

Name _____

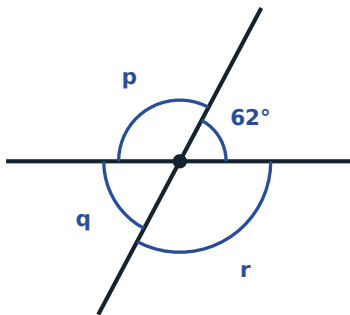
Date _____

5.2 Intersecting lines — worked answers

Recognise the properties of angles on intersecting lines, perpendicular lines, and parallel lines with a transversal. · 98 questions

A · Fluency — Read the crossing and find each angle.

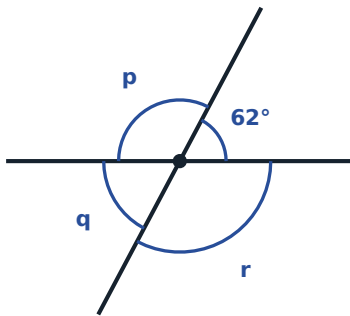
- 1 Two straight lines cross. Work out angle **q**, in degrees.



Answer: 62

q is **vertically opposite** the angle of 62° , and vertically opposite angles are equal, so $q = 62^\circ$.

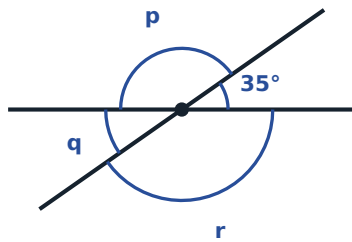
- 2 Two straight lines cross. Work out angle **p**, in degrees.



Answer: 118

p and the angle of 62° lie on a straight line, so $p = 180^\circ - 62^\circ = 118^\circ$.

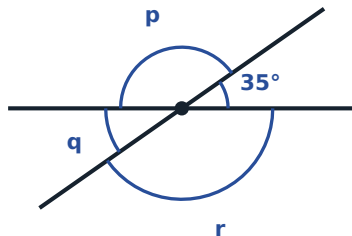
- 3 Two straight lines cross. Work out angle **q**, in degrees.



Answer: 35

q is **vertically opposite** the angle of 35° , and vertically opposite angles are equal, so $q = 35^\circ$.

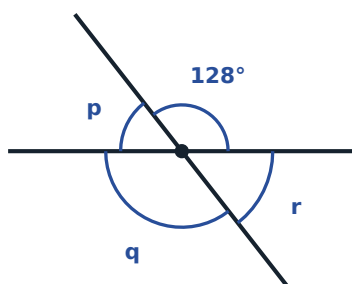
- 4 Two straight lines cross. Work out angle **p**, in degrees.



Answer: 145

p and the angle of 35° lie on a straight line, so $p = 180^\circ - 35^\circ = 145^\circ$.

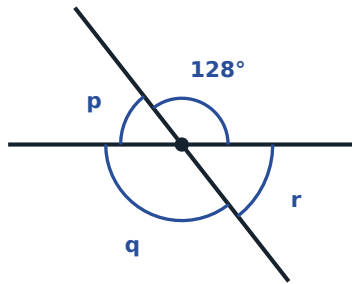
- 5 Two straight lines cross. Work out angle **q**, in degrees.



Answer: 128

q is **vertically opposite** the angle of 128° , and vertically opposite angles are equal, so $q = 128^\circ$.

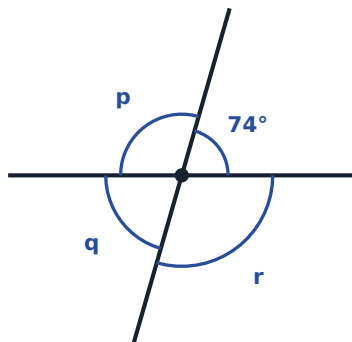
- 6 Two straight lines cross. Work out angle **p**, in degrees.



Answer: 52

p and the angle of 128° lie on a straight line, so $p = 180^\circ - 128^\circ = 52^\circ$.

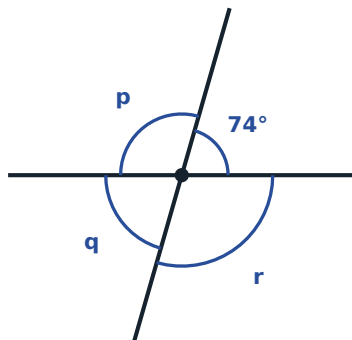
- 7 Two straight lines cross. Work out angle **q**, in degrees.



Answer: 74

q is **vertically opposite** the angle of 74° , and vertically opposite angles are equal, so $q = 74^\circ$.

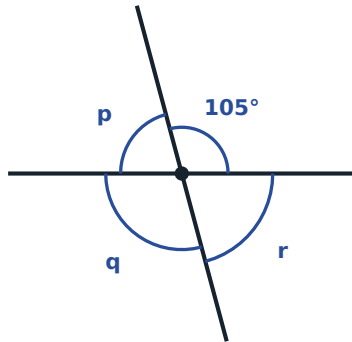
- 8 Two straight lines cross. Work out angle **p**, in degrees.



Answer: 106

p and the angle of 74° lie on a straight line, so $p = 180^\circ - 74^\circ = 106^\circ$.

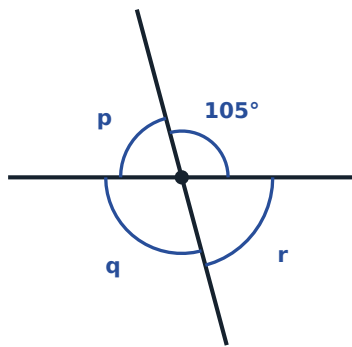
- 9 Two straight lines cross. Work out angle **q**, in degrees.



Answer: 105

q is **vertically opposite** the angle of 105° , and vertically opposite angles are equal, so $q = 105^\circ$.

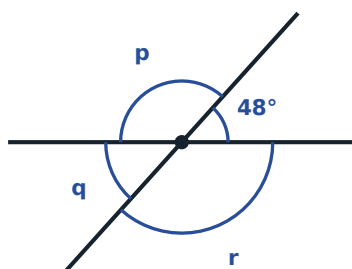
- 10 Two straight lines cross. Work out angle **p**, in degrees.



Answer: 75

p and the angle of 105° lie on a straight line, so $p = 180^\circ - 105^\circ = 75^\circ$.

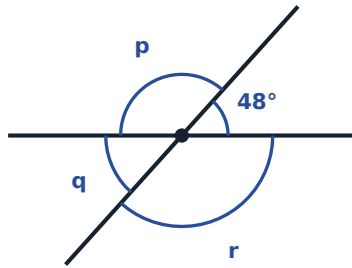
- 11 Two straight lines cross. Work out angle **q**, in degrees.



Answer: 48

q is **vertically opposite** the angle of 48° , and vertically opposite angles are equal, so $q = 48^\circ$.

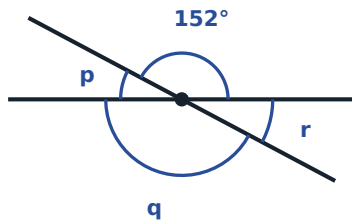
- 12** Two straight lines cross. Work out angle **p**, in degrees.



Answer: 132

p and the angle of 48° lie on a straight line, so $p = 180^\circ - 48^\circ = 132^\circ$.

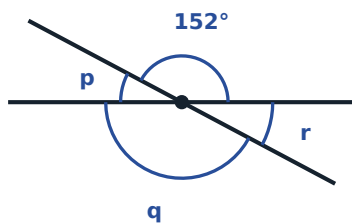
- 13** Two straight lines cross. Work out angle **q**, in degrees.



Answer: 152

q is **vertically opposite** the angle of 152° , and vertically opposite angles are equal, so $q = 152^\circ$.

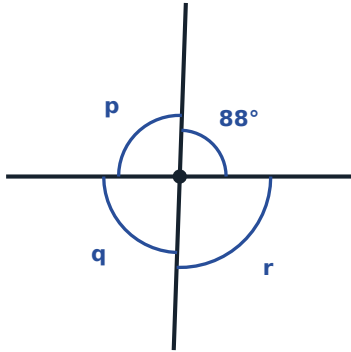
- 14** Two straight lines cross. Work out angle **p**, in degrees.



Answer: 28

p and the angle of 152° lie on a straight line, so $p = 180^\circ - 152^\circ = 28^\circ$.

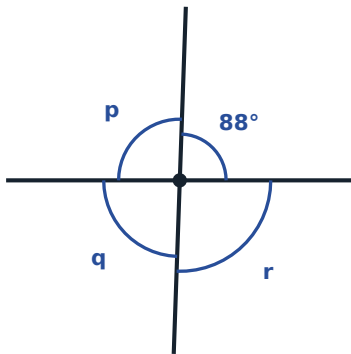
- 15 Two straight lines cross. Work out angle **q**, in degrees.



Answer: 88

q is **vertically opposite** the angle of 88° , and vertically opposite angles are equal, so $q = 88^\circ$.

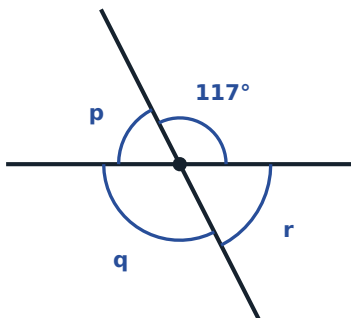
- 16 Two straight lines cross. Work out angle **p**, in degrees.



Answer: 92

p and the angle of 88° lie on a straight line, so $p = 180^\circ - 88^\circ = 92^\circ$.

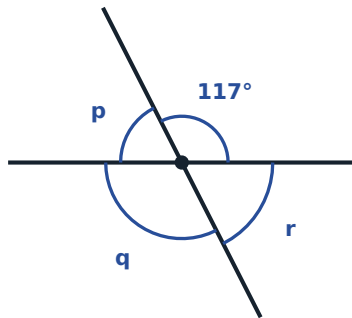
- 17 Two straight lines cross. Work out angle **q**, in degrees.



Answer: 117

q is **vertically opposite** the angle of 117° , and vertically opposite angles are equal, so $q = 117^\circ$.

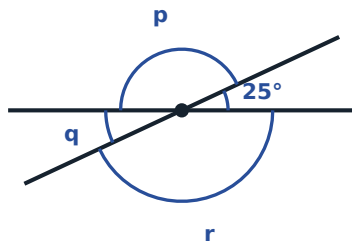
- 18 Two straight lines cross. Work out angle **p**, in degrees.



Answer: 63

p and the angle of 117° lie on a straight line, so $p = 180^\circ - 117^\circ = 63^\circ$.

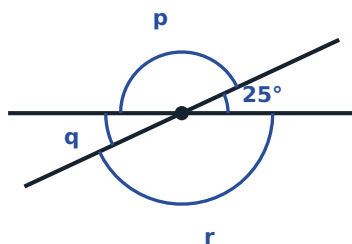
- 19 Two straight lines cross. Work out angle **q**, in degrees.



Answer: 25

q is **vertically opposite** the angle of 25° , and vertically opposite angles are equal, so $q = 25^\circ$.

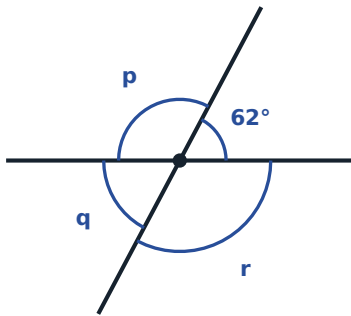
- 20 Two straight lines cross. Work out angle **p**, in degrees.



Answer: 155

p and the angle of 25° lie on a straight line, so $p = 180^\circ - 25^\circ = 155^\circ$.

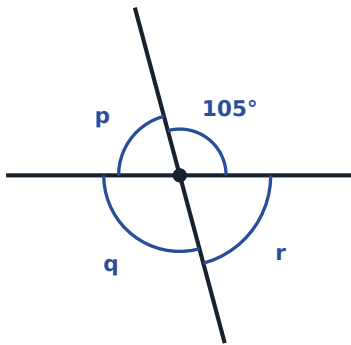
- 21 Two straight lines cross. Work out angle **r**, in degrees.



Answer: 118

r is vertically opposite **p**, and $p = 180^\circ - 62^\circ = 118^\circ$, so $r = 118^\circ$.

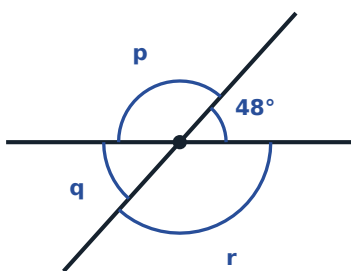
- 22 Two straight lines cross. Work out angle **r**, in degrees.



Answer: 75

r is vertically opposite **p**, and $p = 180^\circ - 105^\circ = 75^\circ$, so $r = 75^\circ$.

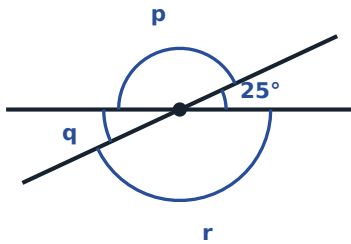
- 23 Two straight lines cross. Work out angle **r**, in degrees.



Answer: 132

r is vertically opposite **p**, and $p = 180^\circ - 48^\circ = 132^\circ$, so $r = 132^\circ$.

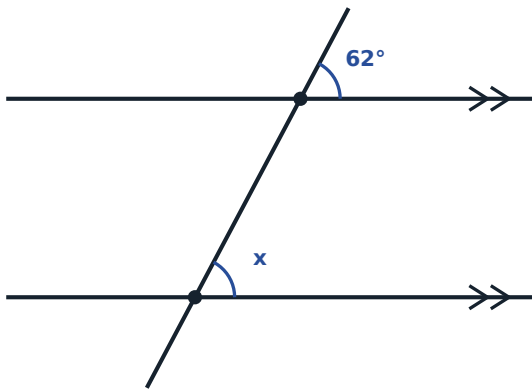
- 24 Two straight lines cross. Work out angle r , in degrees.



Answer: 155

r is vertically opposite p , and $p = 180^\circ - 25^\circ = 155^\circ$, so $r = 155^\circ$.

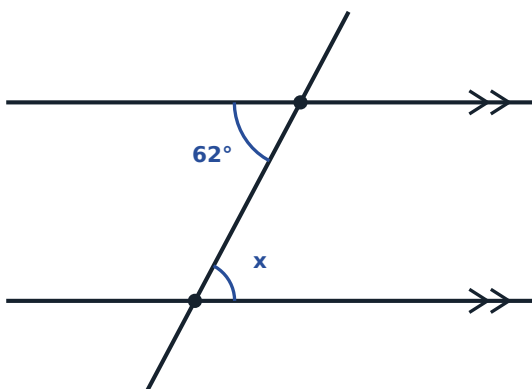
- 25 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 62

The marked angle and x are **corresponding angles**: the same position at each crossing (an F shape), so they are equal. So $x = 62^\circ$.

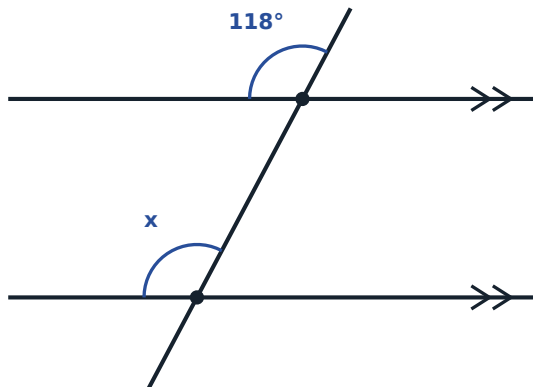
- 26 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 62

The marked angle and x are **alternate angles**: opposite sides of the transversal, between the parallel lines (a Z shape), so they are equal. So $x = 62^\circ$.

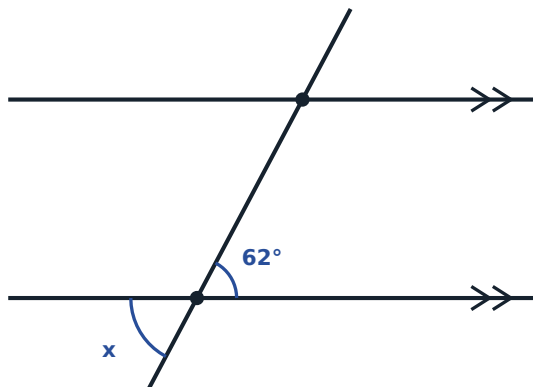
- 27 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 118

The marked angle and x are **corresponding angles**: the same position at each crossing, so they are equal. So $x = 118^\circ$.

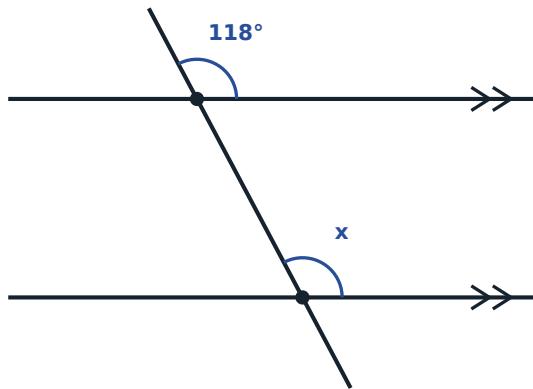
- 28 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 62

The marked angle and x are **vertically opposite angles**: directly opposite each other where the transversal crosses the second line, so they are equal. So $x = 62^\circ$.

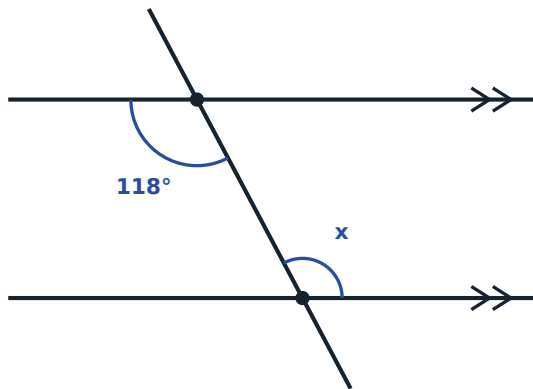
- 29 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 118

The marked angle and x are **corresponding angles**: the same position at each crossing (an F shape), so they are equal. So $x = 118^\circ$.

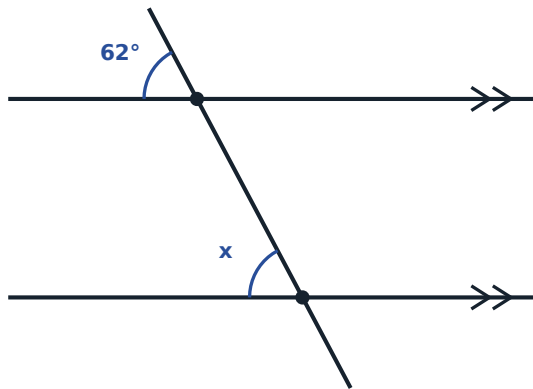
- 30 The two lines with arrows are parallel. Work out angle x , in degrees.



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The marked angle and x are **alternate angles**: opposite sides of the transversal, between the parallel lines (a Z shape), so they are equal. So $x = 118^\circ$.

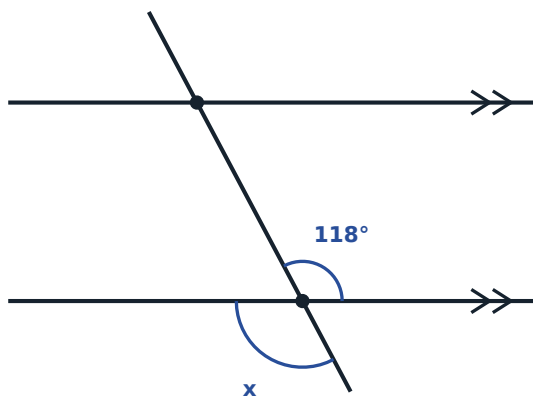
- 31 The two lines with arrows are parallel. Work out angle x , in degrees.



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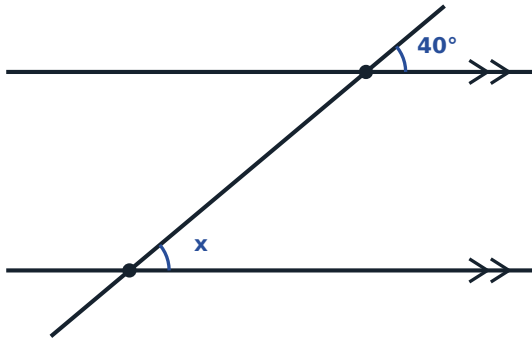
- 32 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 118

The marked angle and x are **vertically opposite angles**: directly opposite each other where the transversal crosses the second line, so they are equal. So $x = 118^\circ$.

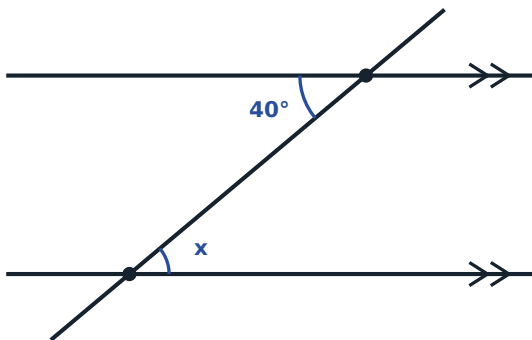
- 33 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 40

The marked angle and x are **corresponding angles**: the same position at each crossing (an F shape), so they are equal. So $x = 40^\circ$.

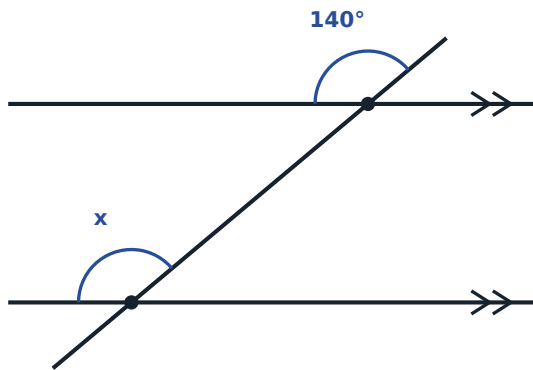
- 34 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 40

The marked angle and x are **alternate angles**: opposite sides of the transversal, between the parallel lines (a Z shape), so they are equal. So $x = 40^\circ$.

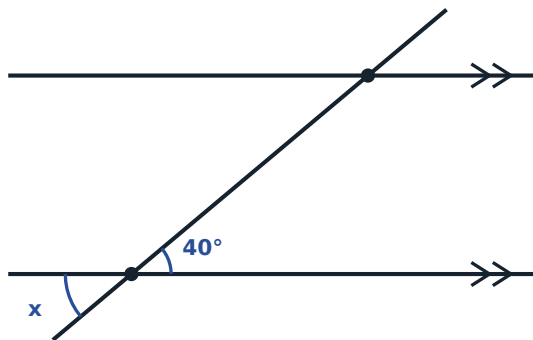
- 35 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 140

The marked angle and x are **corresponding angles**: the same position at each crossing, so they are equal. So $x = 140^\circ$.

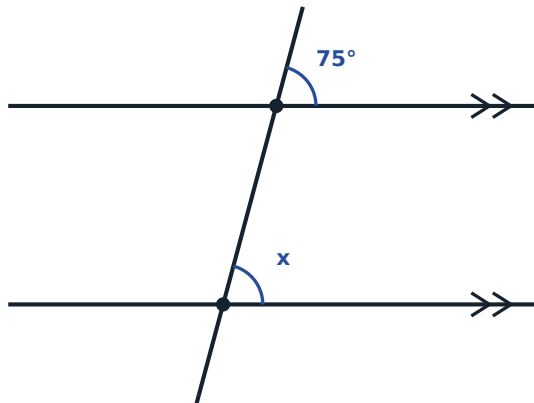
- 36 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 40

The marked angle and x are **vertically opposite angles**: directly opposite each other where the transversal crosses the second line, so they are equal. So $x = 40^\circ$.

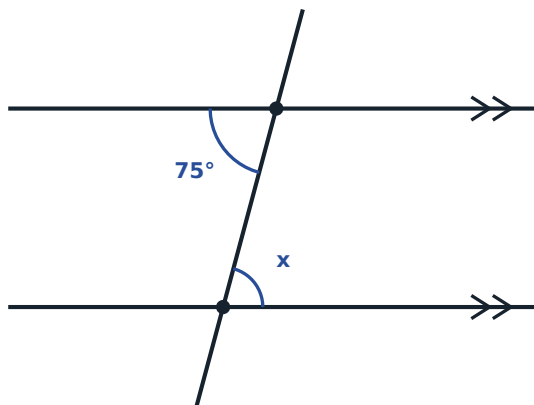
- 37 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 75

The marked angle and x are **corresponding angles**: the same position at each crossing (an F shape), so they are equal. So $x = 75^\circ$.

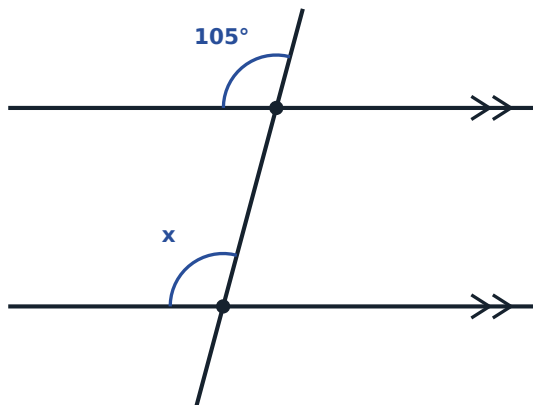
- 38 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 75

The marked angle and x are **alternate angles**: opposite sides of the transversal, between the parallel lines (a Z shape), so they are equal. So $x = 75^\circ$.

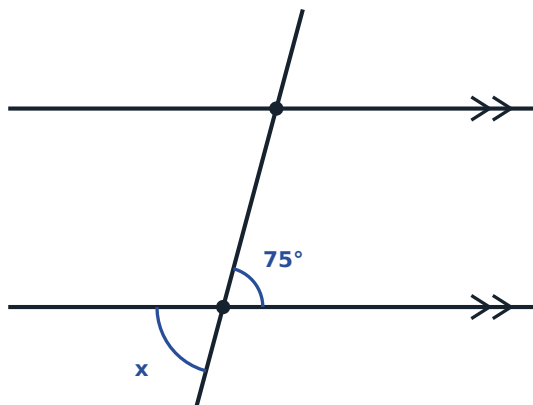
- 39 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 105

The marked angle and x are **corresponding angles**: the same position at each crossing, so they are equal. So $x = 105^\circ$.

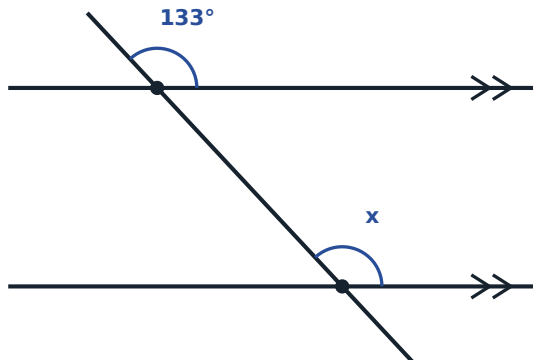
- 40 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 75

The marked angle and x are **vertically opposite angles**: directly opposite each other where the transversal crosses the second line, so they are equal. So $x = 75^\circ$.

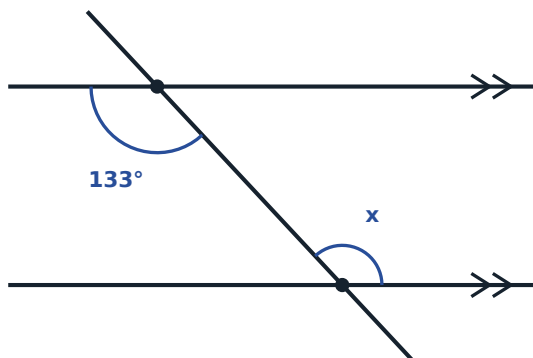
- 41 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 133

The marked angle and x are **corresponding angles**: the same position at each crossing (an F shape), so they are equal. So $x = 133^\circ$.

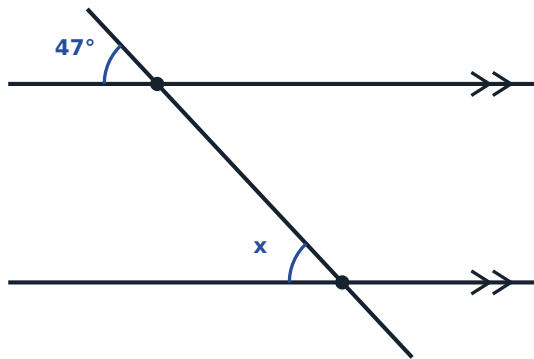
- 42 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 133

The marked angle and x are **alternate angles**: opposite sides of the transversal, between the parallel lines (a Z shape), so they are equal. So $x = 133^\circ$.

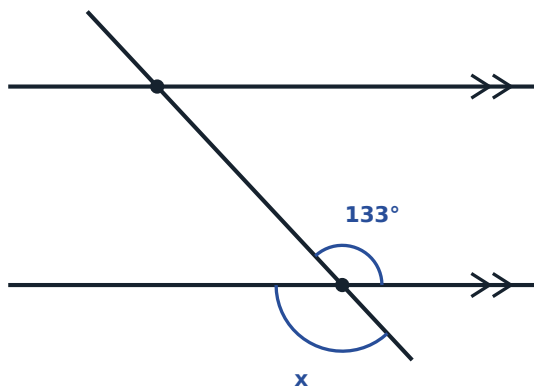
- 43** The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 47

The marked angle and x are **corresponding angles**: the same position at each crossing, so they are equal. So $x = 47^\circ$.

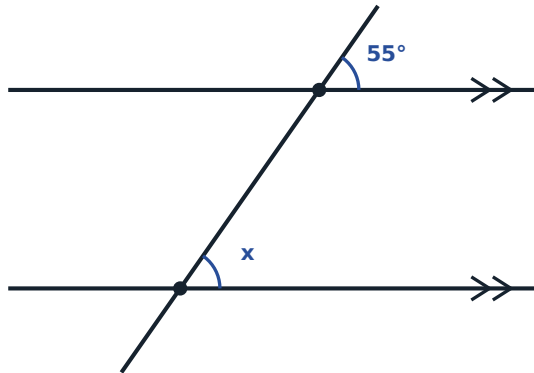
- 44** The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 133

The marked angle and x are **vertically opposite angles**: directly opposite each other where the transversal crosses the second line, so they are equal. So $x = 133^\circ$.

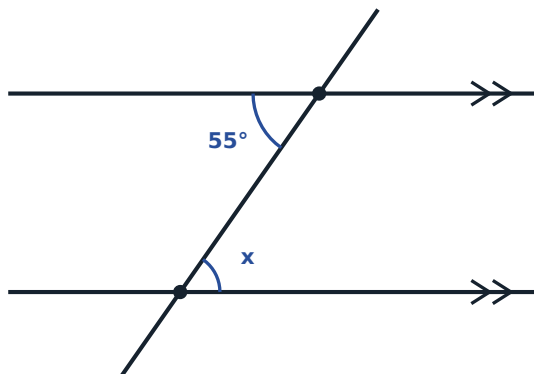
- 45 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 55

The marked angle and x are **corresponding angles**: the same position at each crossing (an F shape), so they are equal. So $x = 55^\circ$.

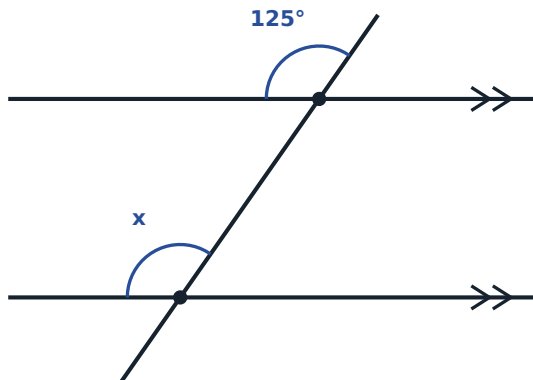
- 46 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 55

The marked angle and x are **alternate angles**: opposite sides of the transversal, between the parallel lines (a Z shape), so they are equal. So $x = 55^\circ$.

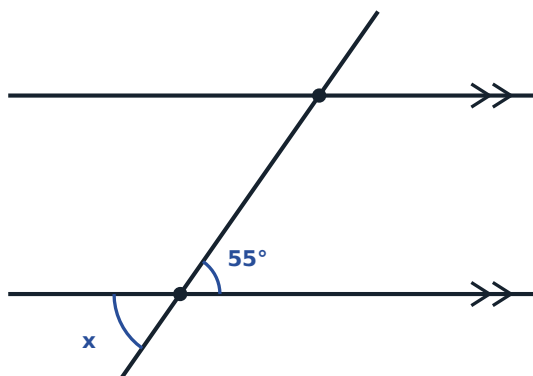
- 47 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 125

The marked angle and x are **corresponding angles**: the same position at each crossing, so they are equal. So $x = 125^\circ$.

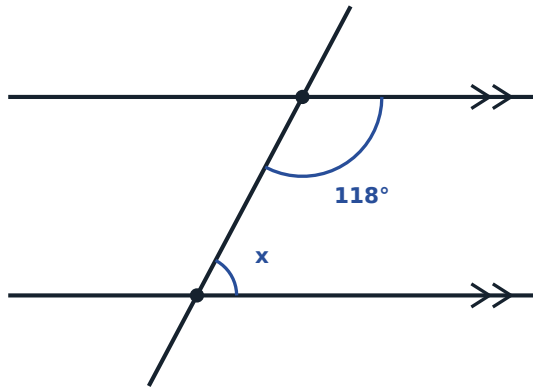
- 48 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 55

The marked angle and x are **vertically opposite angles**: directly opposite each other where the transversal crosses the second line, so they are equal. So $x = 55^\circ$.

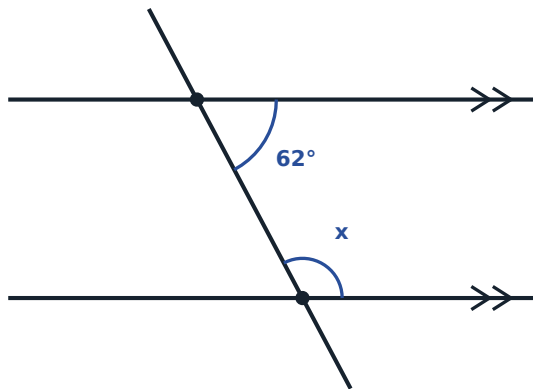
- 49 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 62

These two angles are **co-interior** (a C shape): they lie between the parallel lines on the same side of the transversal, so they add to 180° . $x = 180^\circ - 118^\circ = 62^\circ$.

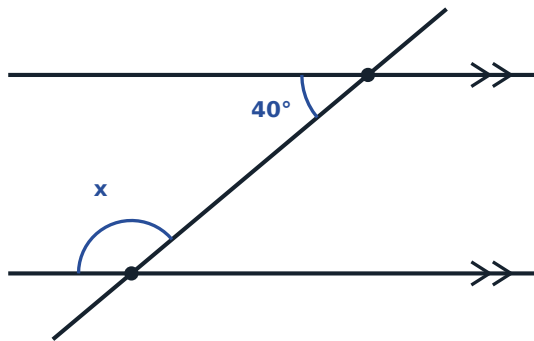
- 50 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 118

These two angles are **co-interior** (a C shape): they lie between the parallel lines on the same side of the transversal, so they add to 180° . $x = 180^\circ - 62^\circ = 118^\circ$.

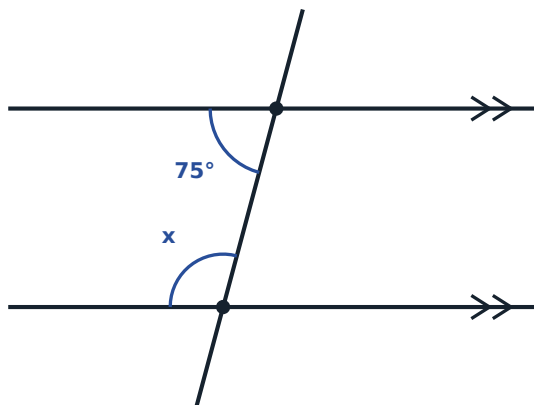
- 51 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 40

These two angles are **co-interior** (a C shape): they lie between the parallel lines on the same side of the transversal, so they add to 180° . $x = 180^\circ - 40^\circ = 140^\circ$.

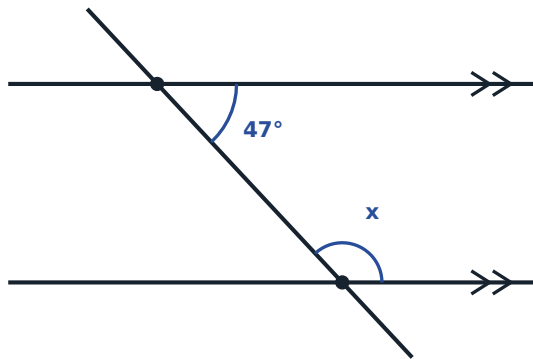
- 52 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 75

These two angles are **co-interior** (a C shape): they lie between the parallel lines on the same side of the transversal, so they add to 180° . $x = 180^\circ - 75^\circ = 105^\circ$.

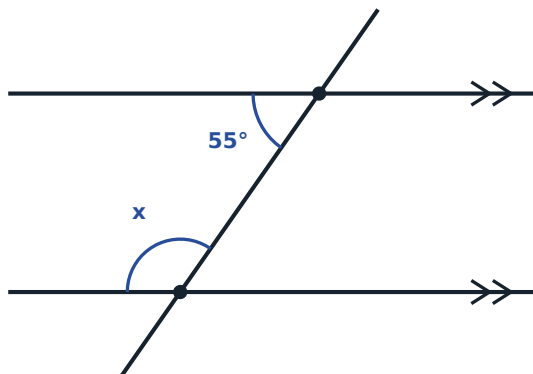
- 53 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 133

These two angles are **co-interior** (a C shape): they lie between the parallel lines on the same side of the transversal, so they add to 180° . $x = 180^\circ - 47^\circ = 133^\circ$.

- 54 The two lines with arrows are parallel. Work out angle x , in degrees.



Answer: 55

These two angles are **co-interior** (a C shape): they lie between the parallel lines on the same side of the transversal, so they add to 180° . $x = 180^\circ - 55^\circ = 125^\circ$.

B · Reasoning — The properties, and why they hold.

- 55 When two straight lines cross, what is true of the angles opposite each other?

- ☐ They add to 180°
- ☐ They are equal
- ☐ They add to 360°
- ☐ One is always 90°

Answer: They are equal

Angles opposite each other at a crossing are called **vertically opposite** angles, and they are always equal.

56 Why are vertically opposite angles equal?

- ☐ Because the lines are the same length
- ☐ Because each of them is 180° minus the same angle
- ☐ Because they look the same
- ☐ Because a full turn is 360°

Answer: Because each of them is 180° minus the same angle

If one angle is a° , the angle next to it is $180^\circ - a$. The angle next to *that* is $180^\circ - (180^\circ - a) = a$ again.

57 Two lines cross. One angle is 70° . What is the angle vertically opposite it, in degrees?

Answer: 70

Vertically opposite angles are equal.

58 Two lines cross. One angle is 70° . What is the angle next to it on the straight line, in degrees?

Answer: 110

$180^\circ - 70^\circ = 110^\circ$.

59 Two lines cross so that one angle is 90° . How big is each of the other three angles, in degrees?

Answer: 90

$180^\circ - 90^\circ = 90^\circ$, and the opposite angles are equal too. The lines are **perpendicular**.

60 What does it mean for two lines to be perpendicular?

- ☐ They never meet
- ☐ They meet at 90°
- ☐ They are the same length
- ☐ They are parallel

Answer: They meet at 90°

Perpendicular lines cross at a right angle.

61 What does it mean for two lines to be parallel?

- ☐ They meet at 90°
- ☐ They always stay the same distance apart and never meet
- ☐ They are the same length
- ☐ They cross once

Answer: They always stay the same distance apart and never meet

Parallel lines are marked with matching arrows on a diagram.

62 A straight line crossing a pair of parallel lines is called a ...

- ☐ diagonal
- ☐ transversal
- ☐ perpendicular
- ☐ bisector

Answer: transversal

The transversal creates equal corresponding and alternate angles.

63 On parallel lines cut by a transversal, corresponding angles are ...

- ☐ equal
- ☐ supplementary
- ☐ always 90°
- ☐ unrelated

Answer: equal

Corresponding angles sit in matching positions, in an F shape.

- 64** On parallel lines cut by a transversal, alternate angles are ...

- ☐ equal
- ☐ supplementary
- ☐ always 90°
- ☐ unrelated

Answer: equal

Alternate angles sit on opposite sides of the transversal, in a Z shape.

- 65** Parallel lines are crossed by a transversal. One angle is 65° . What is the corresponding angle, in degrees?

Answer: 65

Corresponding angles on parallel lines are equal.

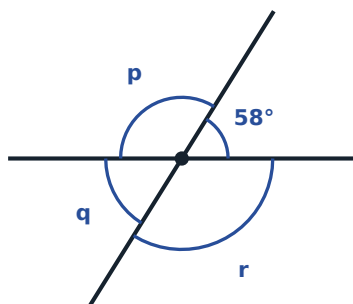
- 66** Parallel lines are crossed by a transversal. One angle is 65° . What is the angle next to it on the same straight line, in degrees?

Answer: 115

$180^\circ - 65^\circ = 115^\circ$.

C · Challenge — Algebra and ratios at a crossing.

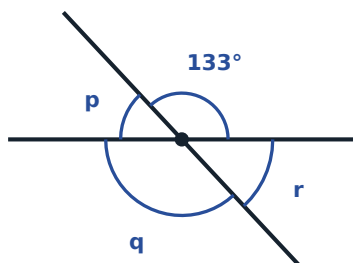
- 67** Two straight lines cross. Work out $p + q$, in degrees.



Answer: 180

$p = 180^\circ - 58^\circ = 122^\circ$ and $q = 58^\circ$, so $p + q = 180^\circ$. They lie on a straight line, so the total is always 180° whatever the angle is.

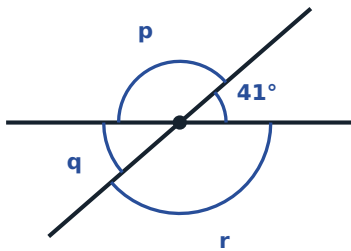
- 68** Two straight lines cross. Work out $p + q$, in degrees.



Answer: 180

$p = 180^\circ - 133^\circ = 47^\circ$ and $q = 133^\circ$, so $p + q = 180^\circ$. They lie on a straight line, so the total is always 180° whatever the angle is.

- 69 Two straight lines cross. Work out $p + q$, in degrees.



Answer: 180

$p = 180^\circ - 41^\circ = 139^\circ$ and $q = 41^\circ$, so $p + q = 180^\circ$. They lie on a straight line, so the total is always 180° whatever the angle is.

- 70 Two lines cross. One of the four angles is 4 times another. What is the smaller of those two angles, in degrees?

Answer: 36

The two angles lie on a straight line, so $x + 4x = 180$, $5x = 180$ and $x = 36^\circ$.

- 71 Two lines cross so that two of the angles are equal. How big is each, in degrees?

Answer: 90

Angles on a straight line: $x + x = 180$, so $x = 90^\circ$. The lines are perpendicular.

- 72 Two lines cross. One angle is $(2x + 10)^\circ$ and the angle vertically opposite is 70° . What is x ?

Answer: 30

Vertically opposite angles are equal, so $2x + 10 = 70$, $2x = 60$ and $x = 30$.

- 73 Three straight lines all pass through one point, making 6 angles. If all 6 are equal, how big is each, in degrees?

Answer: 60

$360^\circ \div 6 = 60^\circ$.

- 74 Parallel lines are crossed by a transversal. One angle is $(3x)^\circ$ and the corresponding angle is 75° . What is x ?

Answer: 25

Corresponding angles are equal, so $3x = 75$ and $x = 25$.

- 75 Parallel lines are crossed by a transversal. Two co-interior angles are $(2x)^\circ$ and $(3x)^\circ$. What is x ?

Answer: 36

Co-interior angles add to 180° , so $5x = 180$ and $x = 36$.

- 76 Two lines cross. One angle is $(5x - 20)^\circ$ and the angle next to it on the straight line is $(3x)^\circ$. What is x ?

Answer: 25

They add to 180° : $5x - 20 + 3x = 180$, so $8x = 200$ and $x = 25$.

- 77 Two lines cross so that one angle is 5 times another. What is the larger of those two angles, in degrees?

Answer: 150

$x + 5x = 180$, so $x = 30^\circ$ and the larger is 150° .

- 78** Four straight lines pass through one point, making 8 equal angles. How big is each, in degrees?

Answer: 45

$$360^\circ \div 8 = 45^\circ.$$

- 79** Parallel lines are crossed by a transversal at 65° . What is the sum of the two co-interior angles on one side, in degrees?

Answer: 180

Co-interior angles always add to 180° , whatever the transversal angle is: $65 + 115 = 180$.

- 80** Two lines cross. The four angles are x° , y° , x° and y° , and x is 40 more than y . What is x ?

Answer: 110

$$x + y = 180 \text{ and } x = y + 40, \text{ so } 2y + 40 = 180, y = 70 \text{ and } x = 110.$$

D · Word problems — Crossings in the real world.

- 81** Two roads cross. One of the angles between them is 55° . What is the angle directly opposite it, in degrees?

Answer: 55

Vertically opposite angles are equal.

- 82** Two roads cross at 55° . What is the angle next to it, in degrees?

Answer: 125

$$180^\circ - 55^\circ = 125^\circ.$$

- 83** A ladder leans against a wall at 72° to the ground. What angle does it make with the ground on the other side, in degrees?

Answer: 108

$$180^\circ - 72^\circ = 108^\circ.$$

- 84** Railway tracks are parallel. A sleeper crosses them at 80° . What is the corresponding angle at the second rail, in degrees?

Answer: 80

Corresponding angles on parallel lines are equal.

- 85** A path crosses two parallel hedges. The angle at the first hedge is 115° . What is the alternate angle at the second hedge, in degrees?

Answer: 115

Alternate angles on parallel lines are equal.

- 86** Scissors open so that the blades cross at 35° . What is the angle between the handles, in degrees?

Answer: 35

The handles are vertically opposite the blades, so the angle is the same.

- 87** A kite string crosses a fence at 48° . What is the angle on the other side of the fence, in degrees?

Answer: 132

$$180^\circ - 48^\circ = 132^\circ.$$

- 88** Two mirrors meet at 90° . Are they perpendicular? Answer 1 for yes, 0 for no.

Answer: 1

Lines that meet at a right angle are perpendicular.

- 89** A road crosses a river at 62° . A second road runs parallel to the first. At what angle does it cross the river, in degrees?

Answer: 62

Parallel lines make equal corresponding angles with the same crossing line.

- 90** A pair of chopsticks cross at 24° . What is the largest of the four angles they make, in degrees?

Answer: 156

$180^\circ - 24^\circ = 156^\circ$.

- 91** A window has two perpendicular bars. What is the angle between them, in degrees?

Answer: 90

Perpendicular means meeting at a right angle.

- 92** Two paths cross so that one angle is twice another. What is the larger angle, in degrees?

Answer: 120

$x + 2x = 180$, so $x = 60^\circ$ and the larger angle is 120° .

- 93** A zebra crossing's stripes are parallel. A kerb crosses them at 73° . What is the corresponding angle at the next stripe, in degrees?

Answer: 73

Corresponding angles on parallel lines are equal.

- 94** A ladder rests on parallel steps. The angle at the top step is 125° . What is the alternate angle at the bottom step, in degrees?

Answer: 125

Alternate angles on parallel lines are equal.

- 95** Two parallel shelves are joined by a diagonal brace. The brace makes an angle of 58° with the top shelf on one side. What is the co-interior angle at the bottom shelf, in degrees?

Answer: 122

Co-interior angles add to 180° : $180 - 58 = 122^\circ$.

- 96** A road crosses a railway at 90° . What is each of the other three angles, in degrees?

Answer: 90

The lines are perpendicular.

- 97** A pair of open scissors makes an angle of 28° between the blades. What is the angle between a blade and a handle, in degrees?

Answer: 152

They lie on a straight line: $180 - 28 = 152^\circ$.

- 98** Two guy ropes cross. One of the four angles is 47° . What is the sum of the two angles next to it, in degrees?

Answer: 266

Each is $180 - 47 = 133^\circ$, and $2 \times 133 = 266^\circ$.