Your notes

Level 2 Further Maths: revision notes

Simultaneous equations and quadratic inequalities

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Simultaneous equations

- Linear and non-linear: substitute the linear equation into the other. For $y = x + 1$ and $x^2 + y^2 = 13$: $x^2 + (x + 1)^2 = 13$ gives $2x^2 + 2x - 12 = 0$, so $x^2 + x - 6 = 0$ and $(x + 3)(x - 2) = 0$. The solutions are $x = 2$, $y = 3$ and $x = -3$, $y = -2$.
- Three unknowns: eliminate one unknown from two pairs of equations, then solve the two equations that are left.
- Example: $x + y + z = 6$, $2x - y + z = 3$ and $x + 2y - z = 2$. Adding the first and third gives $2x + 3y = 8$; adding the second and third gives $3x + y = 5$. Solving gives $x = 1$, $y = 2$ and $z = 3$.

Quadratics

- Solve by factorising, **completing the square** or the formula $x = (-b \pm \sqrt{(b^2 - 4ac)}) \div 2a$.
- **Completing the square**: $x^2 + 4x - 1 = 0$ becomes $(x + 2)^2 = 5$, so $x = -2 \pm \sqrt{5}$.
- The **discriminant** $b^2 - 4ac$ tells you the number of real roots: positive means two, zero means one (repeated) and negative means none.

Quadratic inequalities

- Find the **critical values** by solving the equation, sketch the graph, then read off the region.
- $x^2 - x - 6 < 0$: $(x - 3)(x + 2) < 0$. The curve is below the x-axis between the roots, so $-2 < x < 3$.
- $x^2 - x - 6 > 0$ gives two regions: $x < -2$ or $x > 3$.
- $x^2 \geq 9$ means $x \leq -3$ or $x \geq 3$. Don't just write $x \geq 3$.

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Key terms

Simultaneous equations	Equations that are true at the same time.
Critical values	The solutions of the equation used to solve an inequality.
Discriminant	$b^2 - 4ac$, which shows how many real roots a quadratic has.
Completing the square	Writing a quadratic in the form $(x + p)^2 + q$.
Quadratic inequality	An inequality involving x^2.

Quick questions

Cover the answers and test yourself: remembering is what makes it stick.

1. Solve $x^2 - x - 6 < 0$.
2. Solve $x^2 - 9 \geq 0$.
3. Solve $x + y + z = 6$, $2x - y + z = 3$ and $x + 2y - z = 2$.
4. How many real roots does $x^2 + 4x + 5 = 0$ have?
5. Solve $x^2 + 4x - 1 = 0$.
6. What is the discriminant of $ax^2 + bx + c$?
7. Solve $x^2 > 16$.
8. Solve $(x - 1)(x - 5) \leq 0$.

Answers

1. $-2 < x < 3$
2. $x \leq -3$ or $x \geq 3$
3. $x = 1$, $y = 2$, $z = 3$
4. None
5. $x = -2 \pm \sqrt{5}$
6. $b^2 - 4ac$
7. $x < -4$ or $x > 4$
8. $1 \leq x \leq 5$

What to do next

Practise 10 questions on this topic

Try 3 exam questions, with mark schemes

Read the lesson, one step at a time

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