a balance of values

An equation states that two expressions have the same value. A solution is a value that makes this statement true.

Solving means finding the values that satisfy the equation, while preserving its equality at every step.

Four cases to recognise

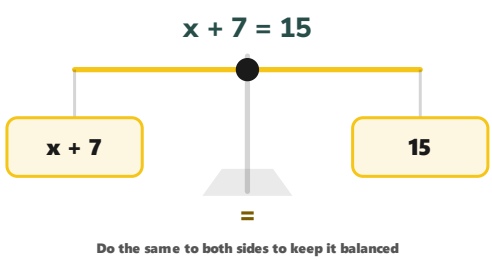
Situation	What to do and why
4x + 3 = 23	Remove three from both sides. Divide twenty by four: x = 5.
3(x + 2) = 21	Divide both sides by three, then subtract two: x = 5.
2x = x + 9	Remove one x from each side. The remaining x equals nine.
Check x = 4 in 5x − 3 = 18	Left side is 17. Equality fails, so four is not a solution.

Read the model

Build the idea

For x + 7 = 15, imagine equal amounts on the two sides of a balance. Remove seven from both sides.

The remaining amounts are still equal, giving x = 8. This represents an inverse operation applied to both sides.



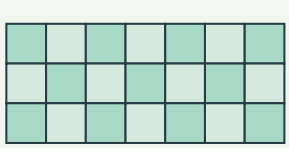
Equation as a balance

Why it works

Making the same change to equal quantities preserves equality. Multiplying or dividing both sides by the same nonzero number also preserves equality.

The purpose of a step is to isolate the unknown without altering which values make the statement true.

solution A value satisfying an equation.
isolate Leave the unknown by itself.
inverse operation An operation that undoes another.



Split this 3 by 7 array after five columns. What equality appears?

3 × 7 = 3 × 5 + 3 × 2. The two pieces cover exactly the original rectangle.

WORKED INVESTIGATION

Weigh the mystery parcel

Three identical parcels and a 2 kg weight balance a 14 kg weight. Let x be the mass of one parcel in kilograms, so 3x + 2 = 14.

Look at this part	What it tells you
Remove 2 kg on both sides	3x = 12
Divide both sides by 3	x = 4
Check	3 × 4 + 2 = 14

Work it through

Removing equal amounts preserves the balance. Dividing the remaining load equally then isolates one parcel.

Catch the mistake

Dividing 14 by three immediately splits the extra weight between the parcels. Remove or account for the 2 kg as well.

Compare the cases

Follow an example

Solve 4x = 28 by dividing both sides by four. Then x = 7.

Substitute to check: 4 × 7 = 28. Checking the original equation catches mistakes introduced while rearranging.

What changes? What stays true?

Do not treat moving a term as magic. Describe the operation on both sides, even if a shortened notation is used later.

An unknown may occur more than once. Every occurrence of the same symbol has the same value in the equation.

Change one condition

If both sides gain 5 kg, the balance reads 3x + 7 = 19. The parcel mass stays four because the change was equal.

4(x + 3)
↓
4x + 4 × 3
↓
4x + 12

Which term is often missed?

The 3 is also multiplied by 4. At x = 2 both sides give 20.

ILLUSTRATED PROBLEM SHEET

Run the operation backwards

Begin with the result and undo the last change first.

1

$$? + 18 = 43$$
$$\downarrow$$
$$43 - 18 = 25$$

What number was hidden?

Twenty-five. Adding eighteen to it returns forty-three.

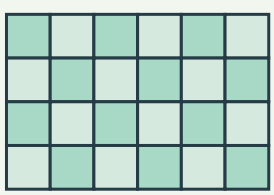
2

$$? - 16 = 27$$
$$\downarrow$$
$$27 + 16 = 43$$

A box lost sixteen and now has twenty-seven. How many at first?

Forty-three. Undo a loss by putting it back.

3



Twenty-four counters fill four identical rows. How many per row?

Six. Four times six gives the original total.

4

$$? \times 3 + 2 = 20$$
$$\downarrow$$
$$20 - 2 = 18$$
$$\downarrow$$
$$18 \div 3 = 6$$

Which change do you undo first?

Remove the final two, then divide by three. Check: three sixes and two make twenty.

□ + 9 = 32
subtract nine: 23.

□ − 9 = 32
add nine: 41.

CHAPTER PROBLEM

Solve 4x + 3 = 23. Why can you subtract 3 on both sides?

Subtracting equal amounts keeps the sides equal. Then 4x = 20 and x = 5. Check: 4 × 5 + 3 = 23.

QUESTION BANK · FOLD OR COVER THE RIGHT COLUMN

Check your reasoning

Try the problem	Solution and reasoning
01 Why can dividing $x^2 = 3x$ by x miss an answer?	It assumes x is nonzero. Factoring $x(x - 3) = 0$ keeps both 0 and 3.
02 Is $35 - 12$ a check for $23 + 12 = 35$?	Yes. Removing one part from the total recovers the other.
03 Two identical boxes plus 5 kg balance 17 kg. Find the mass of one box and check.	Subtract five to leave 12 kg for two boxes. Each is 6 kg and $2 \times 6 + 5 = 17$.
04 Solve $5x - 4 = 16$ and verify.	Add four, divide by five: $x = 4$. Check $20 - 4 = 16$.
05 Three identical bags weigh 18 kg after 3 kg of loose rice is added to the total. What does one bag weigh?	Remove the 3 kg before sharing: $15 \div 3 = 5$ kg.

5x + 15
↓
5(x + 3)

Can you reverse the split?

Both terms contain 5. Dividing each by 5 leaves x and 3 inside the bracket.

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