MATHS FORENSICS
CASE FILE WORKSHEET · GCSE

MF-CF-ALG-FORMEQ
GCSE HIGHER · ABOUT 50 MINUTES

CASE FILE SERIES · ALGEBRA

FORMING AND SOLVING EQUATIONS

Turn words into algebra, then solve it. Secure linear equations, extend to brackets, fractions and shapes, then master the problems that become quadratics.

SECURING · GRADES 4–5 | EXTENDING · GRADES 6–7 | MASTERY · GRADES 8–9

Name _____ Class _____ Date _____

CASE BRIEFING

WHAT YOU NEED TO KNOW

An equation is a balance: do the **same** to both sides and it stays true. To **form** an equation, give the unknown a letter, write two expressions for the same thing, and set them equal.

Brackets first, fractions next (multiply every term by the denominator), then collect the letters on the side with more of them.

1. Define your letter: what does x stand for?
2. Write an expression for each fact, then make them equal.
3. Expand brackets, clear fractions, collect like terms, solve.
4. Answer the question that was asked, with units, and check it.

WORKED EXAMPLE **A rectangle's length is 3 cm more than twice its width. Its perimeter is 42 cm. Find its area.**

SOLUTION

1 Let the width be w cm. Then the length is $2w + 3$.

2 Perimeter: $2(w + 2w + 3) = 42$, so $6w + 6 = 42$.

3 $6w = 36$, so $w = 6$. The length is 15 cm.

4 Area $= 6 \times 15 = 90$ cm². Check: $2(6 + 15) = 42$ ✓

✓ **90 cm²**

KNOWLEDGE CHECK

Use your investigative skills to solve each case. Show full working: the method marks are where most students lose out.

Securing
Linear equations: one and two steps, brackets, unknowns on both sides.
Secured ☐

Extending
Forming equations from shapes and words, fractions, and tampered evidence.
Secured ☐

Mastery
Equations from problems that turn quadratic, and proof.
Secured ☐

SECURING

The method, step by step. Show every line.

1 Solve $5x - 7 = 18$. [2]

$x =$ _____

2 Solve $3(x + 4) = 27$. [2]

$x =$ _____

3 Solve $7x - 3 = 4x + 15$. [2]

$x =$ _____

4 Solve $\frac{x + 5}{3} = 4$. [2]

$x =$ _____

5 I think of a number, multiply it by 4 and subtract 9. The answer is 31. Form an equation and solve it to find my number. [3]

Number _____

FORENSIC TIP The method mark is for the equation. Write it down before you solve it, even if you can do it in your head.

EXTENDING

A step is hidden, or there's a context to unpick. One piece of tampered evidence.

6 A rectangle has length $(2x + 3)$ cm and width $(x - 1)$ cm. Its perimeter is 34 cm. Find its area. [4]

cm² _____

7 Solve $4(2x - 1) = 3(x + 7)$. [3]

x = _____

8 The angles of a triangle are $(x + 20)°$, $2x°$ and $(3x - 20)°$. Find the largest angle. [3]

° _____

9 Solve $\frac{2x - 1}{3} - \frac{x + 2}{4} = 1$. [3]

x = _____

FORENSIC TIP When you multiply through, the minus sign in front of the second fraction applies to **both** terms: $-3(x + 2) = -3x - 6$.

10 Amir solved $3(x - 2) = 2x + 5$. Find his mistake and solve the equation correctly. [2]

TAMPERED EVIDENCE · FIND THE MISTAKE

$3x - 2 = 2x + 5$

$x = 7$

x = _____

MASTERY No hints. Plan before you calculate.

11 A detective is three times as old as her trainee. In 8 years' time she will be twice as old as him. How old are they now? [4]

Ages _____

12 Solve $\frac{3}{x-1} = \frac{5}{x+3}$. [3]

x = _____

13 An isosceles triangle has two equal sides of $(2x + 3)$ cm and a base of $(x + 5)$ cm. Its perimeter is 46 cm. Find the length of each side. [3]

Sides _____

14 A rectangle's length is 4 cm more than its width. Its area is 96 cm². Find its perimeter. [4]

cm _____

15 Prove that the sum of any three consecutive whole numbers is a multiple of 3. [2]

Answer _____

KNOWLEDGE CHECK: SOLUTIONS

Check your method as well as your answer. In the exam, an answer with no working usually earns the final mark at most.

Q1 SECURING

✓ $x = 5$

Q2 SECURING

$3x + 12 = 27$, or divide by 3 first.

✓ $x = 5$

Q3 SECURING

$3x = 18$.

✓ $x = 6$

Q4 SECURING

$x + 5 = 12$.

✓ $x = 7$

Q5 SECURING

$4n - 9 = 31$.

✓ 10

Q6 EXTENDING

$6x + 4 = 34$, $x = 5$: 13 cm by 4 cm.

✓ 52 cm²

Q7 EXTENDING

$8x - 4 = 3x + 21$.

✓ $x = 5$

Q8 EXTENDING

$6x = 180$, $x = 30$: angles 50°, 60°, 70°.

✓ 70°

Q9 EXTENDING

× 12: $4(2x - 1) - 3(x + 2) = 12$, so $5x - 10 = 12$.

✓ $x = 4.4$

Q10 EXTENDING

He only multiplied the x by 3: $3(x - 2) = 3x - 6$.

✓ $x = 11$

Mastery solutions are in the Lab. Grades 8 and 9 are won on method, so a bare answer won't tell you much. Photograph or write your Mastery working in **Forensic Marking** and get it marked mark by mark, with the full solution and the mistake behind every lost mark. Your first marked question is free.

lab.mathsforensics.com/written/?sheet=CF-ALG-FORMEQ

Mark your evidence

Level	Marks	My score	Secured? (every mark)
Securing	11		☐
Extending	15		☐
Mastery	16		☐

R · Reading
Misread or missed part of the question

M · Method
Didn't know how to do it

A · Accuracy
Knew how, slipped in the working

Write R, M or A next to every mark you lost. Mostly R or A? The fix is technique, not more practice of the topic.

CASE CLOSED: FORMING AND SOLVING EQUATIONS

In this case file you've learned to:

- Solve linear equations with brackets, fractions and unknowns on both sides.
- Form an equation from words or a diagram, defining your letter.
- Answer the question asked, not just the value of x.
- Recognise when a problem gives a quadratic, and reject impossible answers.
- Write a short algebraic proof.

Because every case comes down to one principle: numbers don't lie.

YOUR NEXT ASSIGNMENT

Practise every GCSE topic in the Lab

New numbers every time, feedback that names the mistake behind each wrong answer, and handwritten working marked like an examiner. Start free.

https://www.mathsforensics.com/the-lab