

Exercise walk-through

# 2.5

## Inequalities and linear–quadratic pairs

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Pearson Edexcel · International GCSE · Mathematics A

# 1. Topic 2 at a glance

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Foundation rows 2.1-2.4 and 2.6-2.8 are shared; proportion (2.5) is Higher-only, and Higher extends to fractional indices, algebraic fractions, completing the square, proofs, linear-quadratic pairs and quadratic inequalities.

Must-know: index laws on one base; change the subject by balanced operations (powers need rooting); factor before cancelling;  $a(x + b)^2 + c$  exposes the vertex; critical values then the parabola's sign.

## 9. Inequalities and pairs

### Inequalities and pairs

Linear moves mirror equations except that multiplying by a negative flips the sign:

$7 - x \leq 5$  gives  $x \geq 2$ . June 2024 2HR Q20:  $6x^2 - 7x - 20 > 0$  factorises to

$(3x + 4)(2x - 5) > 0$  - positive outside the roots, so  $x < -\frac{4}{3}$  or  $x > \frac{5}{2}$ .

Linear-quadratic pairs substitute the line in:  $y = 2x - 11$  with  $x^2 + y^2 = 25$  gives  $5x^2 - 44x + 96 = 0$ , so  $(4.8, -1.4)$  and  $(4, -3)$  - both kept. Regions: test one point per boundary, shade what satisfies all.

# Check yourself

## Check yourself

Index laws on one base including fractional and negative powers; substitution, expansion (double and triple brackets) and factorising. Rearrange formulae including powers and subject-twice; set up and solve proportion models.

Exact simultaneous pairs by elimination; algebraic fractions factor-cancel-invert; recurring-decimal and identity proofs; complete the square and read vertex-form optima; solve quadratic inequalities with number-line sets; linear-quadratic pairs keeping both points.

## Exercises 2.1·2.3

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**2.1** Solve  $3x - 2 < 10$  and show the solution set on a number line. [2]

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**2.2** Solve  $7 - x \leq 5$  [2]

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**2.3** Solve  $3 < x + 2 \leq 5$  [2]

## Exercises 2.1·2.3

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**2.1** Solve  $3x - 2 < 10$  and show the solution set on a number line. [2]

**2.1**  $3x < 12$ , so  $x < 4$ : open circle at 4, arrow left.

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**2.2** Solve  $7 - x \leq 5$  [2]

**2.2**  $-x \leq -2$ , and dividing by  $-1$  flips the sign:  $x \geq 2$ .

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**2.3** Solve  $3 < x + 2 \leq 5$  [2]

**2.3** Subtract 2 throughout:  $1 < x \leq 3$ .

## Exercises 2.4·3.1

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**2.4** Write down the critical values of  $6x^2 - 7x - 20 = 0$  [3]

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**2.5** Solve  $y = 3x - 1$  and  $y = x + 3$  simultaneously. [2]

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**3.1** (*Edexcel 4MA1 2HR June 2024 Q20, adapted.*) Solve the inequality  $6x^2 - 7x - 20 > 0$  [4]

## Exercises 2.4·3.1

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**2.4** Write down the critical values of  $6x^2 - 7x - 20 = 0$  [3]

**2.4**  $(3x + 4)(2x - 5) = 0$ :  $x = -\frac{4}{3}$  or  $x = \frac{5}{2}$ .

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**2.5** Solve  $y = 3x - 1$  and  $y = x + 3$  simultaneously. [2]

**2.5**  $3x - 1 = x + 3$ , so  $x = 2$  and  $y = 5$ .

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**3.1** (*Edexcel 4MA1 2HR June 2024 Q20, adapted.*) Solve the inequality  $6x^2 - 7x - 20 > 0$  [4]

**3.1**  $(3x + 4)(2x - 5) > 0$ : critical values  $-\frac{4}{3}$  and  $\frac{5}{2}$ . The parabola opens upward, so it is positive outside the roots:  $x < -\frac{4}{3}$  or  $x > \frac{5}{2}$ .

## Exercises 3.2·3.3

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**3.2** (*Edexcel-style, specification example.*) Solve the simultaneous equations  $y = 2x - 11$  and  $x^2 + y^2 = 25$  [4]

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**3.3** (*Original.*) (a) Solve  $x^2 + 3x + 2 > 0$ . (b) Shade, on sketch axes, the region satisfying  $x \geq 0$ ,  $y \geq 1$  and  $x + y \leq 5$ , and write down the coordinates of the region's three vertices. [6]

## Exercises 3.2·3.3

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**3.2** (*Edexcel-style, specification example.*) Solve the simultaneous equations  $y = 2x - 11$  and  $x^2 + y^2 = 25$  [4]

**3.2** Substitute:  $x^2 + (2x - 11)^2 = 25$  gives  $x^2 + 4x^2 - 44x + 121 = 25$ , so  $5x^2 - 44x + 96 = 0$  and  $x = \frac{44 \pm \sqrt{1936 - 1920}}{10} = \frac{44 \pm 4}{10} = 4.8$  or  $4$ . With  $y = 2x - 11$ :  $(4.8, -1.4)$  and  $(4, -3)$ .

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**3.3** (*Original.*) (a) Solve  $x^2 + 3x + 2 > 0$ . (b) Shade, on sketch axes, the region satisfying  $x \geq 0$ ,  $y \geq 1$  and  $x + y \leq 5$ , and write down the coordinates of the region's three vertices. [6]

**3.3** (a)  $(x + 1)(x + 2) > 0$ : positive outside the roots, so  $x < -2$  or  $x > -1$ . (b) The boundaries  $x = 0$ ,  $y = 1$  and  $x + y = 5$  enclose a triangle with vertices  $(0, 1)$ ,  $(0, 5)$  and  $(4, 1)$ ; shade inside it.

Local review guidance: critical values before any inequality direction decision; strict vs non-strict notation matches the original sign; linear–quadratic pairs keep both solutions with both coordinates. This is authored classroom guidance.