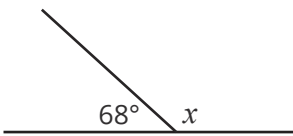
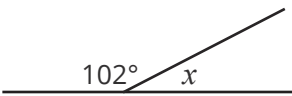
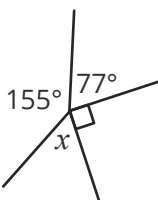
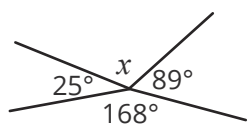
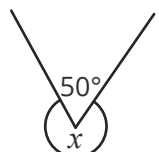
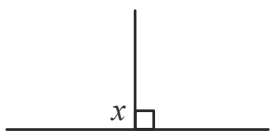
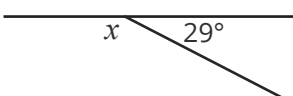
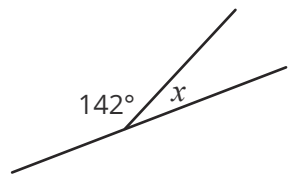
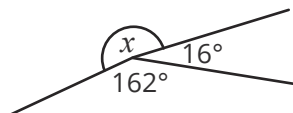
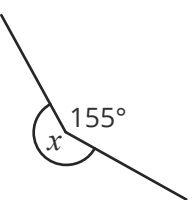
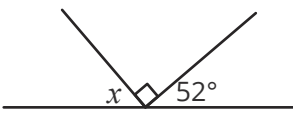
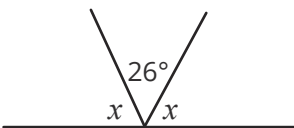
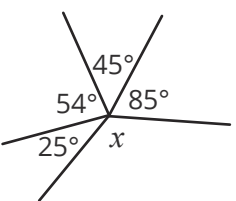
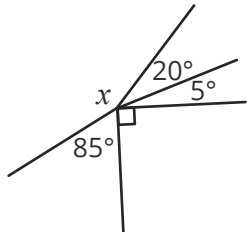


# Angles Code Breaker

Calculate the value of  $x$  in each question. Find the answer in the code given then unscramble the letters to reveal a mathematical word.

38°	108°	42°	77°	90°	101°	31°	25°	160°	56°	62°	78°	88°	119°	99°	37°	205°	151°	112°	310°	182°	275°	144°	200°	32°	64°
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

<p>1.</p> 	<p>2.</p> 	<p>3.</p> 	<p>4.</p> 	<p>5.</p> 	<p>6.</p> 
<p>7.</p> 	<p>8.</p> 	<p>9.</p> 	<p>10.</p> 	<p>11.</p> 	<p>12.</p> 
<p>13.</p> 	<p>14.</p> 	<p>Mathematical word: _____</p> <p>Definition of mathematical word: _____</p> <p>_____</p> <p>_____</p>			

# Angles Code Breaker Answers

Calculate the value of  $x$  in each question. Find the answer in the code given then unscramble the letters to reveal a mathematical word.

38°	108°	42°	77°	90°	101°	31°	25°	160°	56°	62°	78°	88°	119°	99°	37°	205°	151°	112°	310°	182°	275°	144°	200°	32°	64°
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

1.  $180 - 68 = 112^\circ$

S

10.  $360 - 155 = 205^\circ$

Q

2.  $180 - 102 = 78^\circ$

L

11.  $180 - 90 - 52 = 38^\circ$

A

3.  $360 - 155 - 90 - 77 = 38^\circ$

A

12.  $180 - 26 = 154$

$154 \div 2 = 77^\circ$

D

4.  $360 - 168 - 89 - 25 = 78^\circ$

L

13.  $360 - 85 - 54 - 45 - 25 = 151^\circ$

R

5.  $360 - 50 = 310^\circ$

T

14.  $360 - 90 - 85 - 20 - 5 = 160^\circ$

I

6.  $180 - 90 = 90^\circ$

E

7.  $180 - 29 = 151^\circ$

R

8.  $180 - 142 = 38^\circ$

A

9.  $360 - 162 - 16 = 182^\circ$

U

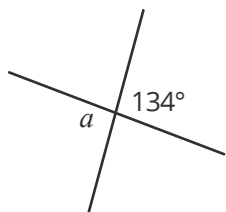
Mathematical word: **Quadrilaterals**

Definition of mathematical word: **A quadrilateral is a polygon that has four sides.**

## Vertically Opposite Angles - Bronze

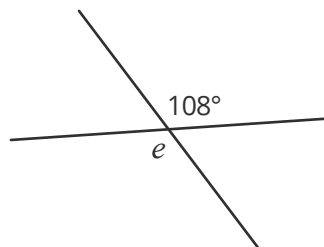
Solve the clues to find the four-digit code to escape the classroom!

1. Find the size of the missing angle marked  $a$ .



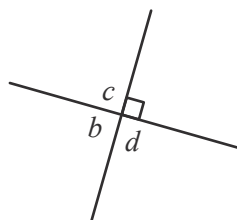
*Not drawn accurately.*

3. Find the size of the missing angle marked  $e$ .



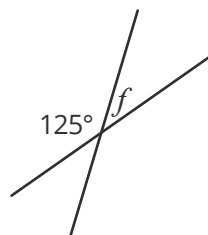
*Not drawn accurately.*

2. Find the size of the missing angles marked  $b$ ,  $c$  and  $d$ .



*Not drawn accurately.*

4. Find the size of the missing angle marked  $f$ .



*Not drawn accurately.*

The first digit of the code is given by the value of the hundreds digit for angle  $a$ . The second digit is given by the value of the units for angle  $b$ . The third digit is given by the sum of all the digits for angle  $e$ . The fourth digit is given by the value of the units for angle  $f$ .

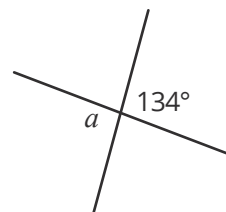
Exit Code:



## Vertically Opposite Angles - Bronze

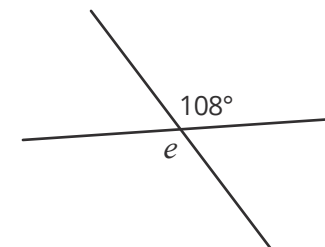
Solve the clues to find the four-digit code to escape the classroom!

1. Find the size of the missing angle marked  $a$ .



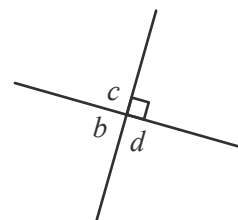
*Not drawn accurately.*

3. Find the size of the missing angle marked  $e$ .



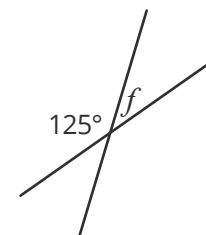
*Not drawn accurately.*

2. Find the size of the missing angles marked  $b$ ,  $c$  and  $d$ .



*Not drawn accurately.*

4. Find the size of the missing angle marked  $f$ .



*Not drawn accurately.*

The first digit of the code is given by the value of the hundreds digit for angle  $a$ . The second digit is given by the value of the units for angle  $b$ . The third digit is given by the sum of all the digits for angle  $e$ . The fourth digit is given by the value of the units for angle  $f$ .

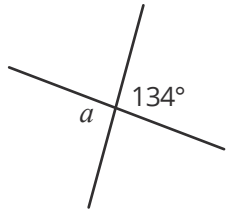
Exit Code:



# Vertically Opposite Angles - Bronze **Answers**

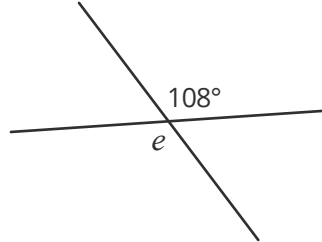
Solve the clues to find the four-digit code to escape the classroom!

1. Find the size of the missing angle marked  $a$ .



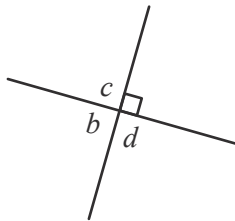
*Not drawn accurately.*

3. Find the size of the missing angle marked  $e$ .



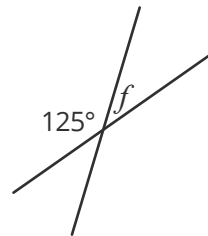
*Not drawn accurately.*

2. Find the size of the missing angles marked  $b$ ,  $c$  and  $d$ .



*Not drawn accurately.*

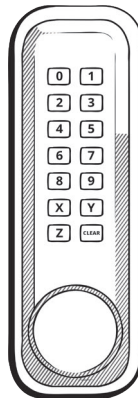
4. Find the size of the missing angle marked  $f$ .



*Not drawn accurately.*

The first digit of the code is given by the value of the hundreds digit for angle  $a$ . The second digit is given by the value of the units for angle  $b$ . The third digit is given by the sum of all the digits for angle  $e$ . The fourth digit is given by the value of the units for angle  $f$ .

Exit Code: **1** **0** **9** **5**



1.  $a = 134^\circ$

3.  $e = 108^\circ$

2.  $b = 90^\circ$

$c = 90^\circ$

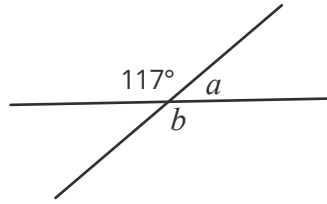
$d = 90^\circ$

4.  $f = 55^\circ$

# Vertically Opposite Angles - Gold

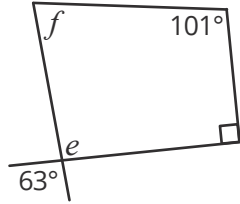
Solve the clues to find the four-digit code to escape the classroom!

1. Find the size of the missing angles marked  $a$  and  $b$ .



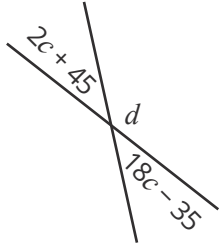
*Not drawn accurately.*

3. Find the size of the missing angles marked  $e$  and  $f$ .



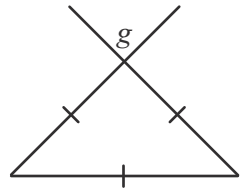
*Not drawn accurately.*

2. Find the size of the missing angle marked  $d$ .



*Not drawn accurately.*

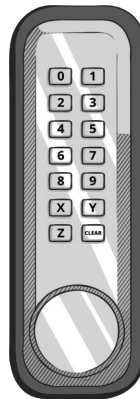
4. Find the size of the missing angle marked  $g$ .



*Not drawn accurately.*

The first digit of the code is given by the value of the units for angle  $a$ . The second digit is given by the value of the hundreds for angle  $d$ . The third digit is given by the value of the units for angle  $f$ . The fourth digit is given by the value of the units for angle  $g$ .

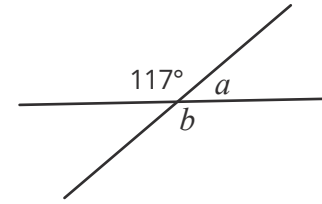
Exit Code:



# Vertically Opposite Angles - Gold

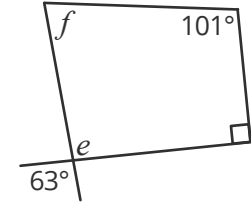
Solve the clues to find the four-digit code to escape the classroom!

1. Find the size of the missing angles marked  $a$  and  $b$ .



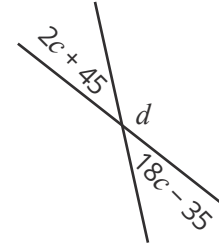
*Not drawn accurately.*

3. Find the size of the missing angles marked  $e$  and  $f$ .



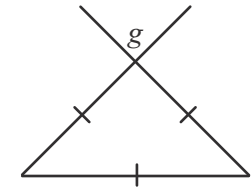
*Not drawn accurately.*

2. Find the size of the missing angle marked  $d$ .



*Not drawn accurately.*

4. Find the size of the missing angle marked  $g$ .



*Not drawn accurately.*

The first digit of the code is given by the value of the units for angle  $a$ . The second digit is given by the value of the hundreds for angle  $d$ . The third digit is given by the value of the units for angle  $f$ . The fourth digit is given by the value of the units for angle  $g$ .

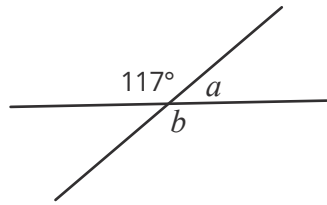
Exit Code:



# Vertically Opposite Angles - Gold Answers

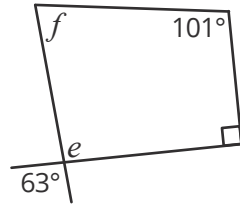
Solve the clues to find the four-digit code to escape the classroom!

1. Find the size of the missing angles marked  $a$  and  $b$ .



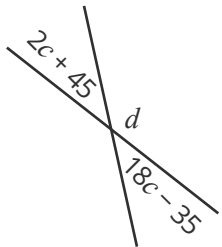
*Not drawn accurately.*

3. Find the size of the missing angles marked  $e$  and  $f$ .



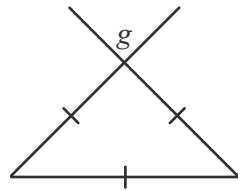
*Not drawn accurately.*

2. Find the size of the missing angle marked  $d$ .



*Not drawn accurately.*

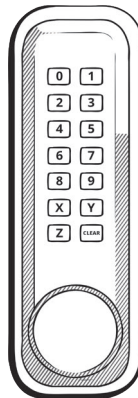
4. Find the size of the missing angle marked  $g$ .



*Not drawn accurately.*

The first digit of the code is given by the value of the units for angle  $a$ . The second digit is given by the value of the hundreds for angle  $d$ . The third digit is given by the value of the units for angle  $f$ . The fourth digit is given by the value of the units for angle  $g$ .

Exit Code: **3 1 6 0**



1.  $a = 63^\circ$

$b = 117^\circ$

3.  $e = 63^\circ$

$$f = 360 - 101 - 90 - 63$$

$$= 106^\circ$$

2.  $2c + 45 = 18c - 35$

$16c = 80$

$c = 5$

$2 \times 5 + 45 = 55^\circ$

$18 \times 5 - 35 = 55^\circ$

$$d = (360 - 55 - 55) \div 2$$

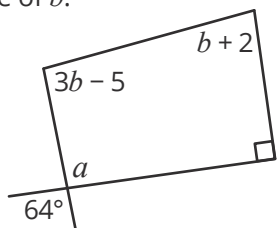
$$= 125^\circ$$

4.  $g = 60^\circ$

## Vertically Opposite Angles - Platinum

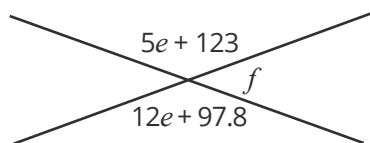
Solve the clues to find the four-digit code to escape the classroom!

1. Find the size of the missing angle marked  $a$ . Use this to calculate the value of  $b$ .



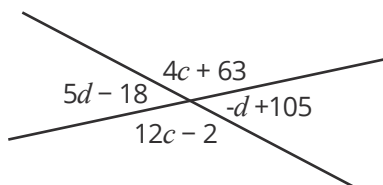
*Not drawn accurately.*

3. Find the size of the missing angle marked  $f$ .



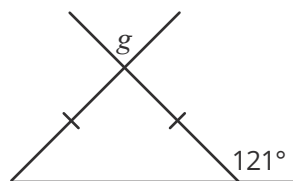
*Not drawn accurately.*

2. Calculate the missing angles.



*Not drawn accurately.*

4. Find the size of the missing angle marked  $g$ .



*Not drawn accurately.*

The first digit of the code is given by the value of the tenths for  $b$ . The second digit is given by the value of the units for angle  $f$ . The third digit and fourth digit are given by the value of both digits for angle  $g$ .

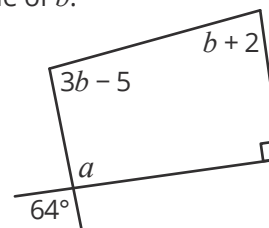
Exit Code:


## Vertically Opposite Angles - Platinum

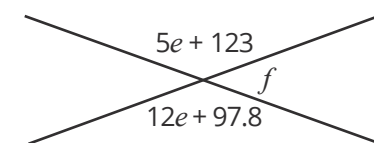
Solve the clues to find the four-digit code to escape the classroom!

1. Find the size of the missing angle marked  $a$ . Use this to calculate the value of  $b$ .



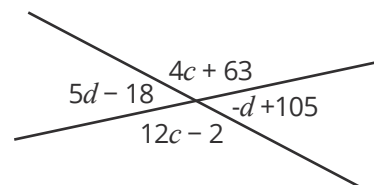
*Not drawn accurately.*

3. Find the size of the missing angle marked  $f$ .



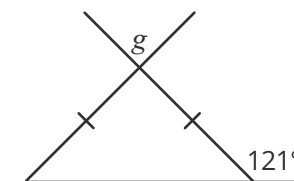
*Not drawn accurately.*

2. Calculate the missing angles.



*Not drawn accurately.*

4. Find the size of the missing angle marked  $g$ .



*Not drawn accurately.*

The first digit of the code is given by the value of the tenths for  $b$ . The second digit is given by the value of the units for angle  $f$ . The third digit and fourth digit are given by the value of both digits for angle  $g$ .

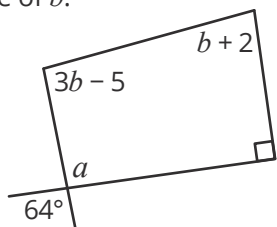
Exit Code:


## Vertically Opposite Angles - Platinum Answers

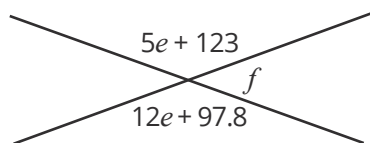
Solve the clues to find the four-digit code to escape the classroom!

1. Find the size of the missing angle marked  $a$ . Use this to calculate the value of  $b$ .



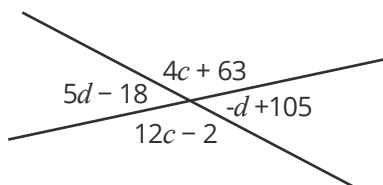
*Not drawn accurately.*

3. Find the size of the missing angle marked  $f$ .



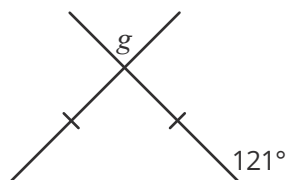
*Not drawn accurately.*

2. Calculate the missing angles.



*Not drawn accurately.*

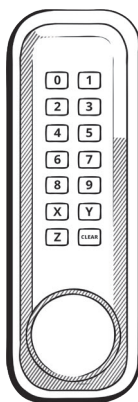
4. Find the size of the missing angle marked  $g$ .



*Not drawn accurately.*

The first digit of the code is given by the value of the tenths for  $b$ . The second digit is given by the value of the units for angle  $f$ . The third digit and fourth digit are given by the value of both digits for angle  $g$ .

Exit Code: **2 9 6 2**



1.  $a = 64^\circ$

$$3b - 5 + b + 2 + 90 + 64 = 360$$

$$4b + 151 = 360$$

$$4b = 209$$

$$b = 52.25$$

3.  $12e + 97.8 = 5e + 123$

$$7e = 25.2$$

$$e = 3.6$$

$$12 \times 3.6 + 97.8 = 141^\circ$$

$$5 \times 3.6 + 123 = 141^\circ$$

$$f = (360 - 141 - 141) \div 2$$

$$f = 39^\circ$$

2.  $4c + 63 = 12c - 2$

$$8c = 65$$

$$c = 8.125$$

$$4 \times 8.125 + 63 = 95.5^\circ$$

$$12 \times 8.125 - 2 = 95.5^\circ$$

$$5d - 18 = -d + 105$$

$$6d = 123$$

$$d = 20.5$$

$$5 \times 20.5 - 18 = 84.5^\circ$$

$$-20.5 + 105 = 84.5^\circ$$

4.  $180 - 121 = 59^\circ$

$$180 - 59 - 59 = 62^\circ$$

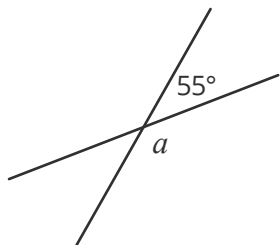
$$g = 62^\circ$$



## Vertically Opposite Angles - Silver

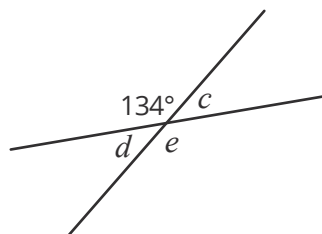
Solve the clues to find the four-digit code to escape the classroom!

1. Find the size of the missing angle marked  $a$ .



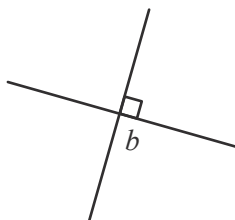
*Not drawn accurately.*

3. Find the size of the missing angles marked  $c$ ,  $d$  and  $e$ .



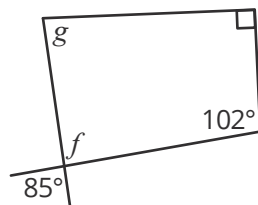
*Not drawn accurately.*

2. Find the size of the missing angle marked  $b$ .



*Not drawn accurately.*

4. Find the size of the missing angles marked  $f$  and  $g$ .



*Not drawn accurately.*

The first digit of the code is given by the value of the units for angle  $a$ . The second digit is given by the value of the units for angle  $b$ . The third digit is given by the value of the tens for angle  $f$ . The fourth digit is given by the value of the units for angle  $g$ .

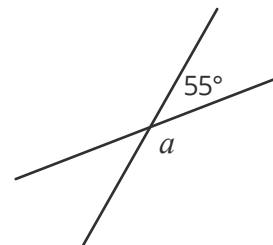
Exit Code:



## Vertically Opposite Angles - Silver

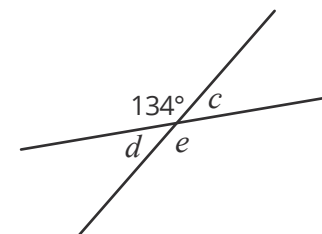
Solve the clues to find the four-digit code to escape the classroom!

1. Find the size of the missing angle marked  $a$ .



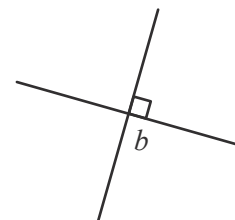
*Not drawn accurately.*

3. Find the size of the missing angles marked  $c$ ,  $d$  and  $e$ .



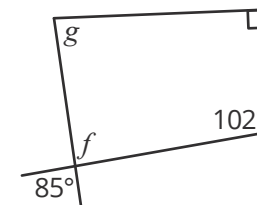
*Not drawn accurately.*

2. Find the size of the missing angle marked  $b$ .



*Not drawn accurately.*

4. Find the size of the missing angles marked  $f$  and  $g$ .



*Not drawn accurately.*

The first digit of the code is given by the value of the units for angle  $a$ . The second digit is given by the value of the units for angle  $b$ . The third digit is given by the value of the tens for angle  $f$ . The fourth digit is given by the value of the units for angle  $g$ .

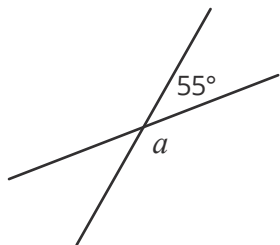
Exit Code:



# Vertically Opposite Angles - Silver Answers

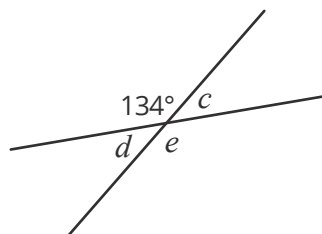
Solve the clues to find the four-digit code to escape the classroom!

1. Find the size of the missing angle marked  $a$ .



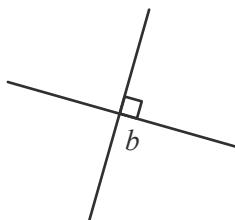
*Not drawn accurately.*

3. Find the size of the missing angles marked  $c$ ,  $d$  and  $e$ .



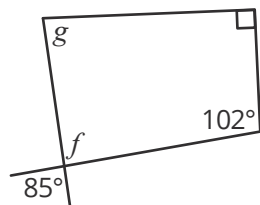
*Not drawn accurately.*

2. Find the size of the missing angle marked  $b$ .



*Not drawn accurately.*

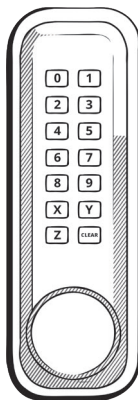
4. Find the size of the missing angles marked  $f$  and  $g$ .



*Not drawn accurately.*

The first digit of the code is given by the value of the units for angle  $a$ . The second digit is given by the value of the units for angle  $b$ . The third digit is given by the value of the tens for angle  $f$ . The fourth digit is given by the value of the units for angle  $g$ .

Exit Code: **5** **0** **8** **3**



1.  $a = 125^\circ$

2.  $b = 90^\circ$

3.  $c = 46^\circ$

$d = 46^\circ$

$e = 134^\circ$

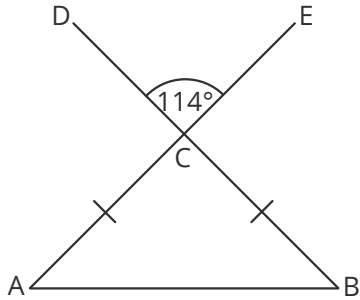
4.  $f = 85^\circ$

$g = 360 - 102 - 90 - 85$

$= 83^\circ$

### Exam Question - Vertically Opposite Angles

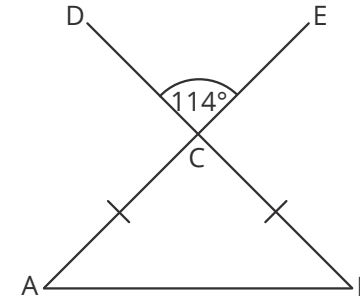
Triangle ABC is an isosceles triangle. Lines BCD and ACE are straight lines.



- a) Find the size of angle ACB. Give a reason for your answer. (2)
- b) Find the size of angle ABC. Give a reason for your answer. (2)

### Exam Question - Vertically Opposite Angles

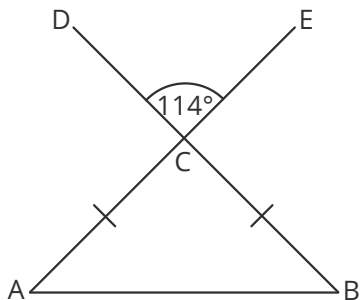
Triangle ABC is an isosceles triangle. Lines BCD and ACE are straight lines.



- a) Find the size of angle ACB. Give a reason for your answer. (2)
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### Exam Question - Vertically Opposite Angles

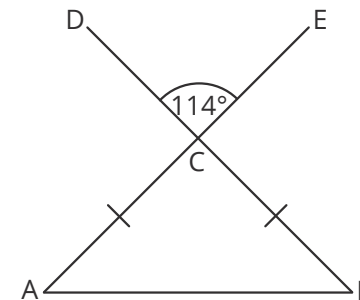
Triangle ABC is an isosceles triangle. Lines BCD and ACE are straight lines.



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### Exam Question - Vertically Opposite Angles

Triangle ABC is an isosceles triangle. Lines BCD and ACE are straight lines.



- a) Find the size of angle ACB. Give a reason for your answer. (2)
- b) Find the size of angle ABC. Give a reason for your answer. (2)

Angle Properties

# Vertically Opposite Angles





# Learning Objective

To calculate vertically opposite angles.

**Targeting Assessment Objectives A01 and A02**

# Success Criteria

- To understand and explain basic angle reasoning.
- To prove the properties of vertically opposite angles.
- To use an angle rule to find a missing value.

# Starter Task



## Angles Code Breaker

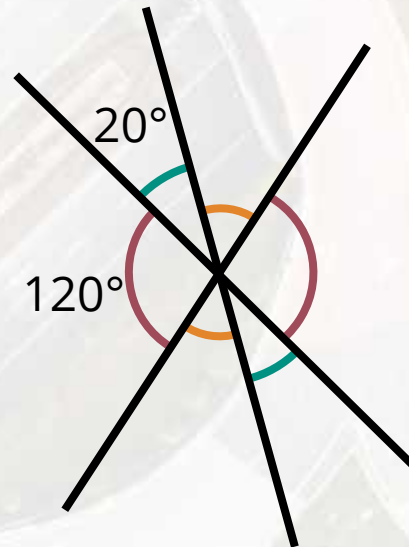
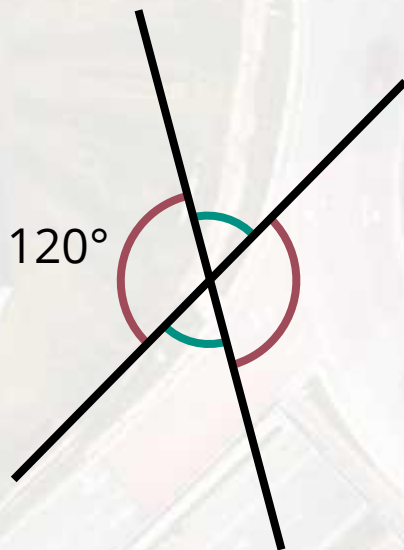
Calculate the value of  $x$  in each question. Find the answer in the code given then unscramble the letters to reveal a mathematical word.

38°	108°	42°	77°	90°	101°	31°	25°	160°	56°	62°	78°	88°	119°	99°	37°	205°	151°	112°	310°	182°	275°	144°	200°	32°	64°
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

1. 	2. 	3. 	4. 	5. 	6. 
7. 	8. 	9. 	10. 	11. 	12. 
13. 	14. 	Mathematical word: _____  Definition of mathematical word: _____ _____ _____			

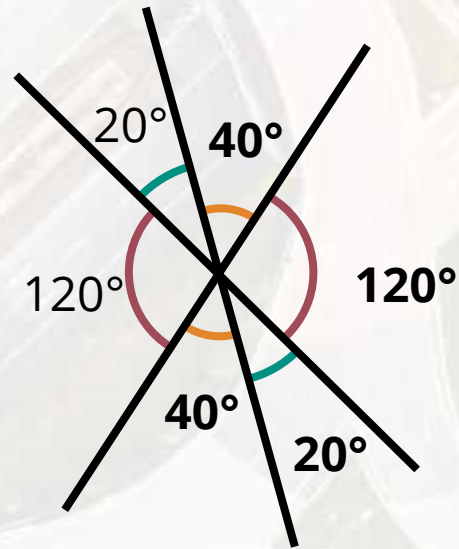
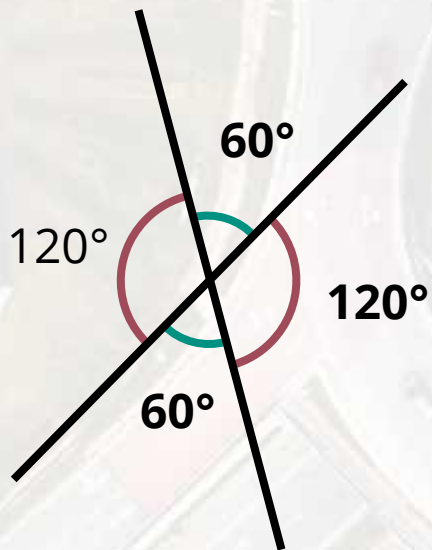
# Angles about a Point

What are the missing angles?



# Angles about a Point

Do you notice a pattern?

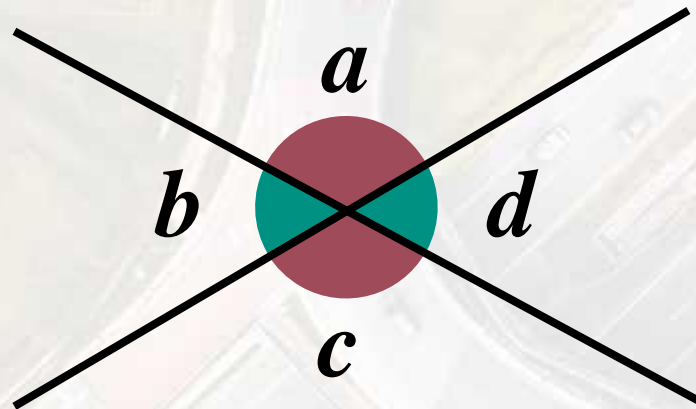




# Vertically Opposite Angles

## Take notes:

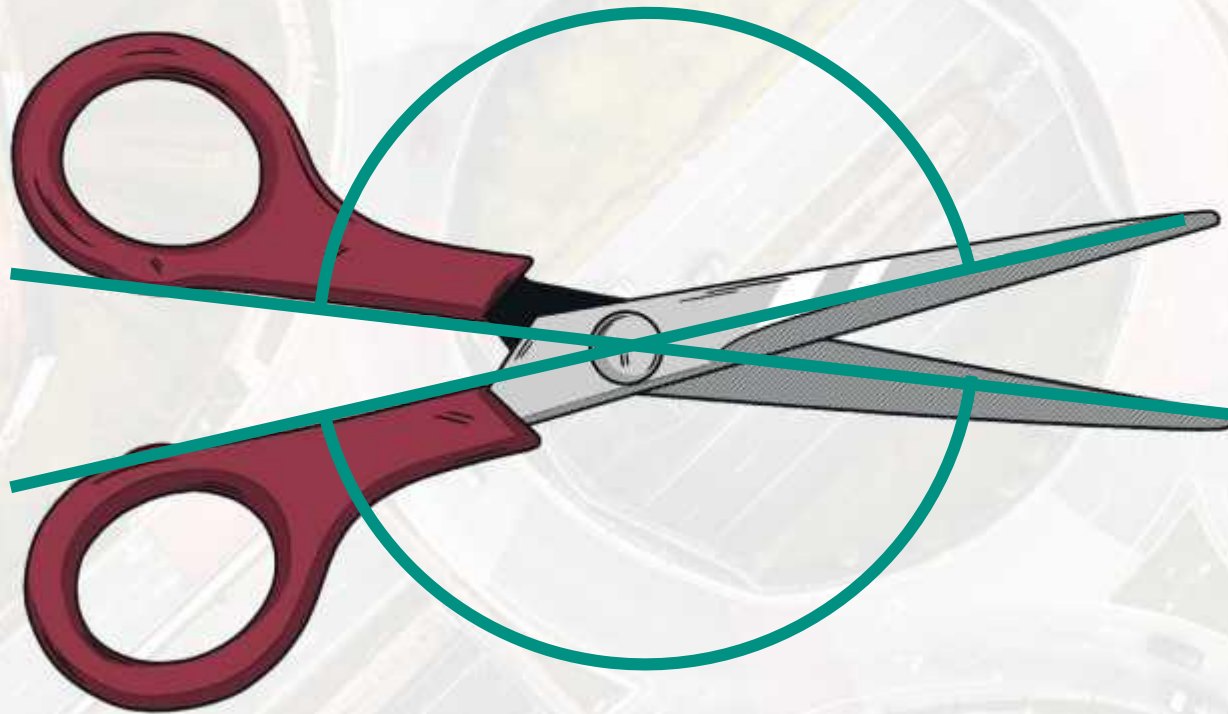
Vertically opposite angles are **equal**. In this case, vertical means where the lines cross (vertex) and not up and down.



$$a = c$$
$$b = d$$

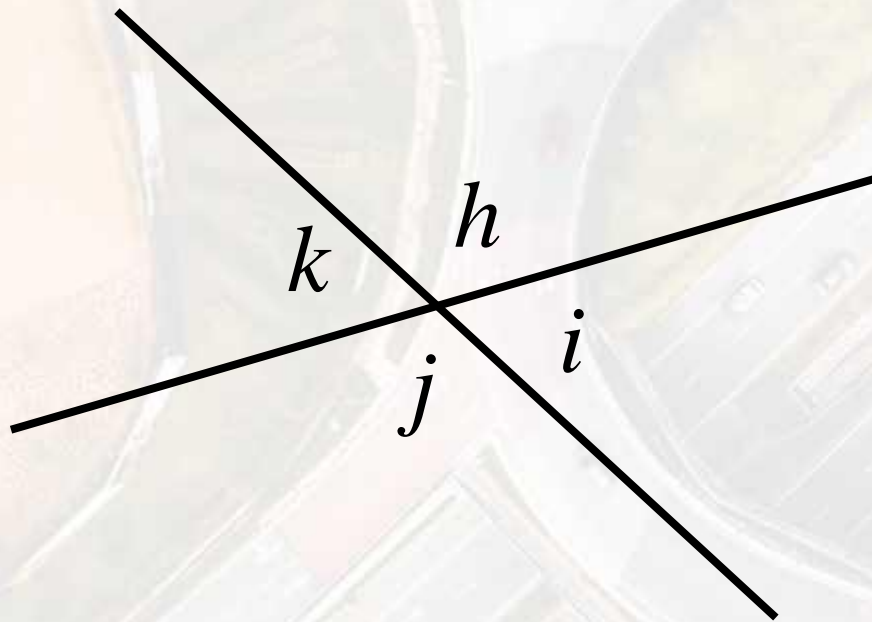
Using the angle facts you already know, how can we prove this?

# Vertically Opposite Angles



# Vertically Opposite Angles

Which pairs of angles are equal?

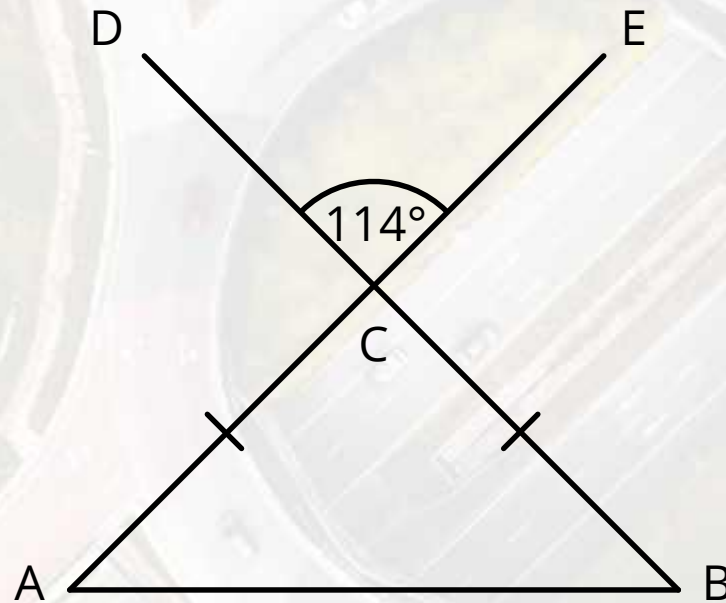


$$h = j$$

$$k = i$$

# Exam Question

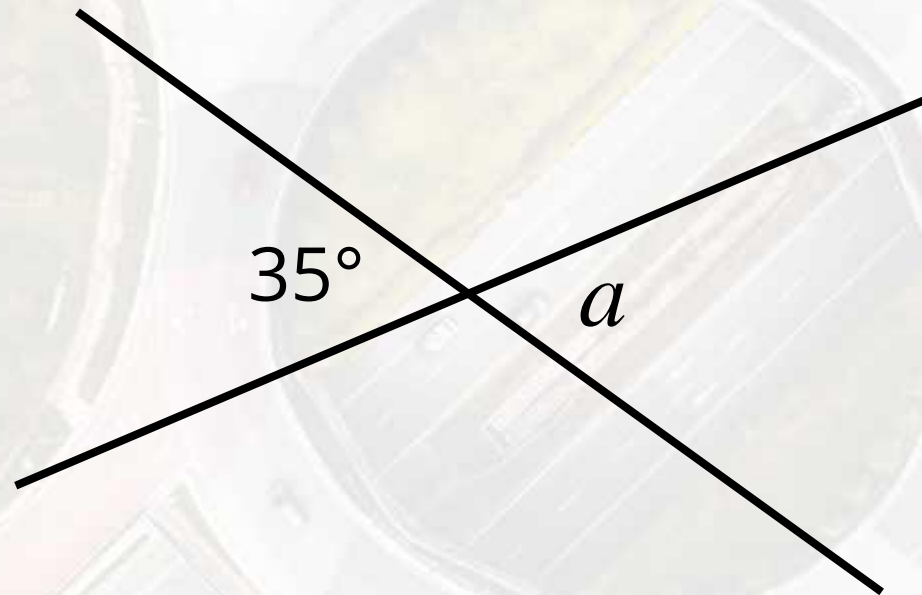
Triangle ABC is an isosceles triangle. Lines BCD and ACE are straight lines.



- Find the size of angle ACB. Give a reason for your answer. (2)
- Find the size of angle ABC. Give a reason for your answer. (2)

# Vertically Opposite Angles

Calculate the missing angle marked  $a$ . You must state a reason for your answer.

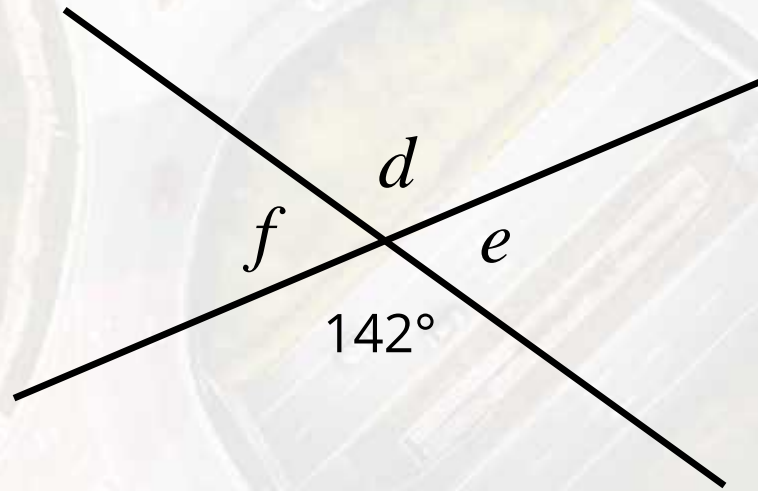


$$a = 35^\circ$$

**Reason: Vertically opposite angles are equal.**

# Vertically Opposite Angles

Calculate the missing angles marked  $d$ ,  $e$  and  $f$ . You must state a reason for each stage of your calculations.



$d = 142^\circ$  because vertically opposite angles are equal.

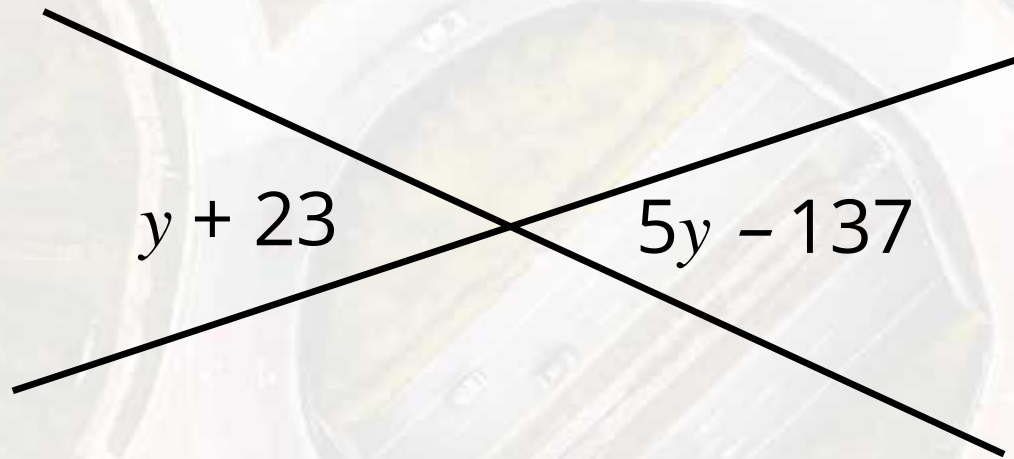
$e = (360 - 142 - 142) \div 2$  because angles about a point add up to  $360^\circ$ .

$e = 38^\circ$

$f = 38^\circ$  because vertically opposite angles are equal.

# Vertically Opposite Angles

Solve to find the missing angles.



$$y + 23 = 5y - 137$$

$$4y = 160$$

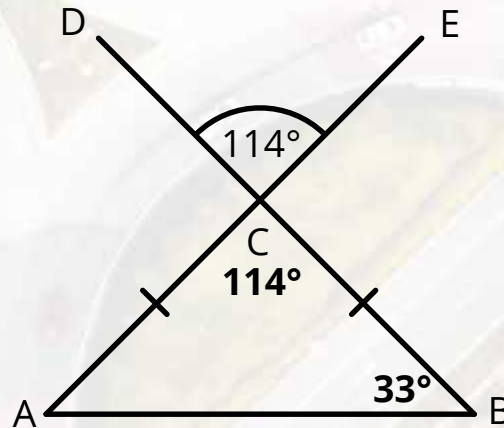
$$y = 40$$

$$40 + 23 = 63^\circ$$

$$5 \times 40 - 137 = 63^\circ$$

# Exam Question

Triangle ABC is an isosceles triangle. Lines BCD and ACE are straight lines.



- a) Find the size of angle ACB. Give a reason for your answer. (2)

**Angle ACB is  $114^\circ$  because vertically opposite angles are equal.**

- b) Find the size of angle ABC. Give a reason for your answer. (2)

**$180 - 114$  (angles in a triangle add up to  $180^\circ$ .)**

**$ABC = 66 \div 2$  because there are two equal angles in an isosceles triangle.**

**$ABC = 33^\circ$**



# Escape the Room



BEYOND MATHS

BEYOND MATHS

BEYOND MATHS

BEYOND MATHS

## Vertically Opposite Angles - Bronze

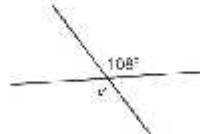
Solve the clues to find the four-digit code to escape the classroom!

1. Find the size of the missing angle marked  $a$ .



*Not drawn accurately.*

3. Find the size of the missing angle marked  $e$ .



*Not drawn accurately.*

2. Find the size of the missing angles marked  $b$ ,  $c$  and  $d$ .



*Not drawn accurately.*

4. Find the size of the missing angle marked  $f$ .



*Not drawn accurately.*

The first digit of the code is given by the value of the hundreds digit for angle  $a$ . The second digit is given by the value of the units for angle  $b$ . The third digit is given by the sum of all the digits for angle  $c$ . The fourth digit is given by the value of the units for angle  $f$ .

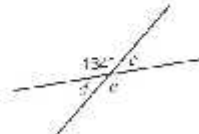
Exit Code:



## Vertically Opposite Angles - Silver

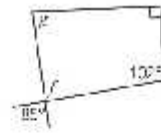
Solve the clues to find the four-digit code to escape the classroom!

3. Find the size of the missing angles marked  $e$ ,  $d$  and  $c$ .



*Not drawn accurately.*

4. Find the size of the missing angles marked  $f$  and  $g$ .



*Not drawn accurately.*

The first digit of the code is given by the value of the hundreds digit for angle  $e$ . The second digit is given by the value of the units for angle  $d$ . The third digit is given by the value of the units for angle  $f$ . The fourth digit is given by the value of the units for angle  $g$ .

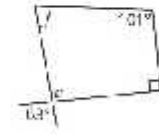
Exit Code:



## Vertically Opposite Angles - Gold

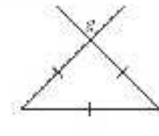
Solve the clues to find the four-digit code to escape the classroom!

3. Find the size of the missing angles marked  $e$  and  $f$ .



*Not drawn accurately.*

7. Find the size of the missing angle marked  $g$ .



*Not drawn accurately.*

The first digit of the code is given by the value of the hundreds digit for angle  $e$ . The second digit is given by the value of the units for angle  $f$ . The third digit is given by the value of the units for angle  $g$ .

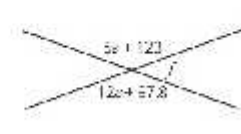
Exit Code:



## Vertically Opposite Angles - Platinum

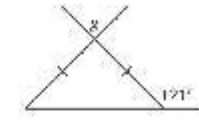
Solve the clues to find the four-digit code to escape the classroom!

3. Find the size of the missing angle marked  $f$ .



*Not drawn accurately.*

4. Find the size of the missing angle marked  $e$ .



*Not drawn accurately.*

The first digit of the code is given by the value of the hundreds digit for angle  $f$ . The second digit is given by the value of the units for angle  $e$ . The third digit is given by the value of the units for angle  $e$ . The fourth digit is given by the value of the units for angle  $e$ .

Exit Code:







## Vertically Opposite Angles Teaching Ideas

### Learning Objective:

To calculate vertically opposite angles.

Targeting Assessment Objectives AO1 and AO2.

### Success Criteria:

- To understand and explain basic angle reasoning.
- To prove the properties of vertically opposite angles.
- To use an angle rule to find a missing value.

### Context

This lesson aims to introduce and secure students' understanding of how to calculate the values of vertically opposite angles. The lesson has the option of keeping concepts basic or, alternatively, extending students' learning by using algebra in the questions. Students should have a good understanding of how to calculate angles on a straight line, about a point as well as in a triangle.

### Resources

PowerPoint

Vertically Opposite Angles Worksheets

Angles Codebreaker Starter

Exam Question

Escape the Room Worksheets

## Starter

The codebreaker starter provides an opportunity for students to familiarise themselves with calculating angles on a straight line and about a point. The maths-related word is quadrilaterals. Students should each receive a copy of the

## Main Activities

### Angles About a Point

Display the question 'What are the missing angles?' on the board and ask students to offer suggestions. Alternatively, allow students a few moments, either in pairs or independently, to work out the missing angles. Encourage students to share their ideas and guide them into making the observation that 'the opposite angles are equal.'

### Vertically Opposite Angles

Encourage students to make a note of the main teaching point in their books (that vertically opposite angles are equal), including the diagram. You may wish to refer to other angle reasons such as 'angles on a straight line add up to  $180^\circ$ ' and 'angles about a point add up to  $360^\circ$ ' by way of proving vertically opposite angles are equal. The following slide contains a real-life example of vertically opposite angles. Additionally, you can check for students' understanding by displaying the question on **Slide 8**. Students could write their answers on mini-whiteboards, in books or verbally share them.

### Exam Question

This slide displays an exam-style question to provide students with some context for the lesson content. This is simply for reference at this stage and will be revisited during the plenary.

### Vertically Opposite Angles

**Slides 10 – 11** are designed to guide students on how to calculate vertically opposite angles. Each slide provides a question followed by the workings broken down into simple steps. You may wish to simply display the question and ask students for suggestions for the missing angles via whole class discussion. Alternatively, you may wish for students to work independently on the questions and display their answers on mini whiteboards. Either way, encourage students to use the angle rule (that vertically opposite angles are equal) to justify their answer by asking them, 'why is your answer correct?' 'Why can't the answer be something else?' You may wish for students to record their answers and calculations in their books. Ensure that students are using the terminology 'vertically opposite angles are equal' and not just 'opposite angles' for correct practice to score full marks on exam questions.

**Slide 12** provides an opportunity to use algebra to calculate vertically opposite angles. Use your best judgement when deciding whether to use this slide or not. It could be used to coach extension students when the rest of the class are working independently, or you may feel that the use of algebra is suitable for the whole class.

Following this, students have the option of completing practice questions. They are able to choose from bronze, silver, gold and platinum worksheets. Please note that the higher and extension sheets use algebra.

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## Exam Question

The plenary draws the lesson together by revisiting the 'context' question from earlier in the lesson and provides a good opportunity for students to apply their understanding. Allow students time to complete the question and then draw the class together. Ensure that students are encouraged to 'convince' you that their answer is correct by using their mathematical reasoning that vertically opposite angles are equal. Again, highlight the importance of not simply saying 'opposite angles'.

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## Escape the Room

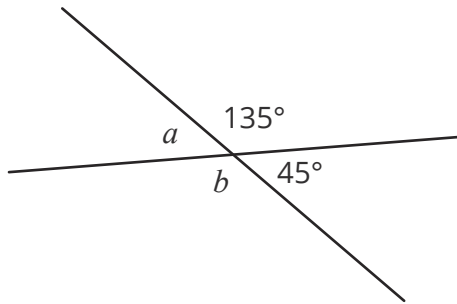
**Escape the Room** requires students to calculate vertically opposite angles for a series of questions then use this information to find a code to 'exit' the room at the end of the lesson. These are differentiated in the same way as the practice questions (gold and platinum include algebra). You may wish for students to pass you their sheets when leaving the classroom in order to assess their understanding and provide insight for subsequent lessons.

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# Vertically Opposite Angles Bronze

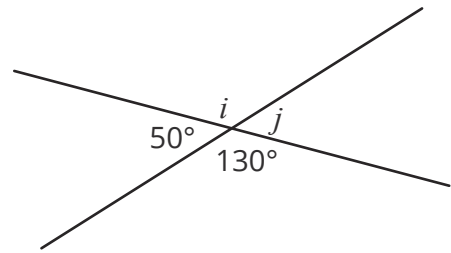
For each question, find both of the missing angles.

1.



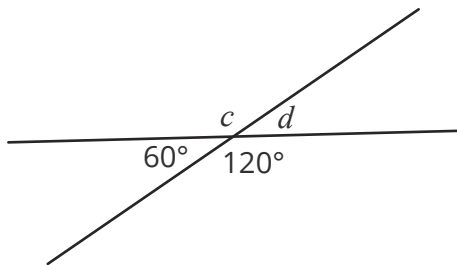
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5.



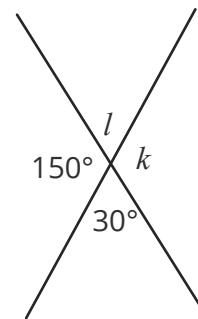
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2.



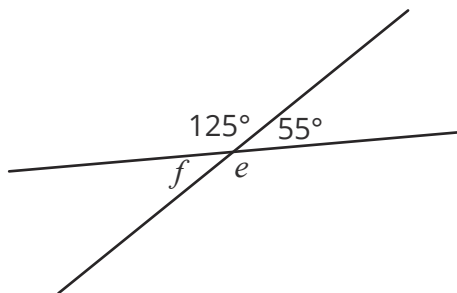
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6.



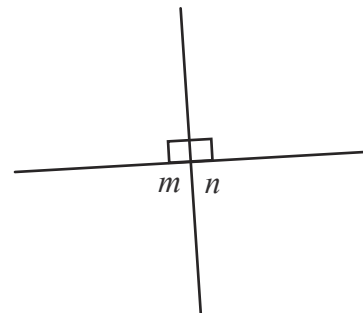
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3.



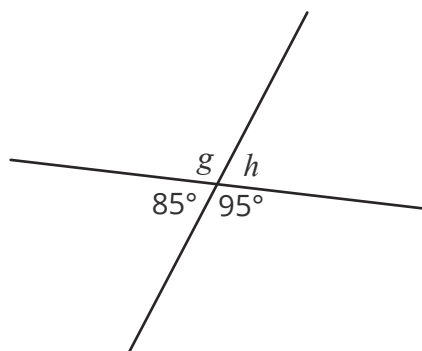
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7.



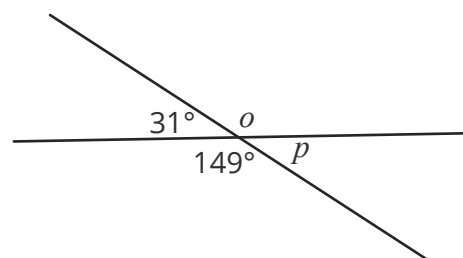
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4.



Not drawn accurately

8.



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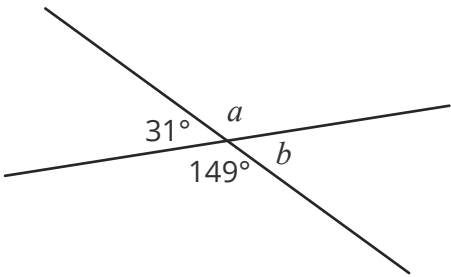
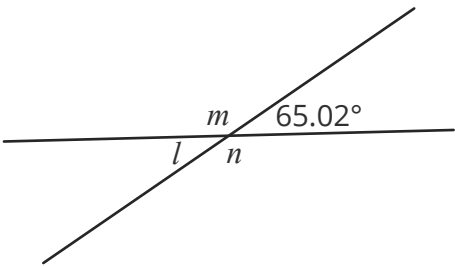
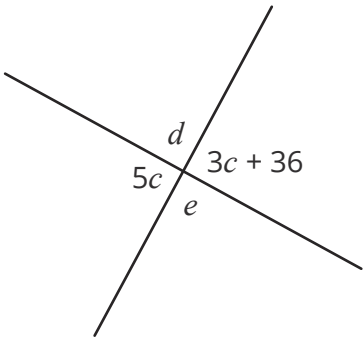
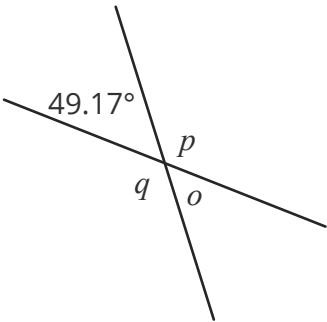
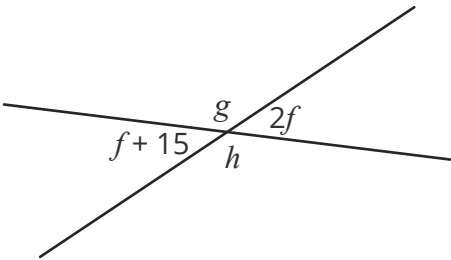
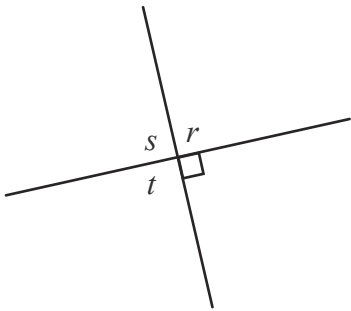
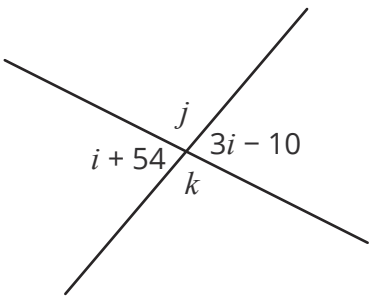
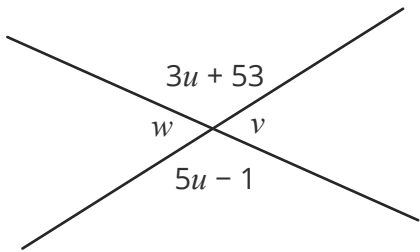
# Vertically Opposite Angles Bronze **Answers**

For each question, find both of the missing angles.

1. $a = 45^\circ$ $b = 135^\circ$	5. $i = 130^\circ$ $j = 50^\circ$
2. $c = 120^\circ$ $d = 60^\circ$	6. $k = 150^\circ$ $l = 30^\circ$
3. $e = 125^\circ$ $f = 55^\circ$	7. $m = 90^\circ$ $n = 90^\circ$
4. $g = 95^\circ$ $h = 85^\circ$	8. $o = 149^\circ$ $p = 31^\circ$

# Vertically Opposite Angles Gold

For each question, find **all** of the missing angles.

<p>1.</p>  <p>Not drawn accurately</p>	<p>5.</p>  <p>Not drawn accurately</p>
<p>2.</p>  <p>Not drawn accurately</p>	<p>6.</p>  <p>Not drawn accurately</p>
<p>3.</p>  <p>Not drawn accurately</p>	<p>7.</p>  <p>Not drawn accurately</p>
<p>4.</p>  <p>Not drawn accurately</p>	<p>8.</p>  <p>Not drawn accurately</p>

# Vertically Opposite Angles Gold Answers

For each question, find **all** of the missing angles.

1.  $a = 149^\circ$

$$b = 31^\circ$$

2.  $5c = 3c + 36$

$$2c = 36$$

$$c = 18$$

$$5 \times 18 = 90^\circ$$

$$3 \times 18 + 36 = 90^\circ$$

$$d = (360 - 90 - 90) \div 2$$

$$d = 90^\circ$$

$$e = 90^\circ$$

3.  $f + 15 = 2f$

$$f = 15$$

$$15 + 15 = 30^\circ$$

$$2 \times 15 = 30^\circ$$

$$g = (360 - 30 - 30) \div 2$$

$$= 150^\circ$$

$$h = 150^\circ$$

4.  $i + 54 = 3i - 10$

$$2i = 64$$

$$i = 32$$

$$32 + 54 = 86^\circ$$

$$3 \times 32 - 10 = 86^\circ$$

$$j = (360 - 86 - 86) \div 2$$

$$= 94^\circ$$

$$k = 94^\circ$$

5.  $l = 65.02^\circ$

$$m = (360 - 65.02 - 65.02) \div 2$$

$$= 114.98^\circ$$

$$n = 114.98^\circ$$

6.  $o = 49.17^\circ$

$$p = (360 - 49.17 - 49.17) \div 2$$

$$= 130.83^\circ$$

$$q = 130.83^\circ$$

7.  $r = 90^\circ$

$$s = 90^\circ$$

$$t = 90^\circ$$

8.  $3u + 53 = 5u - 1$

$$2u = 54$$

$$u = 27$$

$$3 \times 27 + 53 = 134^\circ$$

$$5 \times 27 - 1 = 134^\circ$$

$$v = (360 - 134 - 134) \div 2$$

$$= 46^\circ$$

$$w = 46^\circ$$



# Vertically Opposite Angles Platinum

For each question, find **all** of the missing angles.

1.

Not drawn accurately

5.

Not drawn accurately

2.

Not drawn accurately

6.

Not drawn accurately

3.

Not drawn accurately

7.

Not drawn accurately

4.

Not drawn accurately

8.

Not drawn accurately

# Vertically Opposite Angles Platinum Answers

For each question, find **all** of the missing angles.

1.  $5a + 5 = 2a + 80$

$$3a = 75$$

$$a = 25$$

$$5 \times 25 + 5 = 130^\circ$$

$$2 \times 25 + 80 = 130^\circ$$

$$2b + 30 = b + 40$$

$$b = 10$$

$$2 \times 10 + 30 = 50^\circ$$

$$10 + 40 = 50^\circ$$

2.  $6a + 30 = 8a$

$$2a = 30$$

$$a = 15$$

$$6 \times 15 + 30 = 120^\circ$$

$$8 \times 15 = 120^\circ$$

$$7b - 10 = 4b + 20$$

$$3b = 30$$

$$b = 10$$

$$7 \times 10 - 10 = 60^\circ$$

$$4 \times 10 + 20 = 60^\circ$$

3.  $5a + 40 = -3a + 56$

$$8a = 16$$

$$a = 2$$

$$5 \times 2 + 40 = 50^\circ$$

$$-3 \times 2 + 56 = 50^\circ$$

$$157 - 3b = 5b + 85$$

$$8b = 72$$

$$b = 9$$

$$157 - 3 \times 9 = 130^\circ$$

$$5 \times 9 + 85 = 130^\circ$$

4.  $6a - 10 = 4a + 30$

$$2a = 40$$

$$a = 20$$

$$6 \times 20 - 10 = 110^\circ$$

$$4 \times 20 + 30 = 110^\circ$$

$$8b - 50 = 6b - 20$$

$$2b = 30$$

$$b = 15$$

$$8 \times 15 - 50 = 70^\circ$$

$$6 \times 15 - 20 = 70^\circ$$

5.  $6a - 30 = 2a + 18$

$$4a = 48$$

$$a = 12$$

$$6 \times 12 - 30 = 42^\circ$$

$$2 \times 12 + 18 = 42^\circ$$

$$10b - 82 = 3b + 72$$

$$7b = 154$$

$$b = 22$$

$$10 \times 22 - 82 = 138^\circ$$

$$3 \times 22 + 72 = 138^\circ$$

6.  $5a + 105 = a + 141$

$$4a = 36$$

$$a = 9$$

$$5 \times 9 + 105 = 150^\circ$$

$$9 + 141 = 150^\circ$$

$$107 - 11b = -b + 37$$

$$10b = 70$$

$$b = 7$$

$$107 - 11 \times 7 = 30^\circ$$

$$-7 + 37 = 30^\circ$$

7.  $2a + 81 = -4a + 123$

$$6a = 42$$

$$a = 7$$

$$2 \times 7 + 81 = 95^\circ$$

$$-4 \times 7 + 123 = 95^\circ$$

$$109 - 6b = 101 - 4b$$

$$2b = 8$$

$$b = 4$$

$$109 - 6 \times 4 = 85^\circ$$

$$101 - 4 \times 4 = 85^\circ$$

8.  $-a + 130 = 4a + 105$

$$5a = 25$$

$$a = 5$$

$$-5 + 130 = 125^\circ$$

$$4 \times 5 + 105 = 125^\circ$$

$$3b + 43 = -6b + 79$$

$$9b = 36$$

$$b = 4$$

$$3 \times 4 + 43 = 55^\circ$$

$$-6 \times 4 + 79 = 55^\circ$$

# Vertically Opposite Angles Silver

For each question, find **all** of the missing angles.

1.

Not drawn accurately

5.

Not drawn accurately

2.

Not drawn accurately

6.

Not drawn accurately

3.

Not drawn accurately

7.

Not drawn accurately

4.

Not drawn accurately

8.

Not drawn accurately

# Vertically Opposite Angles Silver **Answers**

For each question, find **all** of the missing angles.

1. $a = 45^\circ$ $b = 135^\circ$	5. $j = 90^\circ$ $k = 90^\circ$ $l = 90^\circ$
2. $c = 120^\circ$ $d = 60^\circ$	6. $m = (360 - 120 - 105 - 15) \div 2$ $= 60^\circ$ $n = 60^\circ$
3. $e = 40^\circ$ $f = 78^\circ$ $g = 62^\circ$	7. $o = 52^\circ$ $p = 360 - 98 - 90 - 52$ $p = 120^\circ$
4. $h = 130^\circ$ $i = 50^\circ$	8. $q = 40^\circ$ $r = 140^\circ$