Properties of Shapes: Vertically Opposite Angles

Aim:	**Success Criteria:**	**Resources:**
Recognise angles where they meet at a point, are on a straight line, or are vertically opposite, and find missing angles. To recognise angles which are vertically opposite and find missing angles.	I know that vertically opposite angles are equal. I can find vertically opposite missing angles.	**Lesson Pack** Individual Whiteboards
	Key/New Words: Degree, acute, obtuse, reflex, vertically opposite, congruent.	**Preparation:** **Differentiated Vertically Opposite Angles Activity Sheets** – one per child **Extra Challenge Activity Sheet** – as required **Angle Challenge Resource Sheet** – one per pair **Diving Into Mastery activity sheets** – as required

Prior Learning: It will be helpful if children have calculated missing angles on a straight line and one whole turn previously.

Learning Sequence

Estimating Angles 2: Children estimate in degrees the size of the angles shown on the **Lesson Presentation**, recording their estimation on individual whiteboards.

Vertically Opposite Angles: Using the images and information displayed on the **Lesson Presentation**, demonstrate that when two straight lines intersect, four angles are created. Explain that the pairs of angles which are opposite each other are congruent (equal) and known as vertically opposite angles.

Missing Angles: As a class, work through the examples shown on the **Lesson Presentation** which demonstrate how we can use vertically opposite angles to answer missing angle questions.

Vertically Opposite Missing Angles: Children complete the differentiated **Vertically Opposite Angles Activity Sheets** to demonstrate that they can find vertically opposite missing angles.

- ★ Find missing angles using vertically opposite angles (to the nearest 10°).
- ★★ Find missing angles using vertically opposite angles (to the nearest 5°).
- ★★★ Find missing angles using vertically opposite angles (to the nearest 1°). An **Extra Challenge Activity Sheet** is provided as an extension activity if required.

Diving into Mastery: Schools using a mastery approach may prefer to use the following as an alternative activity. These sheets might not necessarily be used in a linear way. Some children might begin at the 'Deeper' section and in fact, others may 'dive straight in' to the 'Deepest' section if they have already mastered the skill and are applying this to show their depth of understanding.

- **Children complete fluency problems which involve finding and calculating vertically opposite angles.**
- **Children explore answering reasoning problems which involve finding and calculating vertically opposite angles.**
- **Children use problem solving skills in order to answer an open-ended task that involves a greater depth of thinking when finding and calculating with vertically opposite angles.**

Angle Challenge: An image is shown on the **Lesson Presentation** which has many angles around a point. Some of these angles are labelled, and the children use their understanding of angles around a point, on a straight line and vertically opposite to calculate the missing angles. Children may use the **Angle Challenge Resource Sheet** if required.

Exploreit

2D Shapeit: Explore concave and convex 2D shapes and their angles.

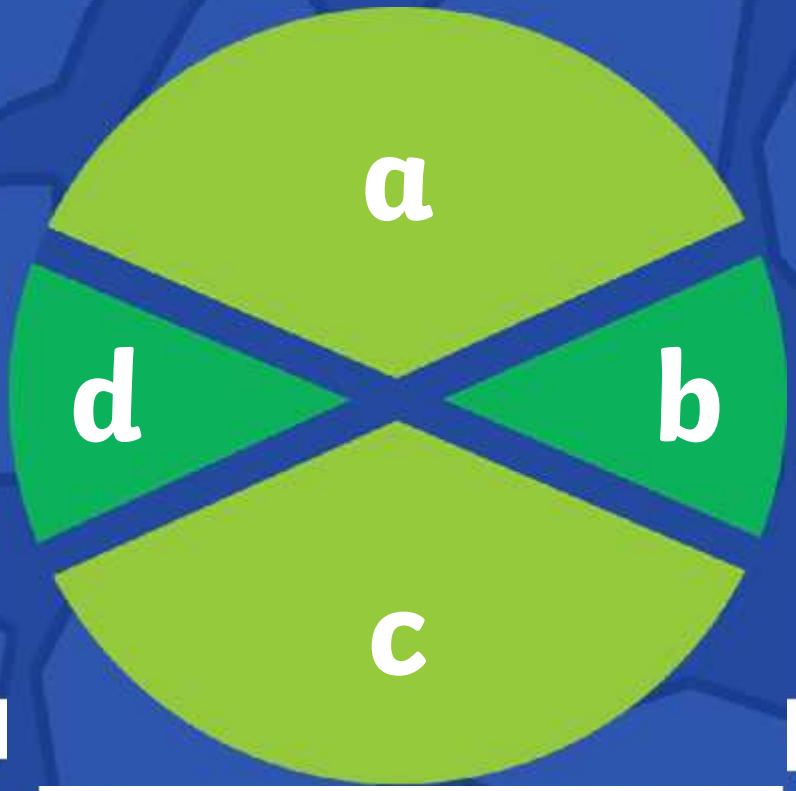
Debateit: Hold a class debate discussing why we need to learn about angles and how we use them in our everyday lives.

Treasure Mapit: Create a class treasure map and write directions using angles to locate the treasure.

Maths

Properties of Shapes

Vertically Opposite Angles



Aim

- To recognise angles which are vertically opposite and find missing angles.

Success Criteria

- I know that vertically opposite angles are equal.
- I can find vertically opposite missing angles.

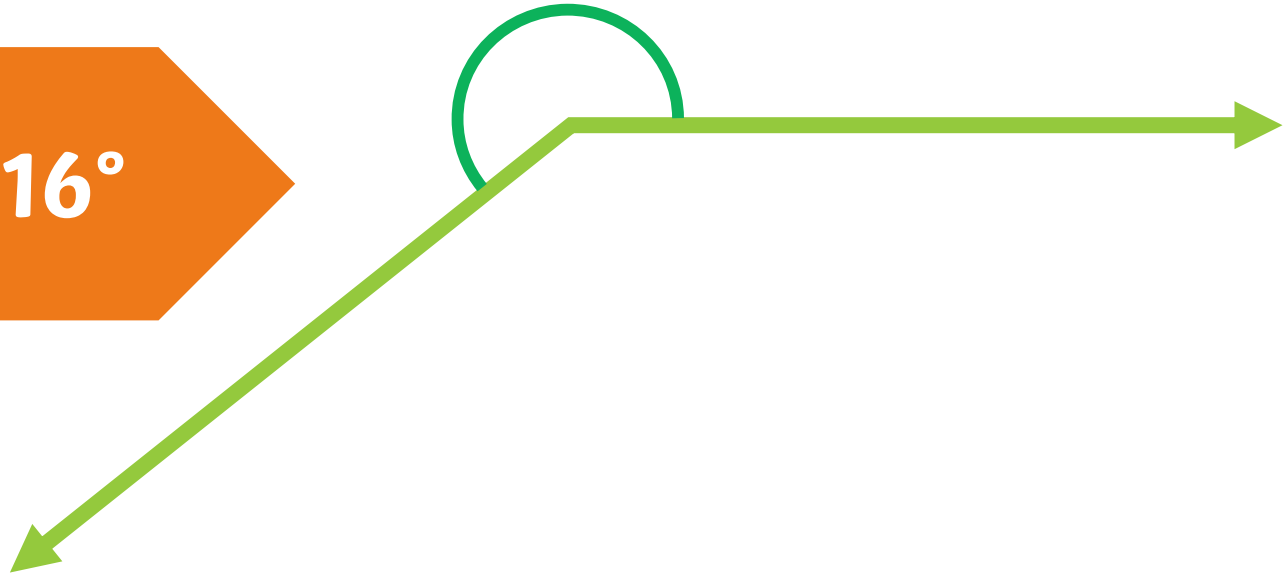
Estimating Angles 2

Estimate in degrees the size of this angle:

138°

Estimating Angles 2

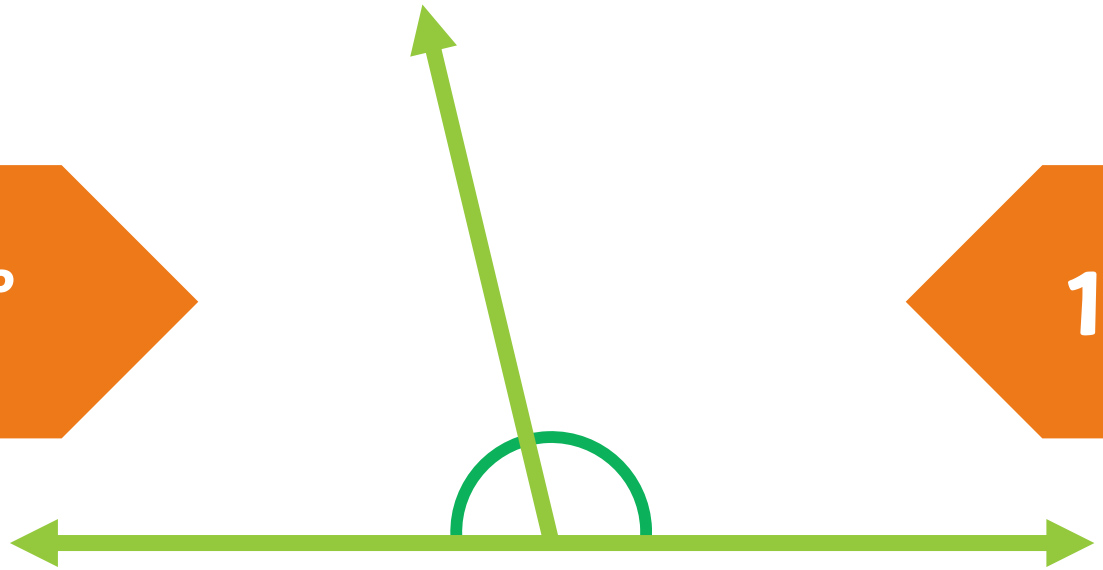
Estimate in degrees the size of this angle:



216°

Estimating Angles 2

Estimate in degrees the sizes of these angles:

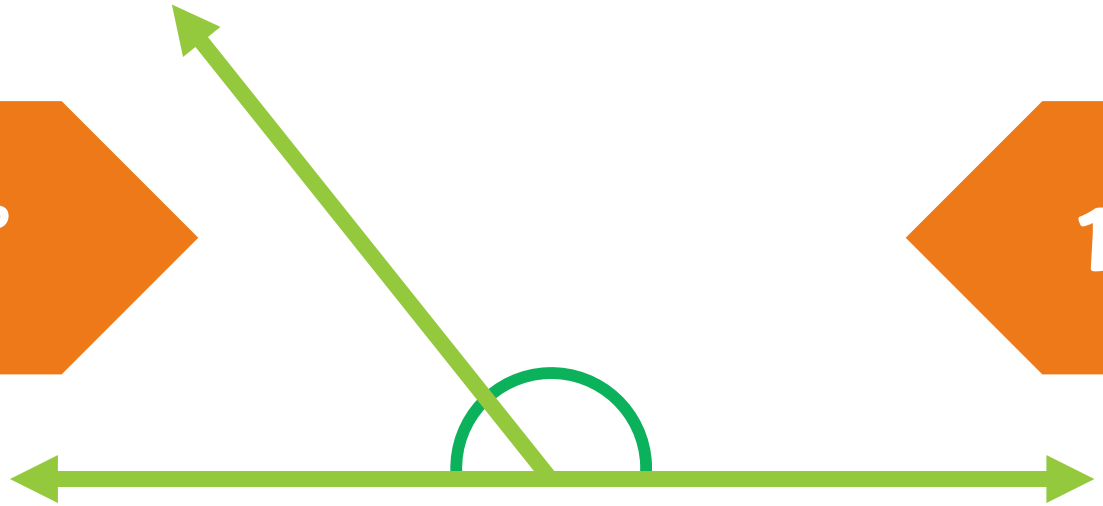


80°

100°

Estimating Angles 2

Estimate in degrees the sizes of these angles:

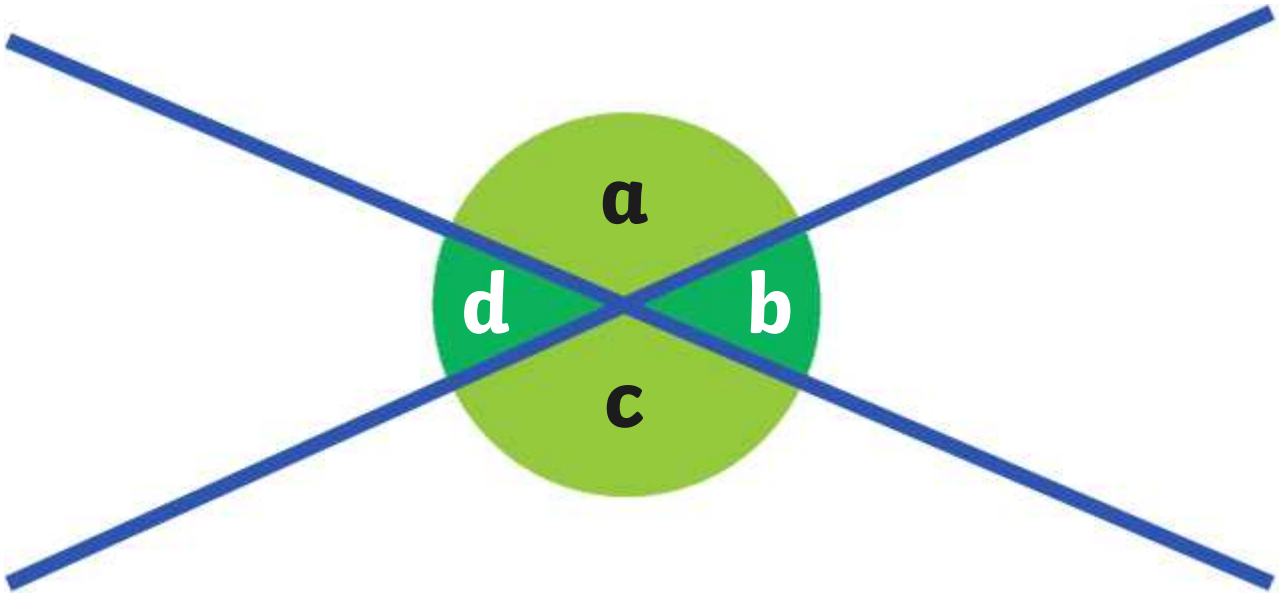


45°

135°

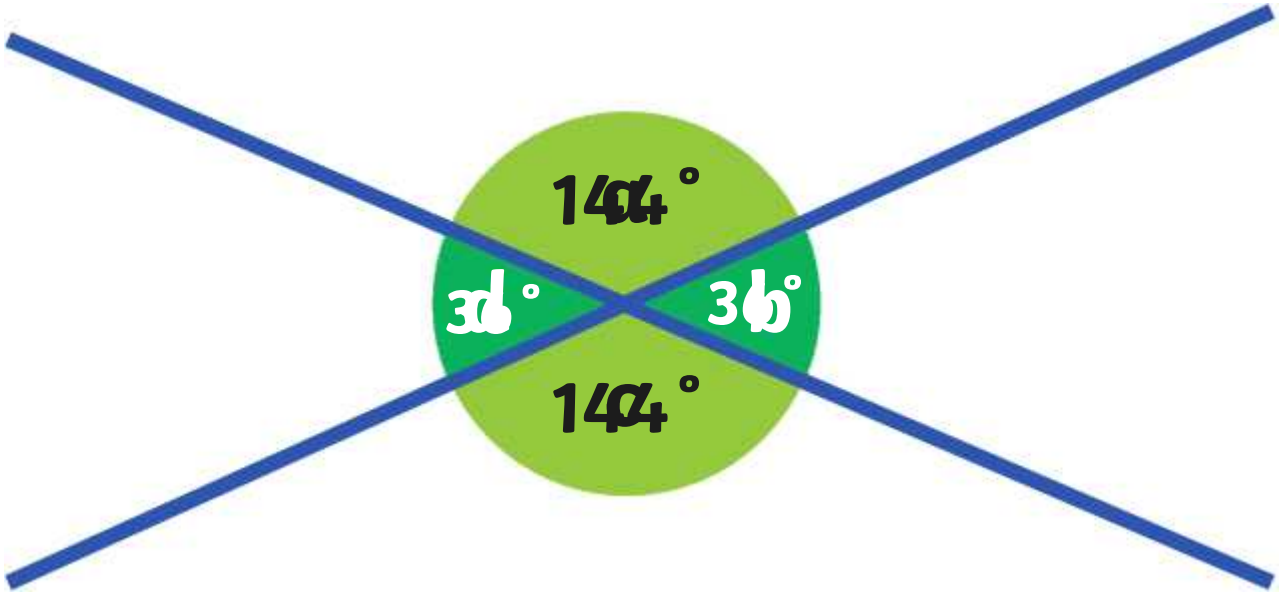
Vertically Opposite Angles

When two straight lines intersect (cross each other), four angles are created around a point which total 360°.



Vertically Opposite Angles

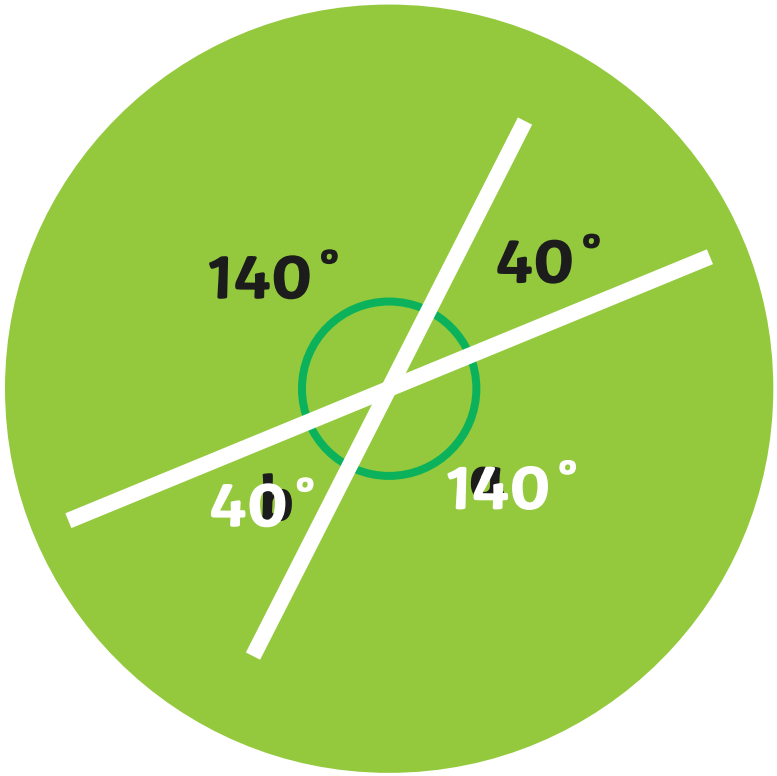
The pairs of angles that are opposite each other measure the same number of degrees and are equal (congruent).

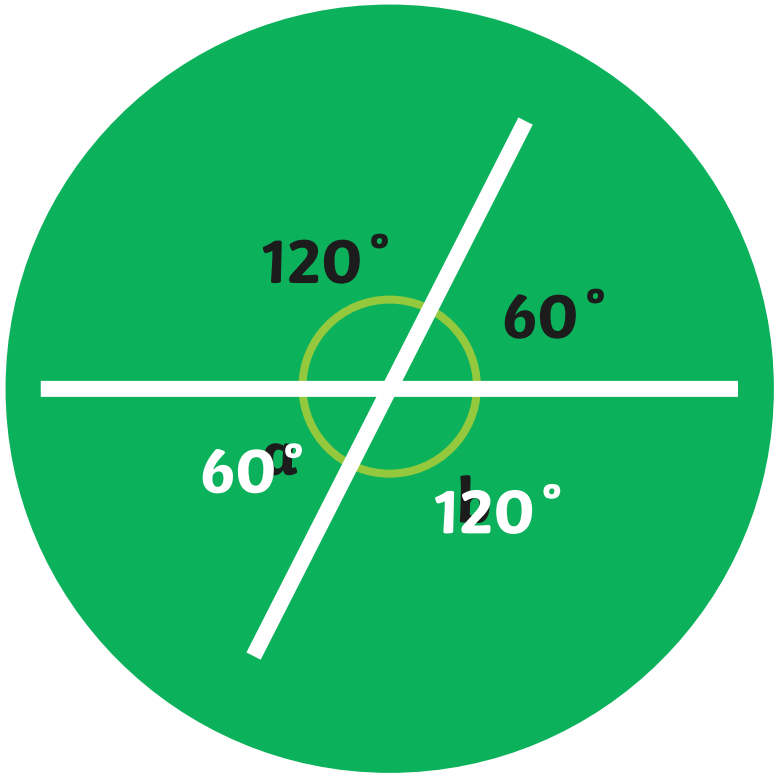


These pairs of angles are called **vertically opposite angles.**

Missing Angles

Identify these missing angles using vertically opposite angle facts:

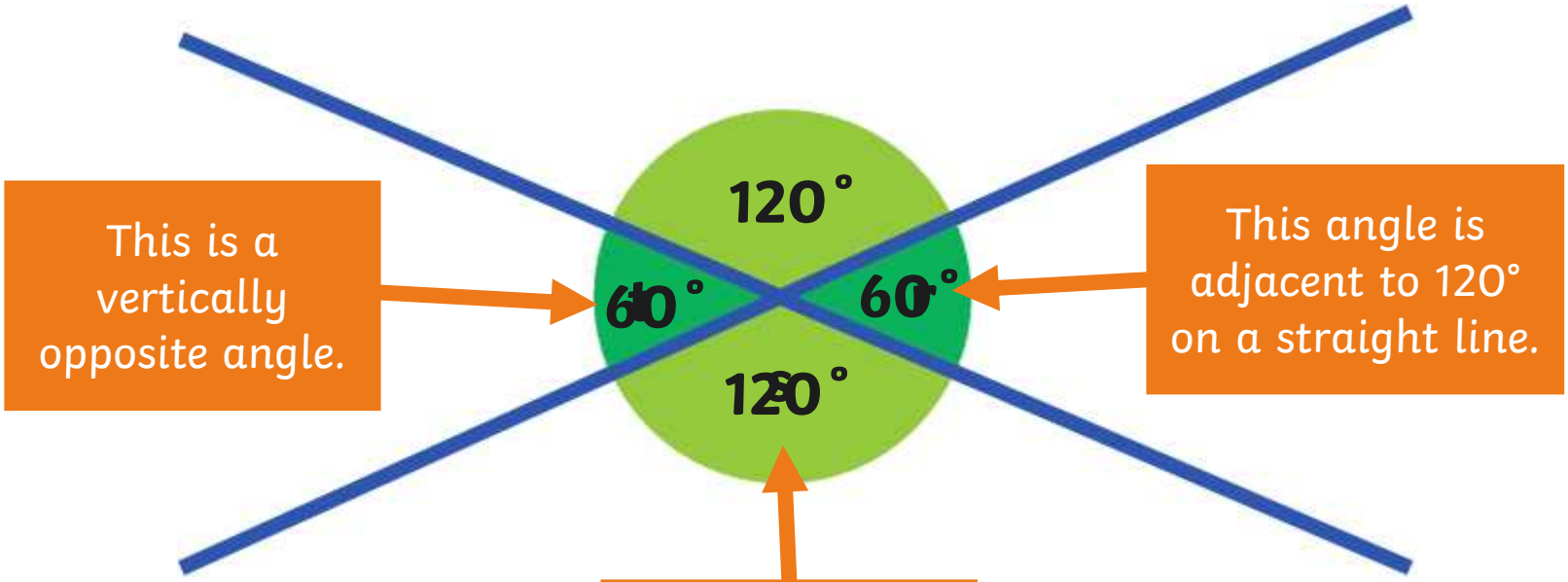




Have you noticed that adjacent angles are on a straight line and total 180°?

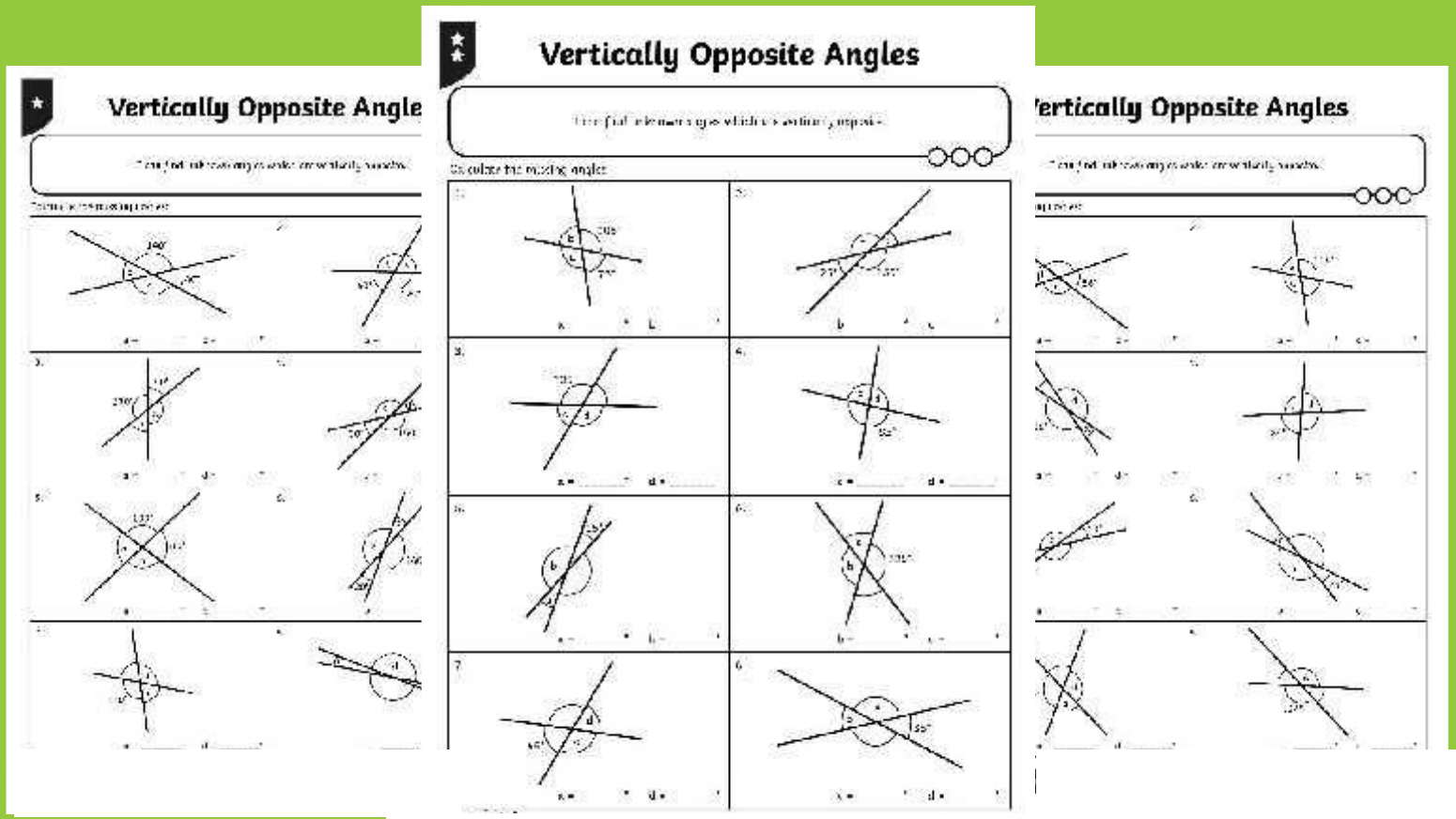
Missing Angles

Calculate the missing angles using known angle facts:



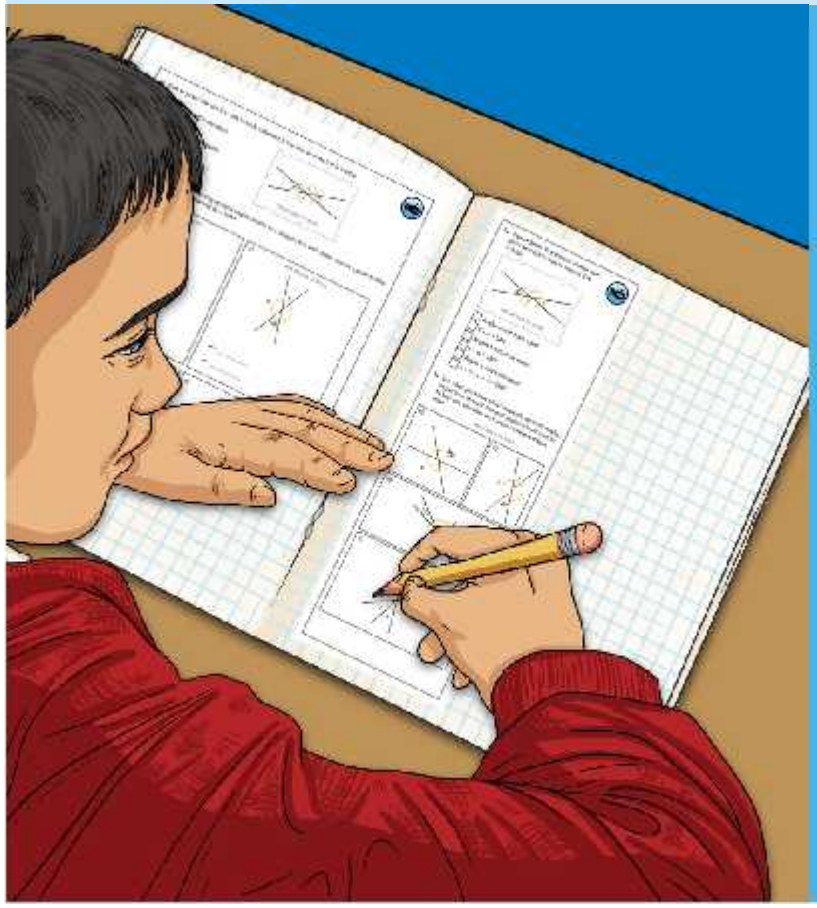
All the angles around the point total 360°.

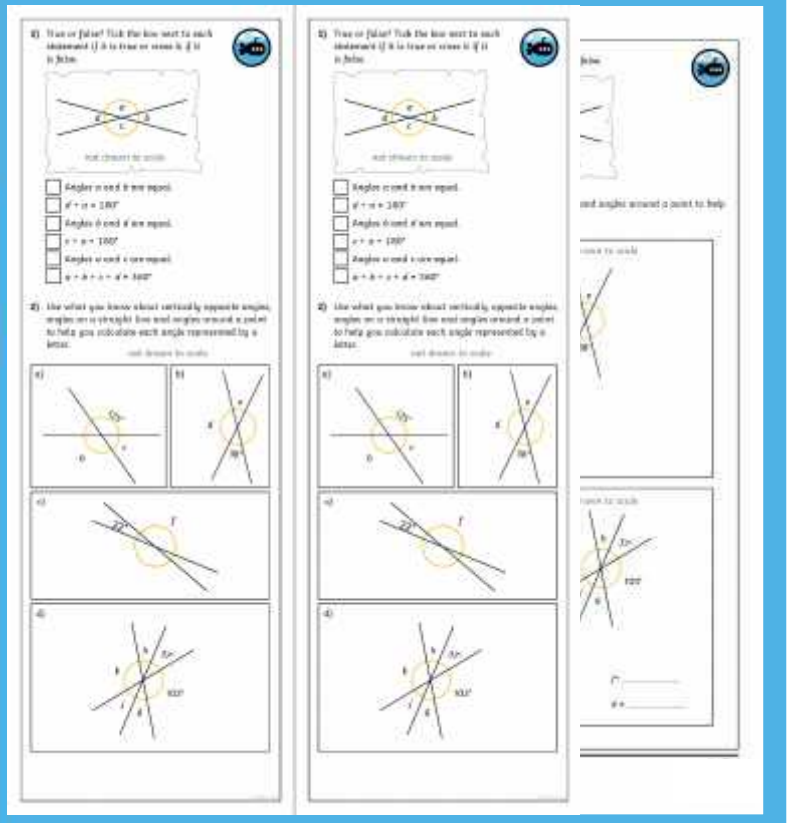
Vertically Opposite Missing Angles



Diving into Mastery

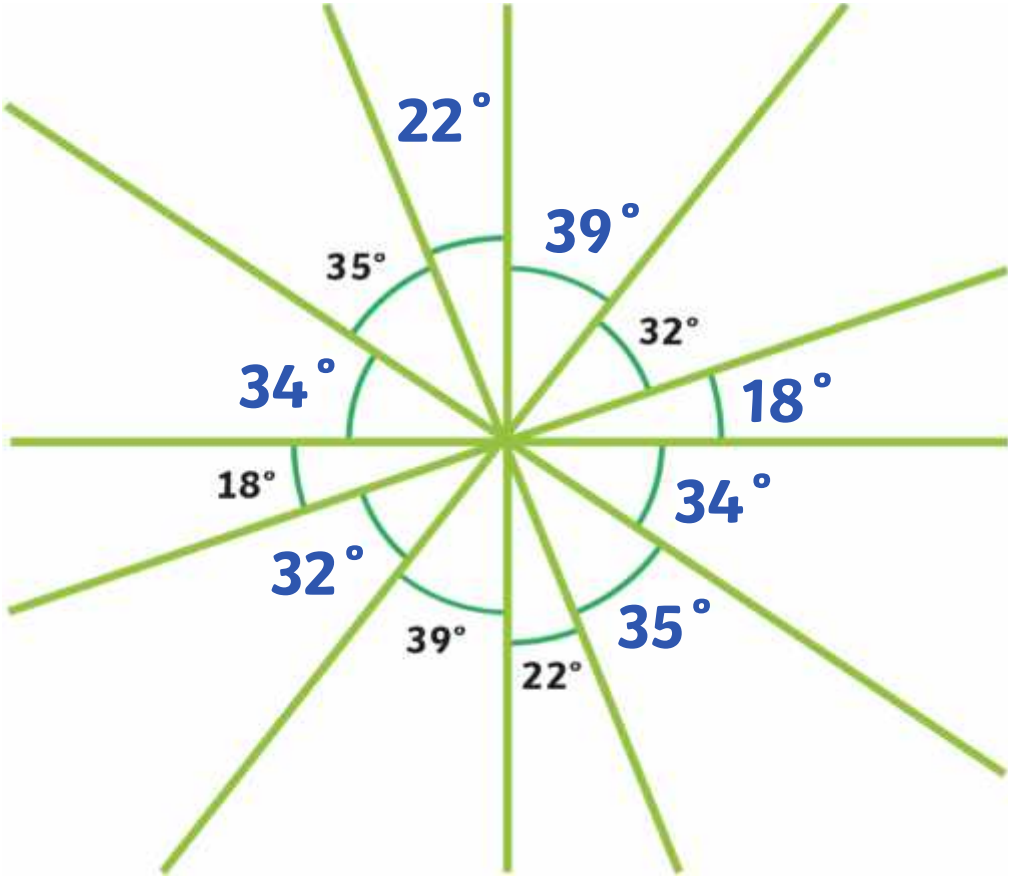
Dive in by completing your own activity!





Angle Challenge

Label and calculate the missing angles.

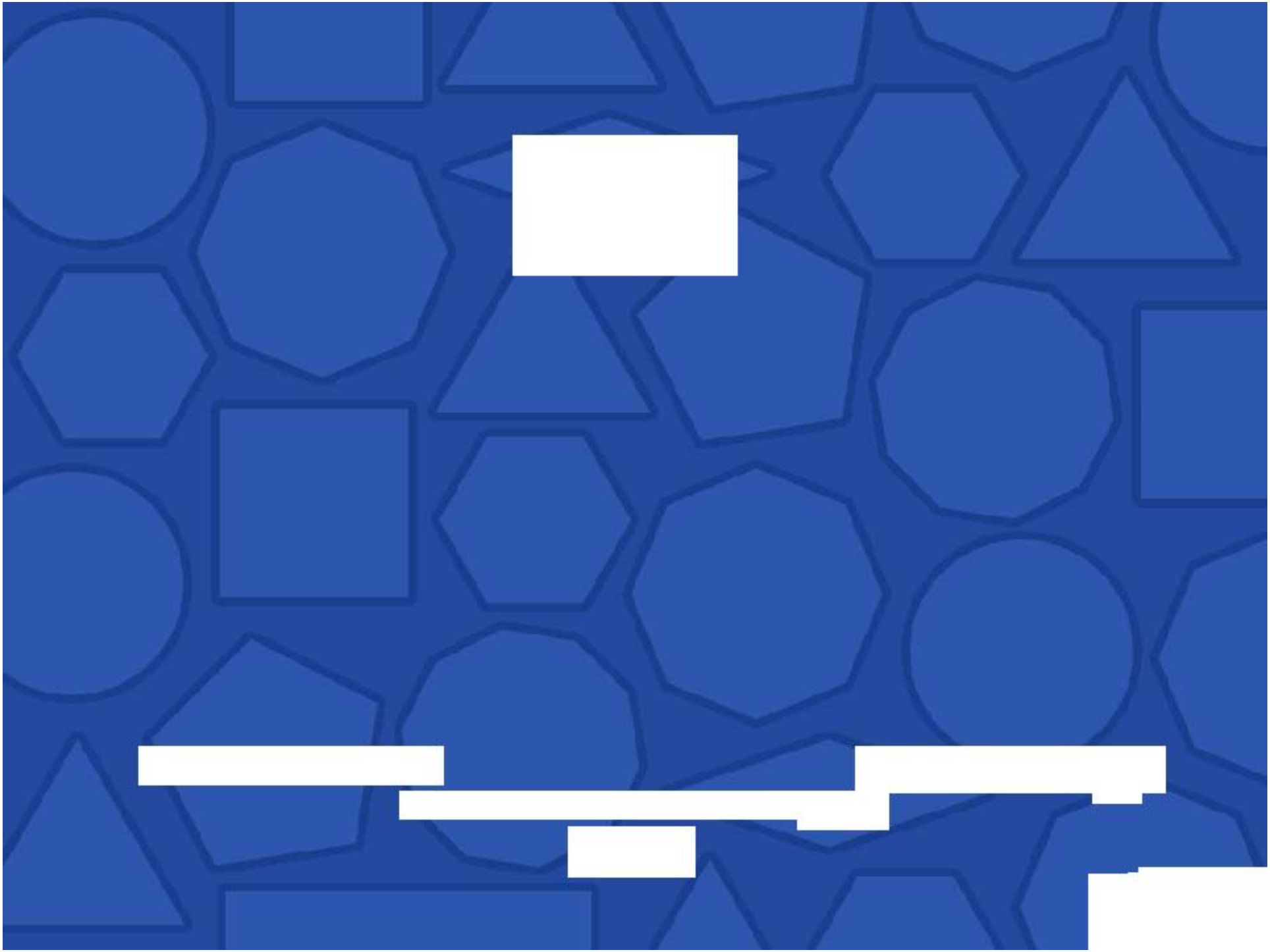


Aim

- To recognise angles which are vertically opposite and find missing angles.

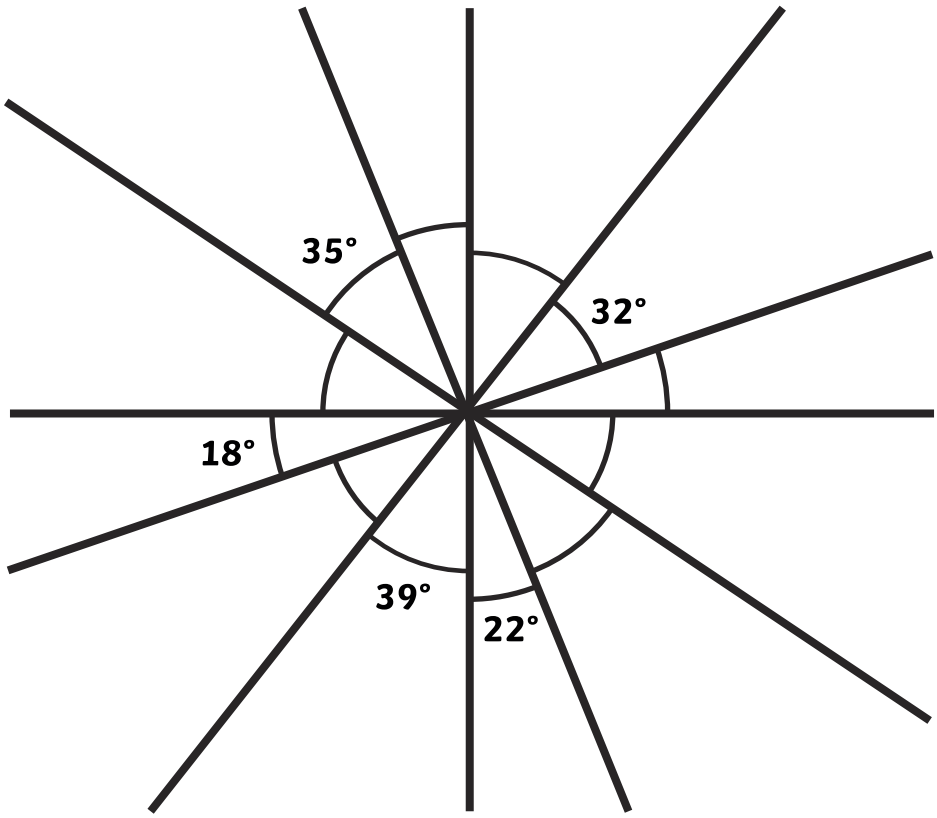
Success Criteria

- I know that vertically opposite angles are equal.
- I can find vertically opposite missing angles.



Angle Challenge

Label and calculate the missing angles.

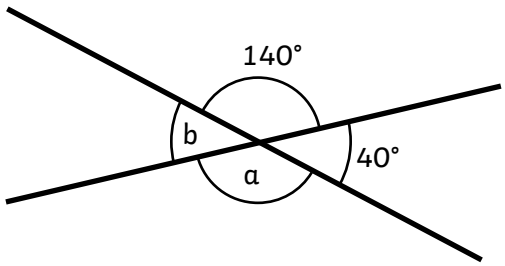


Vertically Opposite Angles

I can find unknown angles which are vertically opposite.

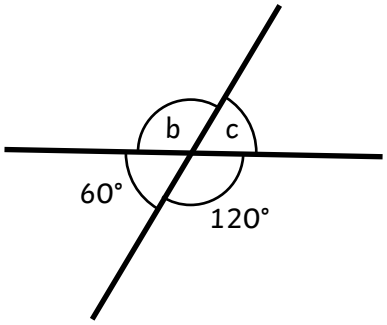
Calculate the missing angles:

1.



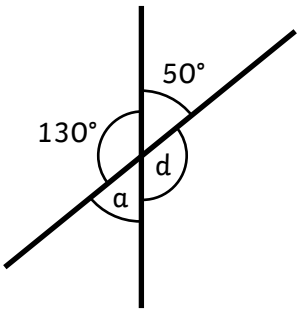
a = _____° b = _____°

2.



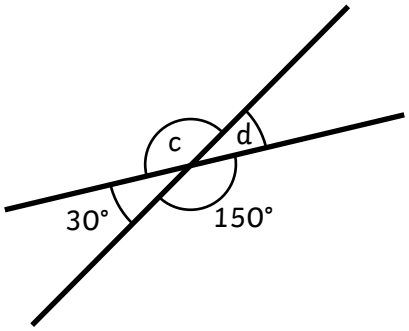
b = _____° c = _____°

3.



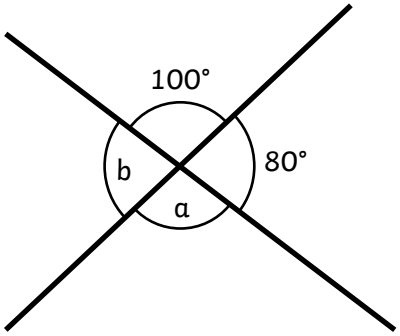
a = _____° d = _____°

4.



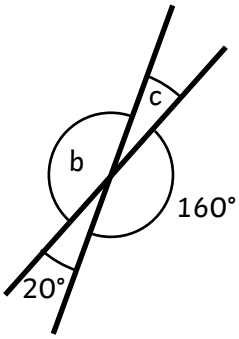
c = _____° d = _____°

5.



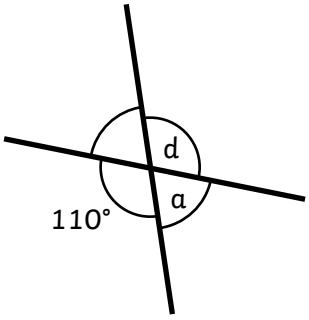
a = _____° b = _____°

6.



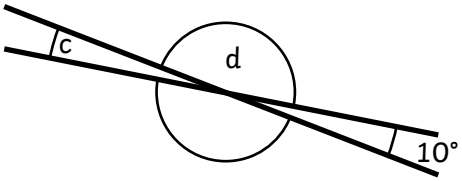
b = _____° c = _____°

7.



a = _____° d = _____°

8.



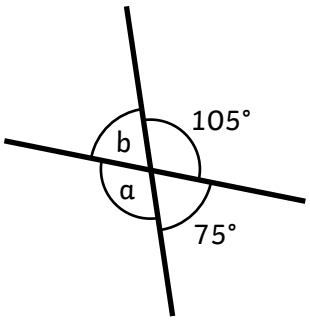
c = _____° d = _____°

Vertically Opposite Angles

I can find unknown angles which are vertically opposite.

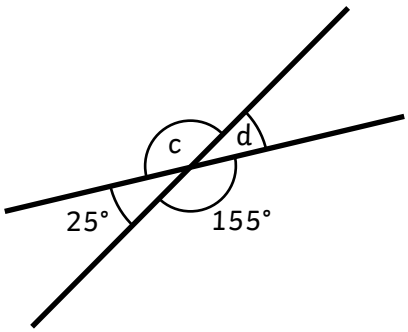
Calculate the missing angles:

1.



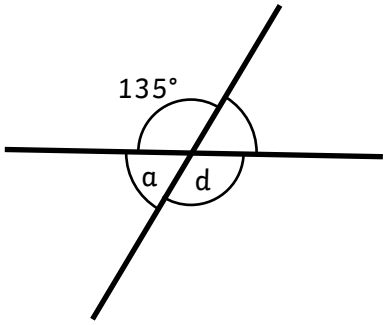
a = _____° b = _____°

2.



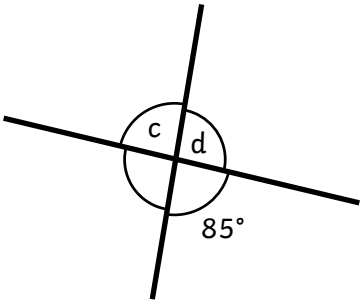
c = _____° d = _____°

3.



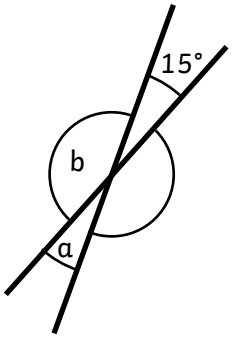
a = _____° d = _____°

4.



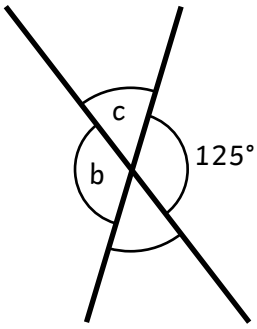
c = _____° d = _____°

5.



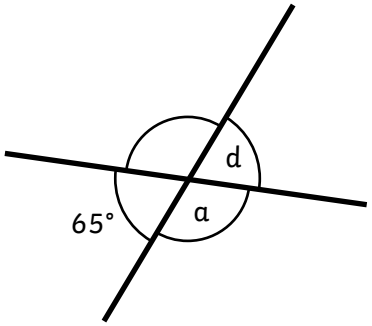
a = _____° b = _____°

6.



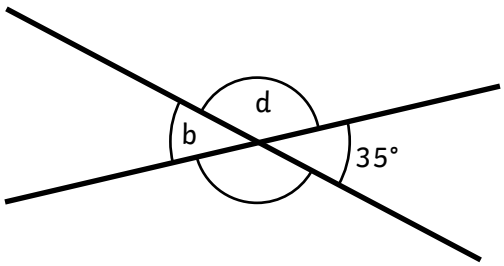
b = _____° c = _____°

7.



a = _____° d = _____°

8.



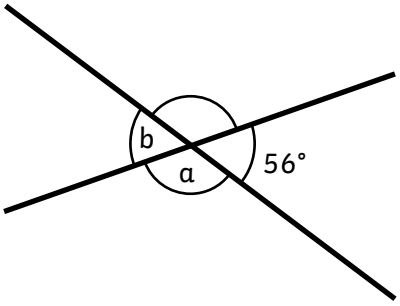
b = _____° d = _____°

Vertically Opposite Angles

I can find unknown angles which are vertically opposite.

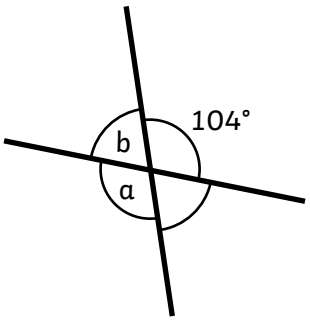
Calculate the missing angles:

1.



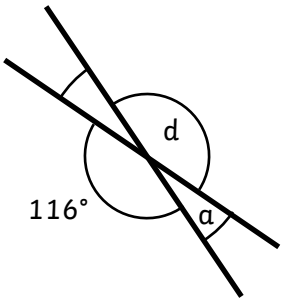
a = _____° b = _____°

2.



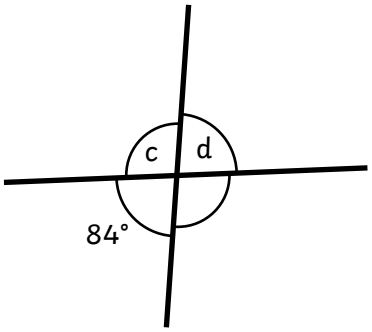
b = _____° c = _____°

3.



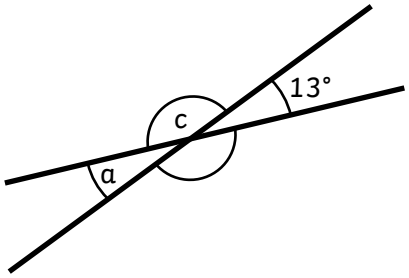
a = _____° d = _____°

4.



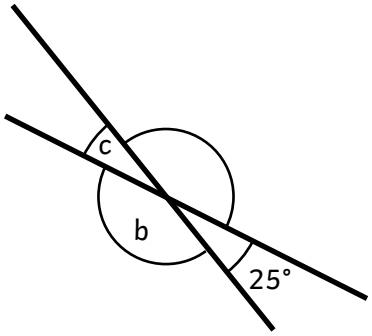
c = _____° d = _____°

5.



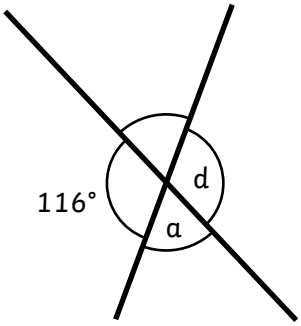
a = _____° b = _____°

6.



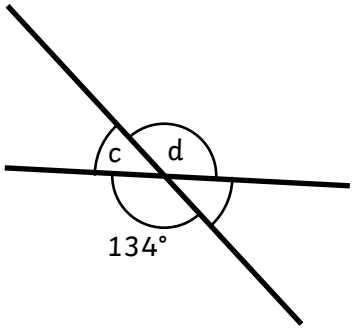
b = _____° c = _____°

7.



a = _____° d = _____°

8.



c = _____° d = _____°

Vertically Opposite Angles

Answers

Question	Answer		Question	Answer	
1.	a = 140°	b = 40°	5.	a = 100°	b = 80°
2.	b = 120°	c = 60°	6.	b = 160°	c = 20°
3.	a = 50°	d = 130°	7.	a = 70°	d = 110°
4.	c = 150°	d = 30°	8.	c = 10°	d = 170°

Question	Answer		Question	Answer	
1.	a = 105°	b = 75°	5.	a = 15°	b = 165°
2.	b = 25°	c = 155°	6.	b = 125°	c = 55°
3.	a = 45°	d = 135°	7.	a = 115°	d = 65°
4.	c = 85°	d = 95°	8.	b = 35°	d = 145°

Question	Answer		Question	Answer	
1.	a = 124°	b = 56°	5.	a = 13°	b = 167°
2.	a = 104°	b = 76°	6.	b = 155°	c = 25°
3.	a = 64°	d = 116°	7.	a = 64°	d = 116°
4.	c = 96°	d = 84°	8.	c = 46°	d = 134°

1) False
True
True
False
True
True

2) a) angle b = 125°
angle c = 55°
b) angle d = 142°
angle e =38°
c) angle f = 158°
d)angle g = 40°
angle h = 40°
angle j = 37°
angle k = 103°

1) p = 42°
x = 48°
z = 138°

2) Mia's strategy would not work. Angles a and d are equal as they are opposite angles. She could work out angle e as $e + a = 180°$, however her method would still leave angles b and c unknown.

Surinder's strategy would work. By revealing angle d, he would be able to calculate the value of angle e as angles $d + e = 180°$. By revealing angle d, he would also know the value of the equal, opposite angle a. If he then knows angle c, he would be able to calculate the value of the only remaining angle, angle b.

3) Dara is incorrect. Angle z is not actually vertically opposite the 84° angle so this strategy will not work.

Conor is correct. By adding the 90° angle and the 42° together and then subtracting the result from 180°, we find that angle z measures 48°.

1) angle x = 51°
angle y = 39°
angle z = 95°

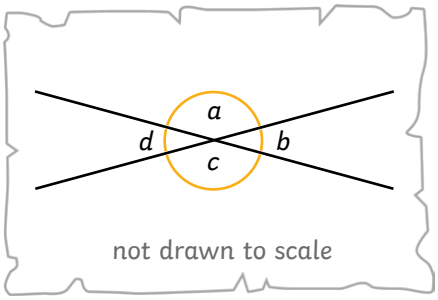
2) a = 77°
b = 77°
c = 96°
d = 96°
e = 55°
f = 46°
g = 93°

3) a) The fewest number of angles that would need to be measured with a protractor would be two angles (either the angle between red and yellow or purple and yellow and the angle between black and purple or black and red). The others could then be calculated.

b) As there are four angles that make up a straight line, you would need to measure three angles. Once you know the three angles on a straight line, you could use the fact that opposite angles are the same to work out the rest of the angles around the point.

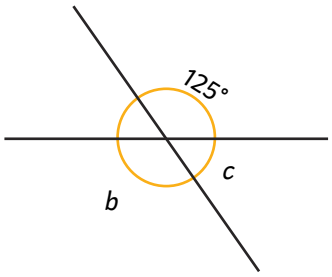
1) True or false? Tick the box next to each statement if it is true or cross it if it is false.

- ☐ Angles a and b are equal.
- ☐ $d + a = 180°$
- ☐ Angles b and d are equal.
- ☐ $c + a = 180°$
- ☐ Angles a and c are equal.
- ☐ $a + b + c + d = 360°$



2) Use what you know about vertically opposite angles, angles on a straight line and angles around a point to help you calculate each angle represented by a letter.

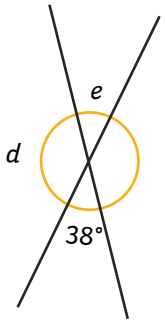
a) not drawn to scale



$b =$ _____

$c =$ _____

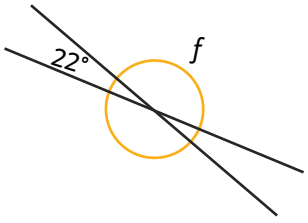
b) not drawn to scale



$d =$ _____

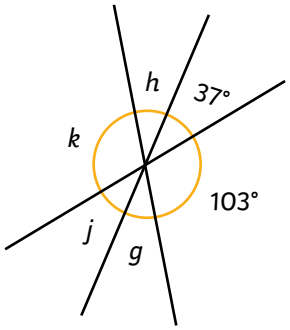
$e =$ _____

c) not drawn to scale



$f =$ _____

d) not drawn to scale



$g =$ _____ $j =$ _____

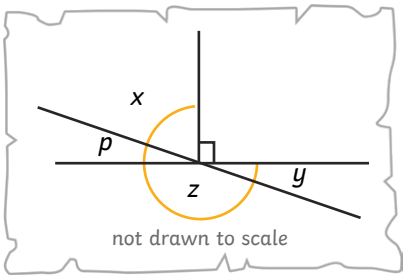
$h =$ _____ $k =$ _____

1) Angle y is 42°. Use this fact to work out all the remaining angles.

p = _____

x = _____

z = _____



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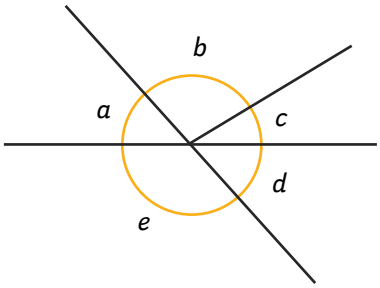

Is either child correct? Explain your answer below. If you would like to explain using a diagram, please use an additional sheet of paper.

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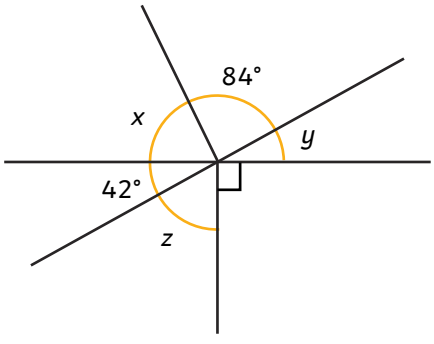

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Dara, "As I know that vertically opposite angles are equal, I think that angle z must equal 84°."

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_____

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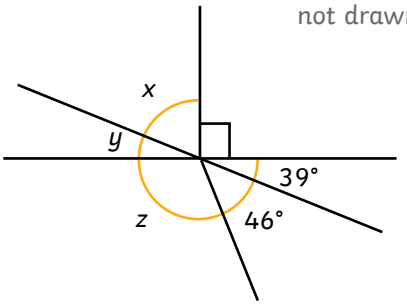
1) Calculate the missing angles.

not drawn to scale



x = _____

y = _____

z = _____

2) Calculate the value of each angle represented by a letter.

a = _____

b = _____

c = _____

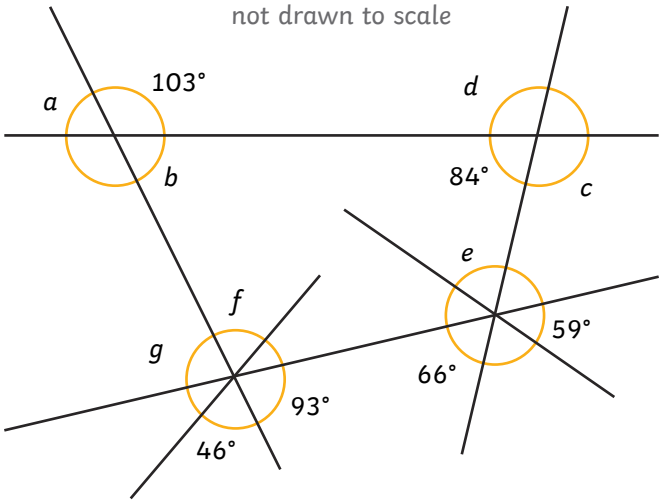
d = _____

e = _____

f = _____

g = _____

not drawn to scale



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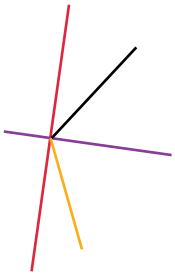
For each drawing, what is the fewest number of angles you need to measure with a protractor before you are able to use what you know about vertically opposite angles, angles on a straight line and angles around a point to help you calculate the value of the remaining angles? Prove it!

a) not drawn to scale



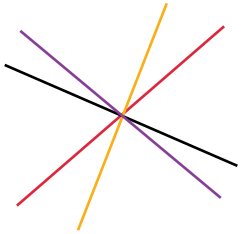
_____

_____

_____

_____

b) not drawn to scale



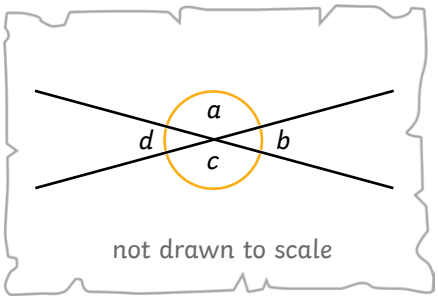
_____

_____

_____

_____

1) True or false? Tick the box next to each statement if it is true or cross it if it is false.



- ☐ Angles a and b are equal.
- ☐ $d + a = 180°$
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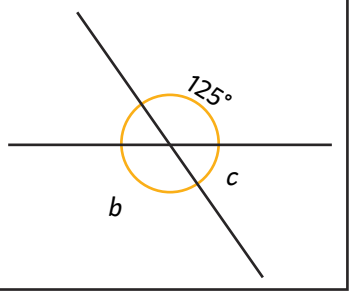
not drawn to scale

a)



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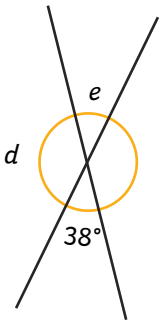
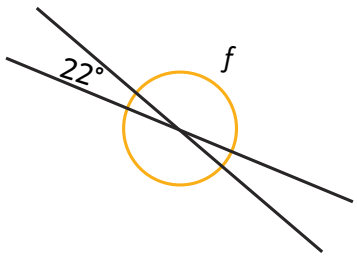


c)



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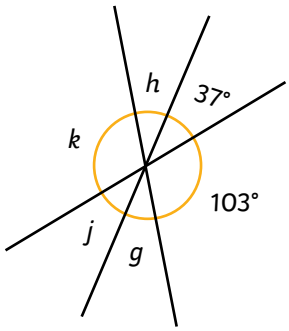

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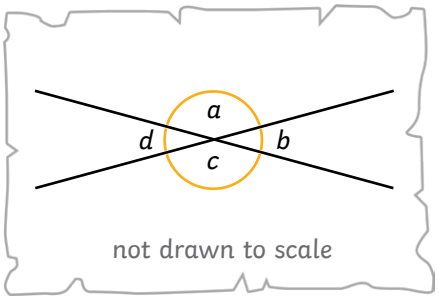

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not drawn to scale

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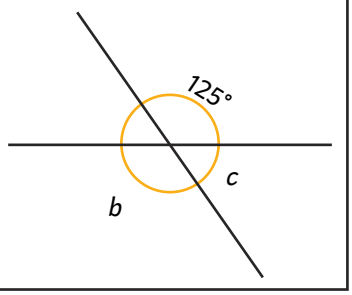

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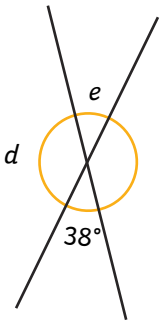

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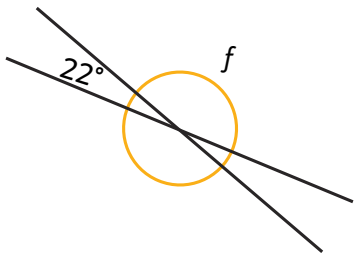

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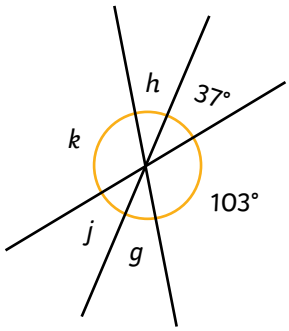

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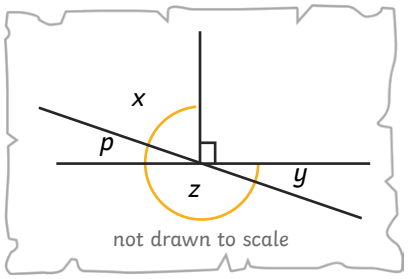

p = _____

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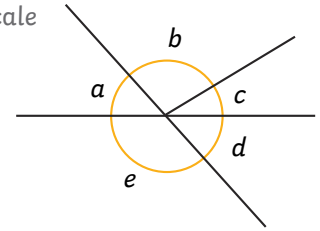

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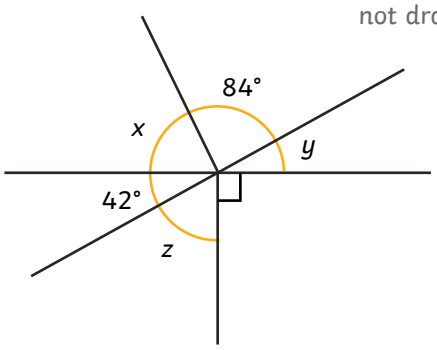

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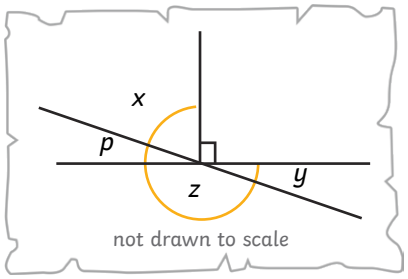

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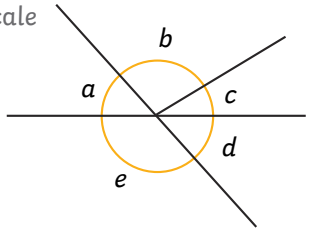

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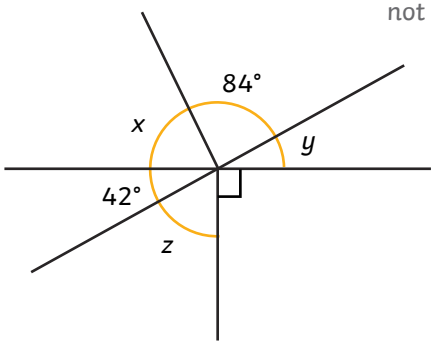

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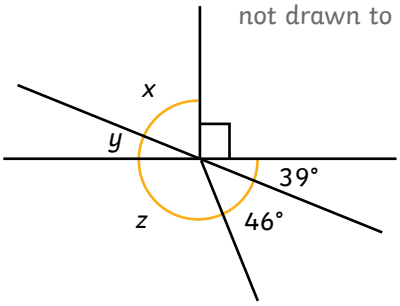

2) Calculate the value of each angle represented by a letter.

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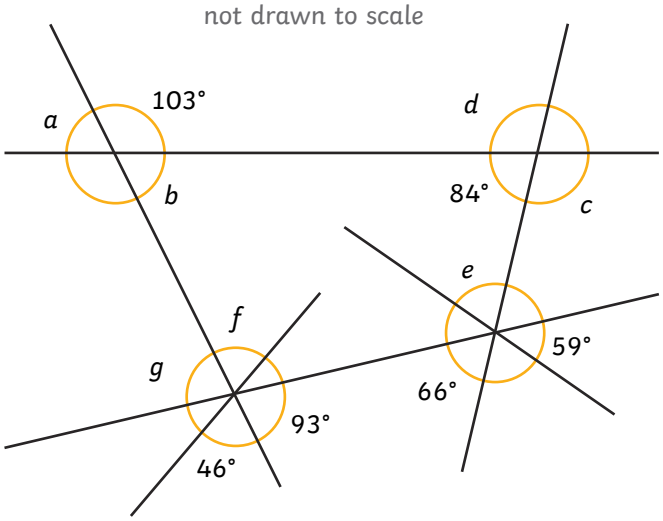

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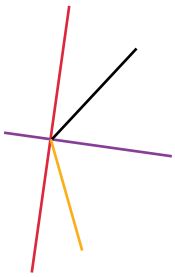
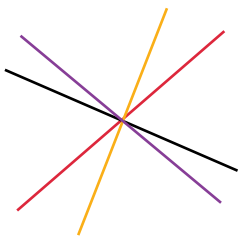
not drawn to scale



b)

not drawn to scale



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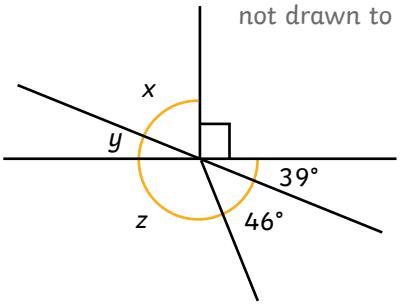

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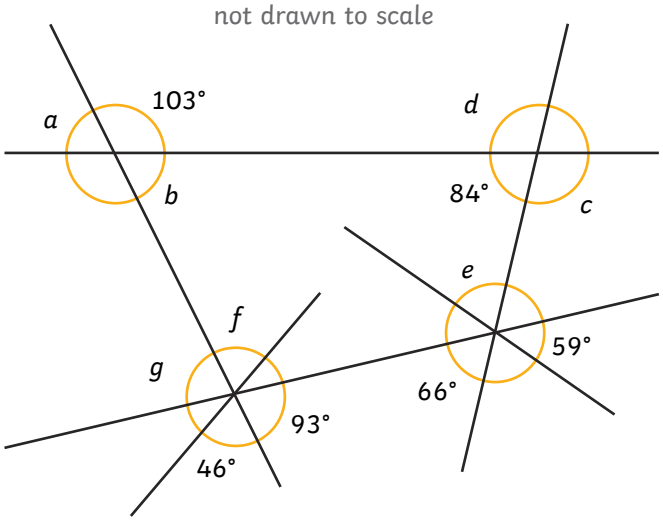

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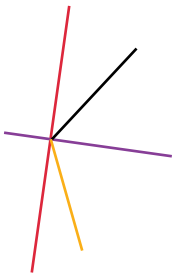
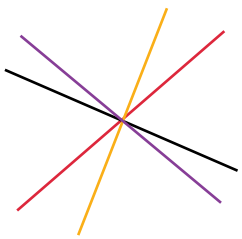


b)

not drawn to scale



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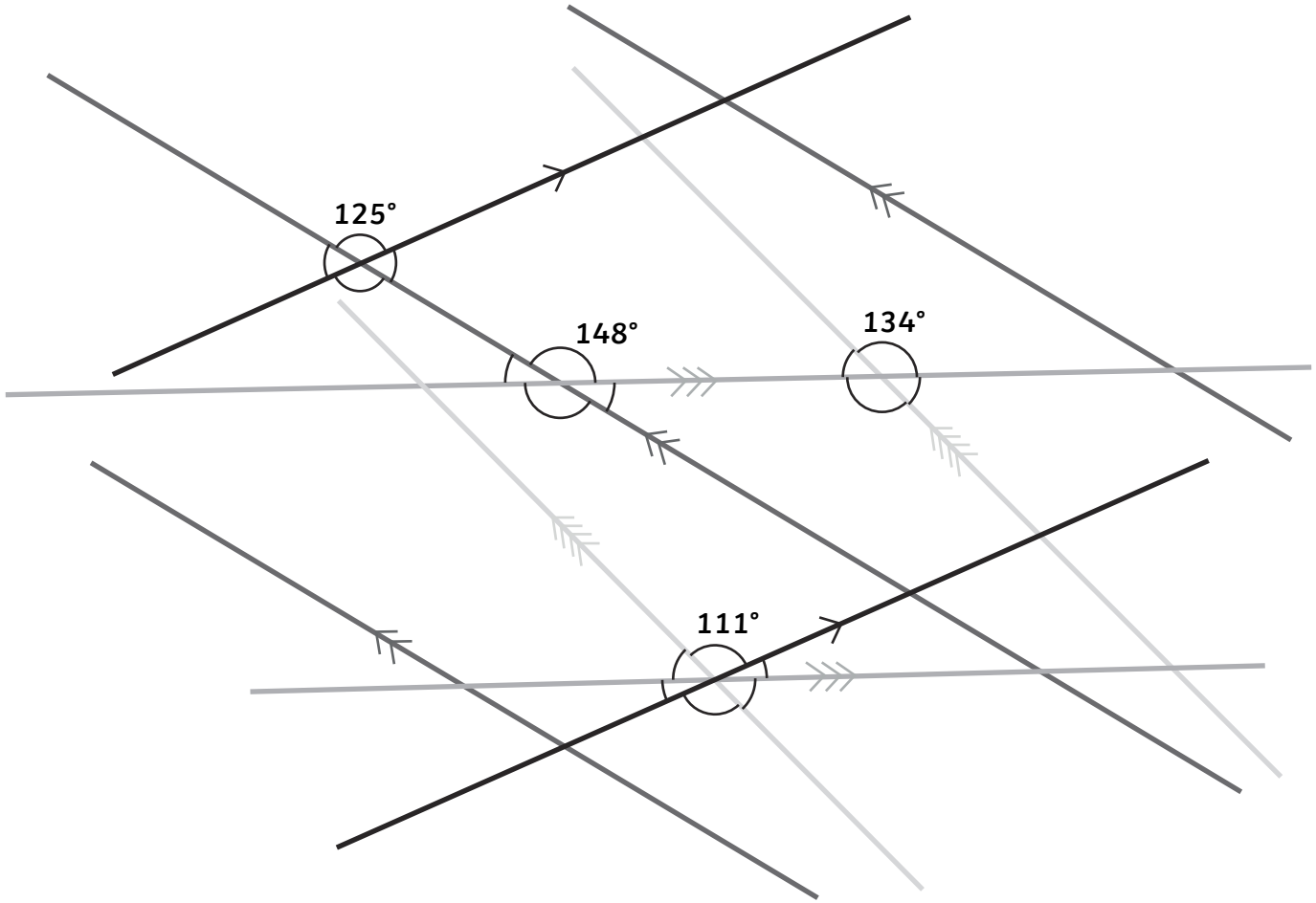
Vertically Opposite Angles Extra Challenge

I can find unknown angles which are vertically opposite.

Using the four given angles and your understanding of vertically opposite angles, can you calculate all the angles made by these intersecting lines?



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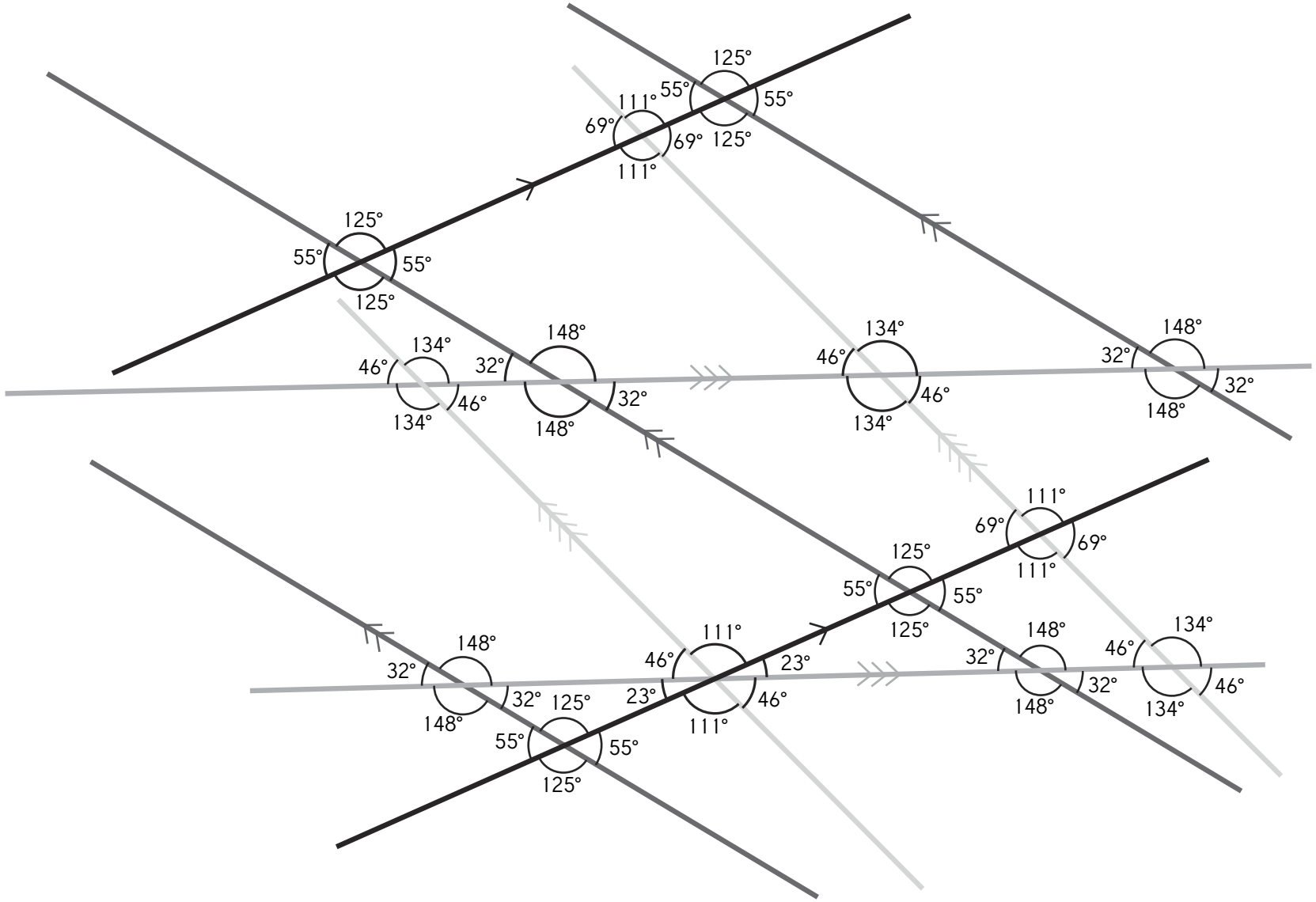

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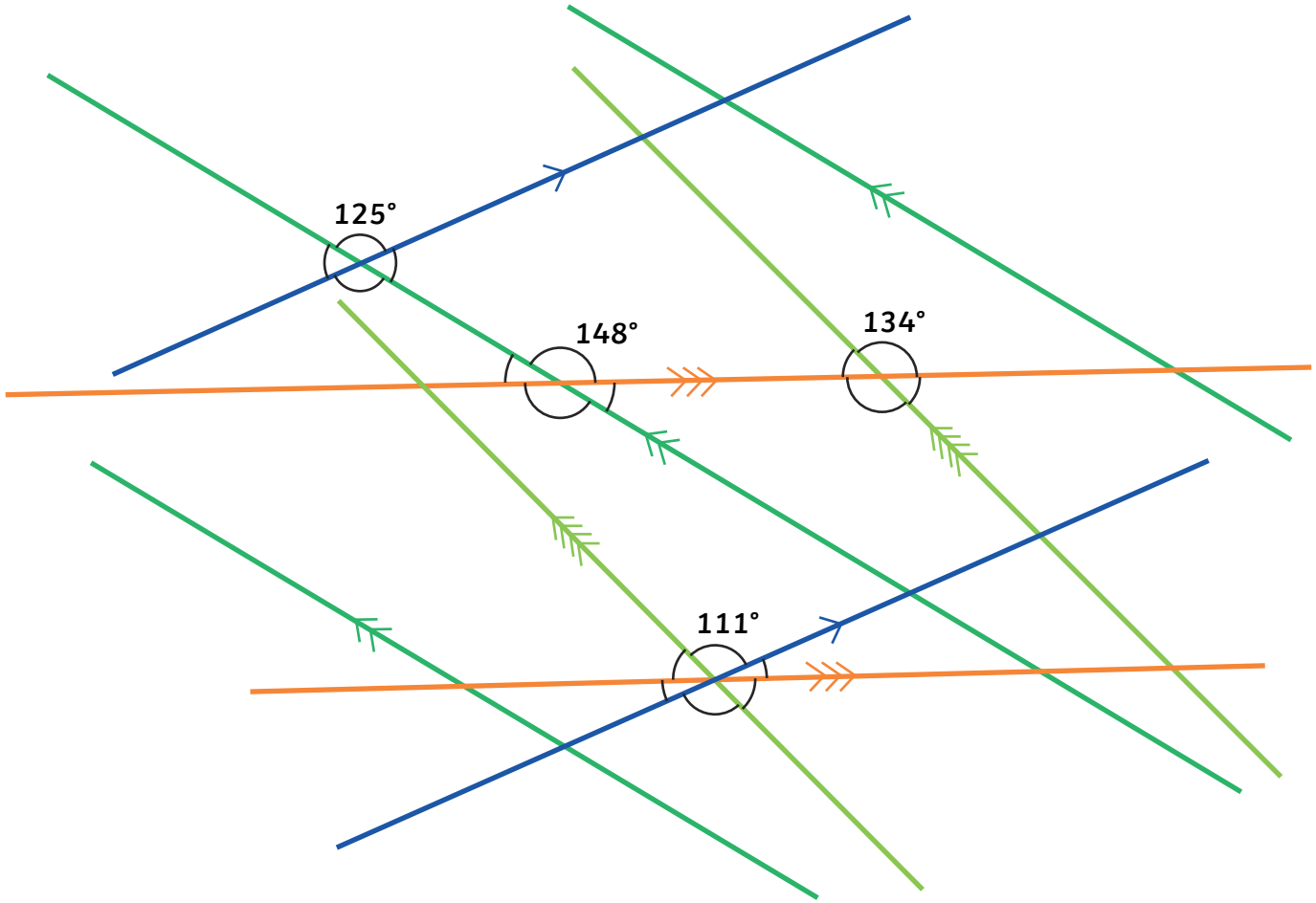

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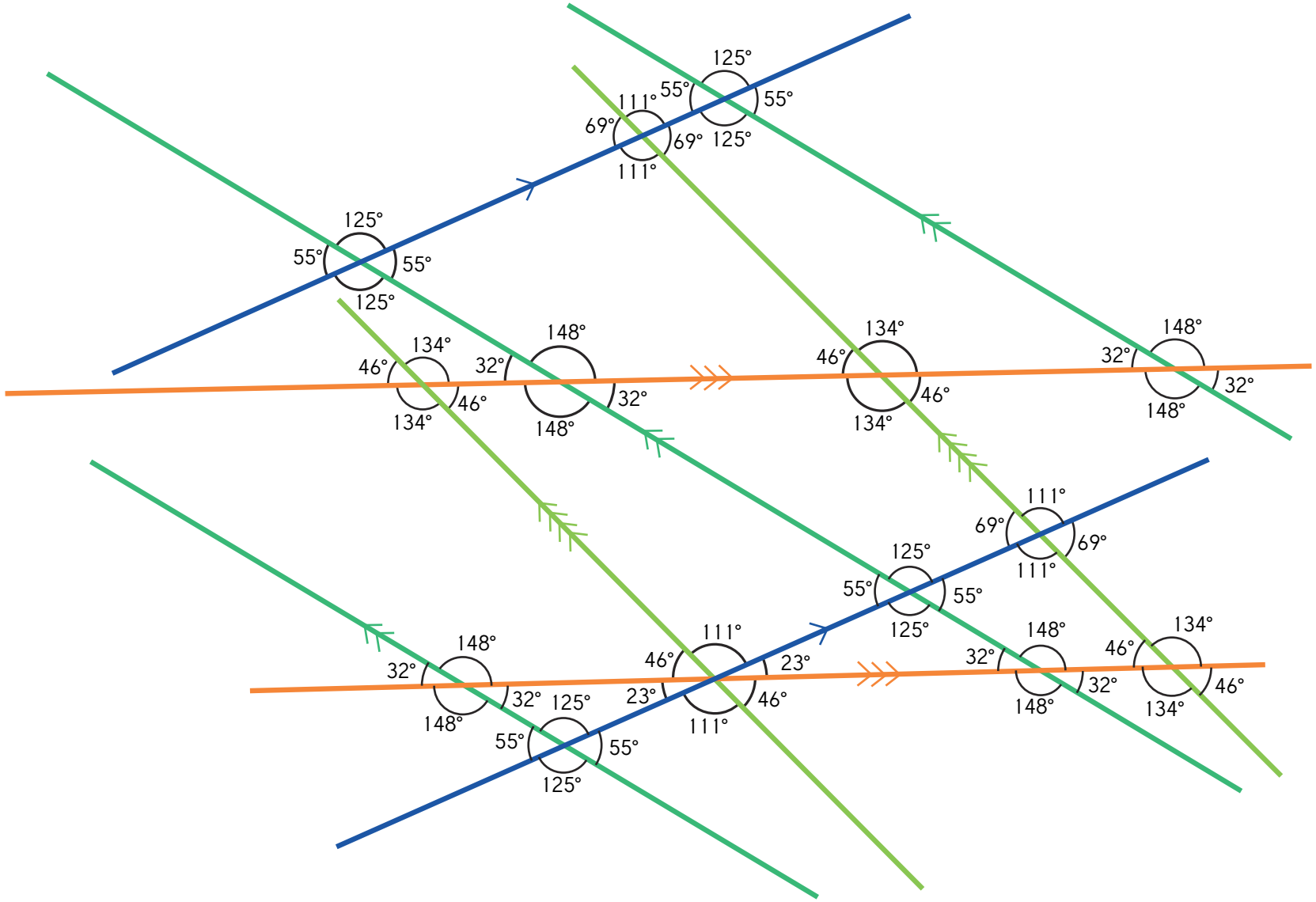

Avery Template: Name Badge Label, 8 per sheet | **Compatible Products**: 15395, 25395, 42395, 45395, 48395, 5395, 8395, 88395, 85395.

Maths | Vertically Opposite Angles

To recognise angles which are vertically opposite and find missing angles.		
I know that vertically opposite angles are equal.		
I can find vertically opposite missing angles.		

Maths | Vertically Opposite Angles

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Maths | Vertically Opposite Angles

To recognise angles which are vertically opposite and find missing angles.		
I know that vertically opposite angles are equal.		
I can find vertically opposite missing angles.		