

Simultaneous

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Name: _____

Date: _____

At a glance

Solving two equations together: elimination, substitution, word problems, and line-and-curve pairs.

1. Elimination
2. Substitution
3. Forming simultaneous equations
4. One linear and one non-linear equation

1. Elimination

☐ I revised this

- Make the coefficient of one letter the same in both equations (multiply one or both equations).
- **Same signs** → **subtract**; **different signs** → **add**.
- Solve for the remaining letter, then substitute back to find the other.
- Check both values in the equation you didn't substitute into.

How to do it

1. Label the equations (1) and (2).
2. Multiply to match one coefficient.
3. Add or subtract to eliminate it.
4. Solve; substitute back; check.

Worked example

Solve $3x + 2y = 19$ and $2x - 5y = -19$.

1. $(1) \times 5: 15x + 10y = 95$. $(2) \times 2: 4x - 10y = -38$.
2. Add: $19x = 57$, so $x = 3$.
3. $3(3) + 2y = 19 \rightarrow y = 5$.
4. Check (2): $6 - 25 = -19$ ✓

$x = 3, y = 5$

2. Substitution

☐ I revised this

- Best when one equation already says $y = \dots$ or $x = \dots$
- Replace that letter in the other equation, solve, then substitute back.

Worked example

Solve $y = 3x - 4$ and $2x + y = 11$.

1. $2x + (3x - 4) = 11$.
2. $5x = 15$, $x = 3$.
3. $y = 3(3) - 4 = 5$.

$x = 3, y = 5$

3. Forming simultaneous equations

☐ I revised this

- Choose a letter for each unknown and say what it means.
- Write one equation for each fact in the question.
- Answer in words with units at the end.

Worked example

2 adult tickets and 3 child tickets cost \$31. 1 adult and 1 child ticket cost \$12. Find the price of each.

1. $2a + 3c = 31$ and $a + c = 12$.
2. From the second, $a = 12 - c$.
3. $2(12 - c) + 3c = 31 \rightarrow c = 7, a = 5$.

Adult \$5, child \$7

4. One linear and one non-linear equation

☐ I revised this

- Rearrange the linear equation to $y = \dots$ (or $x = \dots$) and substitute into the non-linear one.
- This gives a quadratic: solve it to get two x values.
- Find the matching y for **each** x using the linear equation, and pair them.
- Graphically, the solutions are where the line meets the curve (0, 1 or 2 points).

Worked example

Solve $y = x + 1$ and $x^2 + y^2 = 25$.

1. $x^2 + (x + 1)^2 = 25 \rightarrow 2x^2 + 2x - 24 = 0$.
2. $x^2 + x - 12 = 0 \rightarrow (x + 4)(x - 3) = 0$.
3. $x = 3 \rightarrow y = 4; x = -4 \rightarrow y = -3$.

(3, 4) and (-4, -3)

Common mistakes

Don't write	Write instead
 Subtracting when the signs are different	 Different signs: add the equations
 $-2y - (-2y) = -4y$	 $-2y - (-2y) = 0$
 Giving only the x values	 Find each y and pair it with its x
 Squaring $(x + 1)^2$ as $x^2 + 1$	 $(x + 1)^2 = x^2 + 2x + 1$

In the exam

- Write what you do to each equation: $(1) \times 2, (2) \times 3$.
- Check your pair in the original equations — a quick way to catch sign errors.
- In word problems, state the answer in words with units.

My notes

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