

Year 7
Mathematics
Unit 5 – Student



Name: _____

Class: _____

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1 Angles

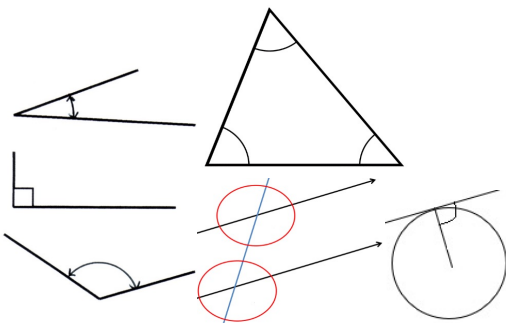
Definition

The amount of turn from one straight line to another straight line connected at a point.

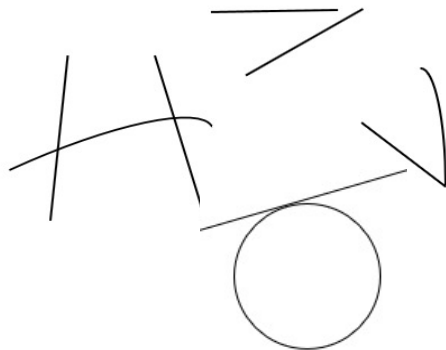
Characteristics

- Two connected straight lines.
- Often measured using the unit “degree”.
- Often measured using a protractor.
- Can be called “acute”, “obtuse”, “reflex” and “right”.

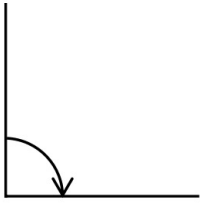
Examples



Non Examples



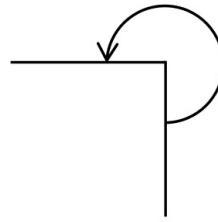
1.1 Types of Turns and Angles



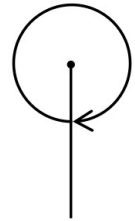
A quarter of a turn clockwise



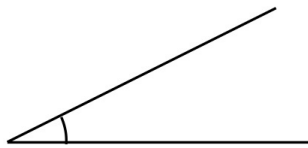
Half a turn anticlockwise



Three quarters of a turn anticlockwise

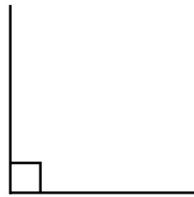


A full turn clockwise



Acute Angle

Any angle between 0° and 90°



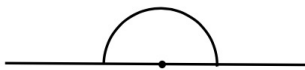
Right Angle

An angle that is exactly 90°



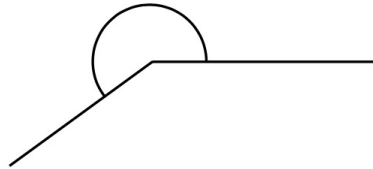
Obtuse Angle

Any angle between 90° and 180°



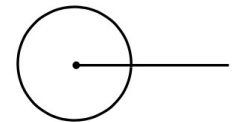
Straight Line

An angle that is exactly 180°



Reflex Angle

Any angle between 180° and 360°

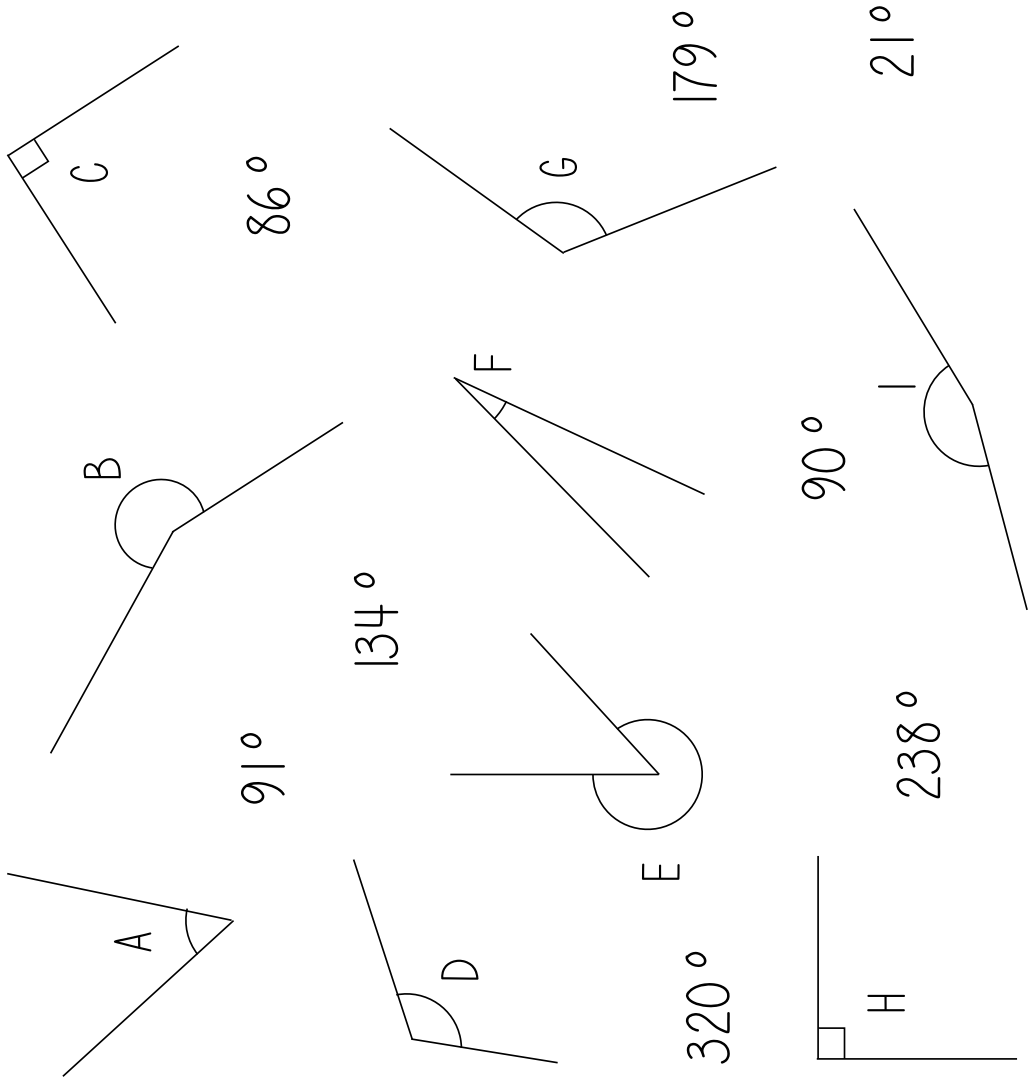


Full Turn

An angle that is exactly 360°

Fluency Practice

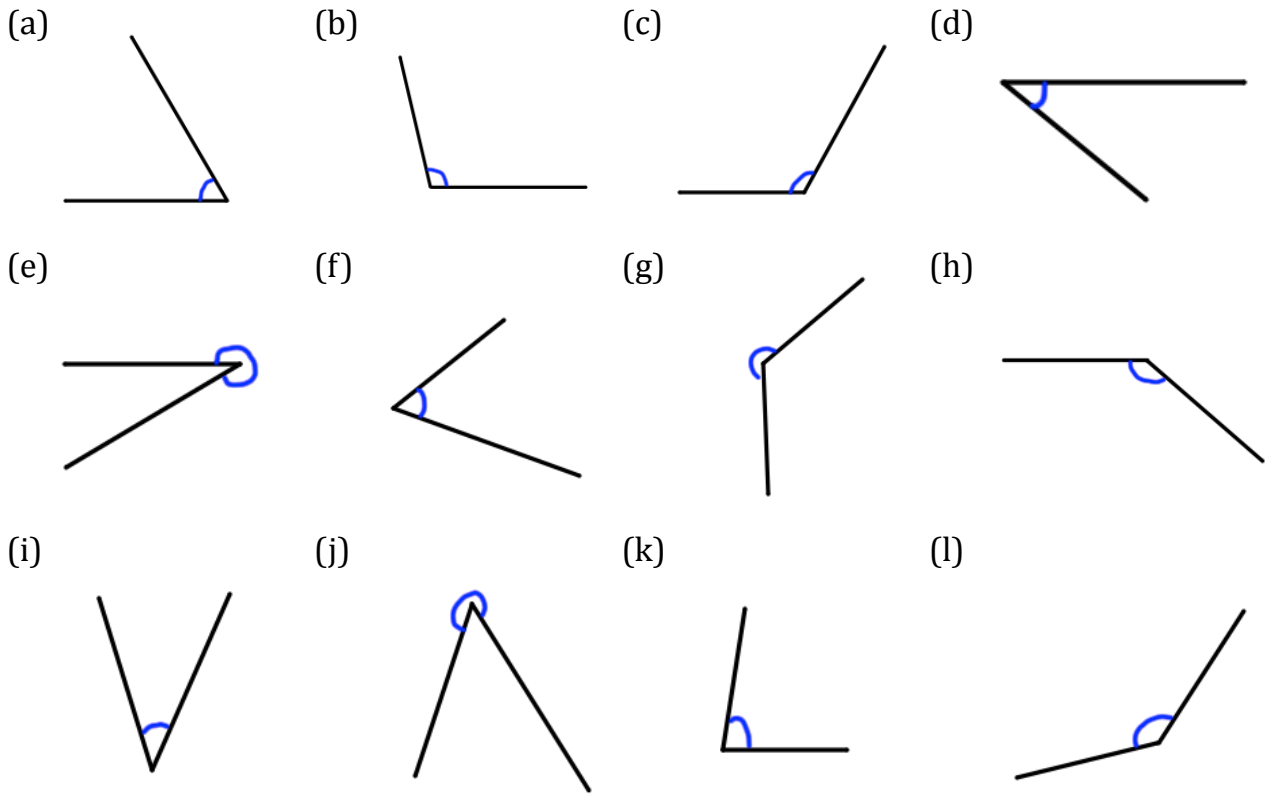
Place the angles into the correct categories



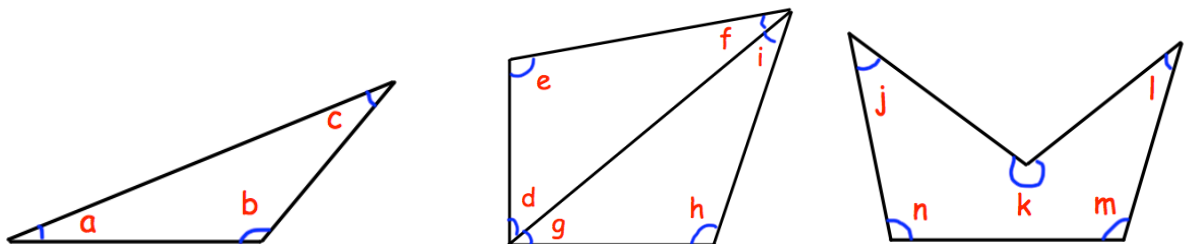
Acute	Right Angle	Obtuse	Reflex
Properties of acute angles	Properties of right angles	Properties of obtuse angles	Properties of reflex angles

Fluency Practice

Question 1: Write down if each angle below is acute, obtuse or reflex.



Question 6: For the shapes below, write down the type of each angle labelled.



Question 7: State the type of each angle below

- | | | | |
|----------------|-----------------|-----------------|-----------------|
| (a) 45° | (b) 105° | (c) 200° | (d) 19° |
| (e) 90° | (f) 179° | (g) 318° | (h) 1° |
| (i) 93° | (j) 82° | (k) 89° | (l) 183° |

1.2 Estimating Angles

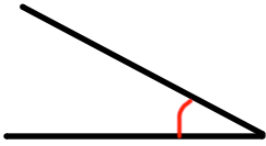
<http://sineofthetimes.org/2018/estimateangle/>

<https://nrich.maths.org/1235>

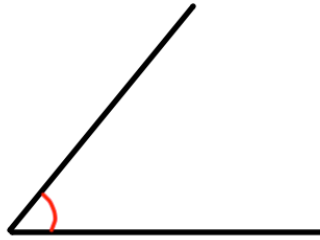
Fluency Practice

Question 1: Estimate the size of each of these angles

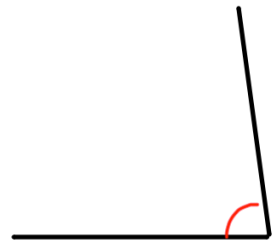
(a)



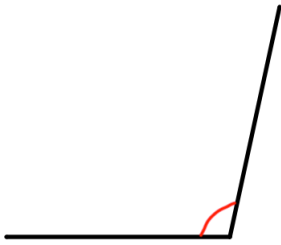
(b)



(c)



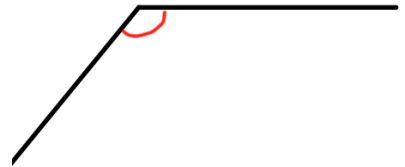
(d)



(e)



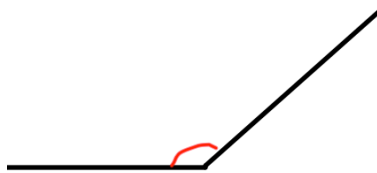
(f)



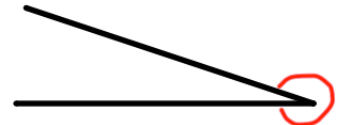
(g)



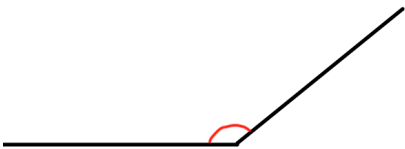
(h)



(i)



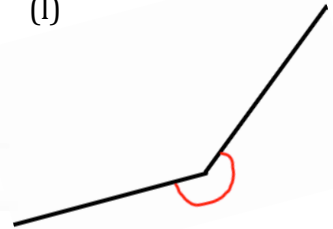
(j)



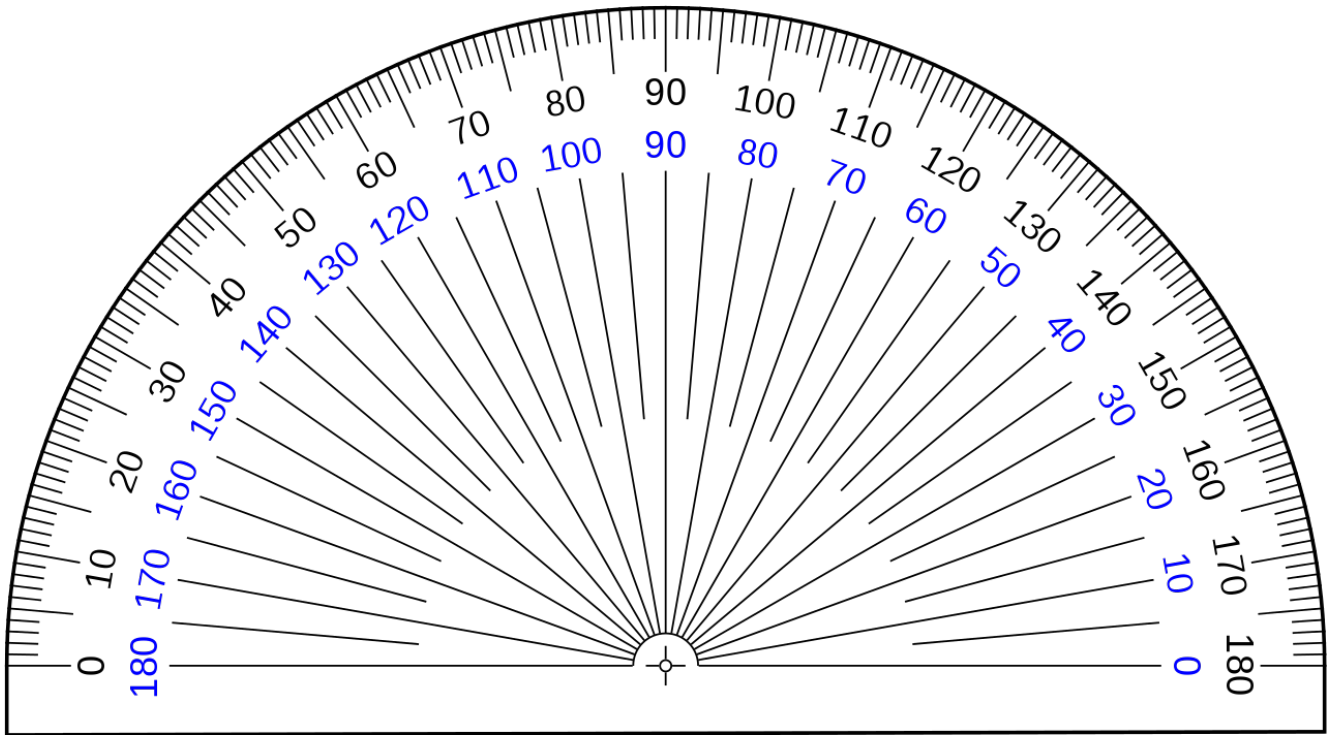
(k)



(l)

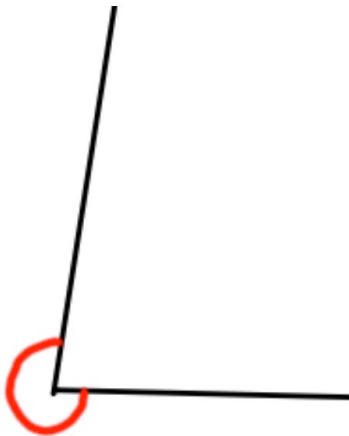
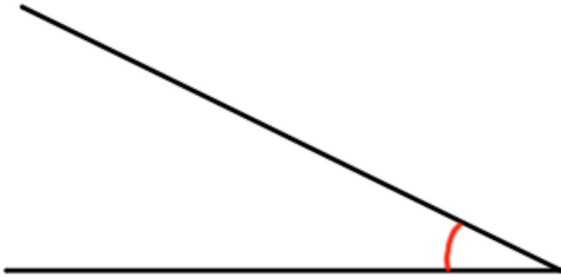


1.3 Measuring Angles



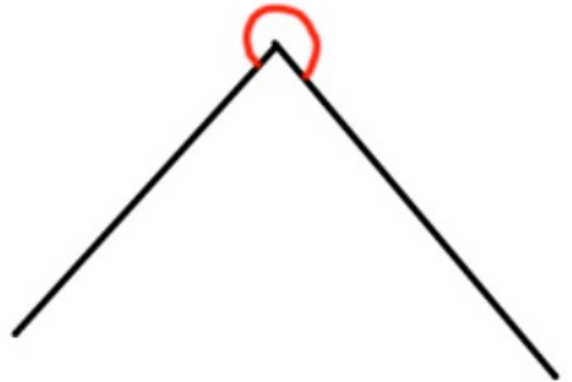
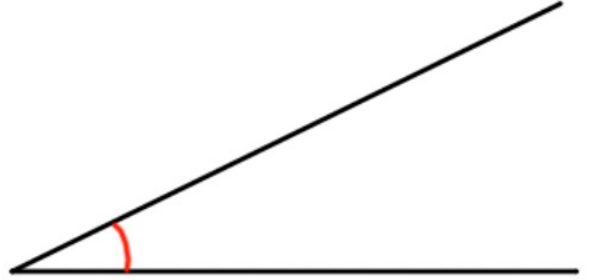
Worked Example

Measure the angles below.



Your Turn

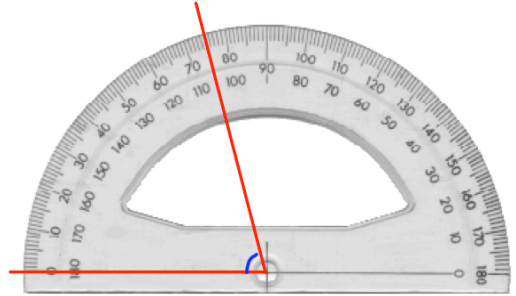
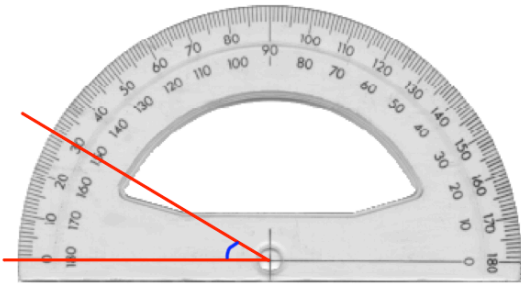
Measure the angles below.



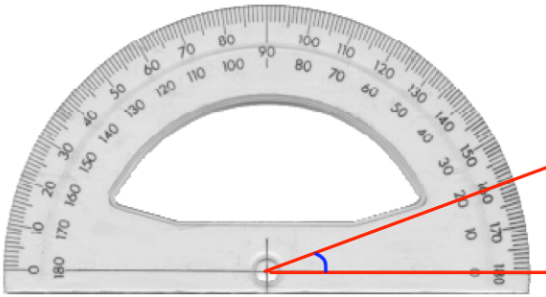
Fluency Practice

Question 1: Write down the size of each angle being measured (2)

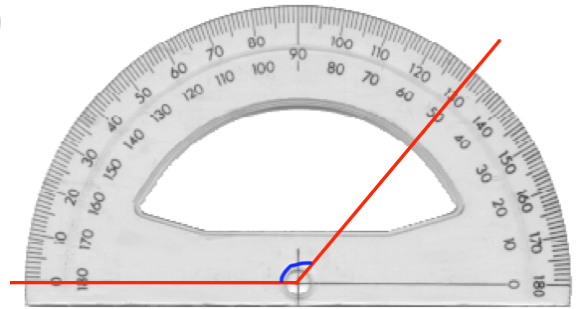
(b)



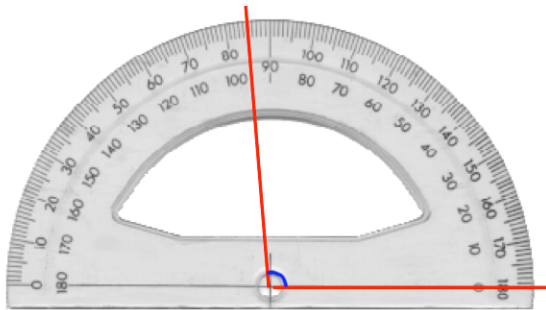
(c)



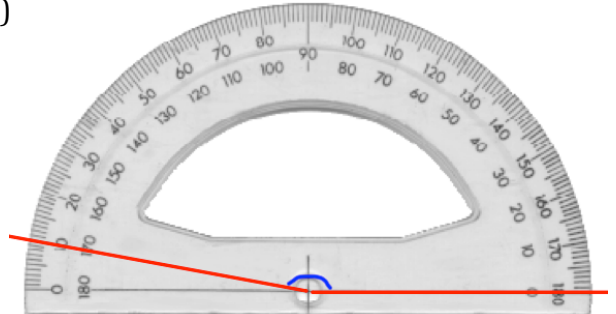
(d)



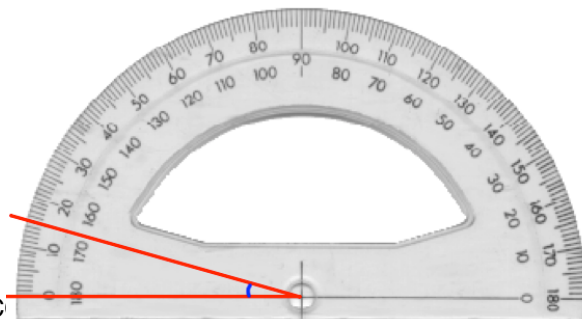
(e)



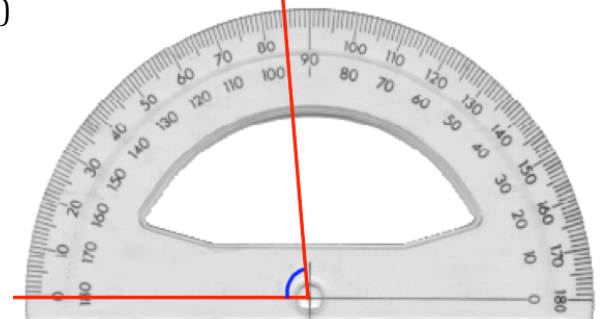
(f)



(g)



(h)



© C

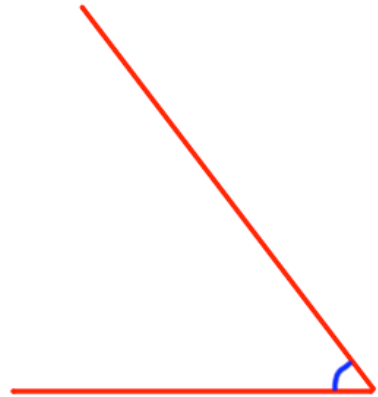
Fluency Practice

Question 2: Measure each angle below

(a)



(b)



(c)



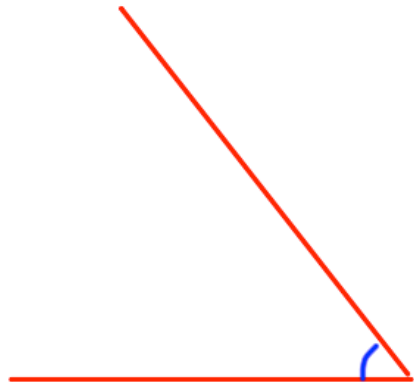
(d)



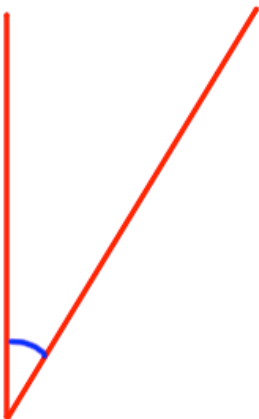
(e)



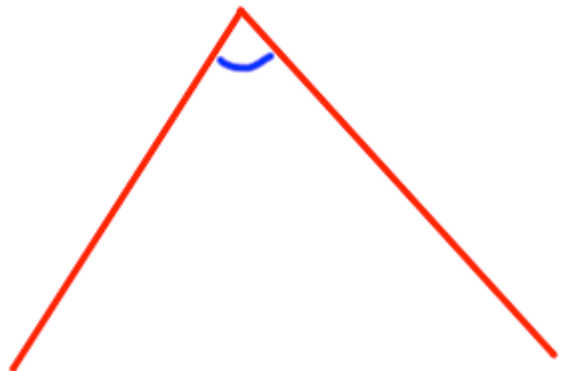
(f)



(g)



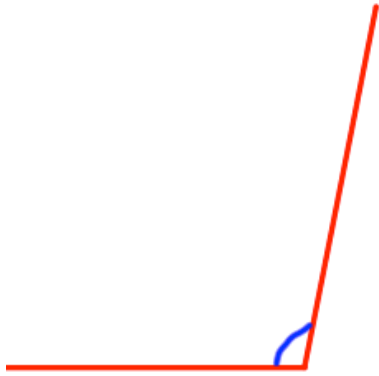
(h)



Fluency Practice

Question 3: Measure each angle below

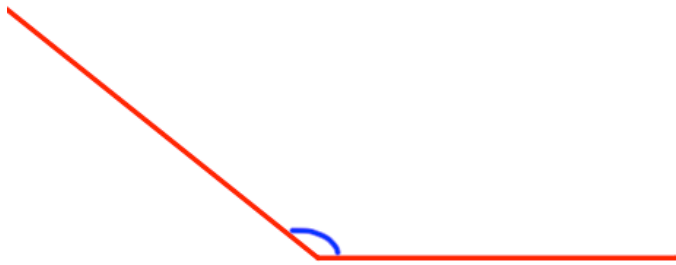
(a)



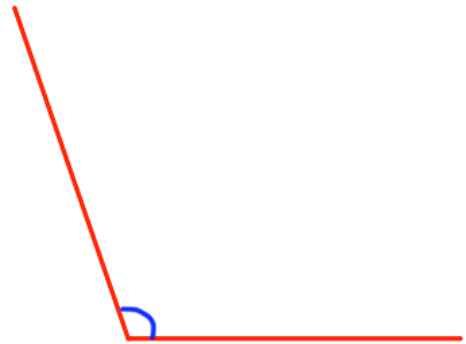
(b)



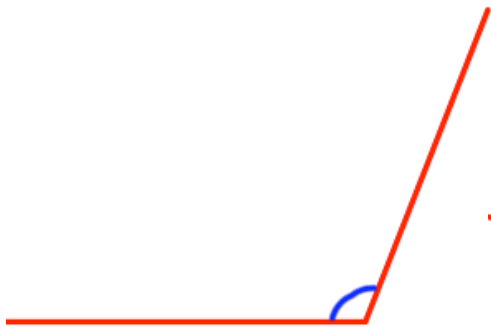
(c)



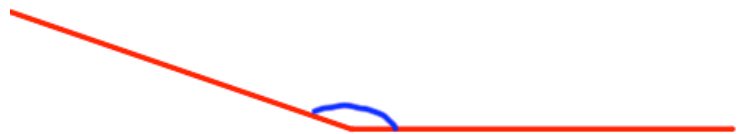
(d)



(e)



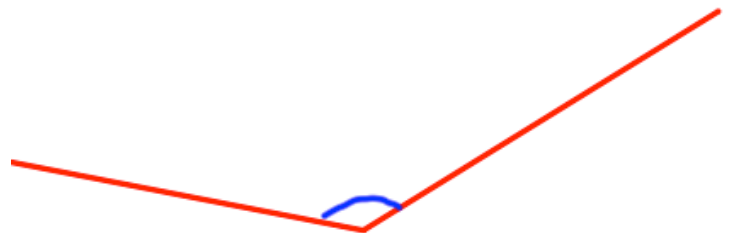
(f)



(g)



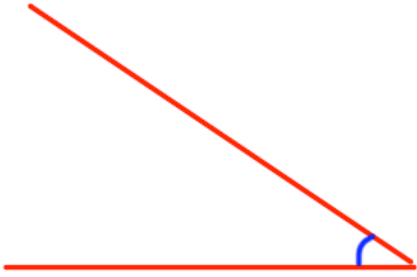
(h)



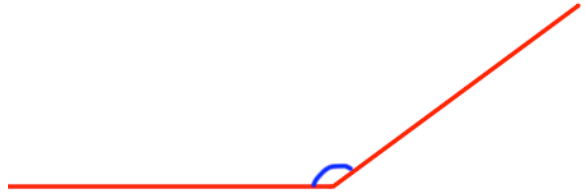
Fluency Practice

Question 4: Measure each angle below

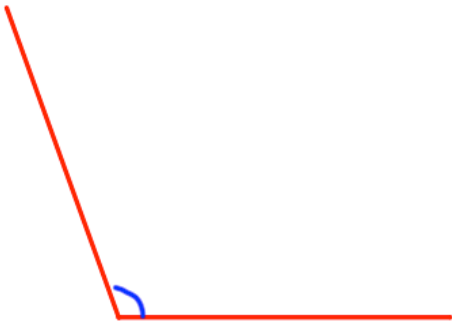
(a)



(b)



(c)



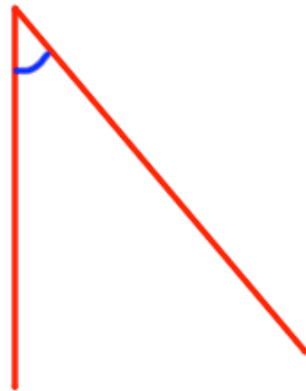
(d)



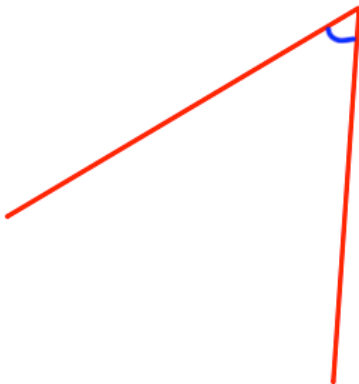
(e)



(f)



(g)



(h)



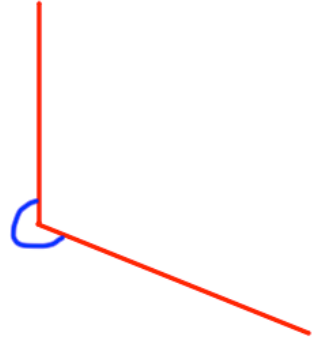
Fluency Practice

Question 5: Measure each reflex angle below

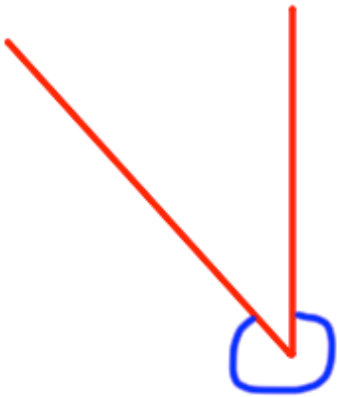
(a)



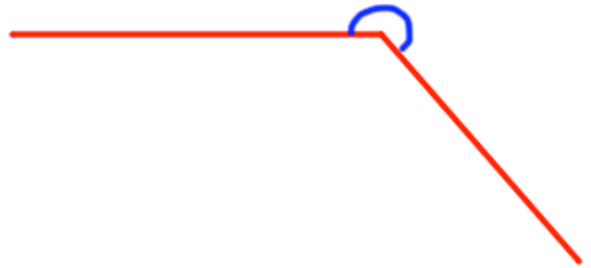
(b)



(c)

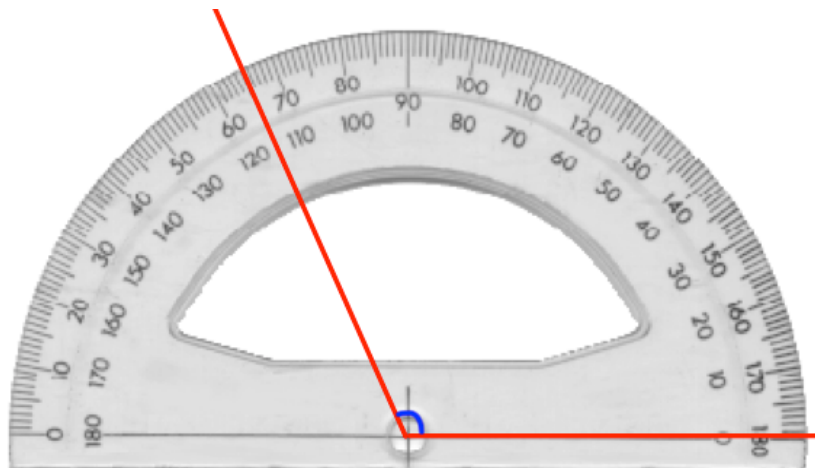


(d)



Extension

Question 1: Sophie has been asked to measure this angle. Her answer is 65° . She has made a mistake. Explain what she has done wrong.



1.4 Drawing Angles

Worked Example

Draw an angle of 70°

Draw an angle of 215°

Your Turn

Draw an angle of 80°

Draw an angle of 225°

Fluency Practice

Question 1: Draw angles of the following size

- | | | | |
|----------------|----------------|----------------|----------------|
| (a) 20° | (b) 60° | (c) 80° | (d) 40° |
| (e) 10° | (f) 70° | (g) 50° | (h) 45° |
| (i) 25° | (j) 85° | (k) 75° | (l) 15° |
| (m) 12° | (n) 62° | (o) 38° | (p) 71° |
| (q) 56° | (r) 23° | (s) 28° | (t) 19° |

Question 2: Draw angles of the following size

- | | | | |
|-----------------|-----------------|-----------------|-----------------|
| (a) 100° | (b) 150° | (c) 160° | (d) 120° |
| (e) 170° | (f) 130° | (g) 110° | (h) 125° |
| (i) 145° | (j) 165° | (k) 105° | (l) 95° |
| (m) 153° | (n) 107° | (o) 98° | (p) 133° |
| (q) 121° | (r) 149° | (s) 167° | (t) 108° |

Question 3: Draw angles of the following size

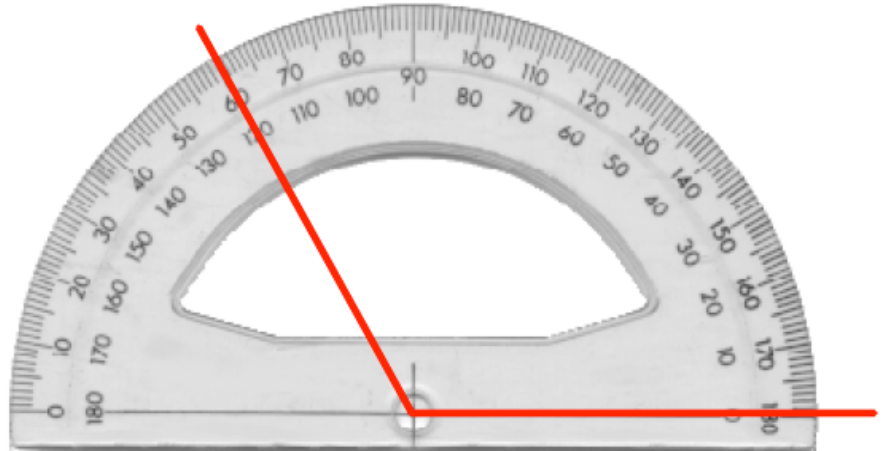
- | | | | |
|-----------------|-----------------|-----------------|-----------------|
| (a) 200° | (b) 240° | (c) 270° | (d) 300° |
| (e) 320° | (f) 350° | (g) 215° | (h) 255° |
| (i) 345° | (j) 195° | (k) 233° | (l) 268° |
| (m) 307° | (n) 321° | (o) 206° | (p) 199° |

Question 4: Draw angles of the following size

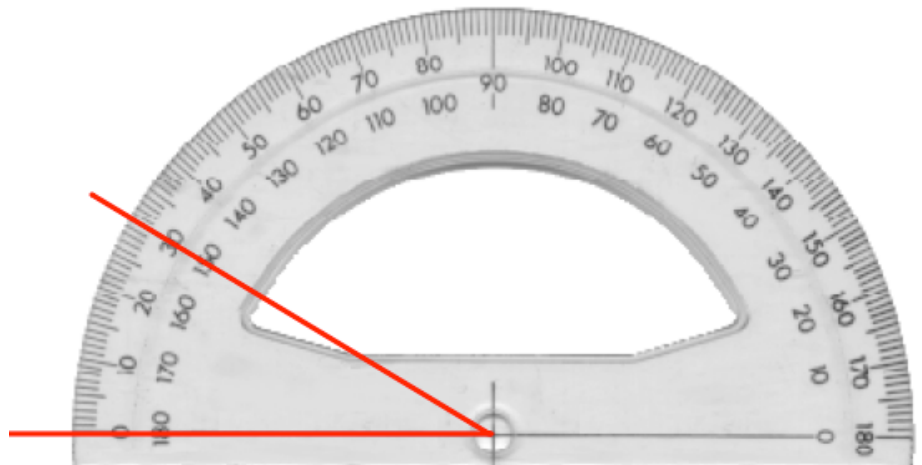
- | | | | |
|-----------------|-----------------|-----------------|----------------|
| (a) 30° | (b) 225° | (c) 175° | (d) 98° |
| (e) 340° | (f) 15° | (g) 63° | (h) 59° |

Extension

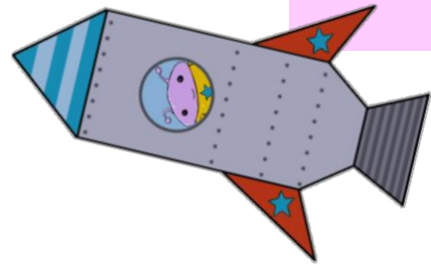
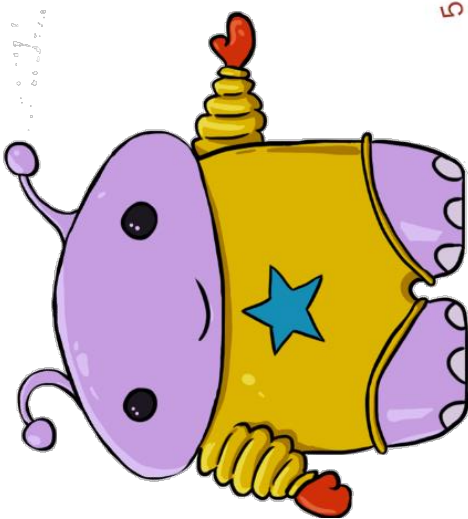
Question 1: Sophie has been asked to draw a 60° angle. She has made a mistake. Explain what she has done wrong.



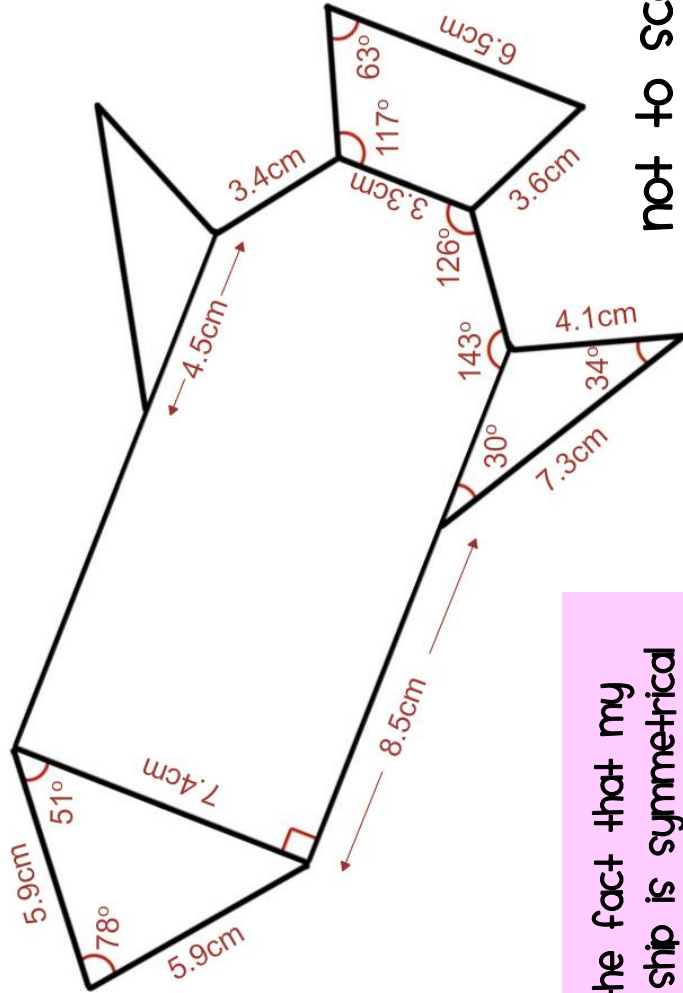
Question 2: Jonathan has been asked to draw a 150° angle. He has made a mistake. Explain what he has done wrong.



Extension



can you draw my rocket ship?
remember to use a ruler and
protractor to draw the lines and
angles accurately!



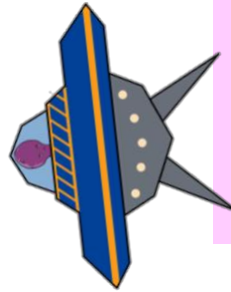
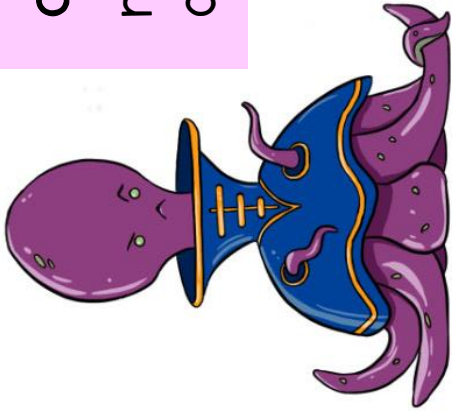
not to scale

use the fact that my
rocket ship is symmetrical
to help you draw it!

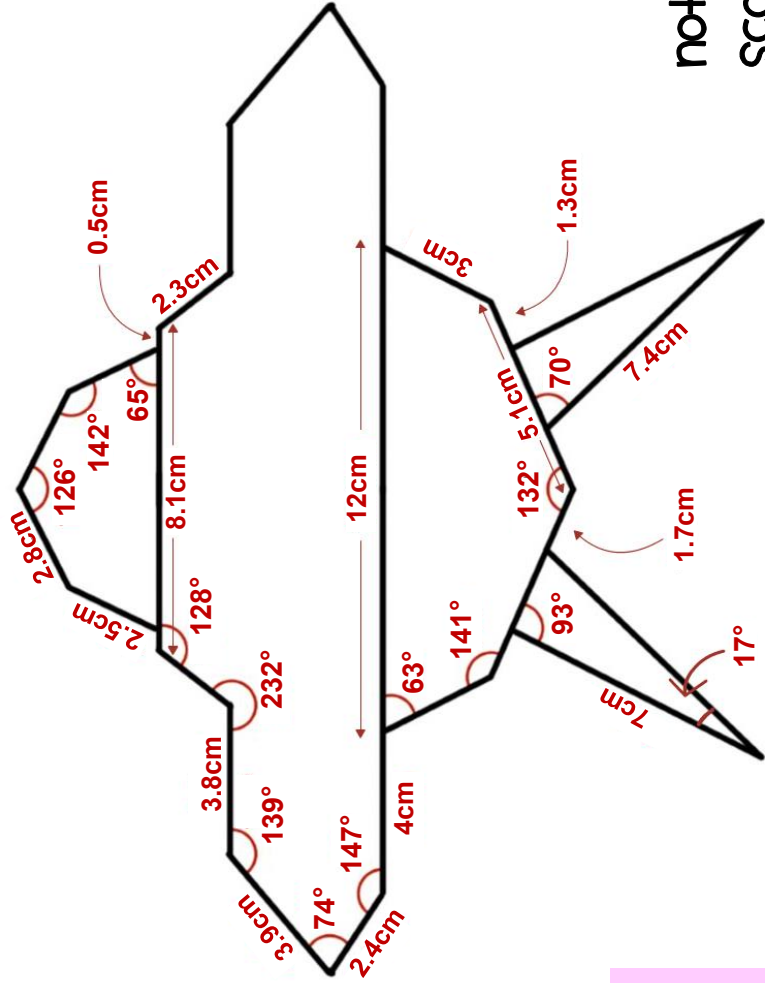
Extension

can you draw my rocket ship?

remember to use a ruler and protractor to draw the lines and angles accurately!



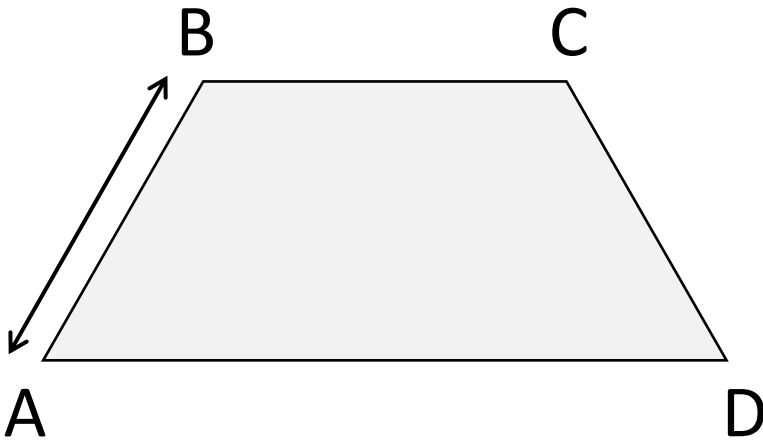
Use the fact that my spaceship is symmetrical to help you



not to scale

1.5 Notation

Labelling Lengths



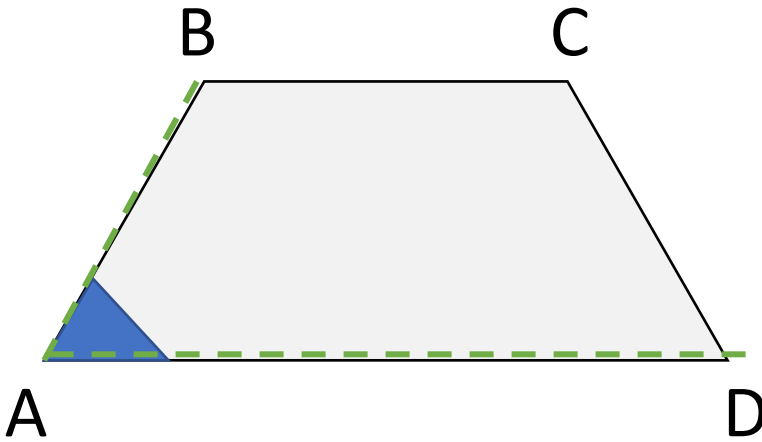
Each point (or corner) of a shape is labelled with a letter.

If we are talking about this distance...

We say we are looking for the length of AB

Because it is the distance between the point labelled A and the point labelled B

Labelling Angles



Each point (or corner) of a shape is labelled with a letter

If we are talking about this angle...

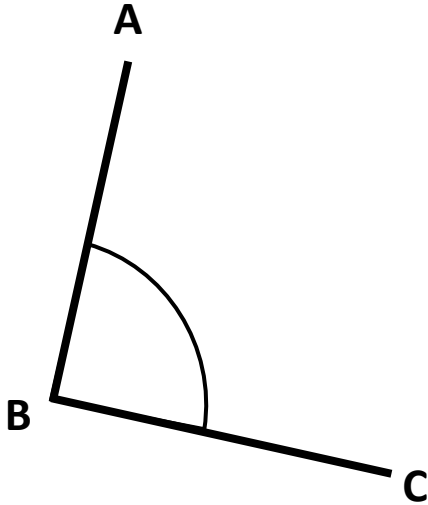
We say we are looking for the angle DAB

Because if we draw a line in order from point D to point A to point B, we draw around the angle

Angle Notation

We can label angles in multiple ways:

$\angle ABC$ or \widehat{ABC} or *Angle ABC*



It can help to see these are instructions rather than labels:

“The turn from line AB to line BC”

We don't need to specify direction yet, so:

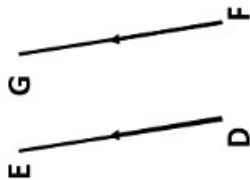
$$\widehat{ABC} = \widehat{CBA}$$

“The turn from line BC to line AB”

Note: We use capital letter for points.

Formal Notation

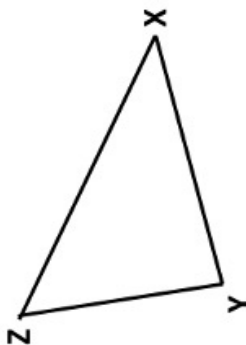
Parallel



If two lines are parallel, they do not meet

What we do: We put arrows on lines that are parallel
What we write: $DE \parallel FG$

Polygons

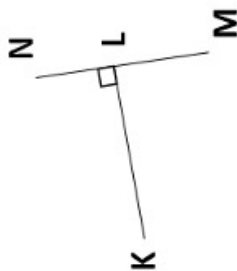


A polygon is a closed 2 dimensional shape made up of straight lines

What we do: Use the points to describe the vertices of the polygon

What we write: Triangle XYZ (we might have other polygons, such as quadrilaterals or pentagons)

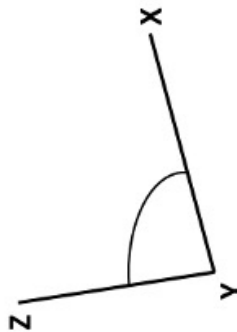
Perpendicular



If two lines are perpendicular, they meet at right angles

What we do: We use a small square to show the right angle
What we write: $KL \perp MN$

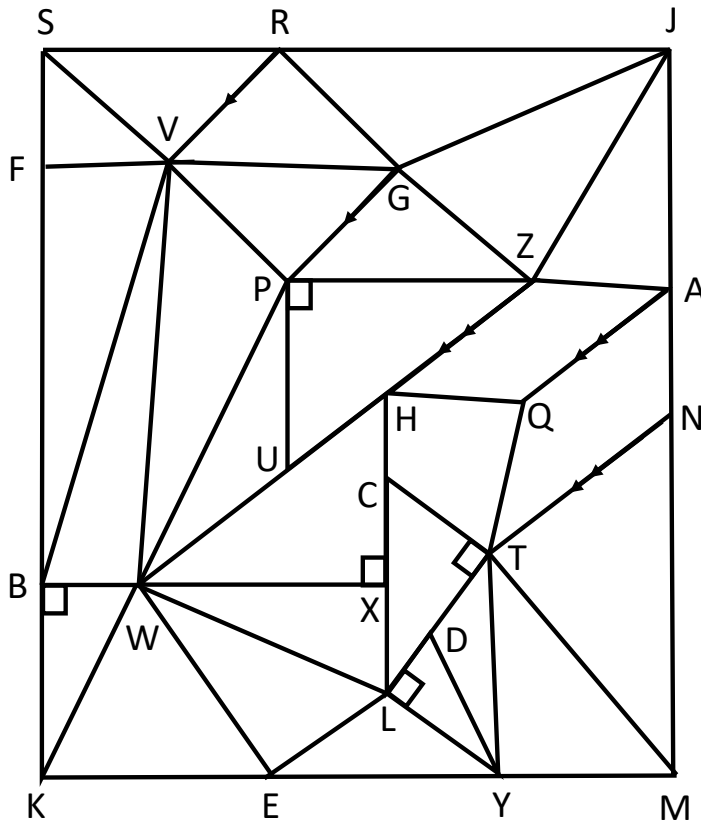
Angles



An angle is a turn from one line to another

What we do: Show the angle with a curved line
What we write: $\angle ZYX$

Fluency Practice



Exercise 1

Shade in each of the following polygons

Triangles

- 1) ZUP
- 2) KBW
- 3) DYL
- 4) LTC
- 5) WXH

Quadrilaterals

- 6) ZAQH
- 7) PGRV

Exercise 2

Complete the table, the first row has been done as an example

Formal Notation	Sentence	True or False?
$CT \perp TL$	CT is perpendicular to TL	True
	VR is parallel to PG	
$\angle WKE = 90^\circ$		
	BF is parallel to WV	
$\angle LTC = \angle UPZ$		
$LY \perp LC$		
	Angle ZHQ is less than angle TQA	
$HZ \parallel PG$		

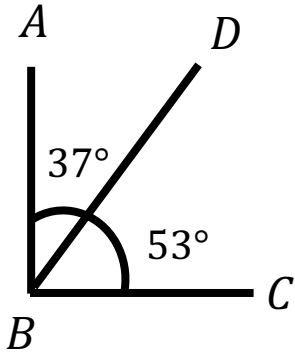
Worked Example

Write down the values of:

$$\angle ABD =$$

$$\angle DBC =$$

$$\angle ABC =$$



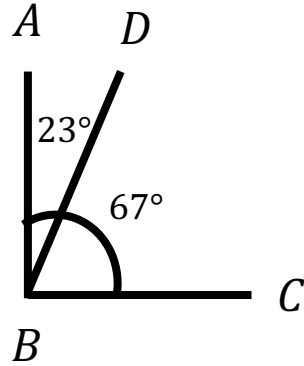
Your Turn

Write down the values of:

$$\angle ABD =$$

$$\angle DBC =$$

$$\angle ABC =$$



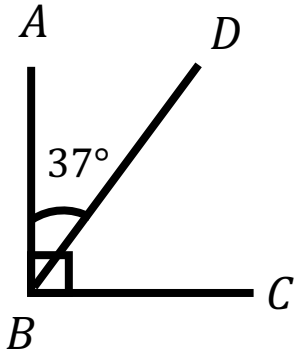
Worked Example

Write down the values of:

$$\angle ABD =$$

$$\angle ABC =$$

$$\angle DBC =$$



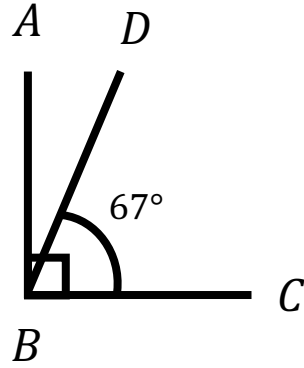
Your Turn

Write down the values of:

$$\angle DBC =$$

$$\angle ABC =$$

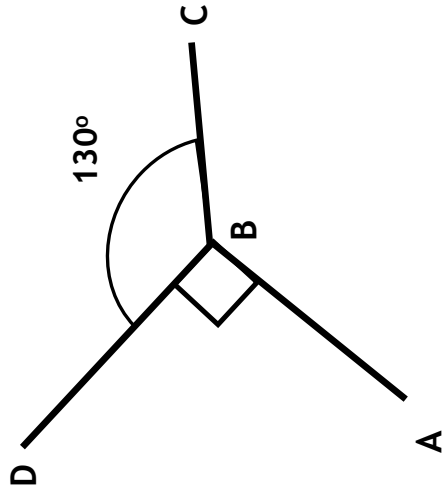
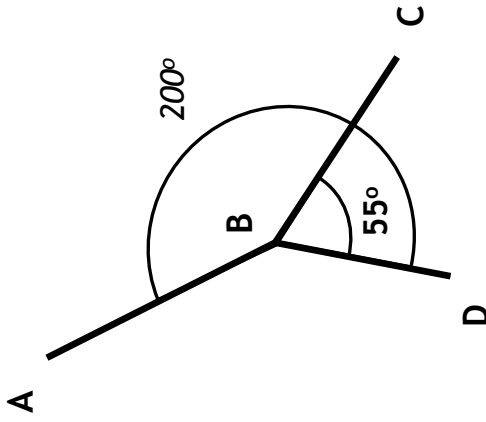
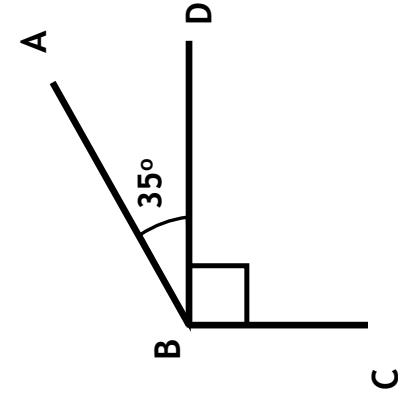
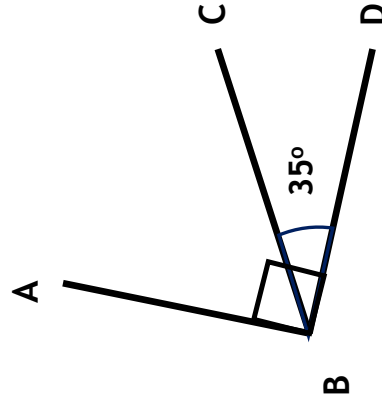
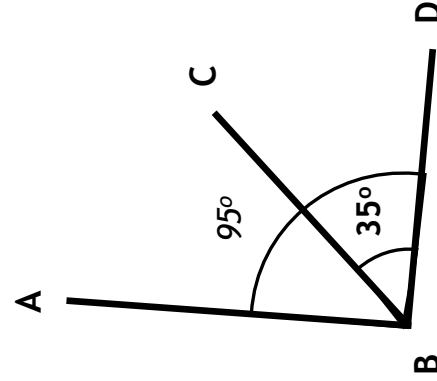
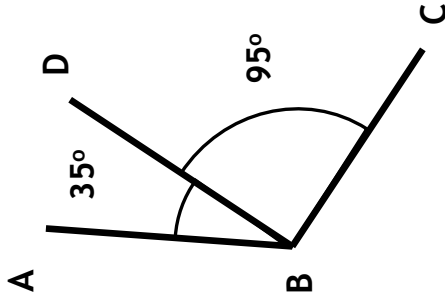
$$\angle ABD =$$



Fluency Practice

Find the value of $\angle ABC$ (clockwise) in each diagram below

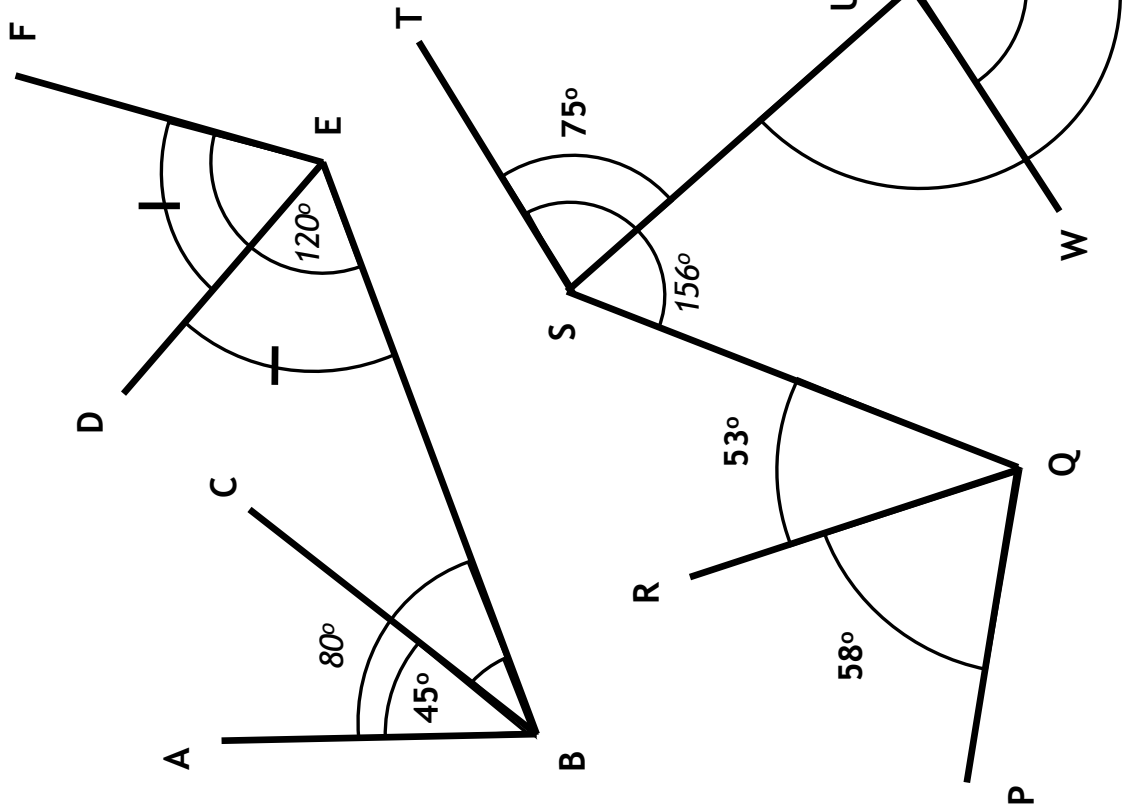
(Angles that intersect another line are labelled in *italics*)



Fluency Practice

Write down the value of each angle below

(Angles that intersect another line are labelled in *italics*)



All angles are measured clockwise

- $\angle PQS =$
- $\angle USQ =$
- $\angle WUS =$
- $\angle GHN =$
- $\angle KNM =$
- $\angle JKN =$
- $\angle CBE =$
- $\angle DEF =$

Fluency Practice

1) Write down the value of each angle below

- | | |
|----------------|----------------|
| $\angle JGH =$ | $\angle AML =$ |
| $\angle DKE =$ | $\angle ADB =$ |
| $\angle BDC =$ | $\angle KGJ =$ |
| $\angle CDK =$ | $\angle LMD =$ |
| $\angle FKG =$ | $\angle EKF =$ |

2) Group the angles above into half turns

3) Write down the value of each angle below

- | | |
|----------------|----------------|
| $\angle EKG =$ | $\angle GKD =$ |
| $\angle FKD =$ | $\angle FKM =$ |

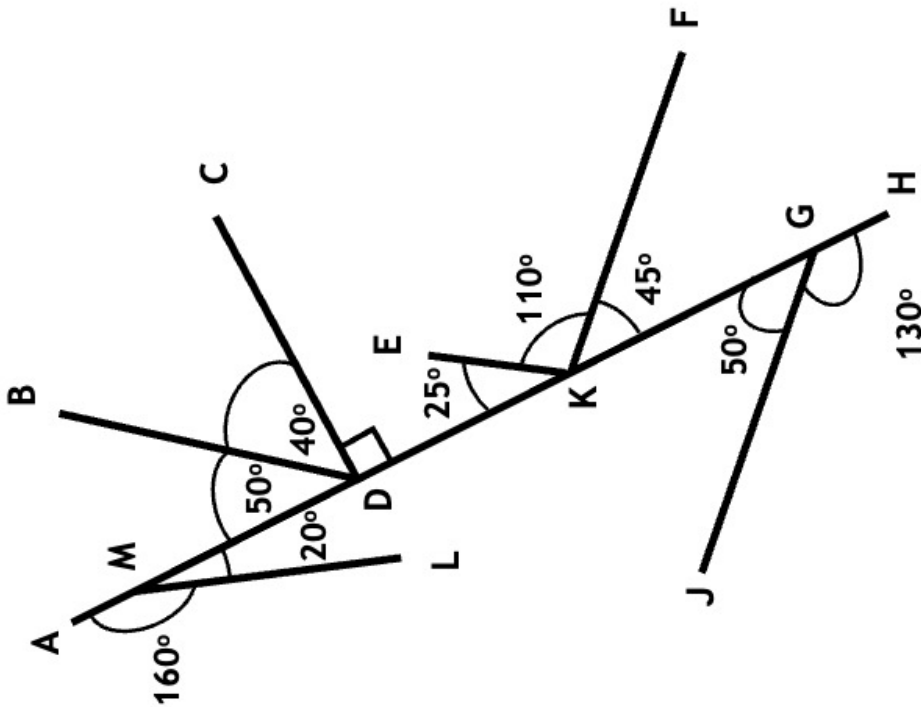


Diagram
not to
scale

1.6 Angles on a Straight Line

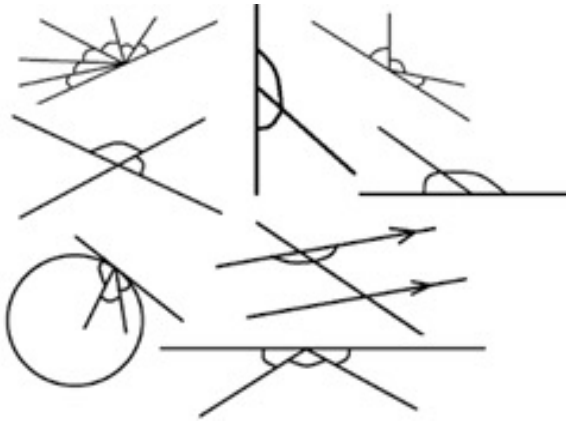
Definition

One or more angles connected at a point, where turning through each angle one after the other results in facing the opposite direction to the initial direction.

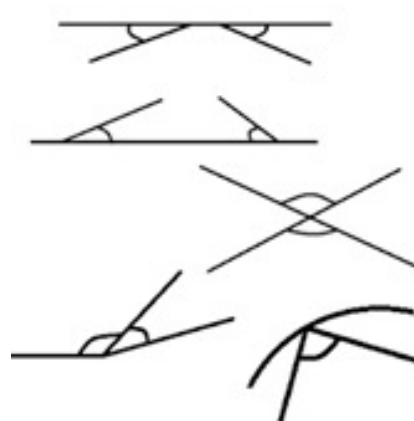
Characteristics

- Two or more lines connected to a single point.
- The angles make a semicircle around the point.
- The total turn is 180° .

Examples



Non Examples



Angles on a Straight Line

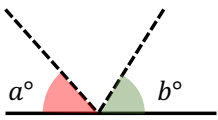
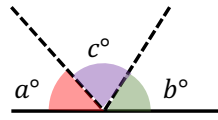
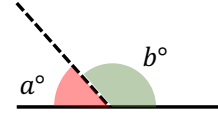
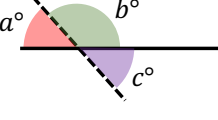
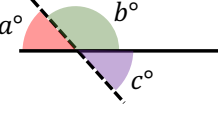

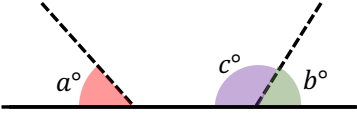
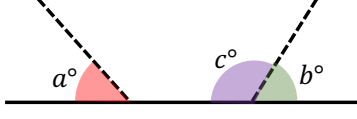
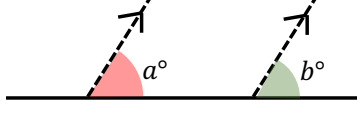
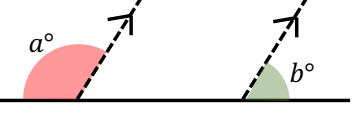
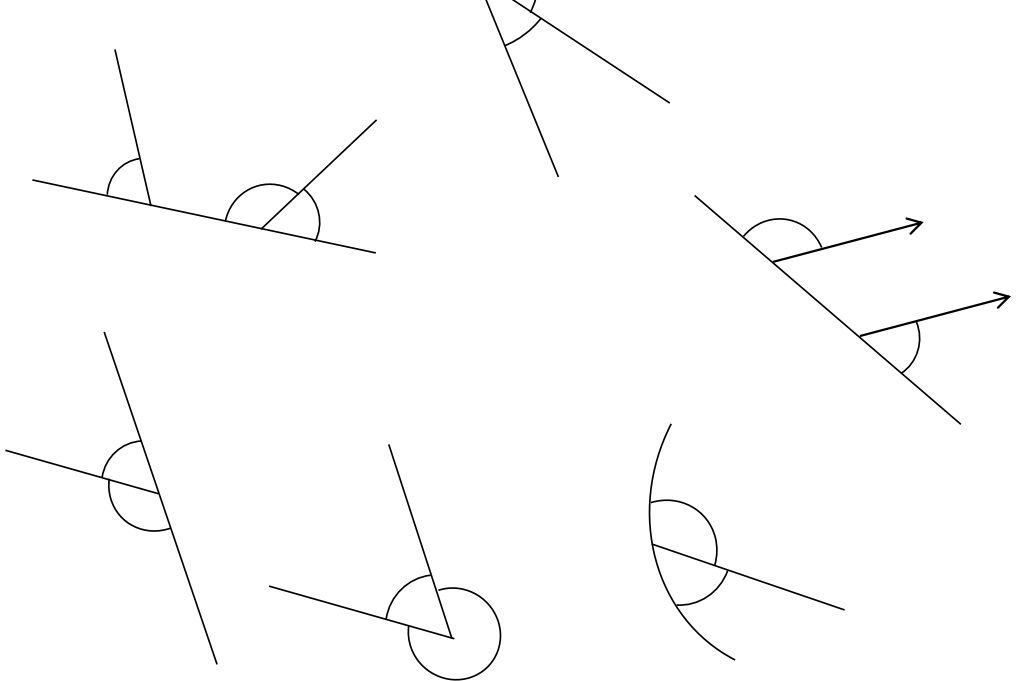
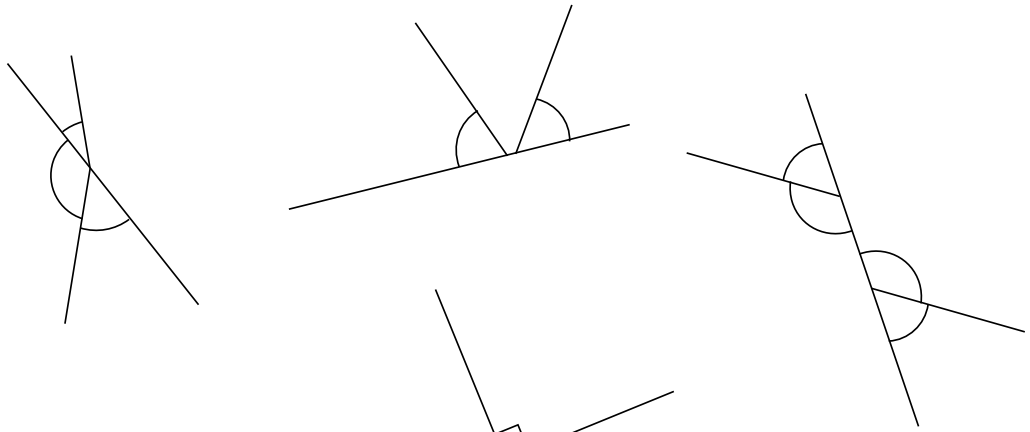
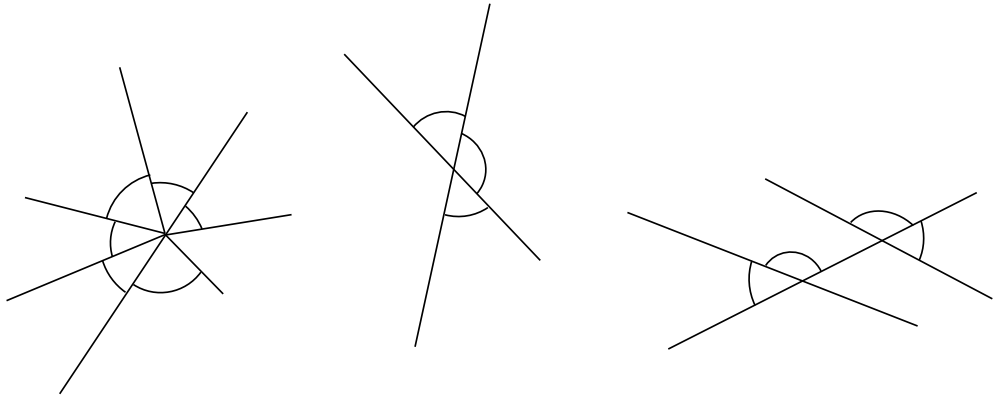
	Diagram	Statement	True / False
1.		$a + b = 180$	
2.		$a + b + c = 180$	
3.		$a + b = 180$	
4.		$a + b + c = 180$	
5.		$b + c = 180$	

	Diagram	Statement	True / False
6.		$a + b = 180$	
7.		$a + b + c = 180$	
8.		$b + c = 180$	
9.		$a + b = 180$	
10.		$a + b = 180$	

Fluency Practice

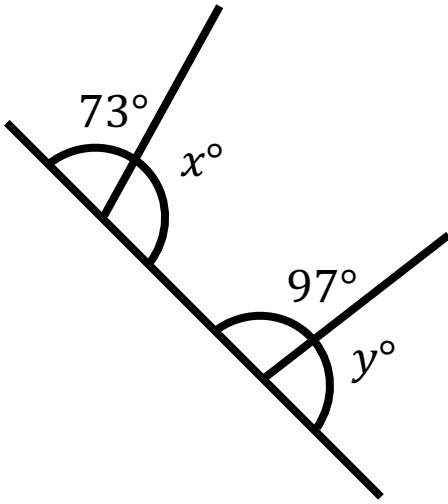
Diagrams not drawn accurately



Highlight any angles that would add to 180°

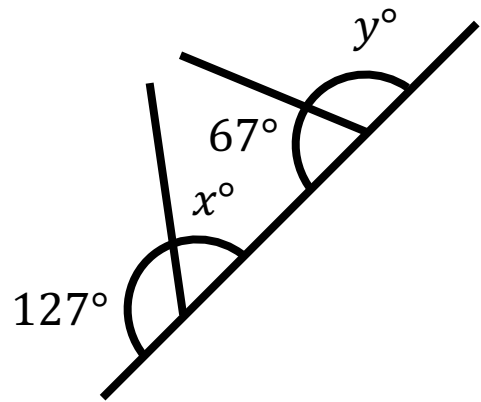
Worked Example

Find the values of x and y

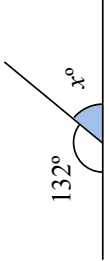
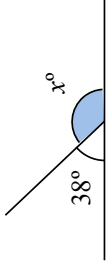
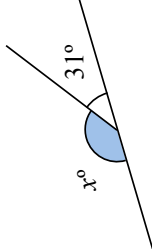
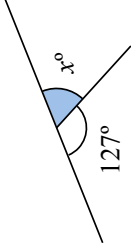
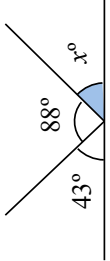
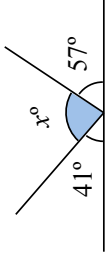
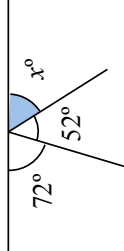
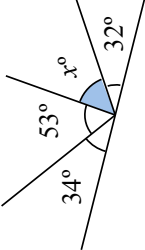
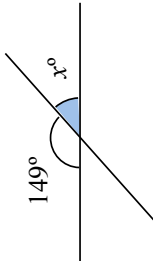
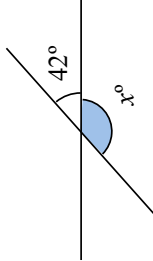
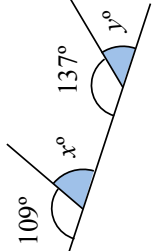
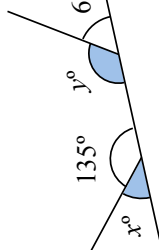


Your Turn

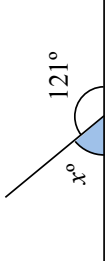
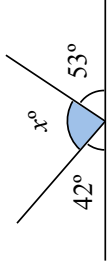
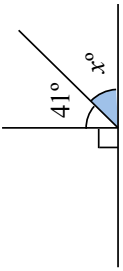
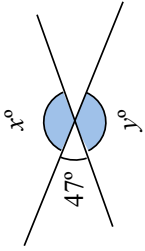
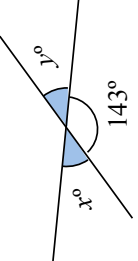
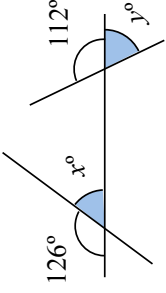
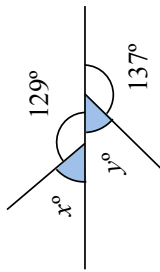
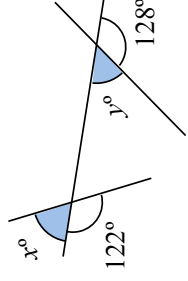
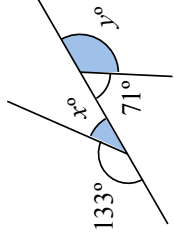
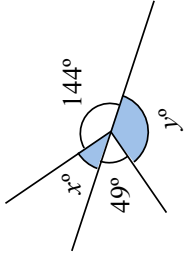
Find the values of x and y



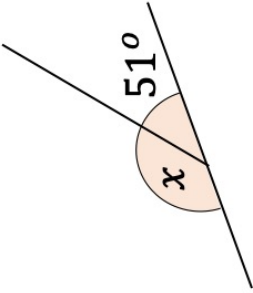
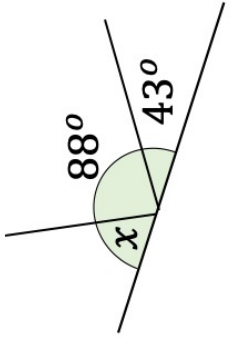
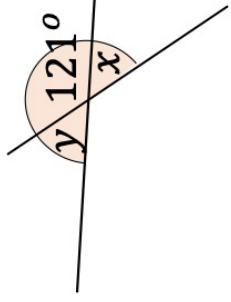
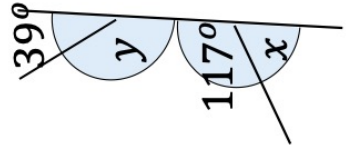
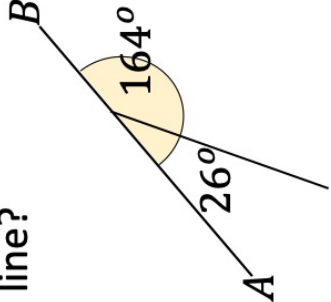
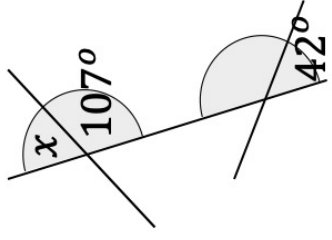
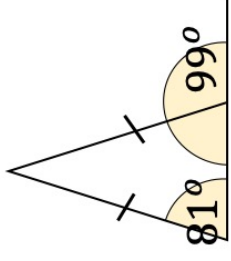
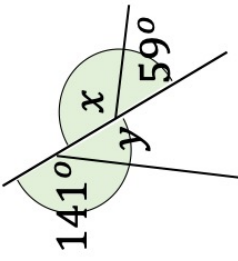
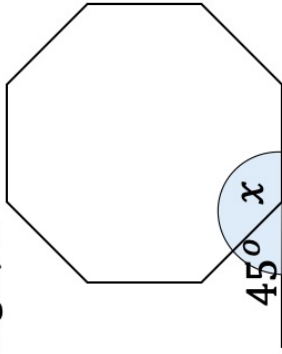
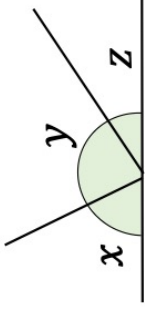
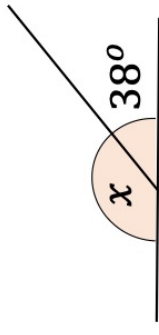
Fluency Practice

<p>A1 Find the value x</p> 	<p>A2 Find the value x</p> 	<p>A3 Find the value x</p> 	<p>A4 Find the value x</p> 
<p>B1 Find the value x</p> 	<p>B2 Find the value x</p> 	<p>B3 Find the value x</p> 	<p>B4 Find the value x</p> 
<p>C1 Find the value x</p> 	<p>C2 Find the value x</p> 	<p>C3 Find the values of x and y</p> 	<p>C4 Find the values of x and y</p> 

Fluency Practice

<p>A1 Find the value x</p> 	<p>A2 Find the value x</p> 	<p>A3 Find the value x</p> 	<p>A4 Three angles measure 77°, 41° and 52°. Do they form a straight line? Explain your answer.</p>
<p>B1 Find the values of x and y</p> 	<p>B2 Four angles measure 53°, 61°, 56° and 71°. Which three can be put together to form a straight line?</p>	<p>B3 Find the values of x and y</p> 	<p>B4 Find the values of x and y</p> 
<p>C1 Find the values of x and y</p> 	<p>C2 Find the values of x and y</p> 	<p>C3 Find the values of x and y</p> 	<p>C4 Find the values of x and y</p> 

Extension

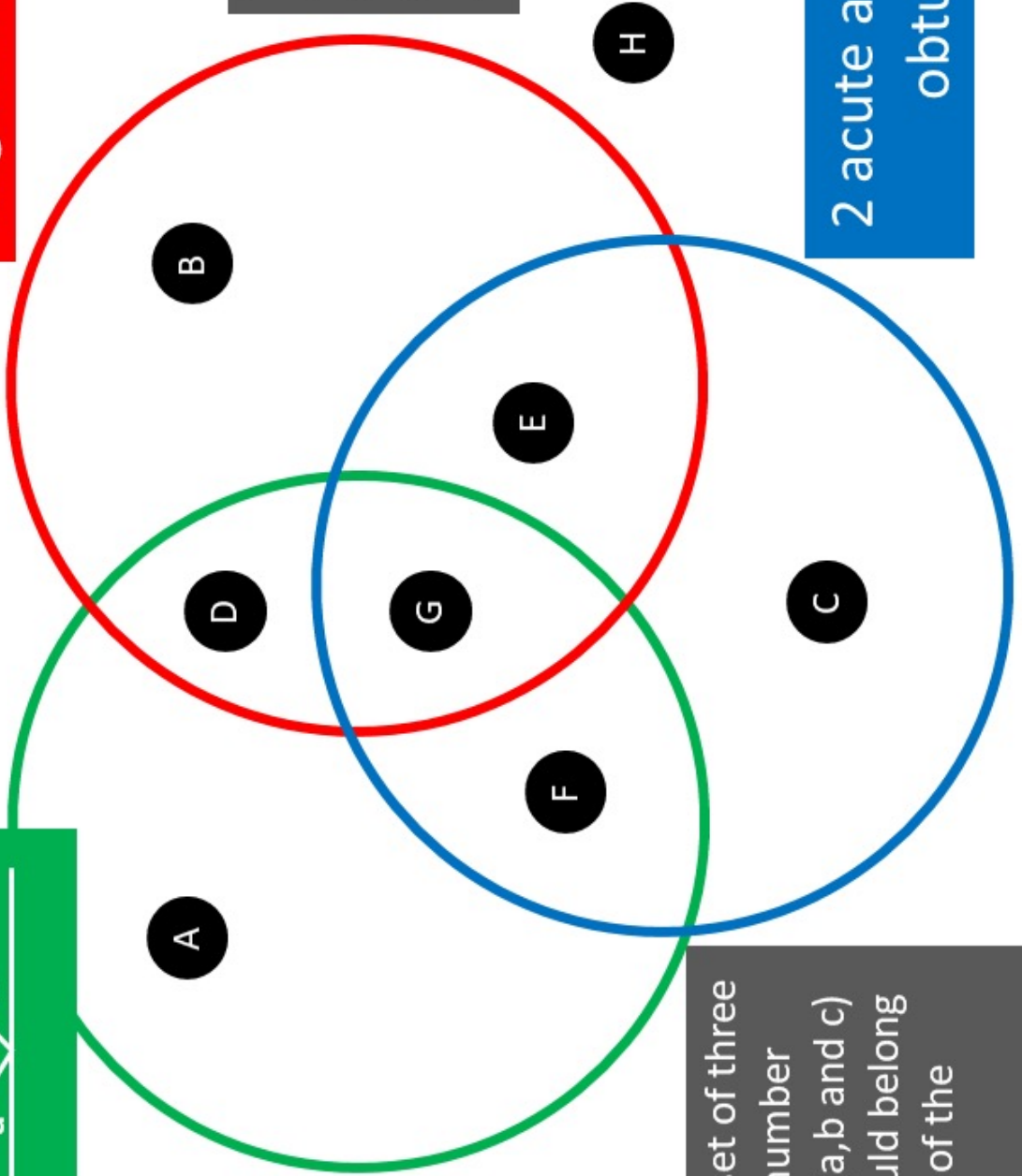
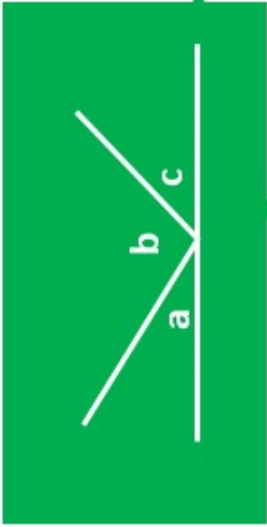
 <p style="text-align: center;">$x = \dots\dots$</p>	 <p style="text-align: center;">$x = \dots\dots$</p>	 <p style="text-align: center;">$x = \dots\dots$ $y = \dots\dots$</p>	 <p style="text-align: center;">$x = \dots\dots$ $y = \dots\dots$</p>
<p>Is length AB a straight line?</p> 	 <p style="text-align: center;">$x = \dots\dots$</p>	 <p>Is the triangle above; an Isosceles triangle?</p>	 <p style="text-align: center;">$x = \dots\dots$ $y = \dots\dots$</p>
<p>Find the interior angle, x</p> 	<p>Which 3 of 4 angles; 78°, 88°, 37°, 65° would make AB a straight line?</p> 	<p>If I am facing North and I turn 056° How much more do I need to turn so I am now facing South?</p>	 <p style="text-align: center;">$x = \dots\dots$</p>

Maths Venns

At least two angles are equal

If you think a region is impossible to fill, convince me why!

2 acute angles, 1 obtuse



Give a set of three whole number angles (a, b and c) that could belong in each of the regions

1.7 Angles around a Point

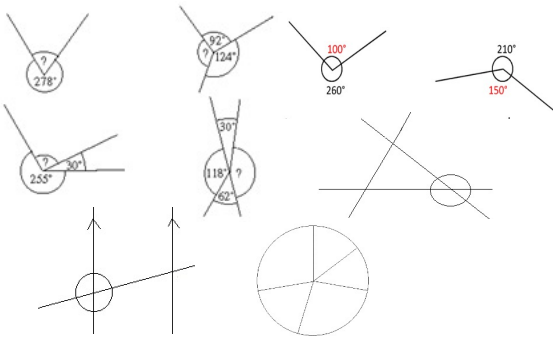
Definition

One or more angles connected at a point, where turning through each angle one after the other results in facing the same direction as not turning at all.

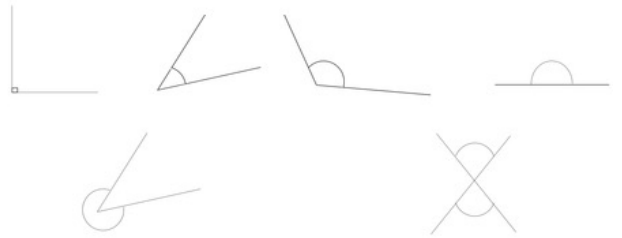
Characteristics

- Two or more lines connected to a single point.
- The angles make a circle around the point.
- The total turn is 360° .

Examples



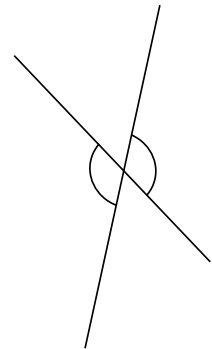
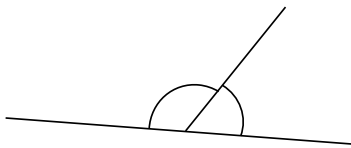
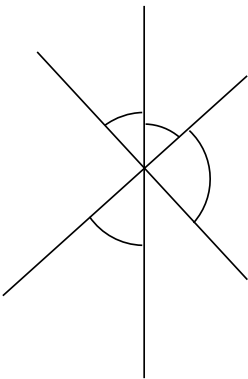
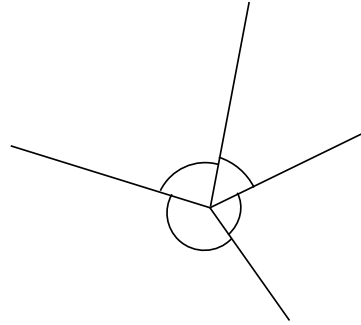
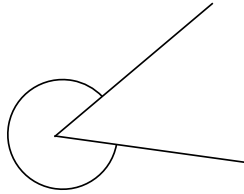
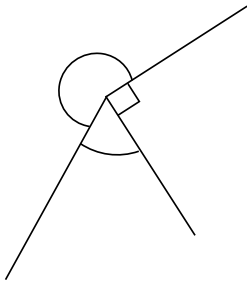
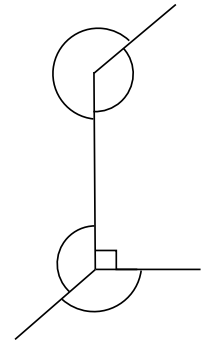
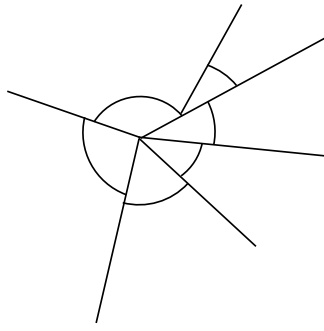
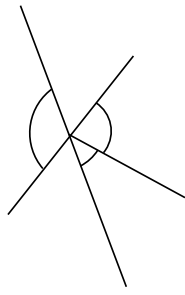
Non Examples



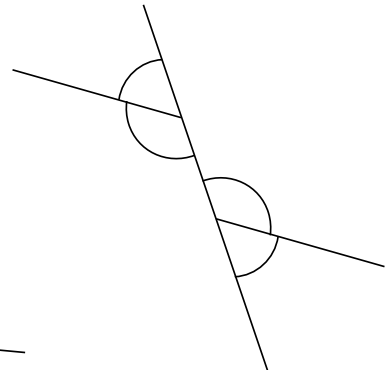
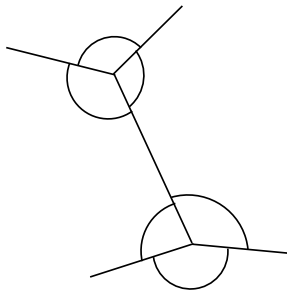
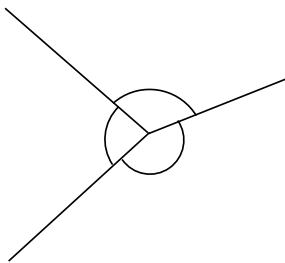
Angles in a full turn add up to 360° . It is thought the number of degrees in a full turn came about due to the Ancient Persians having 360 days in their year.

Fluency Practice

Diagrams not drawn accurately

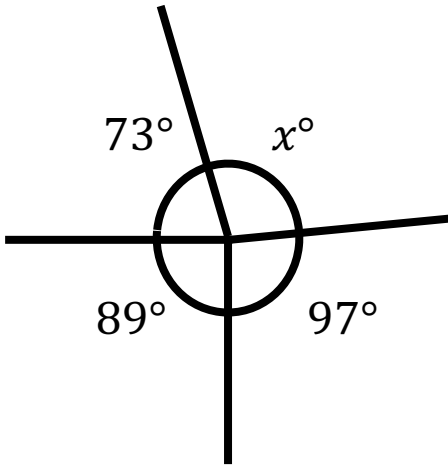


Highlight any angles that would add to 360°



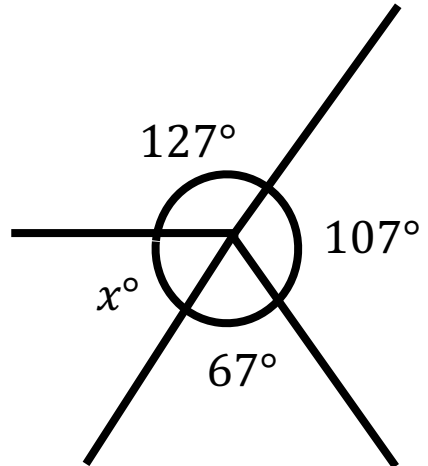
Worked Example

Find the value of x

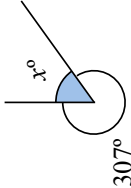
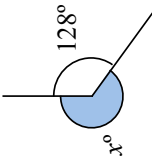
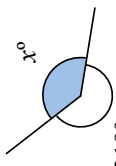
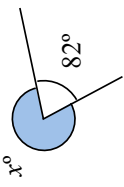
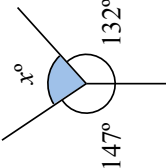
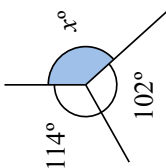
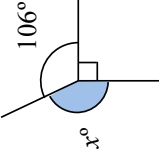
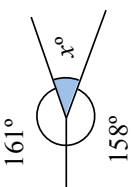
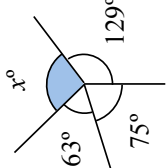
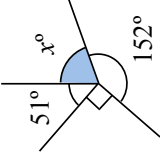
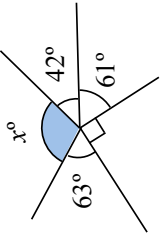
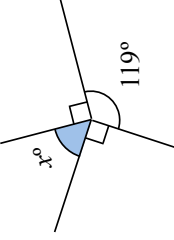


Your Turn

Find the value of x

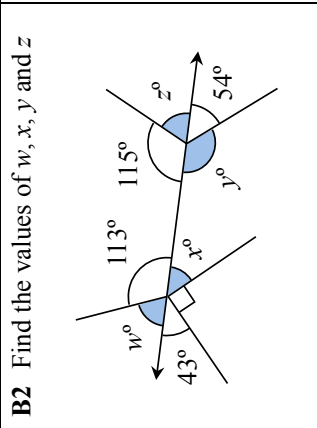
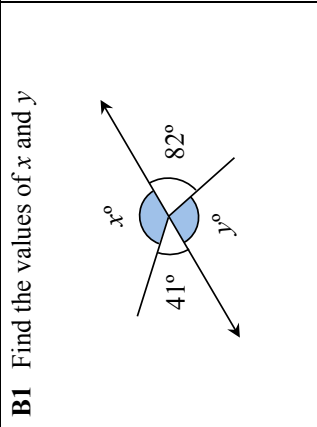
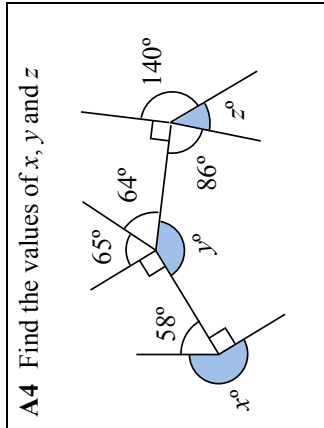
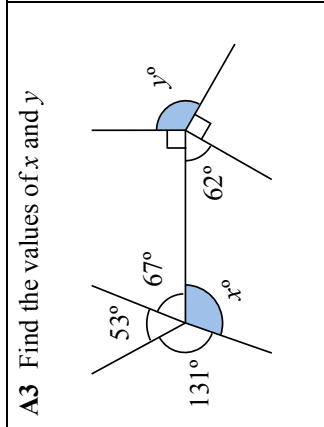
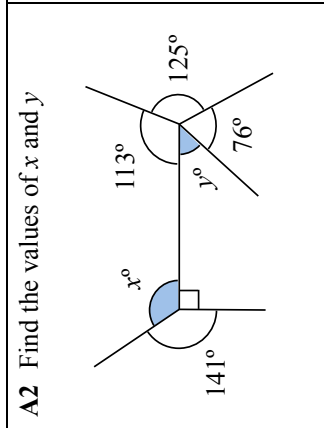


Fluency Practice

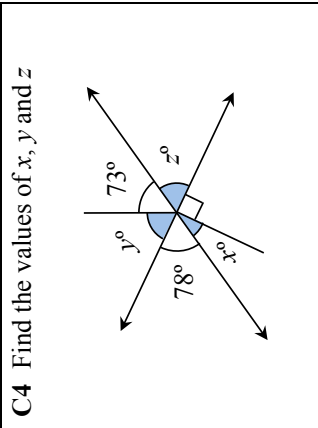
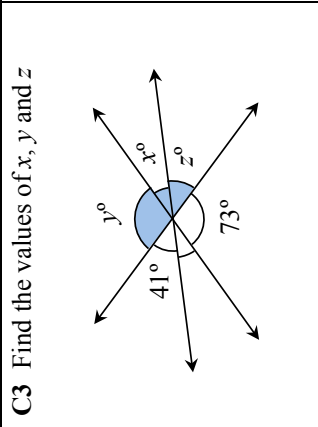
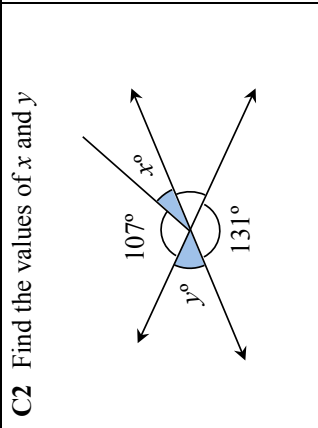
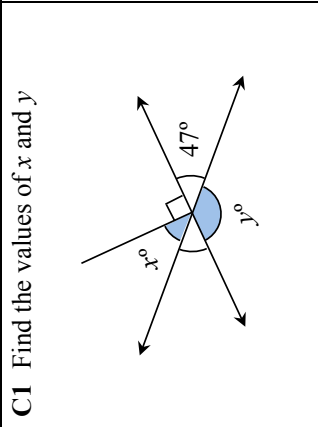
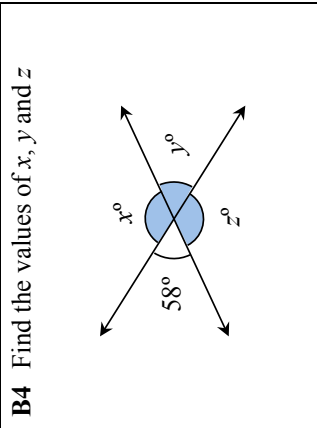
<p>A1 Find the value x</p>  <p style="text-align: right;">307°</p>	<p>A2 Find the value x</p>  <p style="text-align: right;">128°</p>	<p>A3 Find the value x</p>  <p style="text-align: right;">219°</p>	<p>A4 Find the value x</p>  <p style="text-align: right;">82°</p>
<p>B1 Find the value x</p>  <p style="text-align: right;">147°</p> <p style="text-align: right;">132°</p>	<p>B2 Find the value x</p>  <p style="text-align: right;">114°</p> <p style="text-align: right;">102°</p>	<p>B3 Find the value x</p>  <p style="text-align: right;">106°</p>	<p>B4 Find the value x</p>  <p style="text-align: right;">161°</p> <p style="text-align: right;">158°</p>
<p>C1 Find the value of x</p>  <p style="text-align: right;">63°</p> <p style="text-align: right;">75°</p> <p style="text-align: right;">129°</p>	<p>C2 Find the value of x</p>  <p style="text-align: right;">51°</p> <p style="text-align: right;">152°</p>	<p>C3 Find the value of x</p>  <p style="text-align: right;">42°</p> <p style="text-align: right;">61°</p> <p style="text-align: right;">63°</p>	<p>C4 Find the value of x</p>  <p style="text-align: right;">119°</p>

Fluency Practice

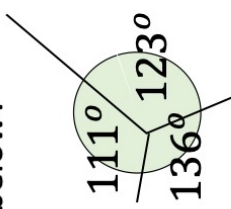
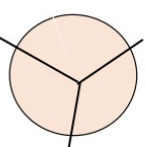
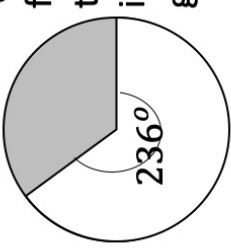
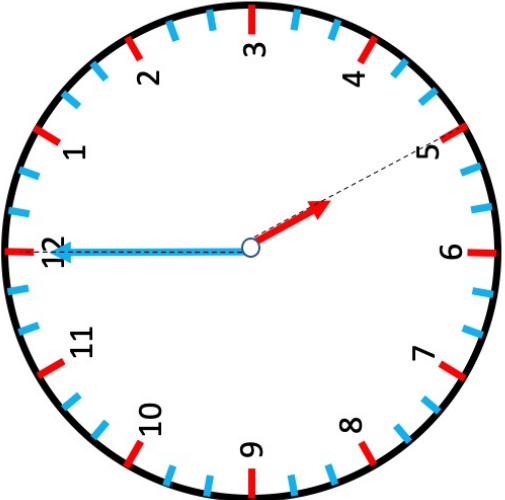
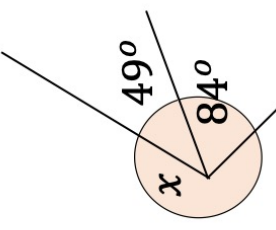
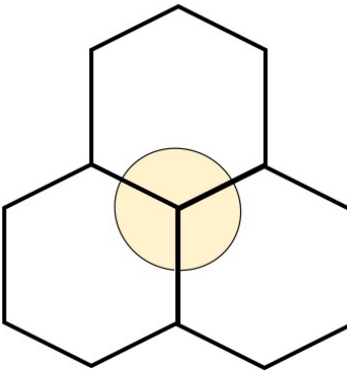
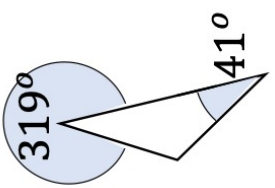
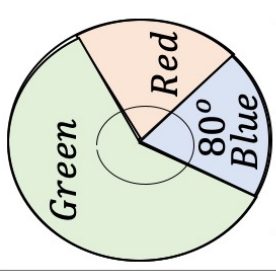
A1 Three angles measure 97° , 145° and 118° . Do these three angles fit exactly around a point? Explain your answer.



B3 Five angles measure 78° , 95° , 113° , 162° and 187° . Which of them can be put together to fit exactly around a point?



Extension

<p>What is wrong with the diagram below?</p> 	<p>Which 3 of 4 angles; 131°, 141°, 106°, 123° make a full turn?</p> 	<p>What fraction of the circle is shaded grey?</p> 	<p>Find the obtuse angle between the hour and minute hands</p> 
<p>Is the triangle isosceles?</p> 	<p>If 3 regular hexagons tessellate, what is the interior angle of a regular hexagon?</p> 	<p>Find the reflex angle between the hour and minute hands</p>	<p>Find the obtuse angle between the hour and minute hands</p>
<p>$x = \dots$</p>	<p>$x = \dots$ $y = \dots$ $z = \dots$</p>	<p>$x = \dots$ $y = \dots$ $z = \dots$</p>	<p>$x = \dots$ $y = \dots$ $z = \dots$</p>
<p>$x = \dots$</p>	<p>If I face North and turn clockwise so I am facing South East. How many more degrees clockwise do I need to turn so I'm facing North again?</p>	<p>What fraction of the circle is shaded grey?</p>	<p>Find the reflex angle between the hour and minute hands</p>
<p>$x = \dots$</p>	<p>Is the triangle isosceles?</p> 	<p>The pie chart shows a classes favorite colour. If the same number liked Red and Blue, what angle on the pie chart is green?</p> 	<p>Find the reflex angle between the hour and minute hands</p>

1.8 Vertically Opposite Angles

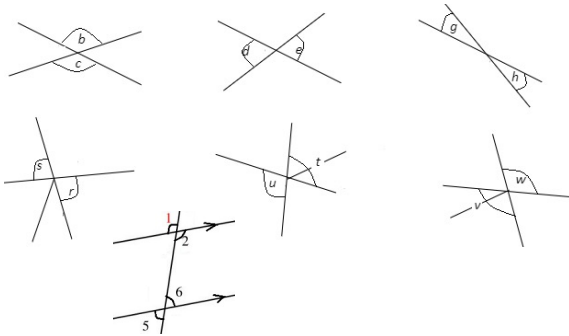
Definition

The angles opposite each other that are formed when two straight lines cross each other.

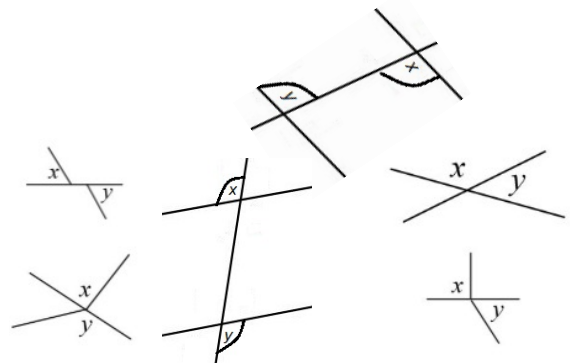
Characteristics

- Angles only connected at the point, not along a line.
- Lines must be straight.
- Vertically opposite angles are equal.

Examples

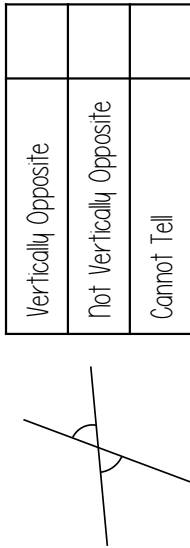


Non Examples



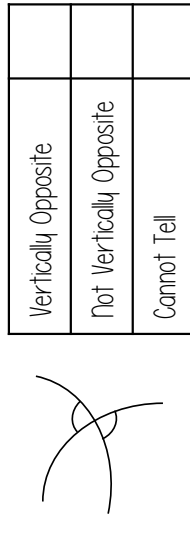
Fluency Practice

Decide which diagrams show vertically opposite angles



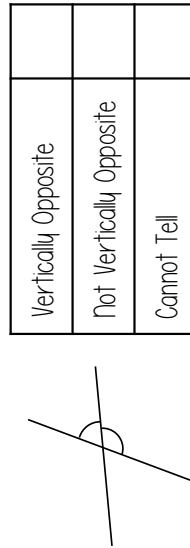
Vertically Opposite	
Not Vertically Opposite	
Cannot Tell	

Explain your reason



Vertically Opposite	
Not Vertically Opposite	
Cannot Tell	

Explain your reason



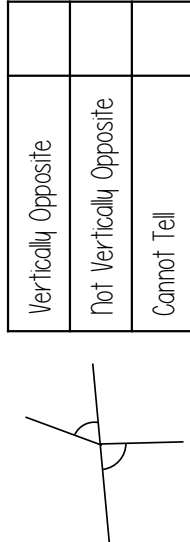
Vertically Opposite	
Not Vertically Opposite	
Cannot Tell	

Explain your reason



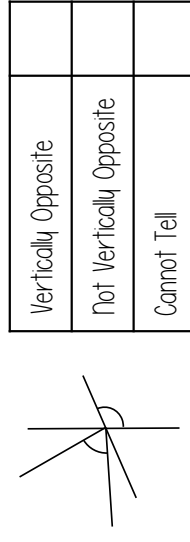
Vertically Opposite	
Not Vertically Opposite	
Cannot Tell	

Explain your reason



Vertically Opposite	
Not Vertically Opposite	
Cannot Tell	

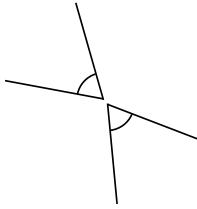
Explain your reason



Vertically Opposite	
Not Vertically Opposite	
Cannot Tell	

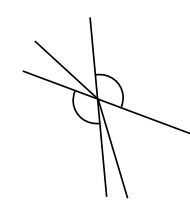
Explain your reason

Diagrams not drawn accurately



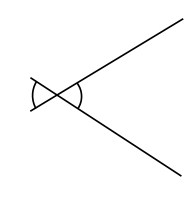
Vertically Opposite	
Not Vertically Opposite	
Cannot Tell	

Explain your reason



Vertically Opposite	
Not Vertically Opposite	
Cannot Tell	

Explain your reason

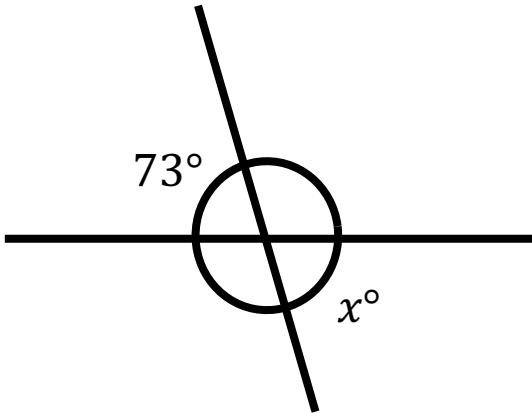


Vertically Opposite	
Not Vertically Opposite	
Cannot Tell	

Explain your reason

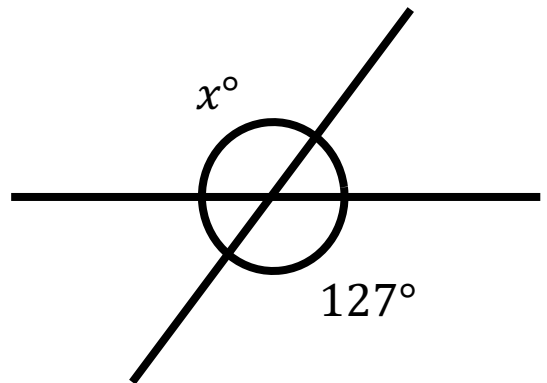
Worked Example

Find the value of x



Your Turn

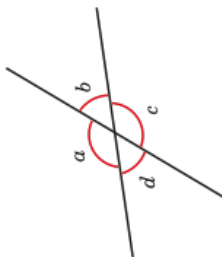
Find the value of x



Fluency Practice

Vertically opposite angles

- 1 The diagram shows four angles formed by two straight lines.



- a) Measure the sizes of the angles.
 $a =$ $b =$ $c =$ $d =$

- b) What is the total of angles a and b ?

Explain why.

Do any other pairs of angles have this same total?

- c) Angles a and c are vertically opposite angles.

What do you notice about the sizes of angles a and c ?

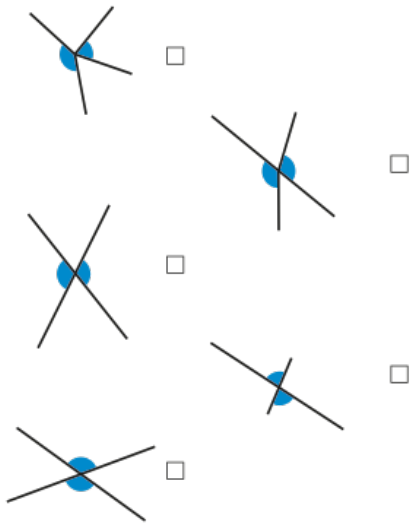
- d) Angles b and d are also vertically opposite angles.

What do you notice about the sizes of angles b and d ?

- e) Complete the sentence.

Vertically opposite angles _____

- 2 Tick the pairs of angles that are vertically opposite.

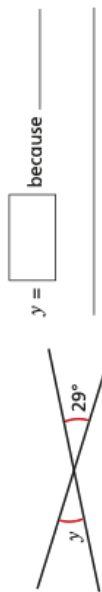


Compare answers with a partner.

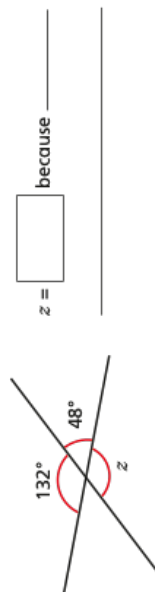
- 3 Work out the sizes of the unknown angles.

Give reasons for your answers.

a)

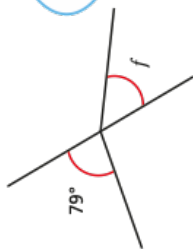


b)



Fluency Practice

4 Annie is working out the size of angle f .

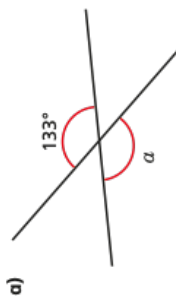


Angle f is equal to 79° because vertically opposite angles are equal.



Do you agree with Annie? _____
Explain your answer.

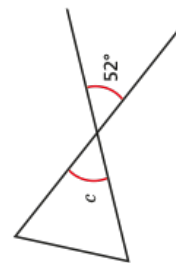
5 Work out the unknown angles.



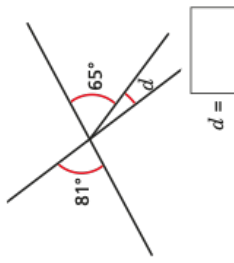
$a =$

b)

$b =$

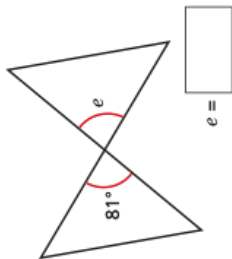


$c =$



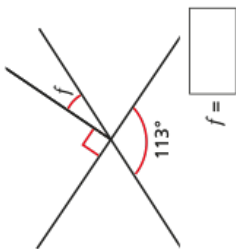
$d =$

e)



$e =$

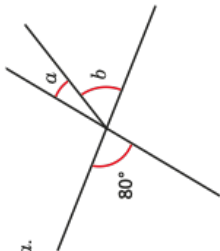
f)



$f =$

Talk about your reasons with a partner.

6 Angle b is three times the size of angle a .

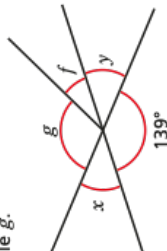


Work out the sizes of angles a and b .

$a =$ $b =$

7 Angle f is one quarter of the size of angle g .

Angle f is 28° .



Are angles x and y vertically opposite? _____
Explain your answer.



1.9 Angles in Triangles

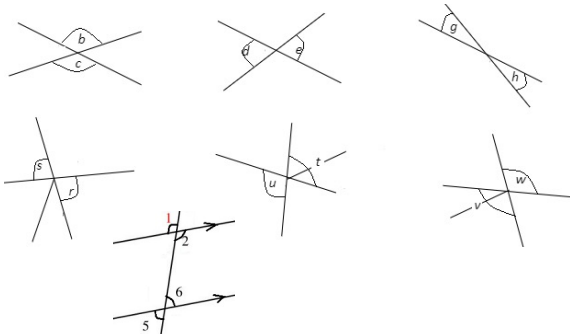
Definition

The angles opposite each other that are formed when two straight lines cross each other.

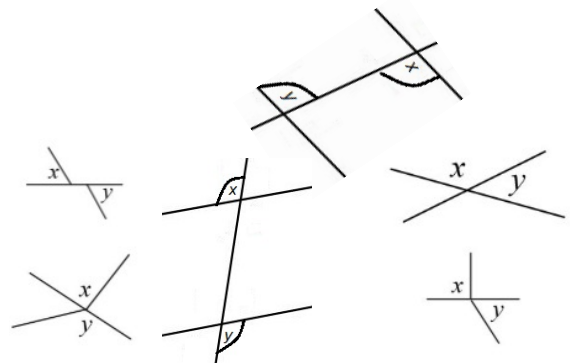
Characteristics

- Angles only connected at the point, not along a line.
- Lines must be straight.
- Vertically opposite angles are equal.

Examples



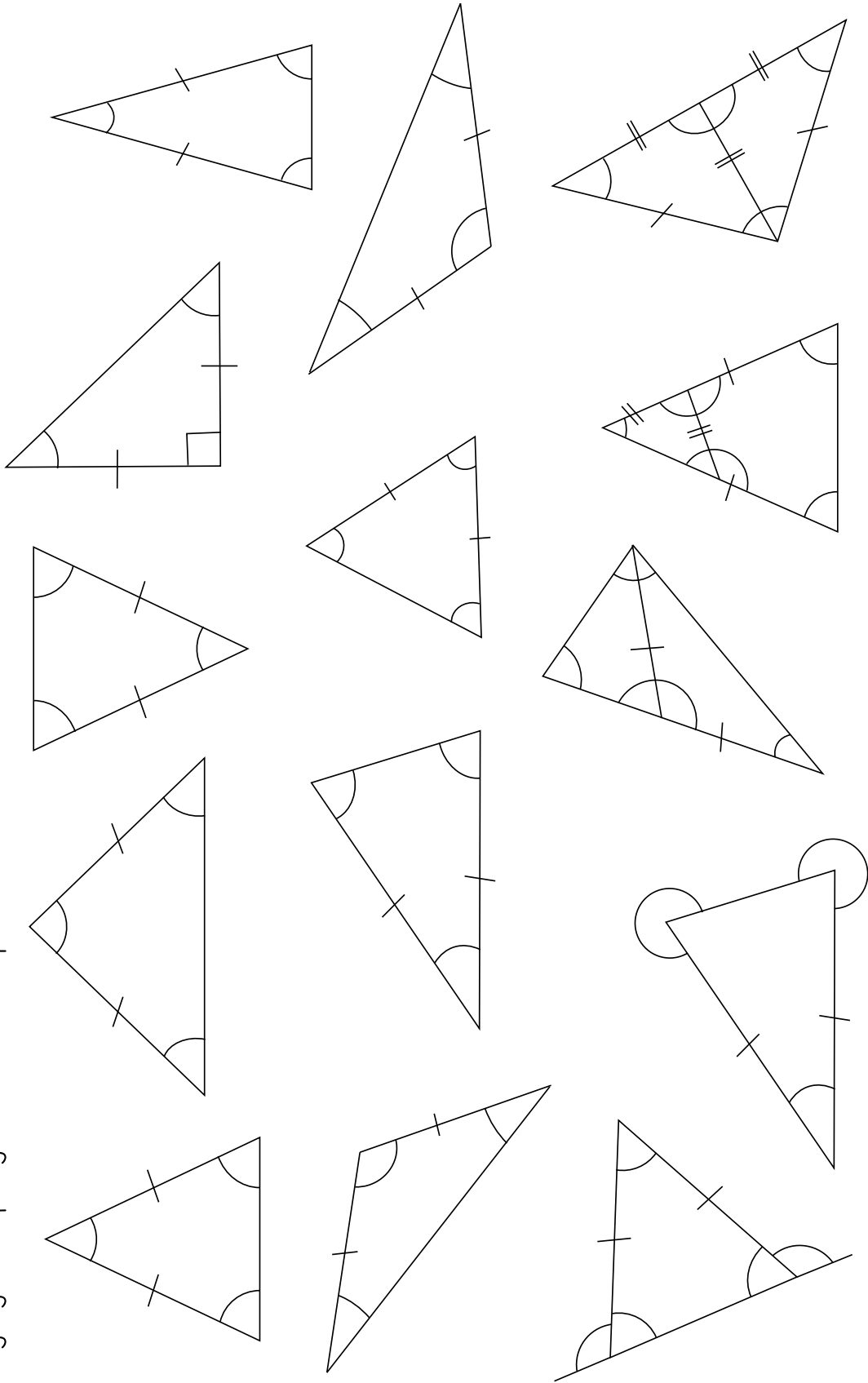
Non Examples



Fluency Practice

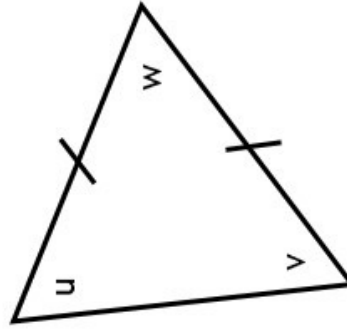
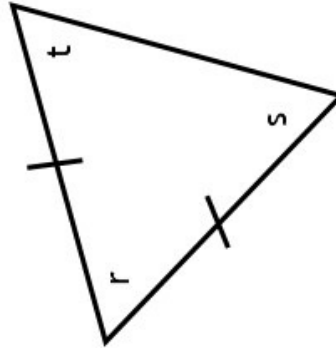
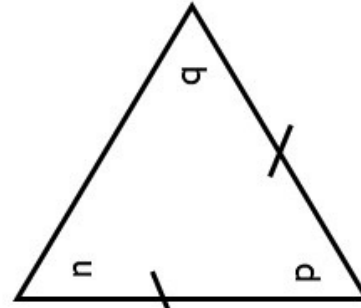
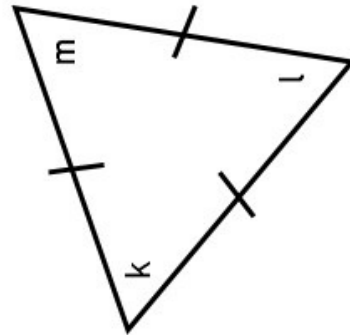
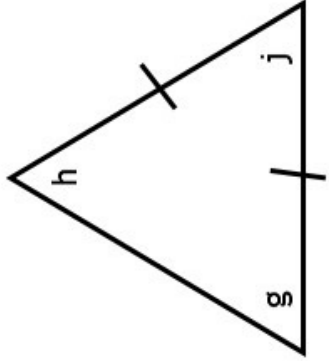
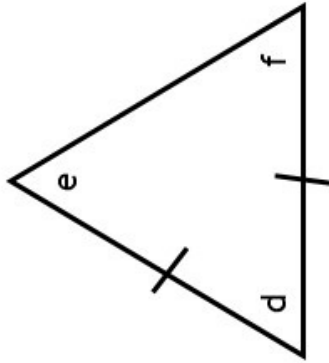
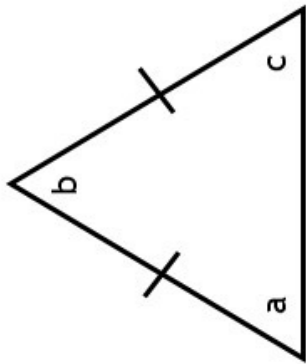
Diagrams are not drawn accurately

Highlight any angles that are equal in size



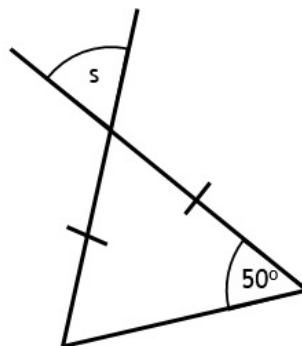
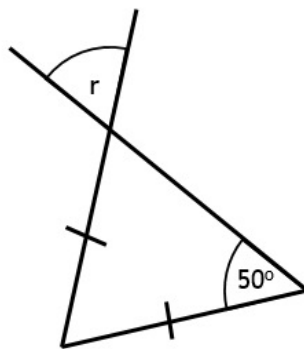
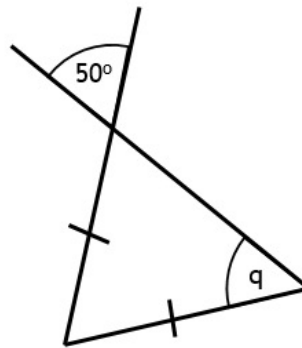
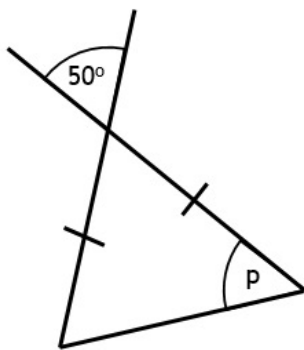
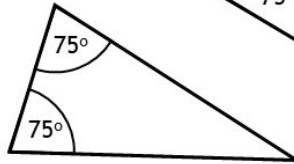
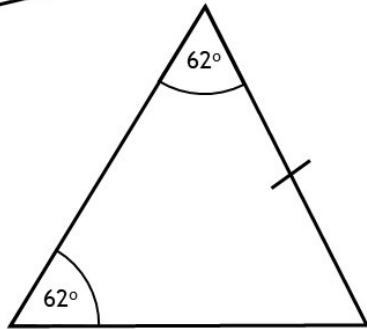
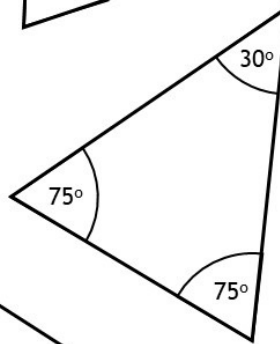
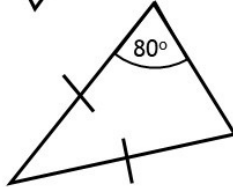
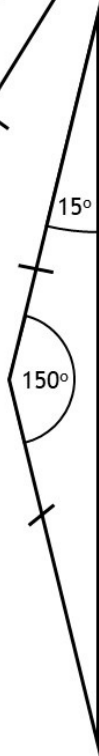
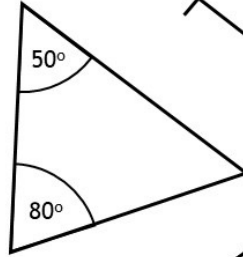
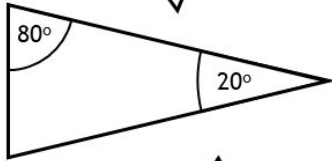
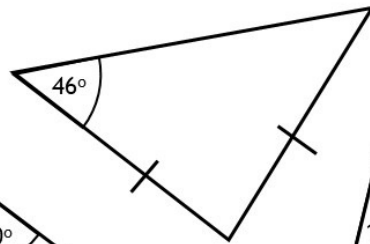
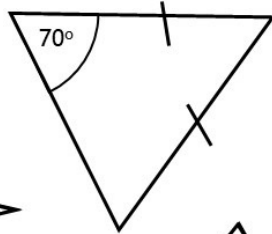
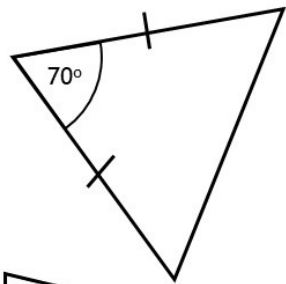
Fluency Practice

For each triangle, write down the letters of the angles with equal value.



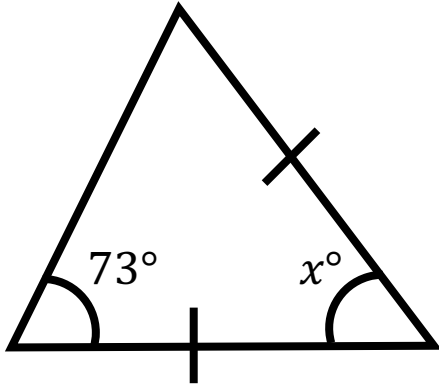
Fluency Practice

In each of these isosceles triangles, mark any missing dashes and find any missing angles.



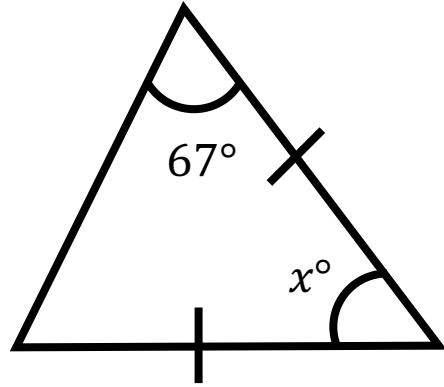
Worked Example

Find the value of x



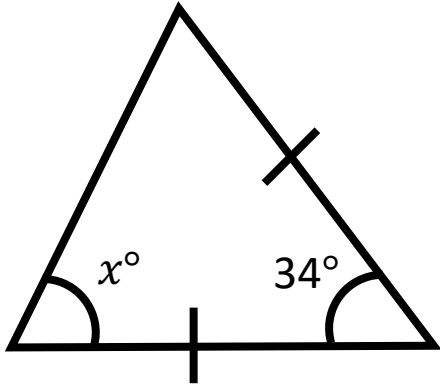
Your Turn

Find the value of x



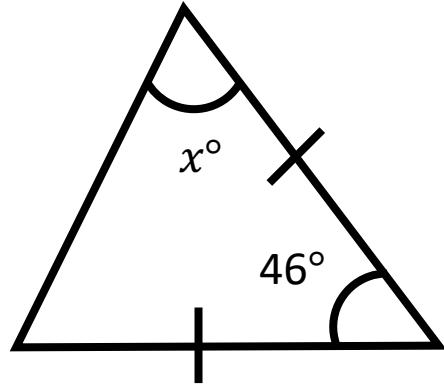
Worked Example

Find the value of x



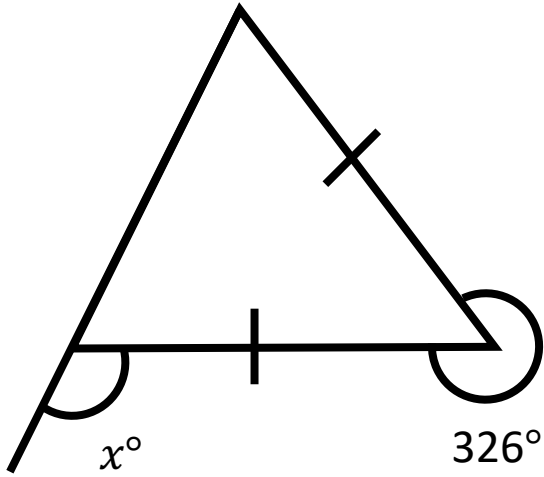
Your Turn

Find the value of x



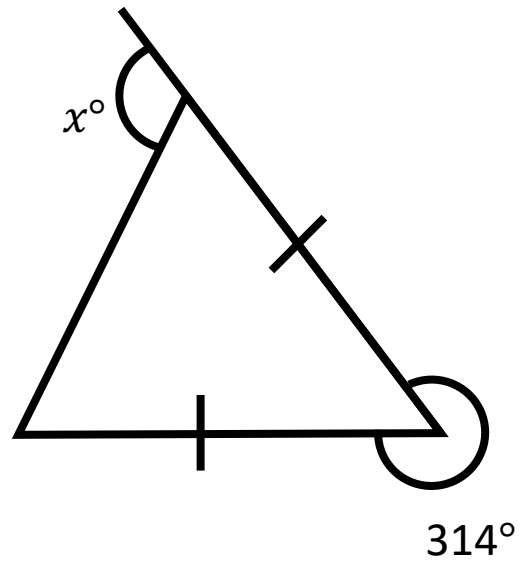
Worked Example

Find the value of x



Your Turn

Find the value of x

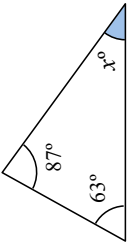
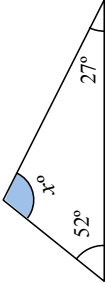
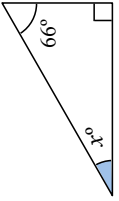
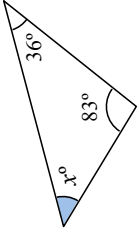
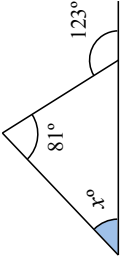
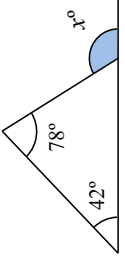
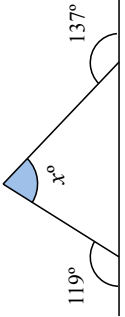
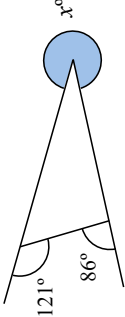
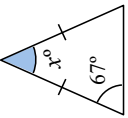
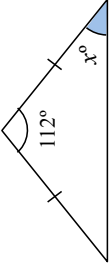
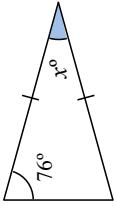
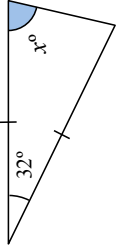
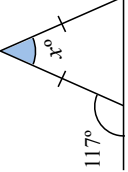
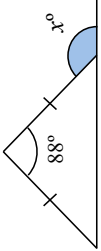
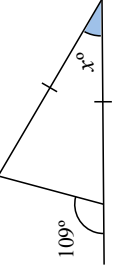
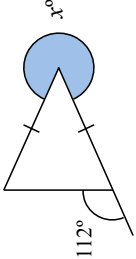




ANGLES IN TRIANGLES

NO PROTRACTOR

Ref: G423. 3F1

<p>A1 Work out the value of x.</p> 	<p>A2 Work out the value of x.</p> 	<p>A3 Work out the value of x.</p> 	<p>A4 Work out the value of x.</p> 
<p>B1 Work out the value of x.</p> 	<p>B2 Work out the value of x.</p> 	<p>B3 Work out the value of x.</p> 	<p>B4 Work out the value of x.</p> 
<p>C1 Work out the value of x.</p> 	<p>C2 Work out the value of x.</p> 	<p>C3 Work out the value of x.</p> 	<p>C4 Work out the value of x.</p> 
<p>D1 Work out the value of x.</p> 	<p>D2 Work out the value of x.</p> 	<p>D3 Work out the value of x.</p> 	<p>D4 Work out the value of x.</p> 



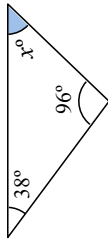
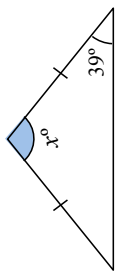
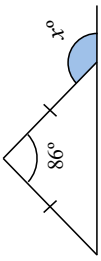
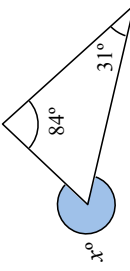
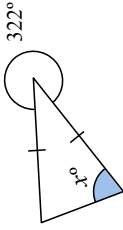
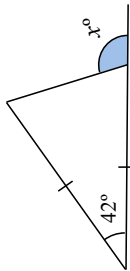
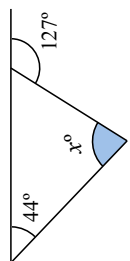
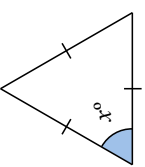
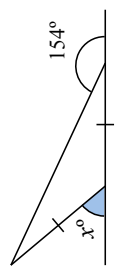
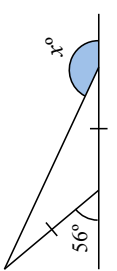
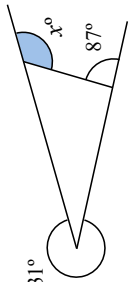
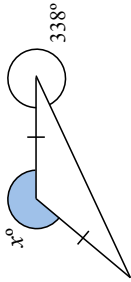
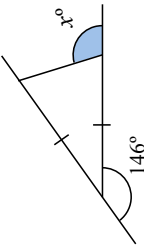
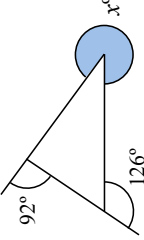
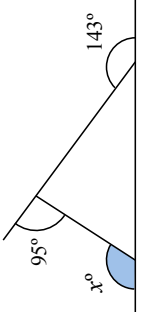
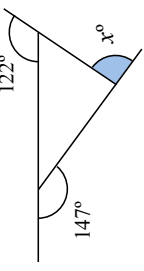
Fluency Practice

ANGLES IN TRIANGLES

NO PROTRACTOR

3S1

Ref: G423.

<p>A1 Work out the value of x.</p> 	<p>A2 Work out the value of x.</p> 	<p>A3 Work out the value of x.</p> 	<p>A4 Work out the value of x.</p> 
<p>B1 Work out the value of x.</p> 	<p>B2 Work out the value of x.</p> 	<p>B3 Work out the value of x.</p> 	<p>B4 Work out the value of x.</p> 
<p>C1 Work out the value of x.</p> 	<p>C2 Work out the value of x.</p> 	<p>C3 Work out the value of x.</p> 	<p>C4 Work out the value of x.</p> 
<p>D1 Work out the value of x.</p> 	<p>D2 Work out the value of x.</p> 	<p>D3 Work out the value of x.</p> 	<p>D4 Work out the value of x.</p> 

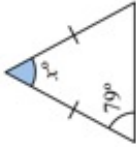
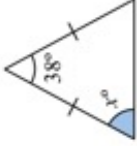
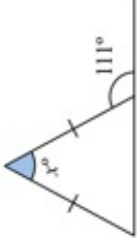
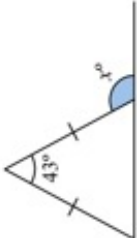
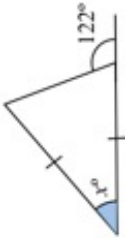
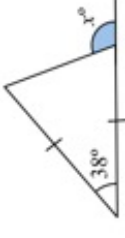
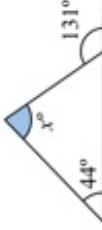

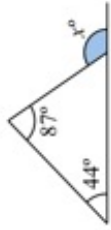

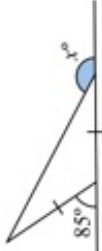







ANGLE ANGLES IN TRIANGLES

NO PROTRACTOR

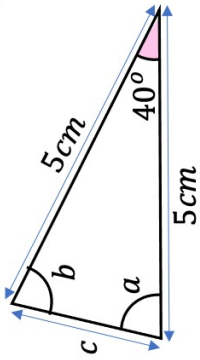
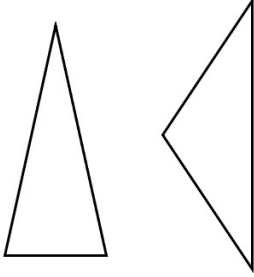
3X1

Ref: G423.

<p>A1 Work out the value of x.</p> 	<p>A2 Work out the value of x.</p> 	<p>A3 Work out the value of x.</p> 	<p>A4 Work out the value of x.</p> 
<p>B1 Work out the value of x.</p> 	<p>B2 Work out the value of x.</p> 	<p>B3 Work out the value of x.</p> 	<p>B4 Work out the value of x.</p> 
<p>C1 Work out the value of x.</p> 	<p>C2 Work out the value of x.</p> 	<p>C3 Work out the value of x.</p> 	<p>C4 Work out the value of x.</p> 
<p>D1 Work out the value of x.</p> 	<p>D2 Work out the value of x.</p> 	<p>D3 Work out the value of x.</p> 	<p>D4 Work out the value of x.</p> 

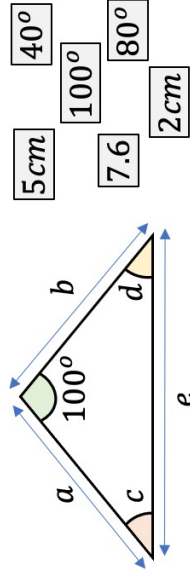
Extension

Label the Isosceles triangles below so each triangle has at least one 40° angle

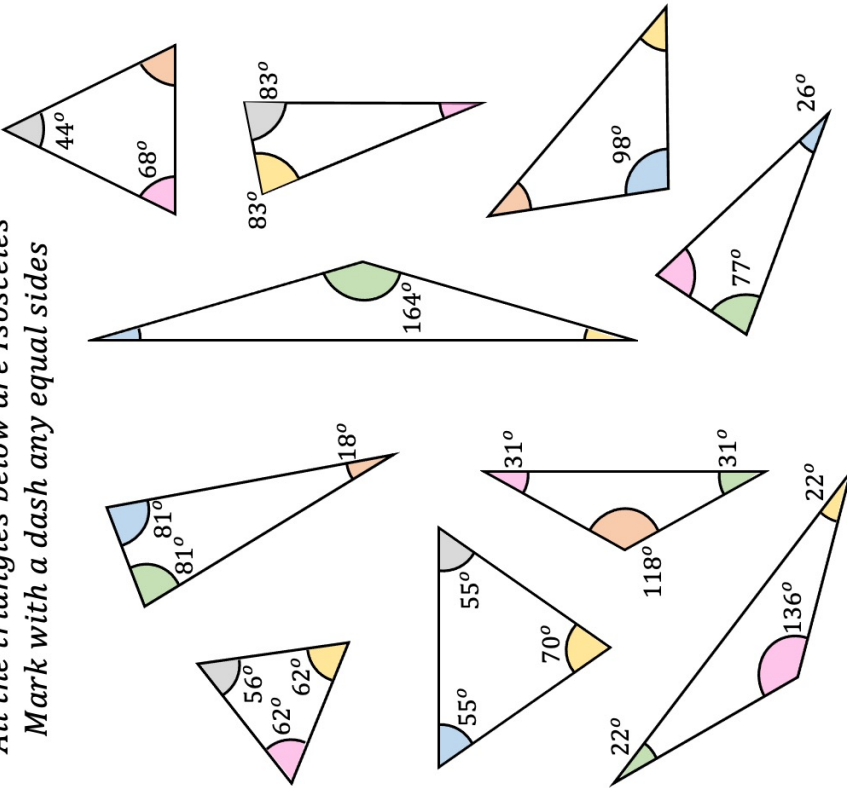


Find the size of angle a	
40°	100°
Find the size of angle b	
40°	100°
Find the length of c	
3 cm	5 cm
	8 cm

Choose the correct labels. Add them to the diagram



All the triangles below are Isosceles. Mark with a dash any equal sides

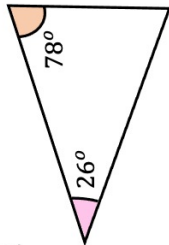


Extension

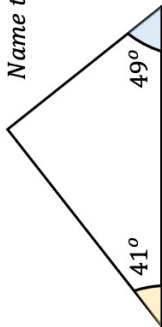
Q1 Name the triangle



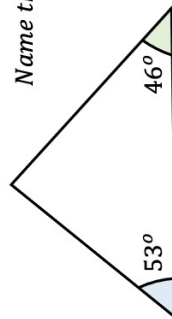
Q2 Name the triangle



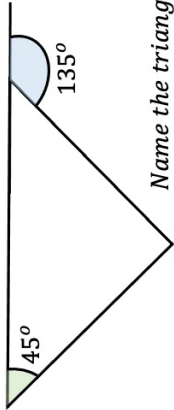
Q3 Name the triangle



Q4 Name the triangle

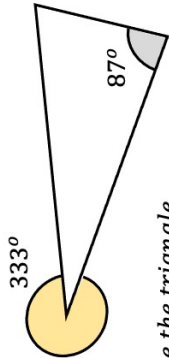


Q5



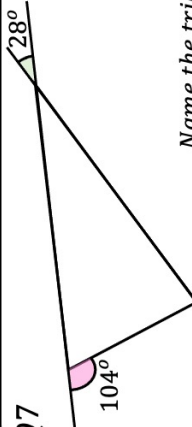
Name the triangle

Q6



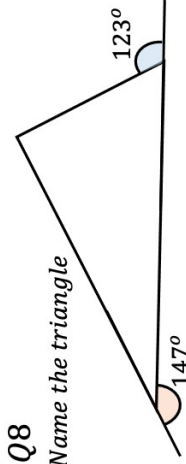
Name the triangle

Q7



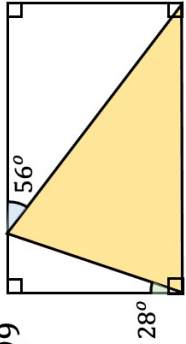
Name the triangle

Q8



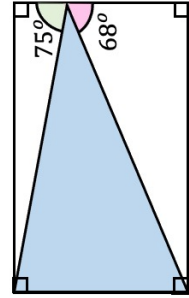
Name the triangle

Q9



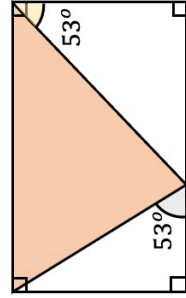
Name the coloured triangle

Q10



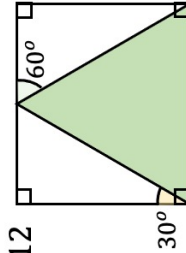
Name the coloured triangle

Q11



Name the coloured triangle

Q12

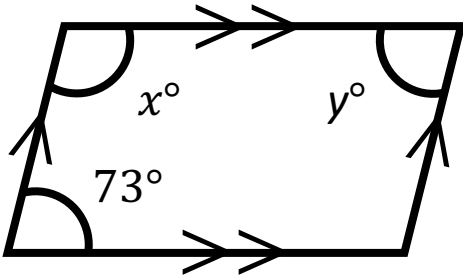


Name the coloured triangle

1.10 Angles in Quadrilaterals

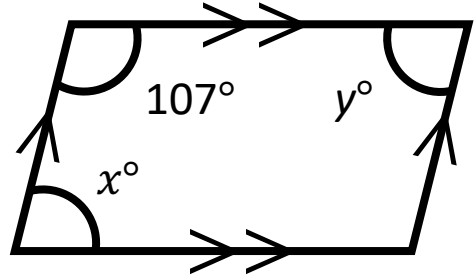
Worked Example

Find the values of x and y



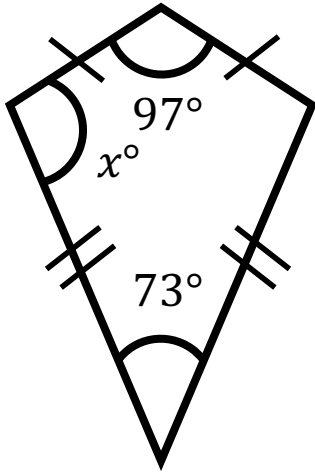
Your Turn

Find the values of x and y



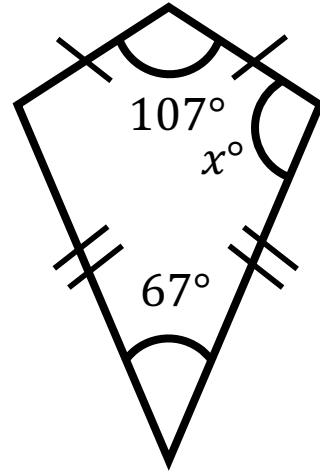
Worked Example

Find the value of x



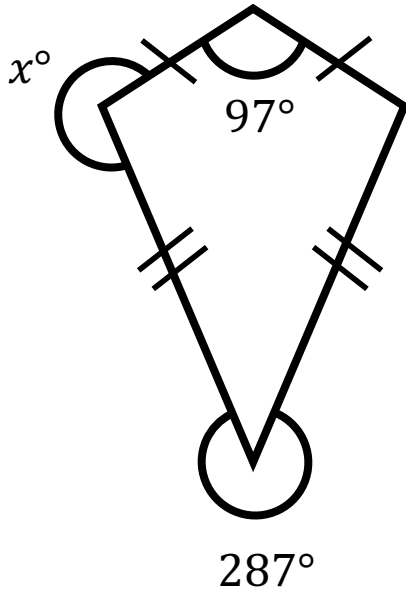
Your Turn

Find the value of x



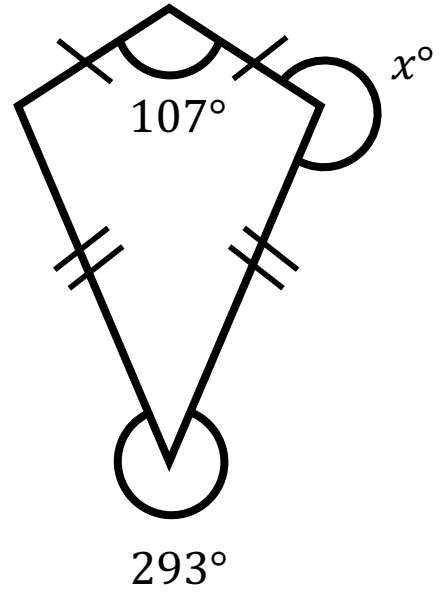
Worked Example

Find the value of x



Your Turn

Find the value of x

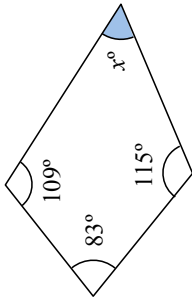
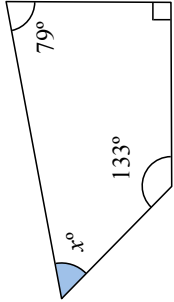
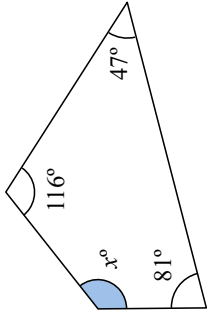
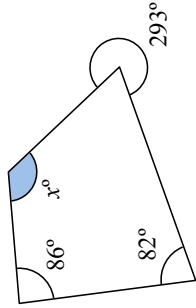
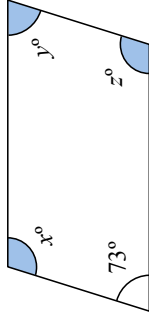
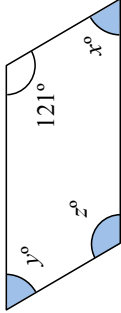
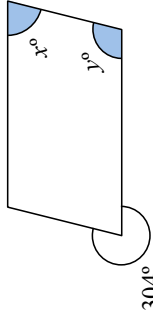
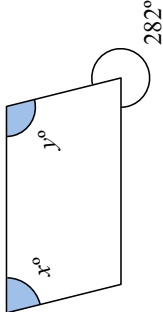
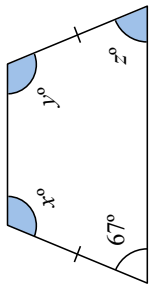
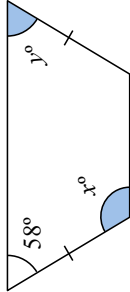
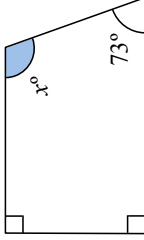
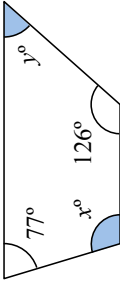




ANGLE ANGLES IN QUADRILATERALS

NO PROTRACTOR

Ref: G512. **5F1**

<p>A1 Work out the value of x</p> 	<p>A2 Work out the value of x</p> 	<p>A3 Work out the value of x</p> 	<p>A4 Work out the value of x</p> 
<p>B1 This is a parallelogram.</p>  <p>Work out the values of x, y and z</p>	<p>B2 This is a parallelogram.</p>  <p>Work out the values of x, y and z</p>	<p>B3 This is a parallelogram.</p>  <p>Work out the values of x and y</p>	<p>B4 This is a parallelogram.</p>  <p>Work out the values of x and y</p>
<p>C1 This is an isosceles trapezium.</p>  <p>Work out the values of x, y and z</p>	<p>C2 This is an isosceles trapezium.</p>  <p>Work out the values of x and y</p>	<p>C3 This is a trapezium.</p>  <p>Work out the value of x</p>	<p>C4 This is a trapezium.</p>  <p>Work out the values of x and y</p>

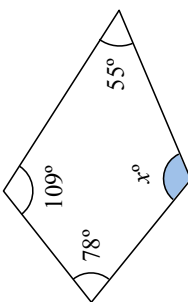
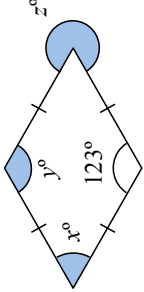
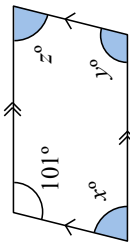
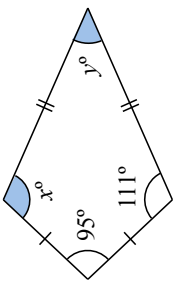
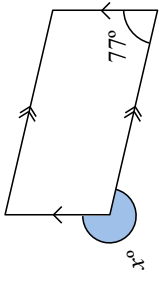
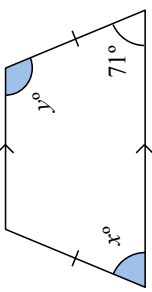
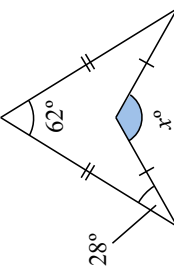
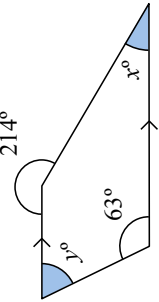
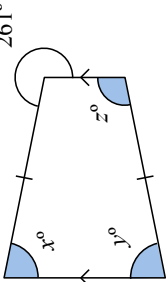
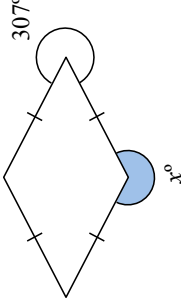
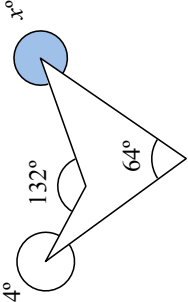


Fluency Practice

ANGLE ANGLES IN QUADRILATERALS

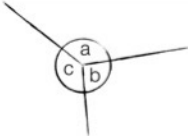
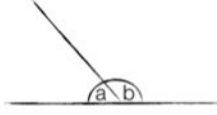
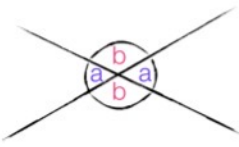
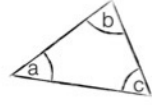
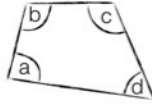
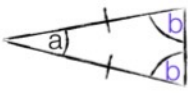
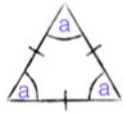
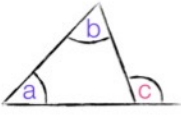
NO PROTRACTOR

Ref: G512. 5S1

<p>A1 This quadrilateral is irregular</p>  <p>Work out the value of x</p> <p>B1 This is a rhombus.</p>  <p>Work out the values of x, y and z</p>	<p>A2 This is a parallelogram.</p>  <p>Work out the values of x, y and z</p> <p>B2 This is a kite.</p>  <p>Work out the values of x and y</p> <p>C2 This is a parallelogram.</p>  <p>Work out the value of x</p>	<p>A3 This is an isosceles trapezium.</p>  <p>Work out the values of x and y</p> <p>B3 This is an arrowhead (delta).</p>  <p>Work out the value of x</p> <p>C3 This is a trapezium.</p>  <p>Work out the values of x and y</p>	<p>A4 This is an isosceles trapezium.</p>  <p>Work out the values of x, y and z</p> <p>B4 This is a rhombus.</p>  <p>Work out the value of x</p> <p>C4 This quadrilateral is irregular.</p>  <p>Work out the value of x</p>
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1.11 Review and Problem Solving

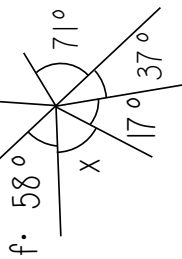
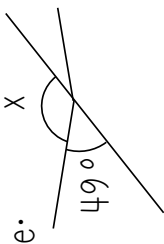
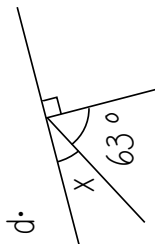
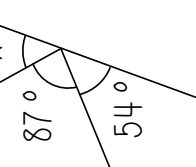
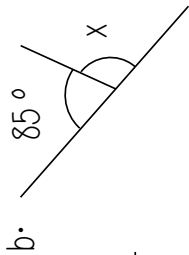
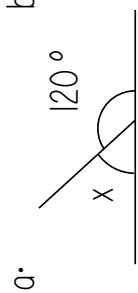
Key facts to memorise- basic angle facts

Basic angle facts	
Angles around a point add up to 360°	 $a + b + c = 360^\circ$
Angles on a straight line add up to 180°	 $a + b = 180^\circ$
Vertically opposite angles are equal	
Angles in a triangle add up to 180°	 $a + b + c = 180^\circ$
Angles in a quadrilateral add up to 360°	 $a + b + c + d = 360^\circ$
Base angles in an isosceles triangle are equal	
Angles in an equilateral triangle are all 60°	 $a = 60^\circ$
The exterior angle of a triangle is equal to the sum of the two opposite interior angles	 $a + c = b$

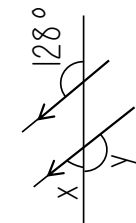
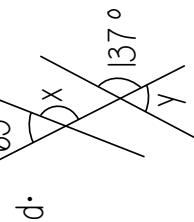
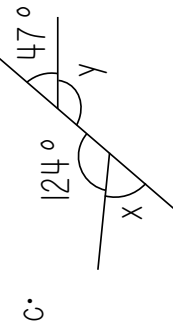
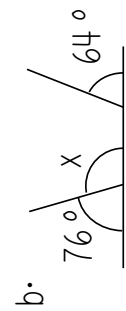
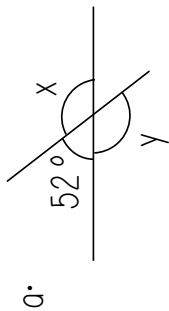
Fluency Practice

The diagrams are not drawn accurately

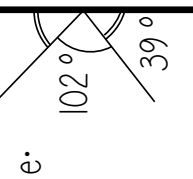
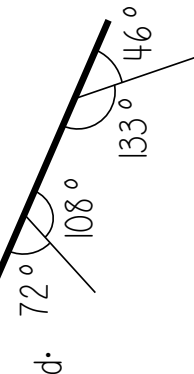
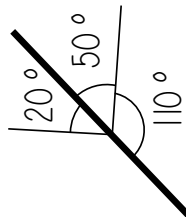
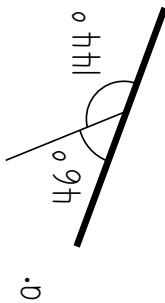
1. Find the value of the missing angle



2. Find the value of the missing angle(s)



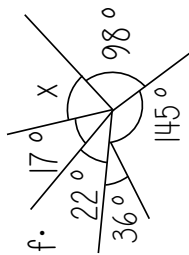
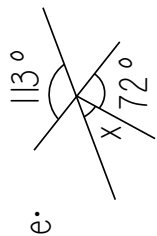
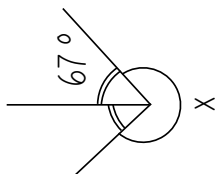
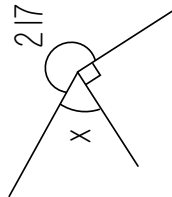
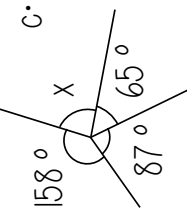
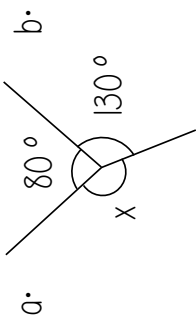
3. Is the bold line straight? Provide a reason for your answer.



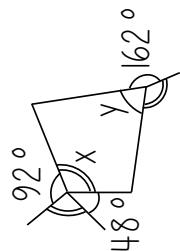
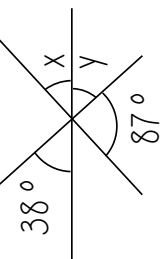
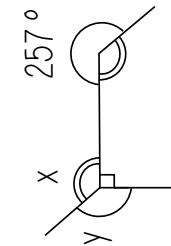
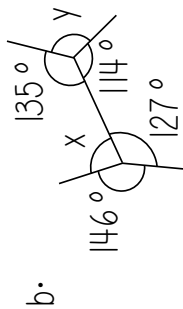
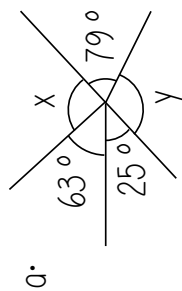
Fluency Practice

The diagrams are not drawn accurately

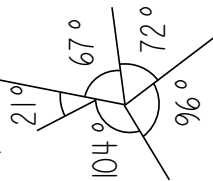
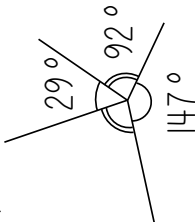
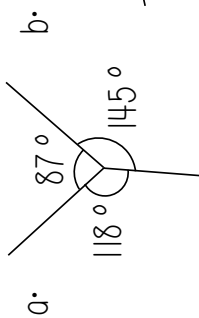
1. Find the value of the missing angle



2. Find the value of the missing angles



3. Do the angles form a point? Give a reason for your answer.



4.

Three angles form a point.

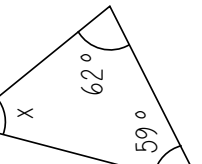
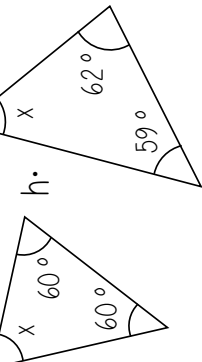
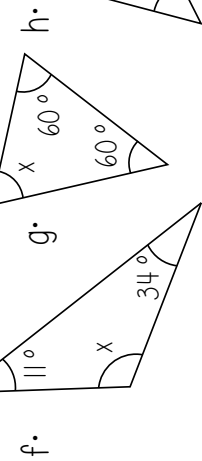
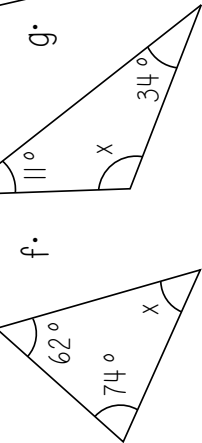
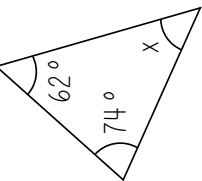
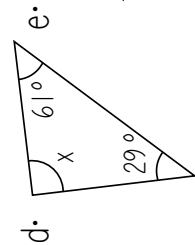
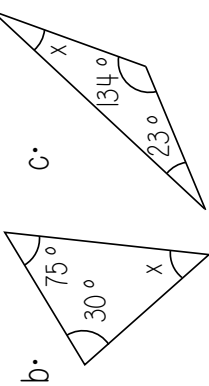
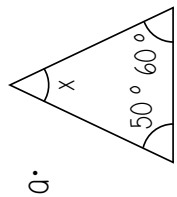
Kevin says the three angles have to be a mix of acute and obtuse angles.

Is Kevin correct? Explain your answer.

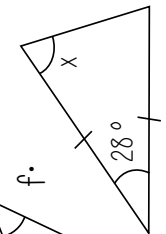
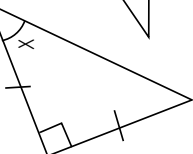
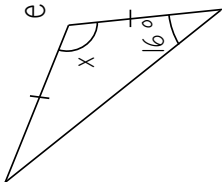
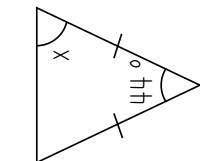
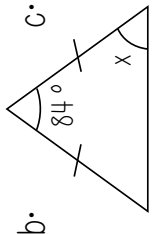
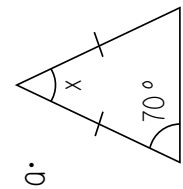
Fluency Practice

The diagrams are not drawn accurately

1. Find the value of the missing angle, and state what type of triangle is shown.



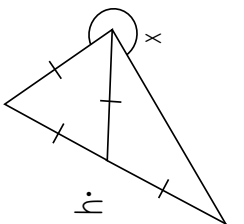
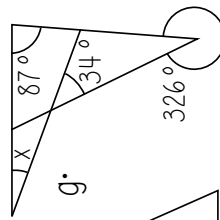
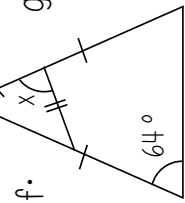
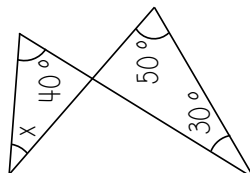
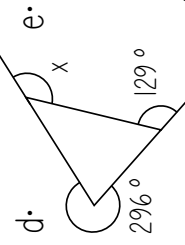
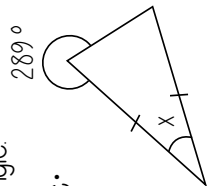
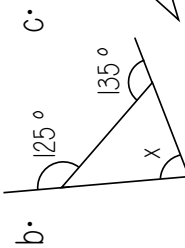
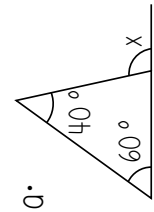
2. Find the value of the missing angle in each isosceles triangle.



3.

One of the angles in an isosceles triangle is 80° . Find the possible values of the other two angles.

4. Find the value of the missing angle.



Fluency Practice

The diagrams are not drawn accurately

1. Find the value of the missing angle in each quadrilateral.

a. b. c. d.

e. f.

2. Find the value of the missing angle in each special quadrilateral.

a. b. c. d.

e. f. g.

h.

3. Find the value of the missing angle.

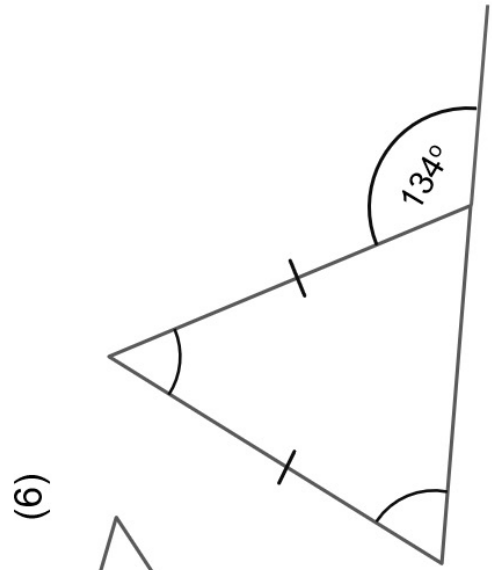
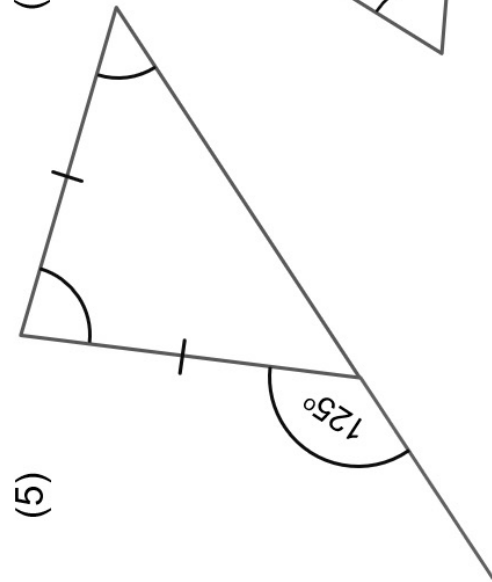
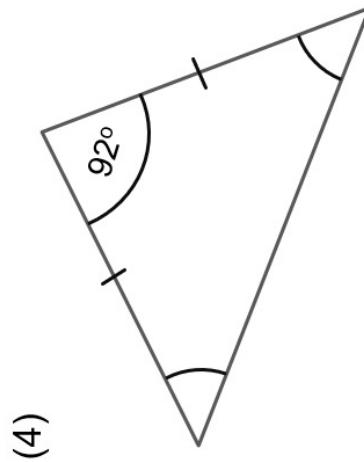
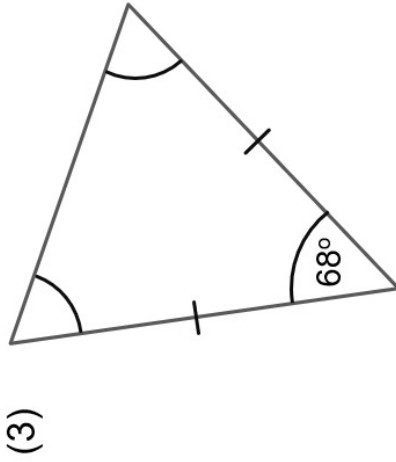
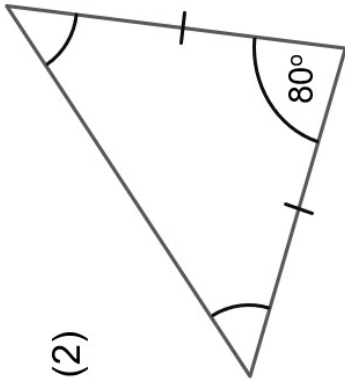
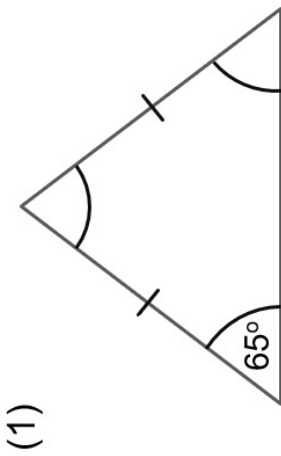
a. b. c.

d. e. f. g.

h.

Isosceles Triangle Angles

isosceles triangle questions (i)

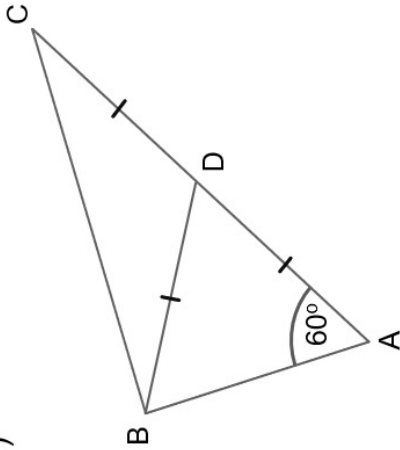


find the missing angles in these triangles

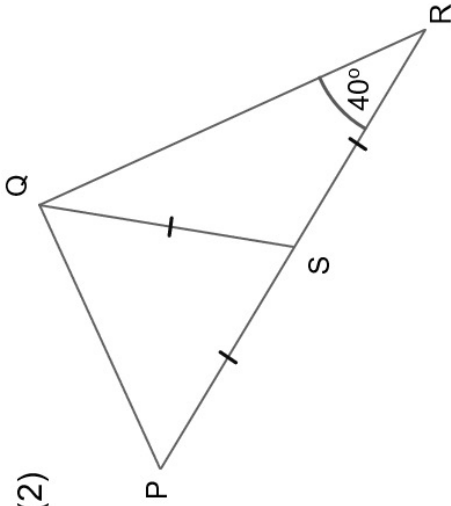
Two Isosceles Triangles Stuck Together

two isosceles triangles (i)

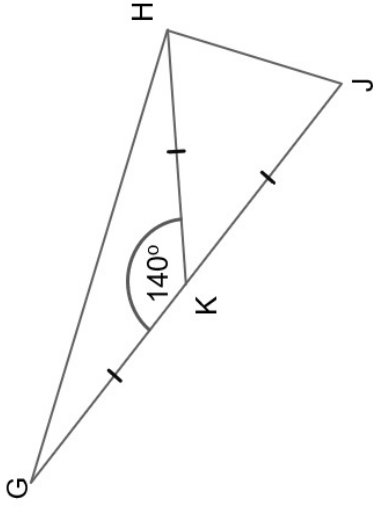
(1)



(2)

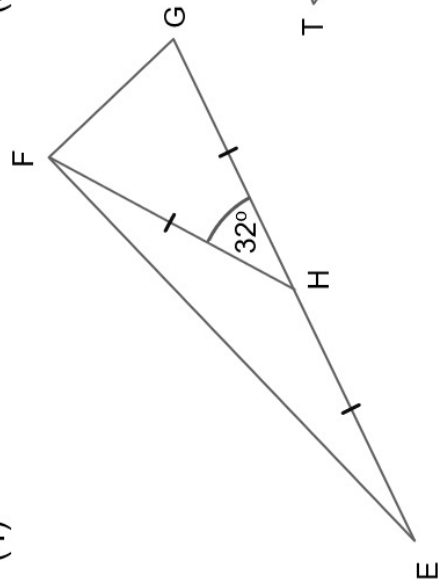


(3)

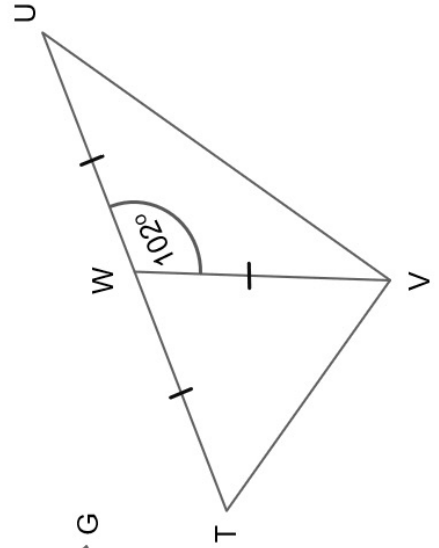


find the missing angles

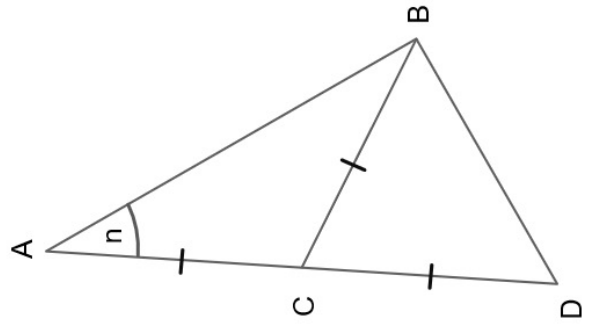
(4)



(5)



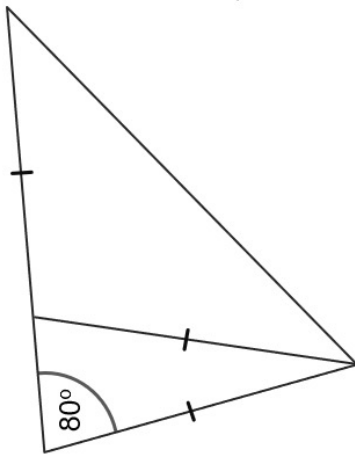
(6)



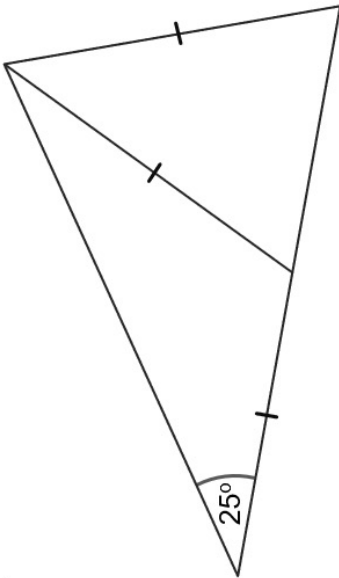
Two Isosceles Triangles Stuck Together

two isosceles triangles (ii)

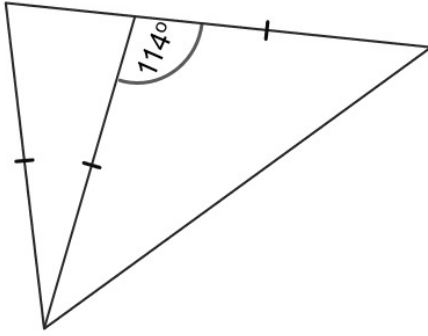
(1)



(2)

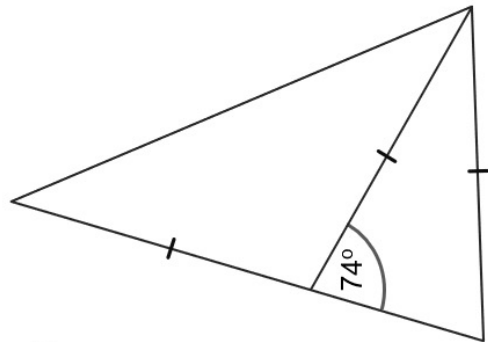


(3)

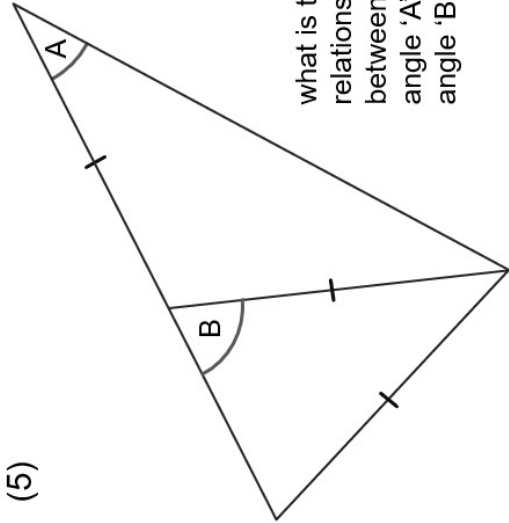


find the missing angles

(4)

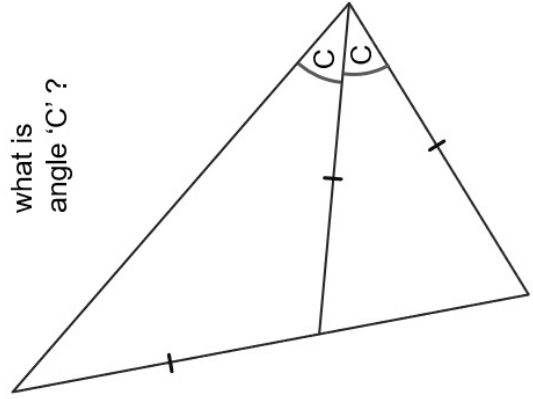


(5)



what is the relationship between angle 'A' and angle 'B'?

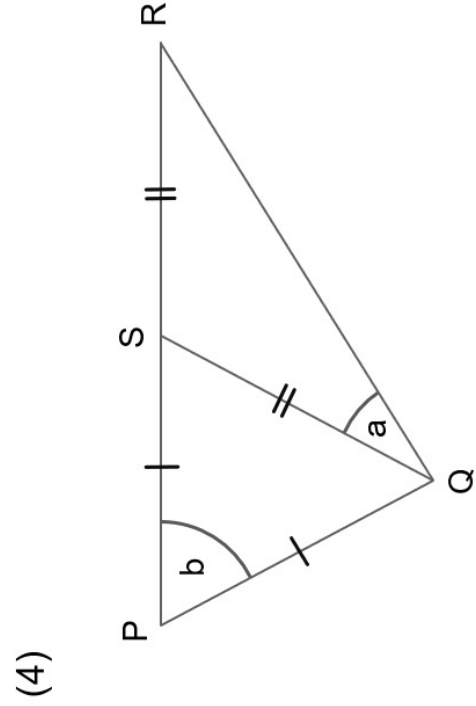
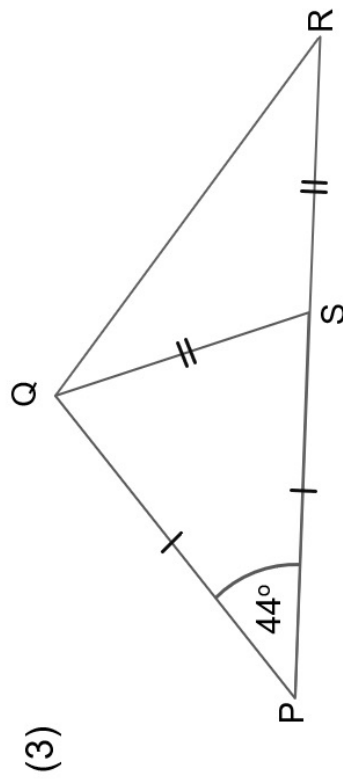
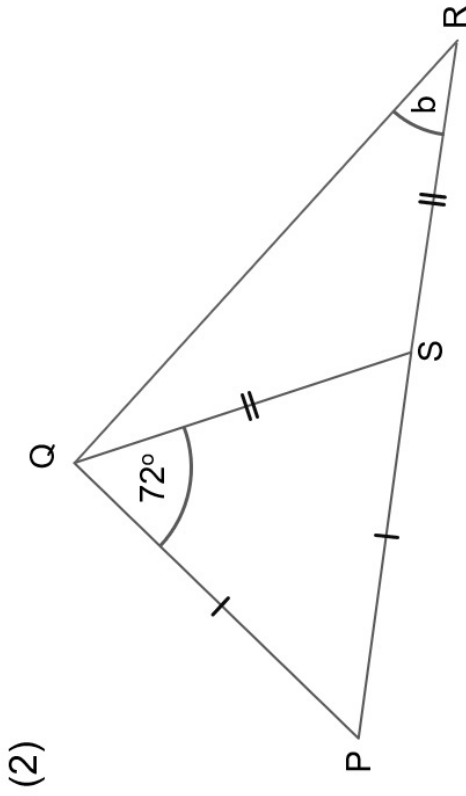
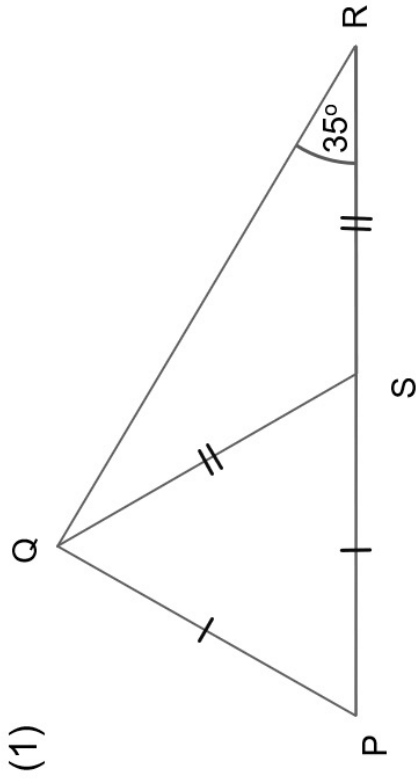
(6)



what is angle 'C'?

Two Isosceles Triangles Stuck Together

isosceles triangle questions (iii)

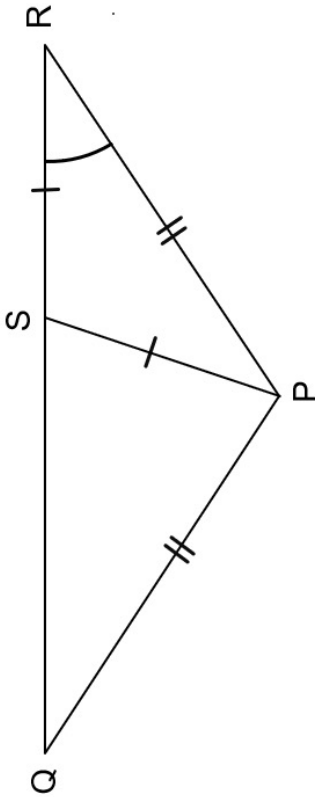


find the missing angles in these triangles

Two Isosceles Triangles Stuck Together

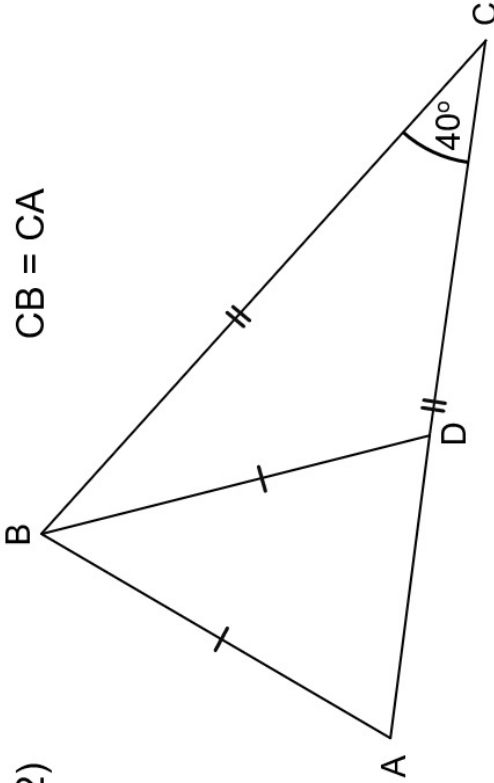
an isosceles triangle with another inside it

(1) $PQ = PR$



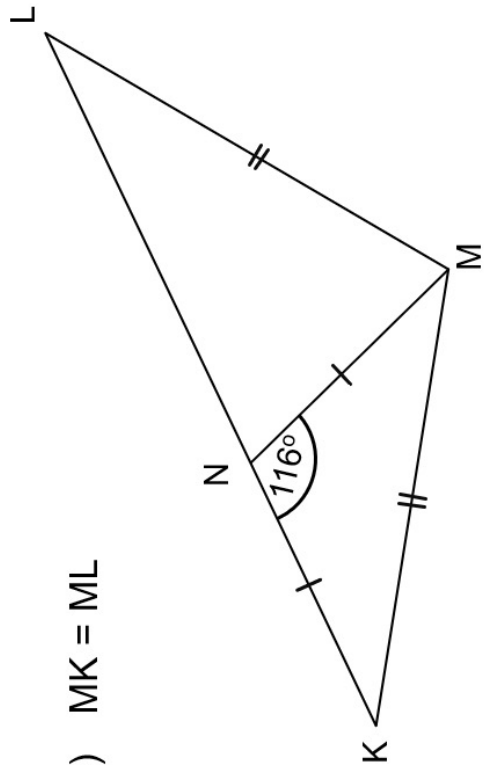
(2)

$CB = CA$

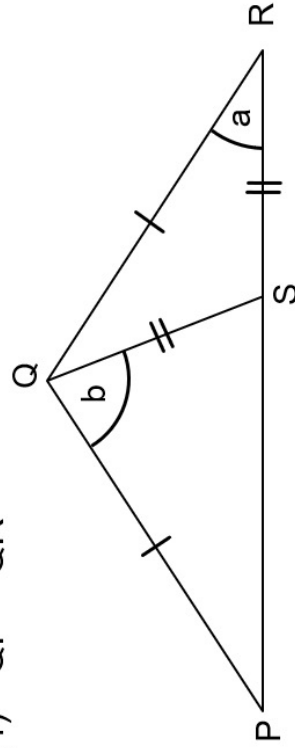


find the missing angles in these triangles

(3) $MK = ML$



(4) $QP = QR$



prove that
 $b = 180^\circ - 3a$

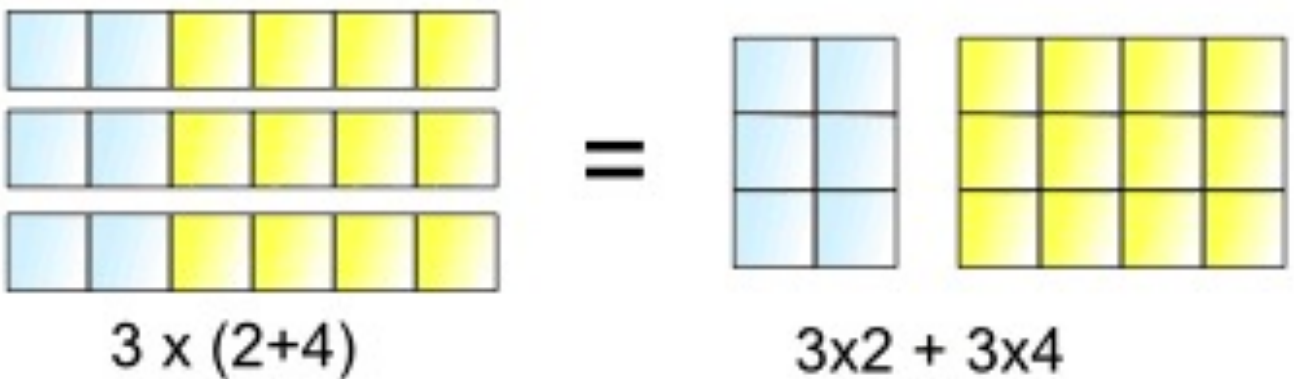
2 Expanding Single Brackets

2.1 Distributive Law

The **distributive law** says that multiplying a number by a group of numbers added together is the same as doing each multiplication separately.

For example: $3 \times (2 + 4) = 3 \times 2 + 3 \times 4$

So the "3" can be "distributed" across the "2 + 4" into 3 times 2 and 3 times 4.



Worked Example

Use the distributive property to calculate:

a) $7 \times (80 + 3)$

b) $(70 + 8) \times 3$

Your Turn

Use the distributive property to calculate:

a) $3 \times (80 + 7)$

b) $(30 + 8) \times 7$

Intelligent Practice

Use the distributive property to calculate:

1) $7 \times (80 + 4)$

2) $7 \times (80 + 5)$

3) $8 \times (80 + 5)$

4) $8 \times (90 + 5)$

5) $(90 + 5) \times 8$

6) $(70 + 5) \times 8$

7) $(70 + 5) \times 16$

8) $(70 + 5) \times y$

9) $(70 + y) \times 5$

10) $(y + 70) \times 5$

2.2 Expanding Single Brackets

Frayer Model – Expand

Definition

The act of multiplying an expression by another expression using the distributive law to create the 'expanded form' of an expression.

Characteristics

- The expression starts with at least one bracket and the result has no brackets

Examples

- $5 \times (4 + 7) = 5 \times 4 + 5 \times 7$
- $3(x + 2) = 3x + 6$

Non Examples

- $3x + 5x = 8x$
- $10x - 15 = 5(2x - 3)$

Can use the distributive property

$$2(a + 3) \equiv 2a + 6$$

$$2(a - 3) \equiv 2a - 6$$

$$b(b + 7) \equiv b^2 + 7b$$

$$b(2b + 7) \equiv 2b^2 + 7b$$

$$-3x(7 - 2x) \equiv -21x + 6x^2$$

Can't use the distributive property

$$2(a \times 3)$$

This is just $2 \times (a \times 3) \equiv 6a$

$$b(2b \div 7)$$

This is just $b \times (2b \div 7) \equiv \frac{2b^2}{7}$

Worked Example

Expand:

a) $2(x - 3)$

b) $-2(x - 3)$

Your Turn

Expand:

a) $2(3 - x)$

b) $-2(3 - x)$

Fluency Practice

Question 1: Expand the following brackets

- | | | | |
|------------------|-------------------|------------------|-----------------------|
| (a) $5(y + 3)$ | (b) $4(a + 2)$ | (c) $8(w + 10)$ | (d) $3(x - 7)$ |
| (e) $9(s - 1)$ | (f) $2(8 - t)$ | (g) $7(4 + h)$ | (h) $10(a + 2b + 3c)$ |
| (i) $4(3y + 2)$ | (j) $5(2p - 1)$ | (k) $3(7a + 2)$ | (l) $9(2x - 5)$ |
| (m) $5(4 + 3t)$ | (n) $7(9 - 2c)$ | (o) $8(3w + 1)$ | (p) $9(1 - 4p)$ |
| (q) $11(2k - 5)$ | (r) $20(6a + 5c)$ | (s) $3(15w - 7)$ | (t) $3(9 - 2a)$ |

Question 2: Expand the following brackets

- | | | | |
|-----------------|------------------|------------------|-------------------|
| (a) $-2(w + 5)$ | (b) $-3(c + 7)$ | (c) $-8(c + 7)$ | (d) $-10(y - 2)$ |
| (e) $-7(g - 3)$ | (f) $-4(2w + 3)$ | (g) $-9(3w - 5)$ | (h) $-9(5x - 1)$ |
| (i) $-5(6 - c)$ | (j) $-6(4 + 3m)$ | (k) $-2(1 + 9c)$ | (l) $-5(8a - 7w)$ |

Question 3: Expand the following brackets

- | | | | |
|------------------|------------------|------------------|-------------------|
| (a) $a(c + 2)$ | (b) $c(d - 3)$ | (c) $a(b + c)$ | (d) $w(8 - y)$ |
| (e) $c(5 + a)$ | (f) $w(a - 9)$ | (g) $y(s + t)$ | (h) $2a(c - 3)$ |
| (i) $5x(y + 8)$ | (j) $3a(2c + 9)$ | (k) $6g(2c - 1)$ | (l) $9k(2 + d)$ |
| (m) $5(2f + 9w)$ | (n) $3y(5p + 2)$ | (o) $2s(t + 1)$ | (p) $-4a(8x - 3)$ |

Intelligent Practice

Expand:

10) $-6(2 - x)$

1) $3(x + 4)$

11) $6(x - 2)$

2) $3(4 + x)$

12) $6(x - 2y)$

3) $3(4 - x)$

13) $6(5x - 2y)$

4) $3(x - 4)$

14) $-6(2y - 5x)$

5) $3(-x - 4)$

15) $-6(2y - 5x - 7z)$

6) $-3(x + 4)$

16) $-6(5x - 2y - 7z)$

7) $-3(x - 4)$

17) $-6(-5x - 2y - 7z)$

8) $-3(2x - 4)$

18) $-w(-5x - 2y - 7z)$

9) $-3(4 - 2x)$

19) $-(-5x - 2y - 7z)$

- Why are the answers to questions 1 and 2 the same?
- Why are the answers to questions 5 and 6 the same?
- Why are the answers to questions 9 and 10 the same?

Worked Example

Expand:

a) $2x(x - 3)$

b) $-2x(x - 3)$

Your Turn

Expand:

a) $2x(3 - x)$

b) $-2x(3 - x)$

Fluency Practice

Question 4: Expand the following brackets

(a) $a(a + 2)$

(b) $y(y - 5)$

(c) $w(a + w)$

(d) $c(9 - c)$

(e) $p(2p + 5)$

(f) $2w(3w - 1)$

(g) $9y(2y + 3)$

(h) $4c(2a + 5c)$

(i) $2u(3 - u)$

(j) $m(m^2 + 3)$

(k) $y(y^2 - 7)$

(l) $g^2(g - 8)$

(m) $2w(w^2 + 6)$

(n) $4a(2a^2 - 3)$

(o) $5c(3c^2 - a)$

(p) $8w(3w^2 + 3y)$

(q) $x^2(x^2 + 4)$

(r) $3w^2(7 + 2w^2)$

Intelligent Practice

Expand:

10) $-3x(2 - x)$

1) $x(x + 4)$

11) $3x(x - 2)$

2) $x(4 + x)$

12) $3x(x - 2y)$

3) $x(4 - x)$

13) $3x(5x - 2y)$

4) $x(x - 4)$

14) $-3x(2y - 5x)$

5) $x(-x - 4)$

15) $-3x^2(2y - 5x)$

6) $-x(x + 4)$

16) $-3y^2(2y - 5x)$

7) $-x(x - 4)$

17) $-3y^2(2y - 5xy)$

8) $-x(2x - 4)$

18) $-3y^3(2 - 5x)$

9) $-x(4 - 2x)$

19) $-3y^3(2y^2 - 5x^2)$

- Why are the answers to questions 1 and 2 the same?
- Why are the answers to questions 5 and 6 the same?
- Why are the answers to questions 17 and 18 the same?

Extension

Mark the work. Which is right. Which is wrong. Say why.

3: Expand these brackets, showing your working

a) $4(a + 2) = 4a + 2$

b) $3(x + 5) = 3x + 15$

c) $5(2y + 3) = 7y + 8$

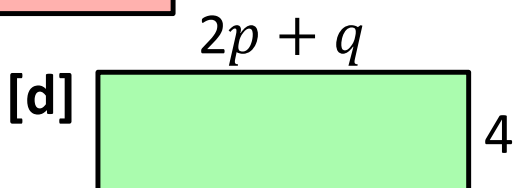
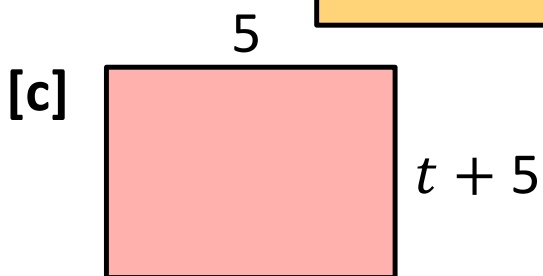
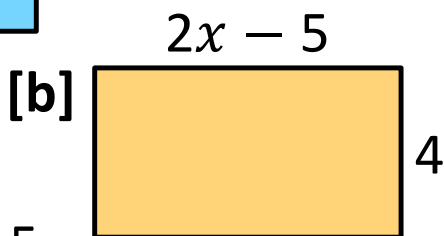
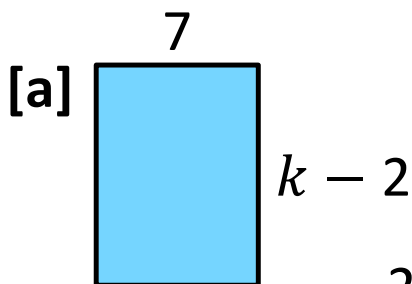
d) $7(4b - 2) = 28b + 14$

e) $8m(m - 6) = 8mm - 48m$

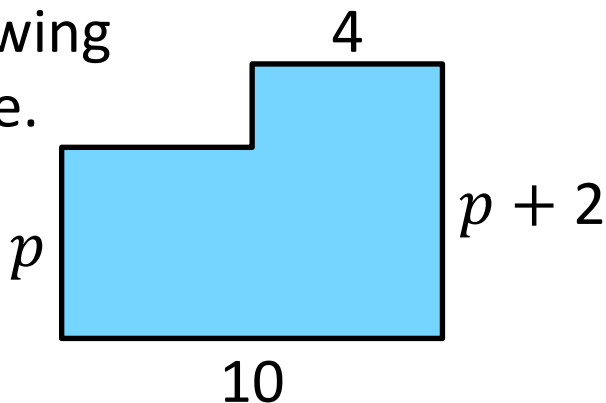
f) $2a(2a + 5) = 2a^2 + 10a$

Extension

Write an expanded expression for the area of each of the following rectangles.

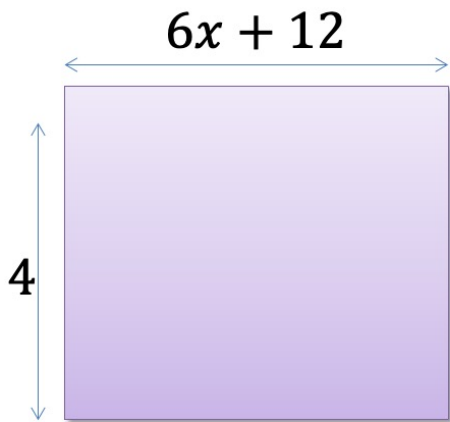


Find an expanded expression for the area of the following compound shape.

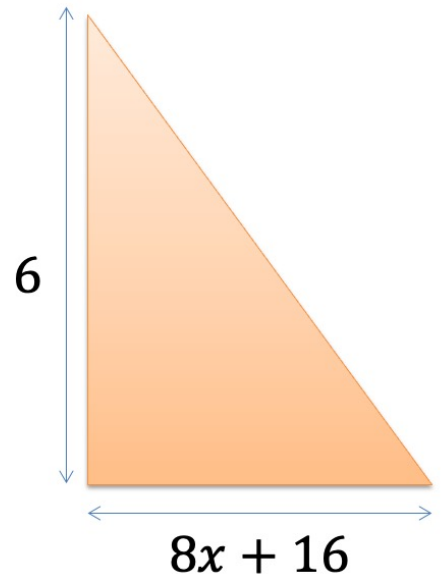


Extension

Which has the bigger area?



$$12x + 24$$



Worked Example

Expand and simplify:

a) $2(x - 1) + 3(x - 4)$

b) $2(x - 1) - 3(x - 4)$

Your Turn

Expand and simplify:

a) $2(x - 1) + 5(x - 4)$

b) $2(x - 1) - 5(x - 4)$

Fluency Practice

Question 5: Expand and simplify

(a) $5(y + 3) + 2(y + 7)$

(b) $6(2w + 5) + 9(w + 2)$

(c) $3(y - 2) + 4(2y + 5)$

(d) $7(2g + 3) - 5(g + 2)$

(e) $6(x - 2) - 4(x - 8)$

(f) $2(3y - 8) - 5(2y - 1)$

(g) $8(5 + 2m) + 3(5 - 3m)$

(h) $4(w + 7) - 2(2w + 1)$

(i) $9(1 + 2y) + 3(3 - y)$

Intelligent Practice

Expand and simplify:

- | | |
|---------------------------|---------------------------|
| 1) $2(x + 1) + 3(x + 4)$ | 10) $3(x + 1) - 4(x + 2)$ |
| 2) $3(x + 4) + 2(x + 1)$ | 11) $3(x + 1) - (x + 2)$ |
| 3) $3(x + 1) + 2(x + 4)$ | 12) $3(x - 1) - (x - 2)$ |
| 4) $3(x - 1) + 2(x + 4)$ | 13) $3(x - 1) - (5x - 2)$ |
| 5) $3(x + 1) + 2(x - 4)$ | 14) $3(x - 1) - 5x$ |
| 6) $3(x - 1) + 2(x - 4)$ | 15) $5x - 3(x - 1)$ |
| 7) $3(x - 1) - 2(x - 4)$ | 16) $5 - 3(x - 1)$ |
| 8) $3(x + 1) - 2(x + 4)$ | 17) $5 + 3(1 - x)$ |
| 9) $3(x + 1) - 2(2x + 4)$ | 18) $5 + 3(y - x)$ |
| | 19) $5 - 3(y - x)$ |

- Why are the answers to questions 1 and 2 the same?
- Why are the answers to questions 9 and 10 the same?
- Why are the answers to questions 16 and 17 the same?

Worked Example

Expand and simplify:

a) $2x(x - 1) - 3x(x - 4)$

b) $2x(x - 1) - 3(x - 4)$

Your Turn

Expand and simplify:

a) $2x(x - 1) - 5x(x - 4)$

b) $2x(x - 1) - 5(x - 4)$

Fluency Practice

Question 6: Expand and simplify

(a) $w(w + 5) + w(w + 7)$

(b) $2g(4g + 3) + g(g - 7)$

(c) $n(n - 4) - n(5 - n)$

(d) $2e(4e + 3) - 3e(e - 5)$

(e) $a(3 + c) + c(a + 2)$

(f) $m(a + 7) - a(4 - 3m)$

(g) $8c(8 - 3a) + 3(4 - c)$

(h) $5y(3y + z) - 2y(4y - 3z)$

(i) $4c(3c - c^2) - 2c^2(4 - 5c)$

Intelligent Practice

Expand and simplify:

10) $3x(x + 1) - 5(x + 4)$

1) $2x(x + 1) + 3x(x + 4)$

11) $3x^2(x + 1) - 5x(x + 4)$

2) $3x(x + 4) + 2x(x + 1)$

12) $3x^2(x - 1) - 5x(x - 4)$

3) $3x(x + 1) + 2x(x + 4)$

13) $3x^2(x - 1) - (5x^2 - 4)$

4) $3x(x - 1) + 2x(x + 4)$

14) $3x^2(x - 1) - 5x$

5) $3x(x + 1) + 2x(x - 4)$

15) $5x^2 - 3x^2(x - 1)$

6) $3x(x - 1) + 2x(x - 4)$

16) $5 - 3x^2(x - 1)$

7) $3x(x - 1) - 2x(x - 4)$

17) $5 + 3x^2(1 - x)$

8) $3x(x + 1) - 2x(x + 4)$

18) $5 + 3x^2(y - x)$

9) $3x(x + 1) - 2(x + 4)$

19) $5 - 3x^2(y - x)$

- Why are the answers to questions 1 and 2 the same?
- Why are the answers to questions 16 and 17 the same?

Extension

Question 1: Can you spot any mistakes in the questions below.

Expand $3(2y - 1)$

$$6y - 1$$

Multiply out $x(x + 3)$

$$2x + 3x = 5x$$

Expand and simplify $6(w + 3) - 2(w - 5)$

$$\begin{aligned} &6w + 18 - 2w - 10 \\ &= 4w + 8 \end{aligned}$$

2.3 Review and Problem Solving

Expanding and Simplifying

simplification

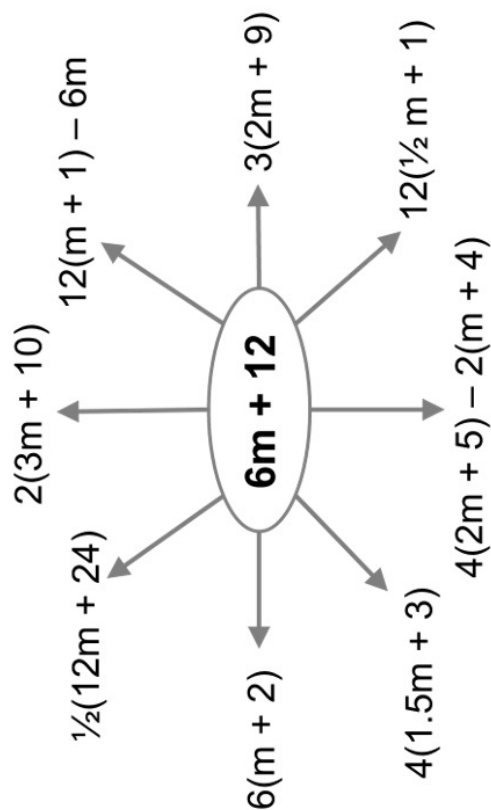
a) expand the brackets and then simplify the expressions

- 1) $5(b + 5) + 7(b + 2) + 2(b + 1)$
- 2) $3(2a + 1) + 6(a + 3)$
- 3) $3(2m + 15) + 10(m + 1) + 4(5m + 2)$
- 4) $5(2n + 3) + 3(10n + 3) + \frac{1}{2}(6n + 20)$
- 5) $4(2t + 3) + 5(t + 6) + \frac{1}{2}(4t + 18)$
- 6) $15(3k + 1) + 2(17k + 1) + \frac{1}{2}(4k + 2)$
- 7) $6(5d + 8) + 3(4d - 5) + d + 1$
- 8) $8(p + 5) + 6(7p - 3) + 2(p + 1.5)$
- 9) $2(4h + 21) + 5(4h - 1) - 5(h + 1)$

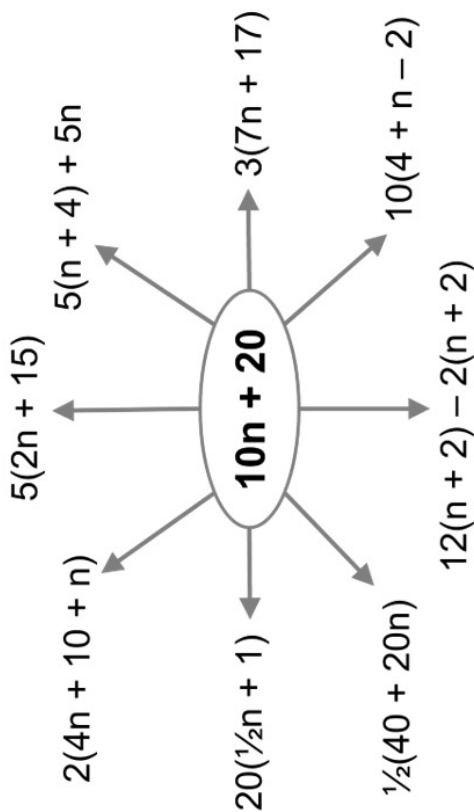
b) six expressions:

- 1) $2(9b - 13a)$
which two sum to $4(3b - 2a)$?
- 2) $3(2b - 11a)$
which two add to $7(4a - 3b)$?
- 3) $4(3a - 5b)$
which three sum to zero?
- 4) $5(2a - 3b)$
which three add to $4(a - 2b)$?
- 5) $6(3a - b)$
- 6) $7(3a + 2b)$

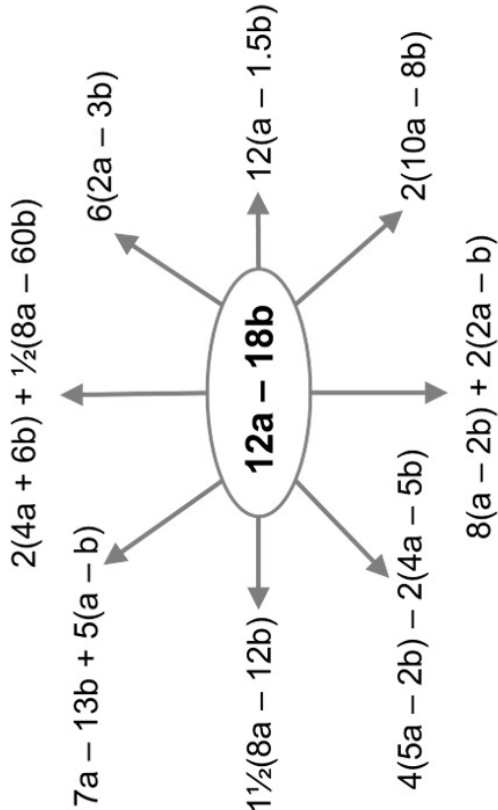
One Incorrect Simplification



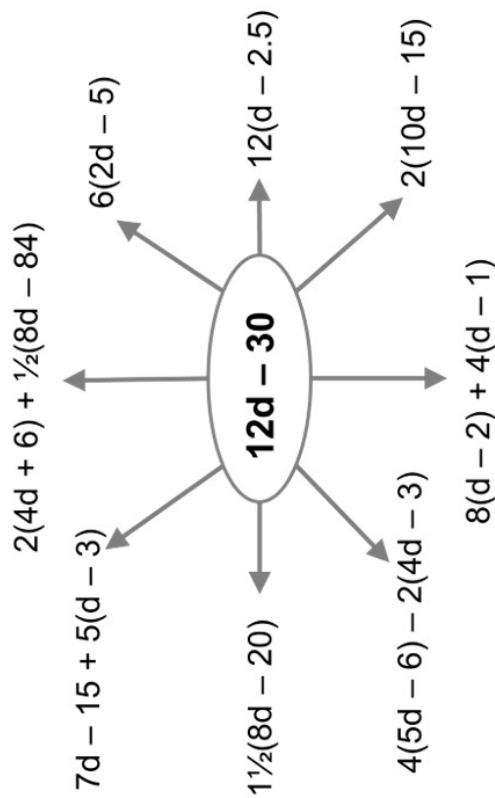
which expressions are **not** the same as $6m + 12$?



which expressions are **not** the same as $10n + 20$?



which expressions are **not** the same as $12a - 18b$?



which expressions are **not** the same as $12d - 30$?

Find the Gaps

3p - 1

find the missing expression or numbers:

$$(1) \quad 7(p - 3) - 4(\boxed{}) = 3p - 1$$

$$(2) \quad 3(5p + 9) - 4(\boxed{}) = 3p - 1$$

$$(3) \quad 8(3p + 1) - 3(\boxed{}) = 3p - 1$$

$$(4) \quad 3(5p - 3) - 4(\boxed{}) = 3p - 1$$

$$(5) \quad 11(3p - 5) - 6(\boxed{}) = 3p - 1$$

$$(6) \quad 5(\boxed{} + 1) - 6(\bigcirc + 1) = 3p - 1$$

$$(7) \quad 14(\boxed{} + 1) - 5(\bigcirc + ?) = 3p - 1$$

$$(8) \quad \boxed{}(p - 2) + 5(\bigcirc - 3p) = 3p - 1$$

$$(9) \quad \boxed{}(2p - 9) - \bigcirc(3p - 16) = 3p - 1$$

$$(10) \quad \boxed{}(5p - 7) - \bigcirc(2p - 3) = 3p - 1$$

Find the Gaps

complete the expression sums

$$(1) \quad p + 3 + p + 5 - \boxed{} = p$$

$$(2) \quad 2p - 3 + p - 4 + \boxed{} = p$$

$$(3) \quad p + 3 + 2p - 8 + \boxed{} = p$$

$$(4) \quad 3p - 2 + 4(2 - p) + 2 \boxed{} = p$$

$$(5) \quad 4(p - 1) + 2(3p - 1) + 3 \boxed{} = p$$

$$(6) \quad p + 1 + 2p - 2 - \boxed{} = p$$

$$(7) \quad 4(p - 1) + 2(p - 3) - 5 \boxed{} = p$$

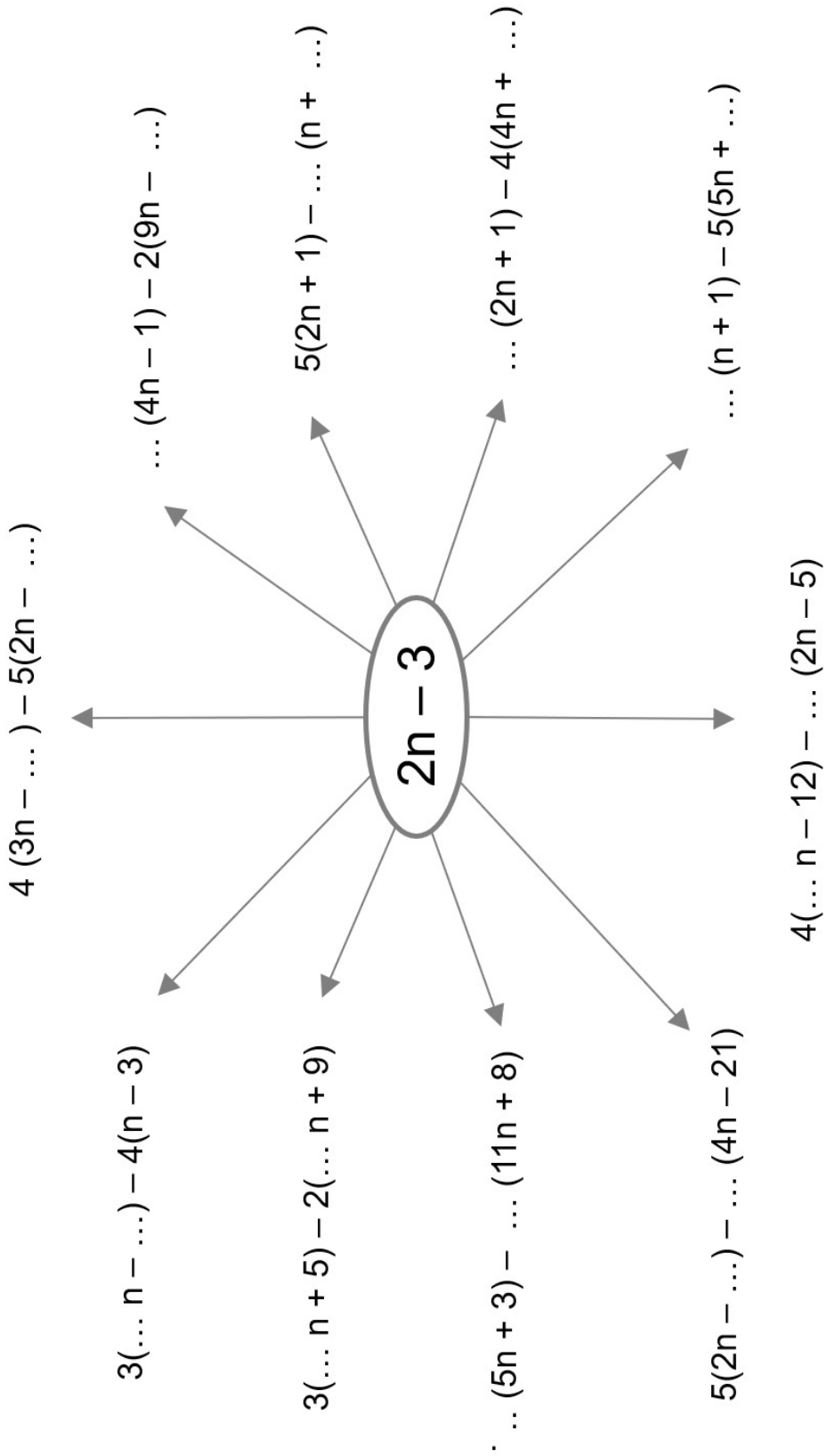
$$(8) \quad 7(p - 1) - 4(3p - 1) + 3 \boxed{} = p$$

$$(9) \quad 2(3 - p) + 6(2p - 3) - 3 \boxed{} = p$$

Equivalent Things

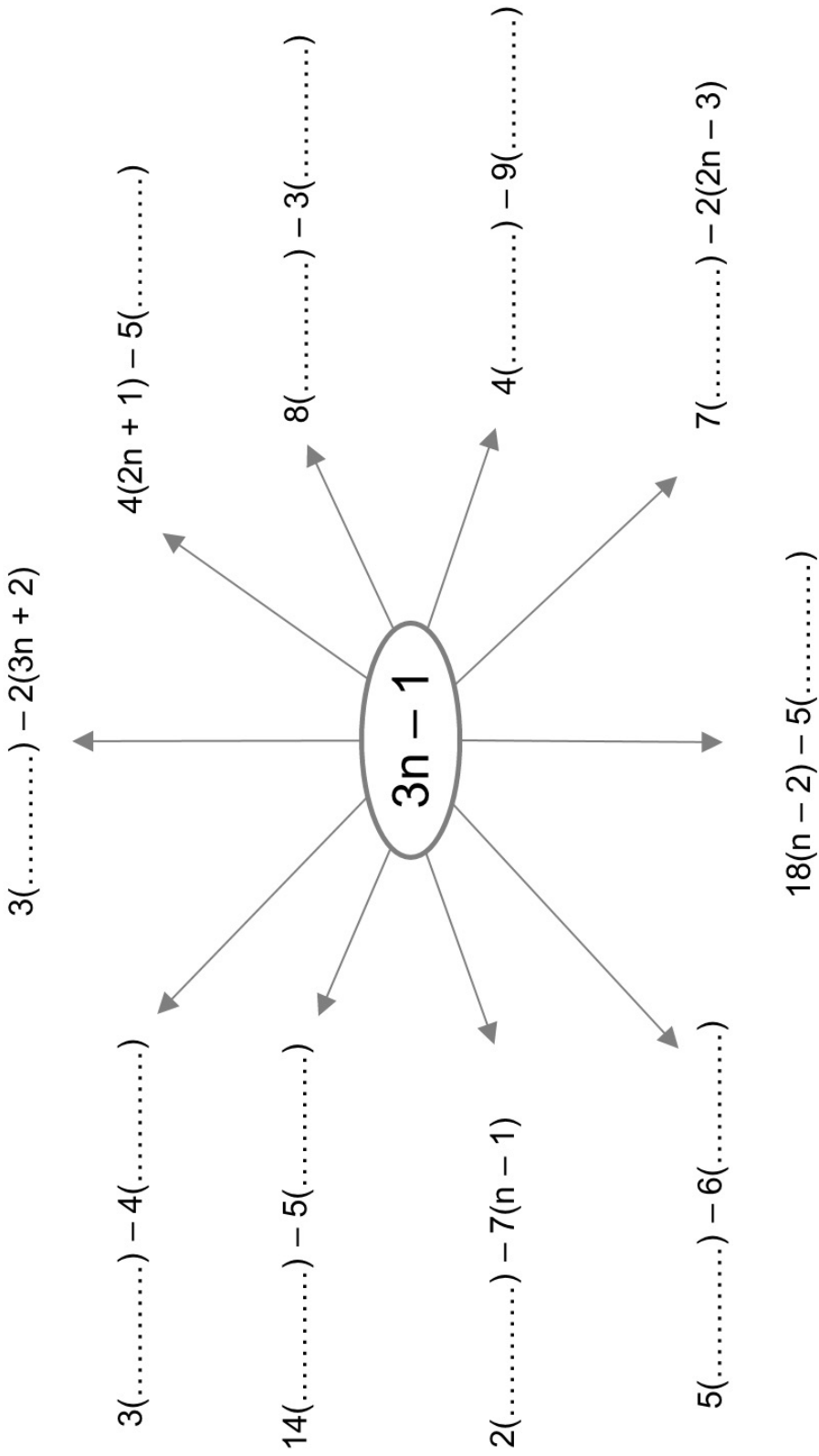
what numbers go in the missing (blank) spaces so that the expression simplifies to $2n - 3$?

e.g. $7(6n - 5) - 8(5n - 4) \equiv 2n - 3$



Equivalent Things

what expressions go in the missing (blank) spaces to create $3n - 1$?



Simplifying Expressions

Simplify these four expressions.

(a) $(3x + 4y) + 2(x + 2y)$

(b) $4(2x + 5y) - 3(x + 4y)$

(c) $3(2x + 3y) - (x - y)$

(d) $3(x + 3y) + (2x - y)$

Which one is the odd one out?

If you finish, try to make up some more that fit the pattern.

The answer is $5x + 8y$: What's the question?

$5x + 8y$ is the answer – your job is to make up the questions!

The only brackets that you are allowed to use are:

$$(x + y) \quad (x + 2y) \quad (x - 2y) \quad (x + 4y) \quad \text{and} \quad (2x + 3y)$$

Pick any **two** of these brackets and combine them with numbers and + or – to make an expression.

For example, you could pick

- the brackets $(x + 2y)$ and $(x + 4y)$
- and the numbers 3 and -2

and make

$$3(x + 2y) - 2(x + 4y)$$

... but unfortunately that **doesn't** make $5x + 8y$.

Can you find a way to make $5x + 8y$ using **two** different brackets?

Can you find a way to make $5x + 8y$ using **more than two** different brackets?

Can you find a way to make $5x + 8y$ using **all five** brackets?