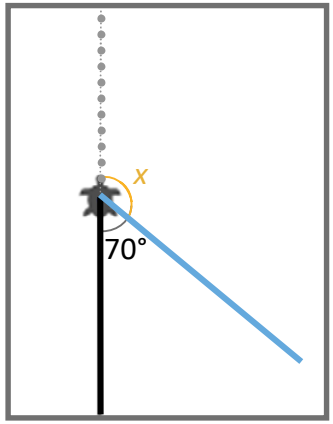
CATAPULT High Value Manufacturing

WMG THE UNIVERSITY OF WARWICK

Turtlestitch Maths

Finding missing angles on a straight line

A key element of stitching shapes is working out how many degrees the turtle needs to turn.



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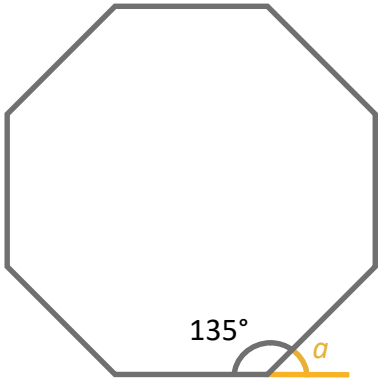
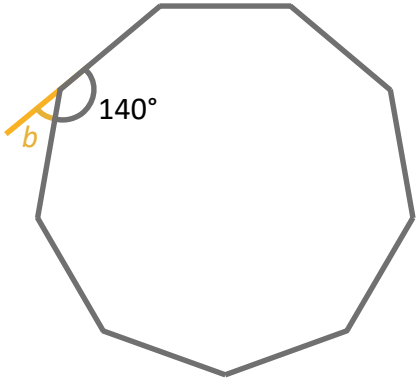
We want the turtle to walk along the blue line. To do this, how far does it need to turn?

What fact can you use to work out the missing angle?

1. Calculate the values of the missing angles.





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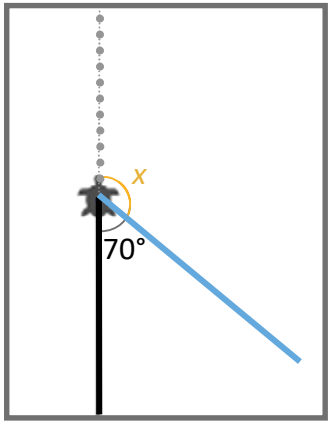

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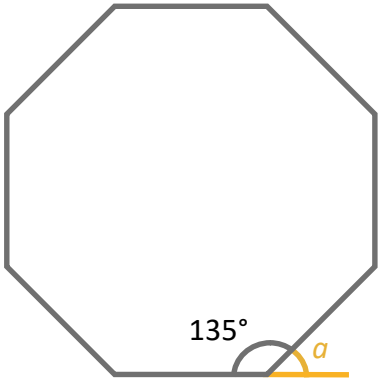

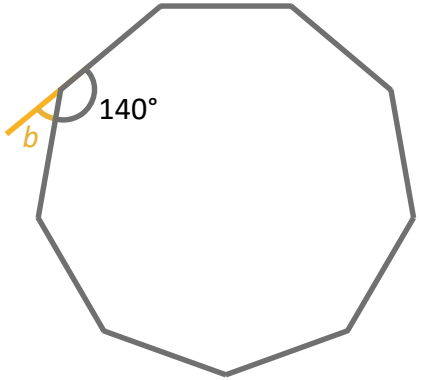

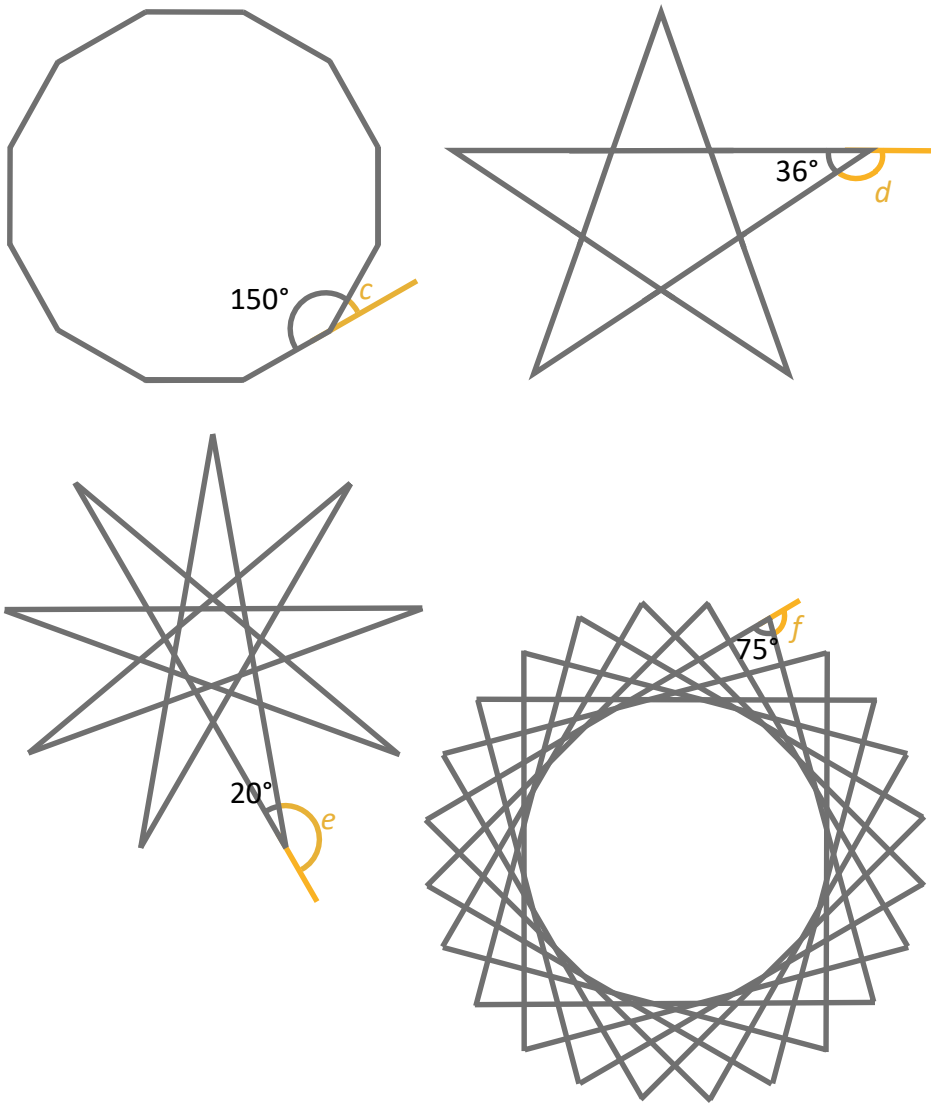

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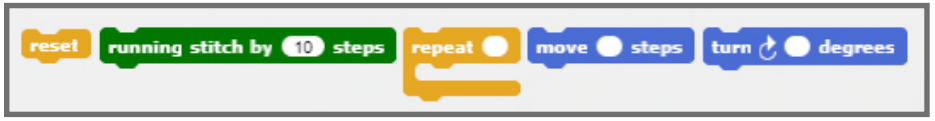

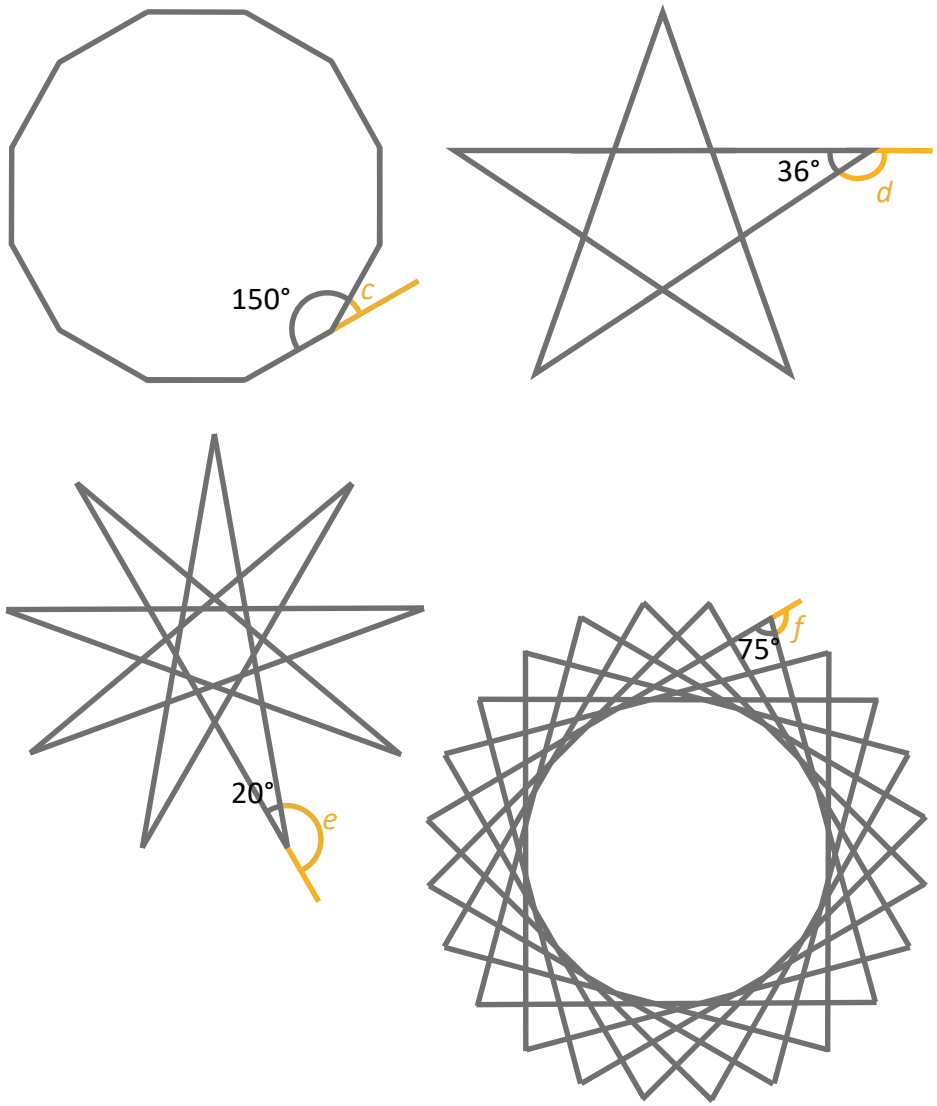

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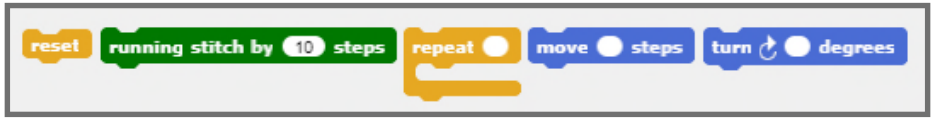
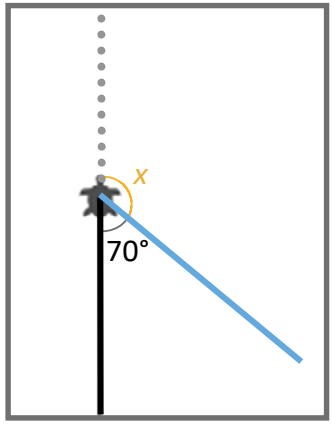


www.warwick.ac.uk/wmgoutreach www.warwick.ac.uk/turtlestitch

Turtlestitch Maths Answers

Finding missing angles on a straight line

A key element of stitching shapes is working out how many degrees the turtle needs to turn.



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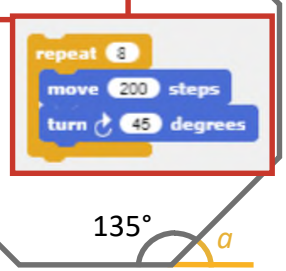
What fact can you use to work out the value of angle *x*?

Angles at a point on a straight line total 180°.
180 - 70 = 110
x = 110°

1. Calculate the values of the missing angles.

180 - 135 = 45
a = 45°



180 - 140 = 40
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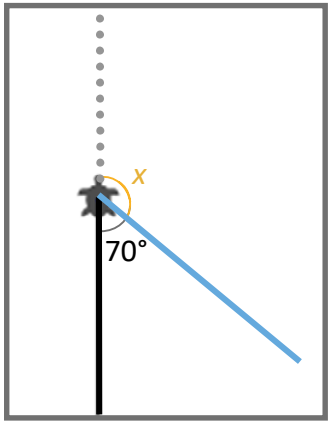

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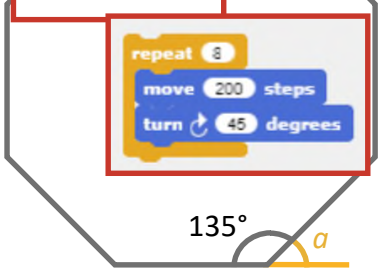

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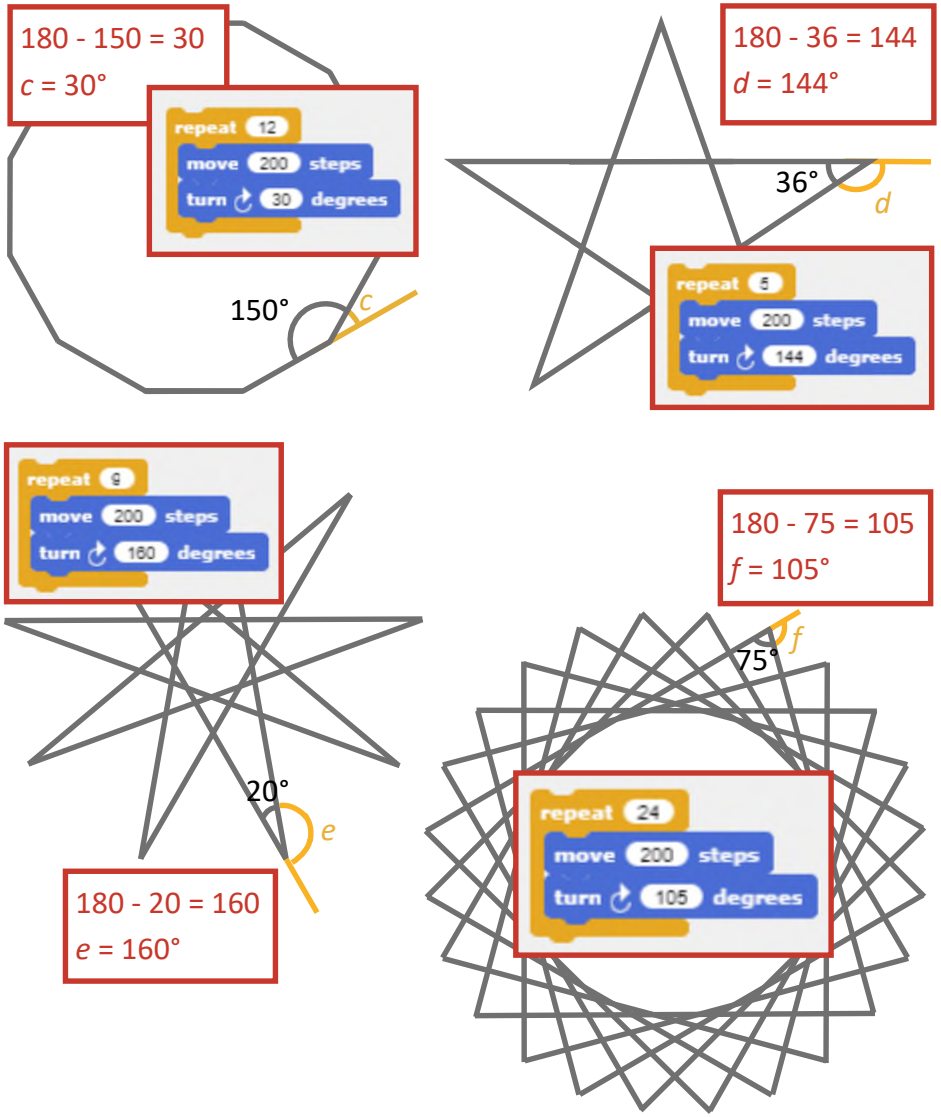

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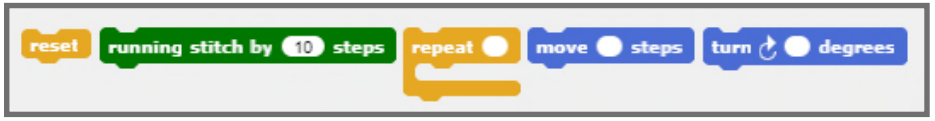

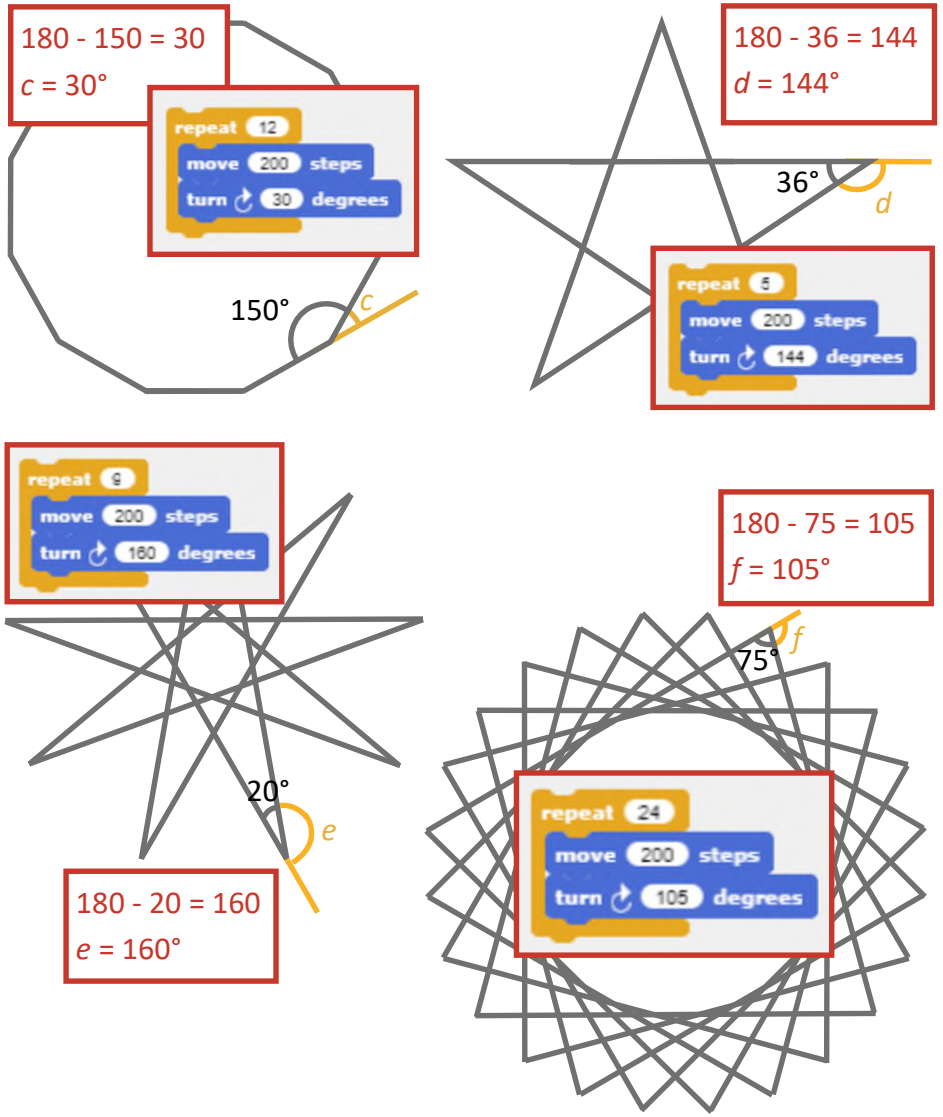

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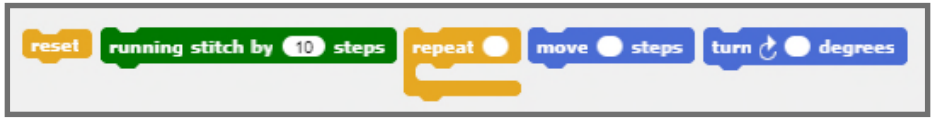

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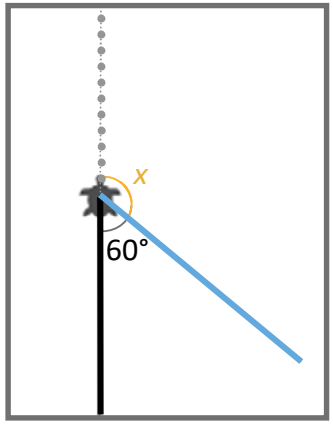

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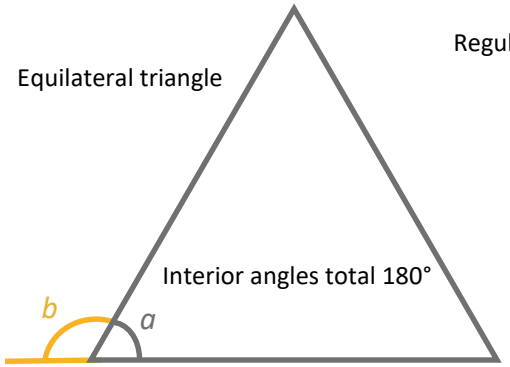
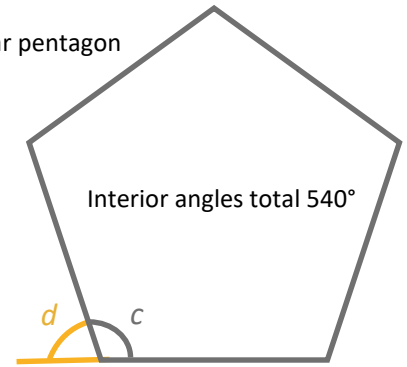
What fact can you use to work out the missing angle?

1. Using the information about each shape, calculate the values of the angles.

Equilateral triangle



Regular pentagon



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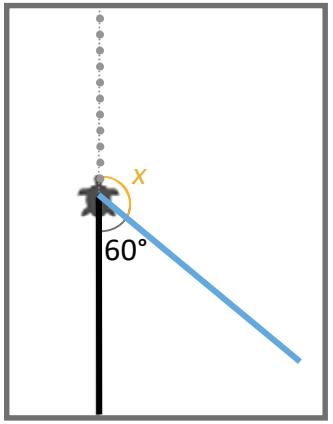

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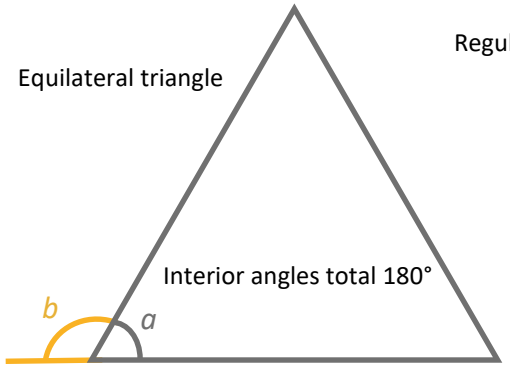

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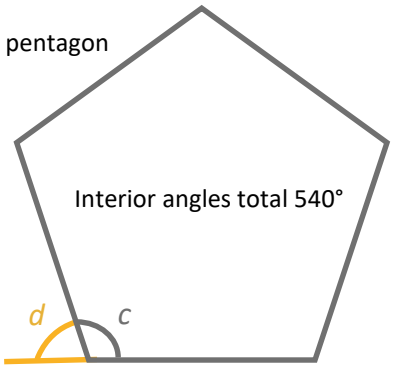
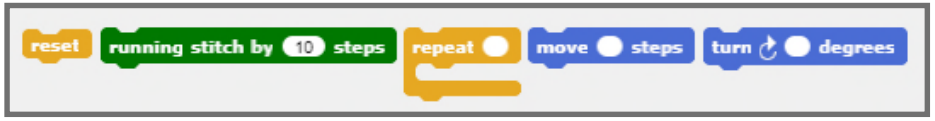
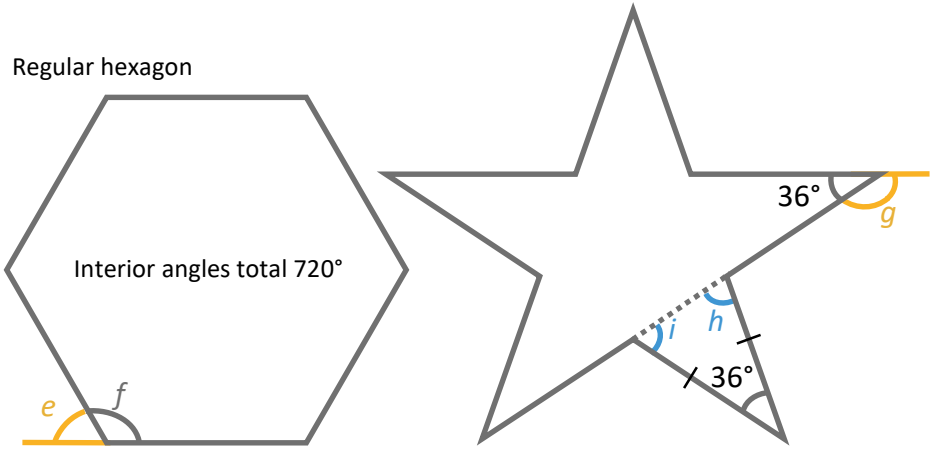


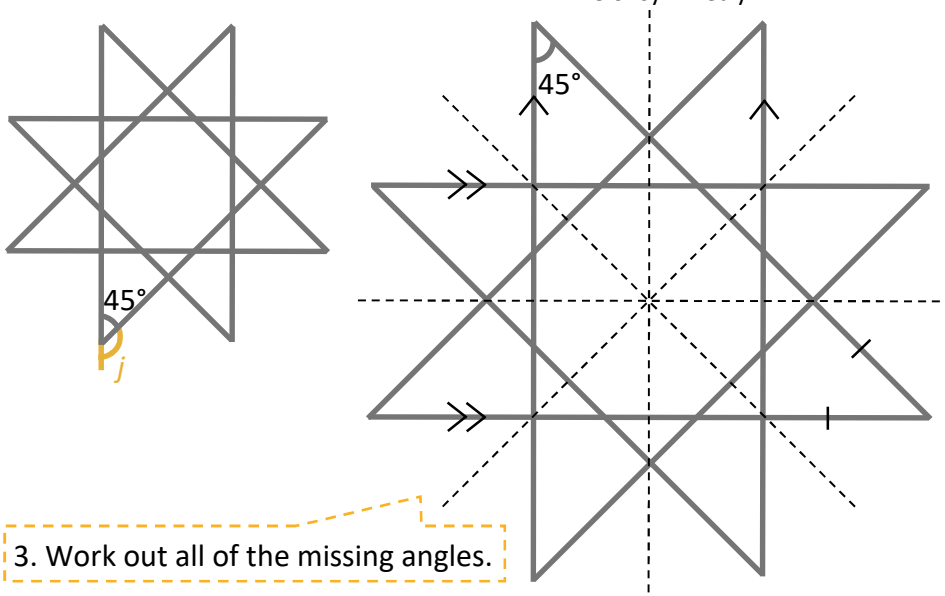
2. Check your answers as you go along by stitching the shapes on Turtlestitch with these blocks.



Regular hexagon

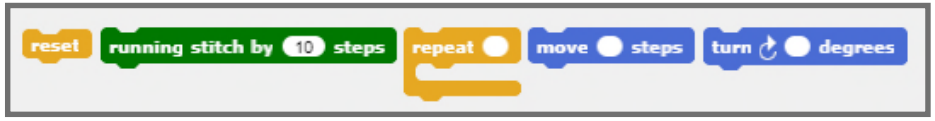


Line of symmetry



3. Work out all of the missing angles.

2. Check your answers as you go along by stitching the shapes on Turtlestitch with these blocks.



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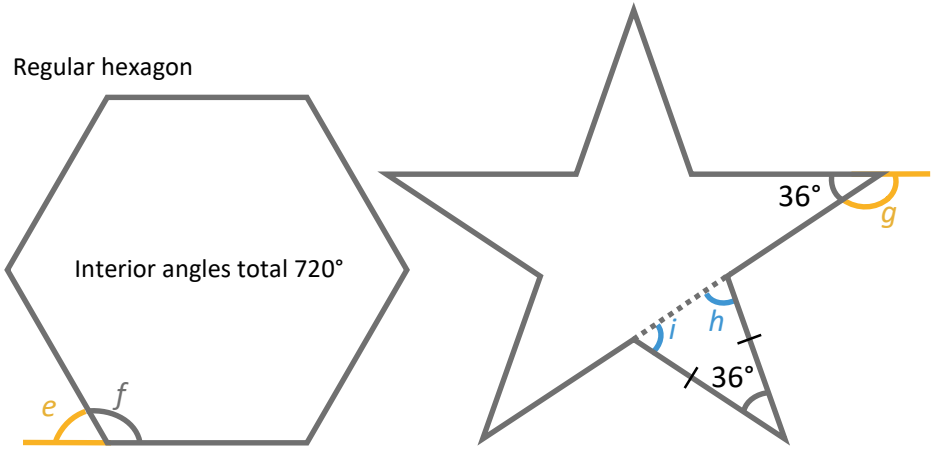

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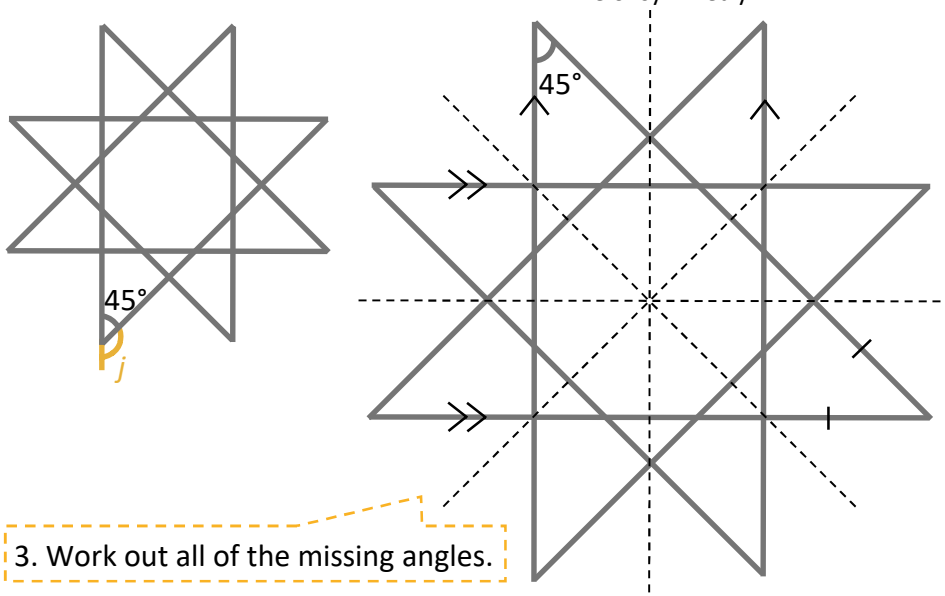

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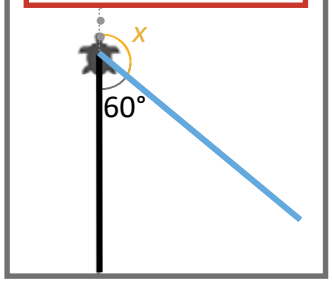
Turtlestitch Maths Answers

Finding angles using properties of shapes

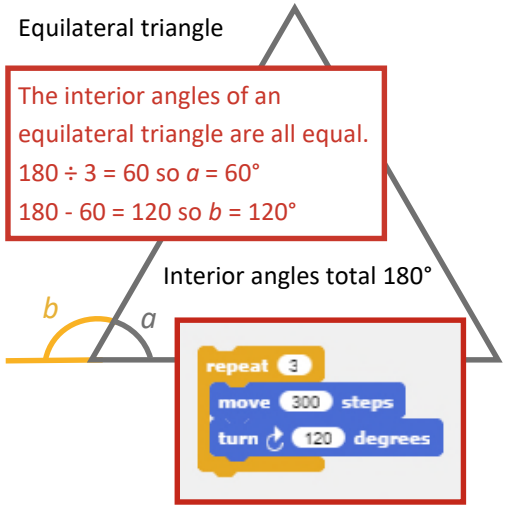
Angles at a point on a straight line total 180°.
180 - 60 = 120
x = 120°



Equilateral triangle

The interior angles of an equilateral triangle are all equal.
180 ÷ 3 = 60 so a = 60°
180 - 60 = 120 so b = 120°

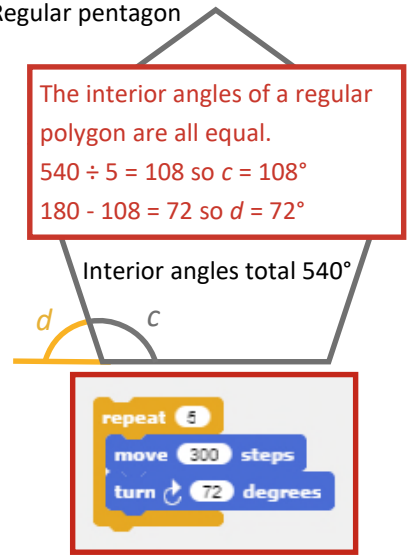
Interior angles total 180°



Regular pentagon

The interior angles of a regular polygon are all equal.
540 ÷ 5 = 108 so c = 108°
180 - 108 = 72 so d = 72°

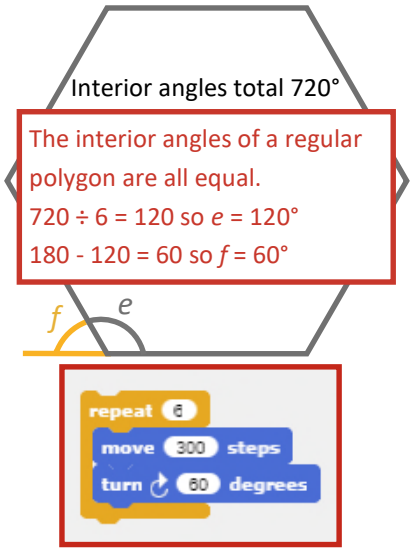
Interior angles total 540°



Regular hexagon

Interior angles total 720°

The interior angles of a regular polygon are all equal.
720 ÷ 6 = 120 so e = 120°
180 - 120 = 60 so f = 60°



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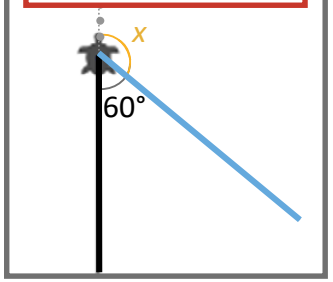

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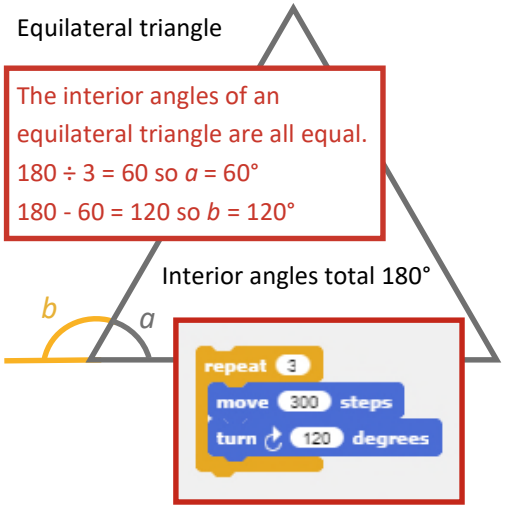
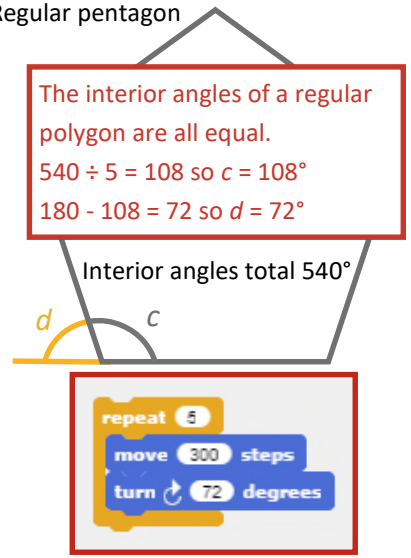


Regular pentagon

The interior angles of a regular polygon are all equal.
540 ÷ 5 = 108 so c = 108°
180 - 108 = 72 so d = 72°

Interior angles total 540°



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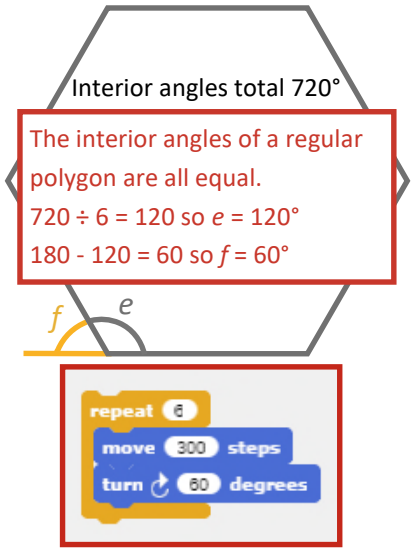
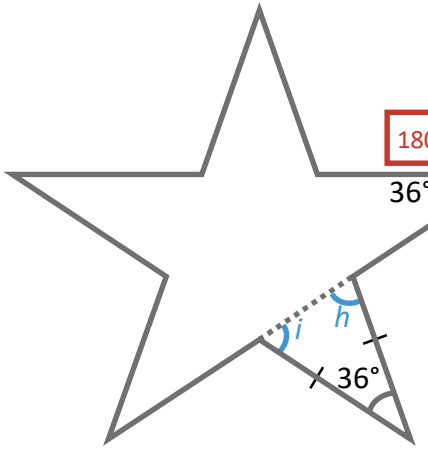
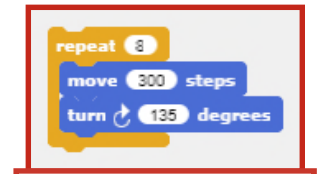




180 - 36 = 144 so g = 144°

The markings show us that this is an isosceles triangle, so $h = i$.
180 - 36 = 144
144 ÷ 2 = 72 so h = 72° and i = 72°



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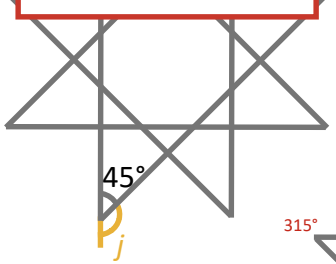

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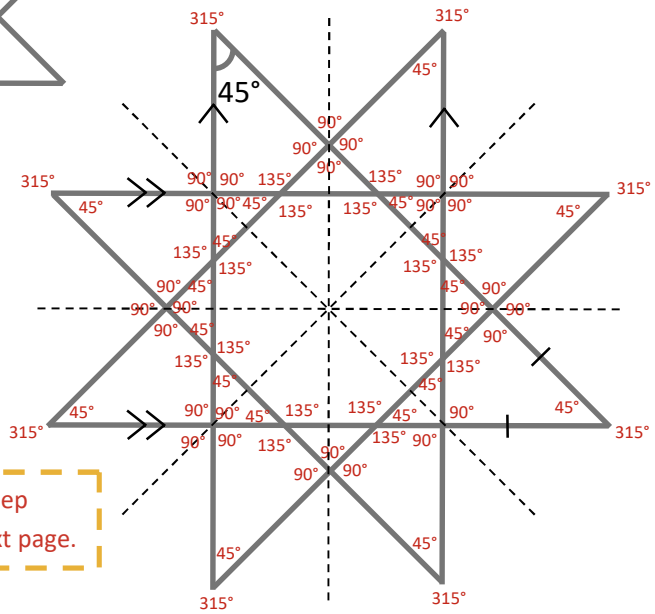

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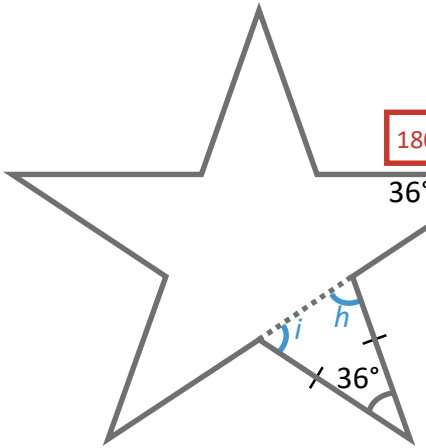

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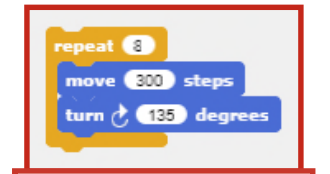

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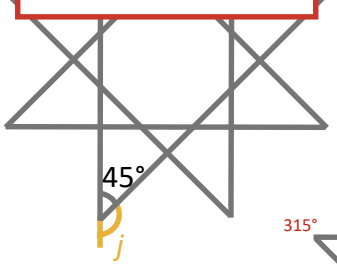

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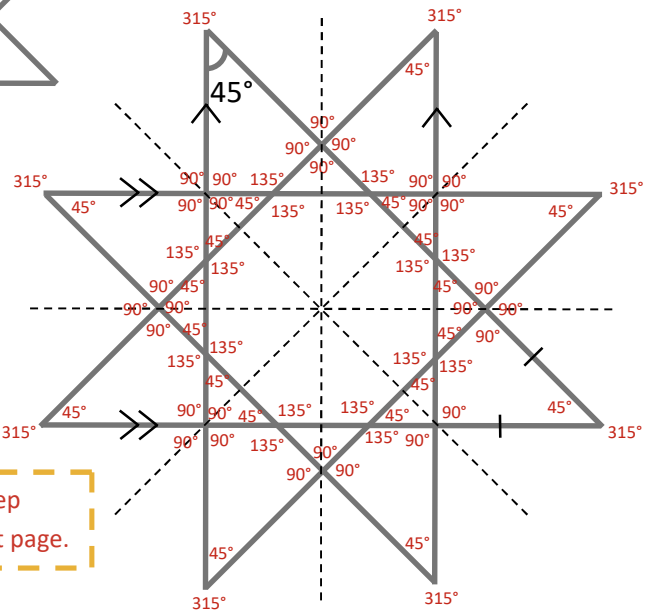

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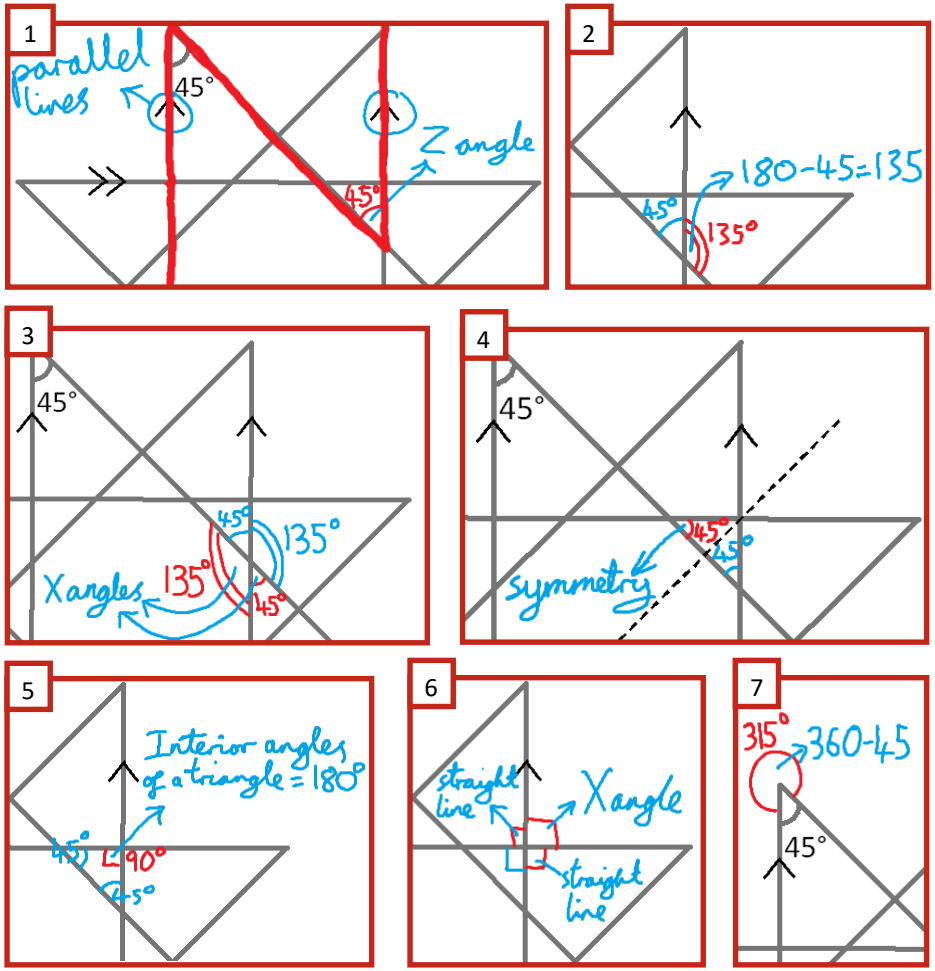
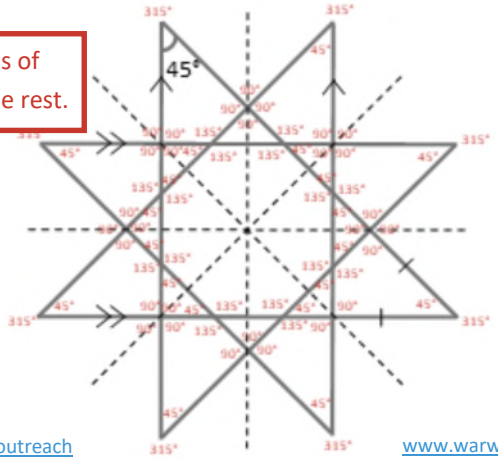
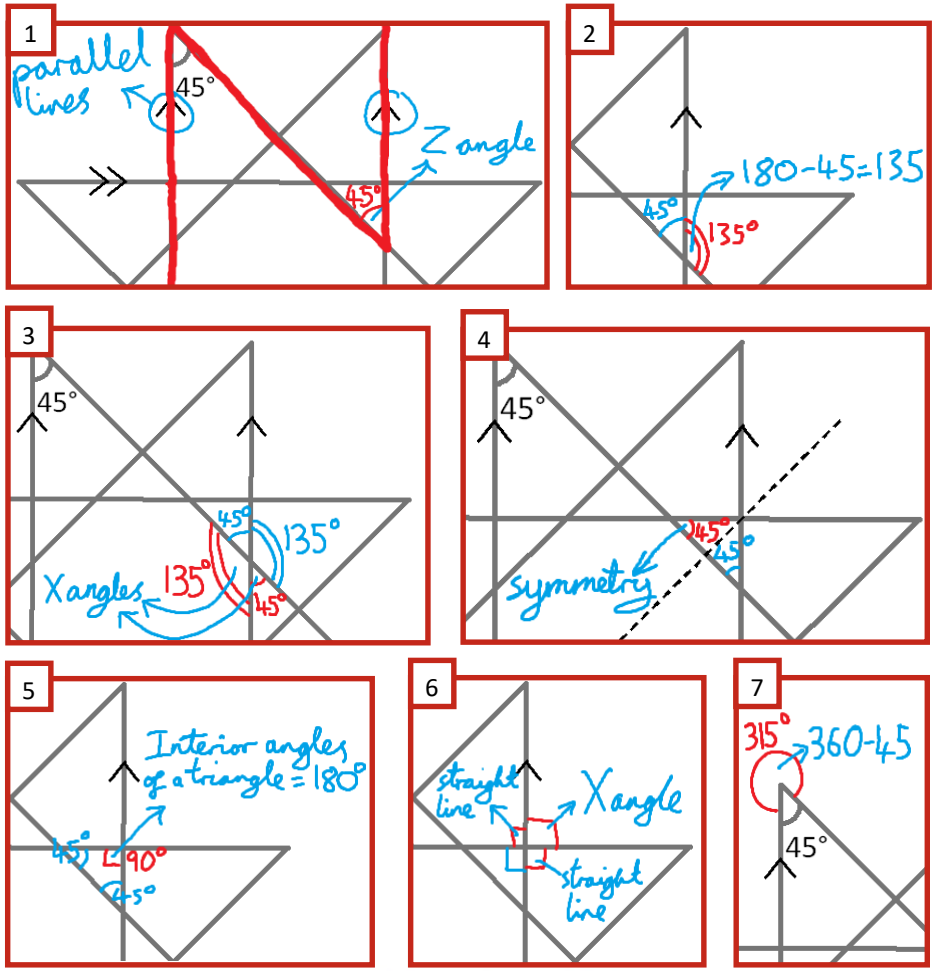
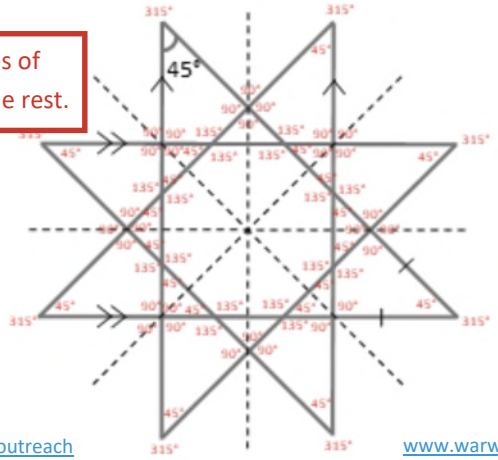


8 Now use the lines of symmetry to fill in the rest.





8 Now use the lines of symmetry to fill in the rest.



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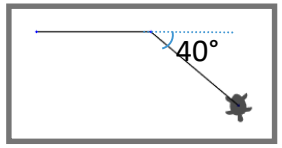
Turtlestitch Maths

Using the highest common factor

Now we're going to learn how to work out the number of repetitions needed to complete some shapes.

In this example, the turtle turns 40° to start making a shape.

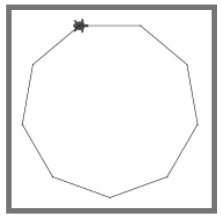


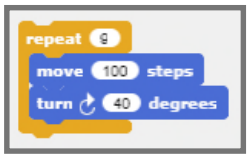
How many repetitions will close the shape?

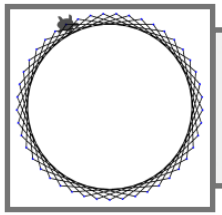
1. Work out the highest common factor of the turning angle and 360. *The highest common factor of 40 and 360 is 40.*

2. Divide 360 by the highest common factor. *360 ÷ 40 = 9*

3. That answer is the number of repetitions needed to complete the shape. *Repeat 9 times.*







HCF of 56 and 360 is 8. 360 ÷ 8 = 45

The HCF of 144 and 360 is 72.
360 ÷ 72 = 5
So I need to loop it 5 times.

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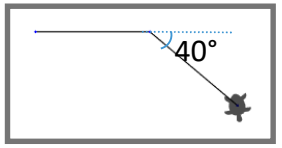
Turtlestitch Maths

Using the highest common factor

Now we're going to learn how to work out the number of repetitions needed to complete some shapes.

In this example, the turtle turns 40° to start making a shape.

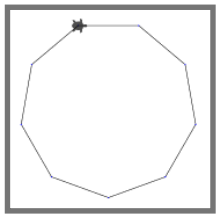


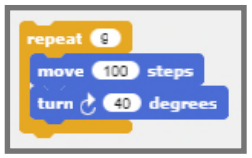
How many repetitions will close the shape?

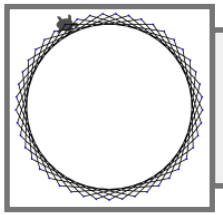
1. Work out the highest common factor of the turning angle and 360. *The highest common factor of 40 and 360 is 40.*

2. Divide 360 by the highest common factor. *360 ÷ 40 = 9*

3. That answer is the number of repetitions needed to complete the shape. *Repeat 9 times.*





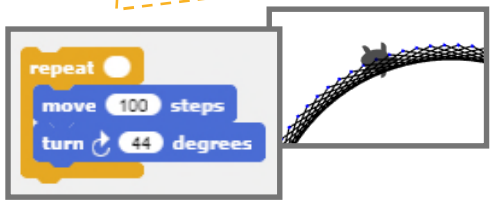


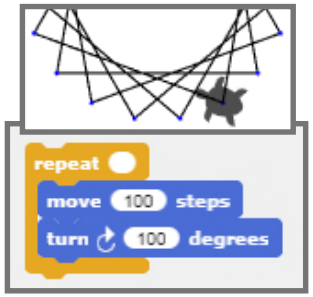
HCF of 56 and 360 is 8. 360 ÷ 8 = 45

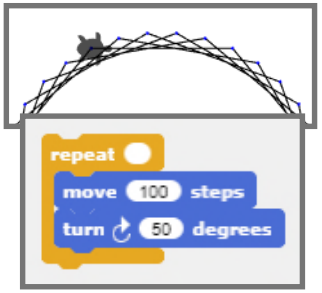
The HCF of 144 and 360 is 72.
360 ÷ 72 = 5
So I need to loop it 5 times.

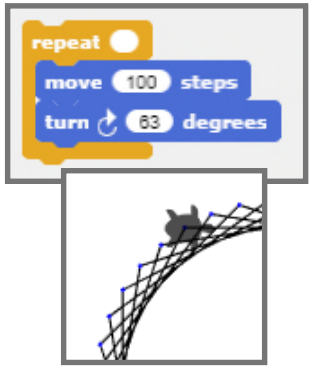
Use the method shown overleaf to complete these shapes.

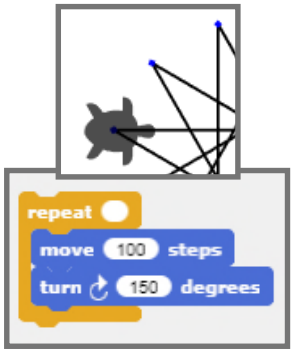
What is the highest common factor of 44 and 360?
Divide 360 by that number.
Put the answer in the repeat loop.

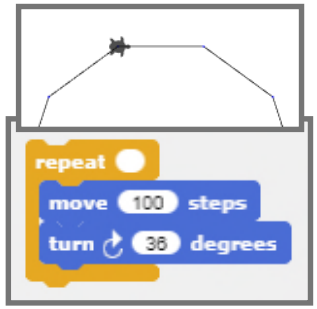


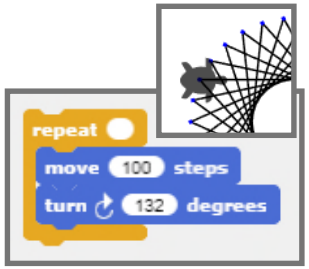












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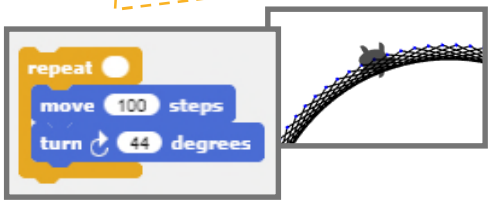
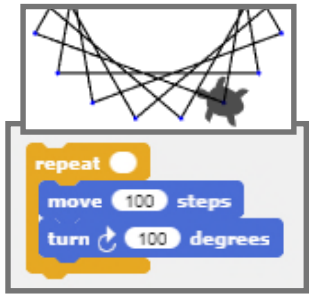
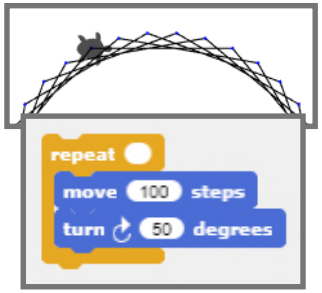
www.warwick.ac.uk/turtlestitch

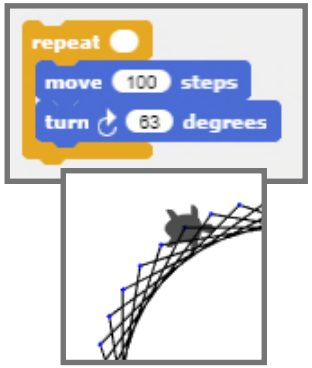
Use the method shown overleaf to complete these shapes.

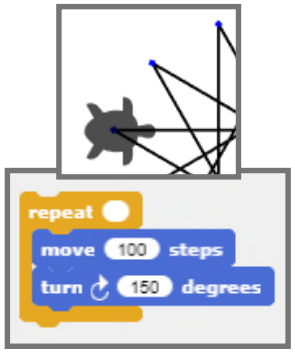
What is the highest common factor of 44 and 360?
Divide 360 by that number.
Put the answer in the repeat loop.

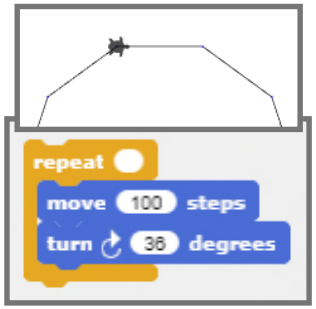


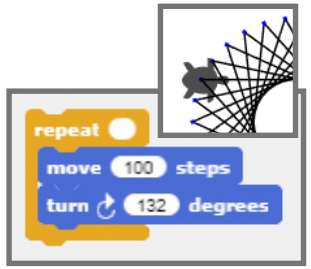












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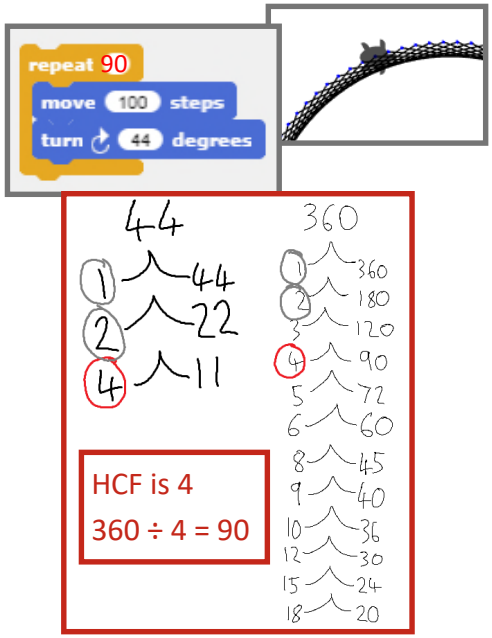
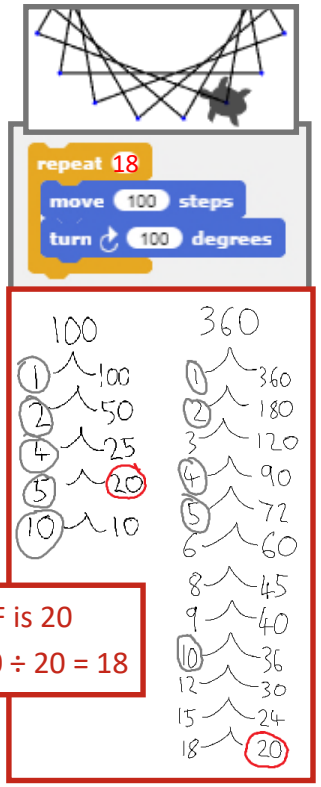
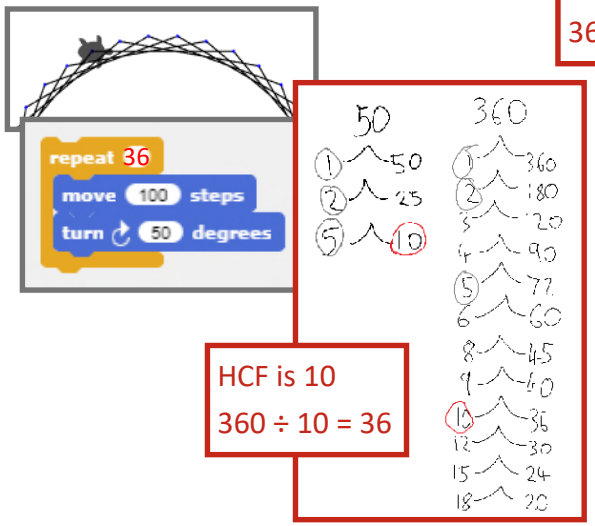
Turtlestitch Maths Answers

Using the highest common factor







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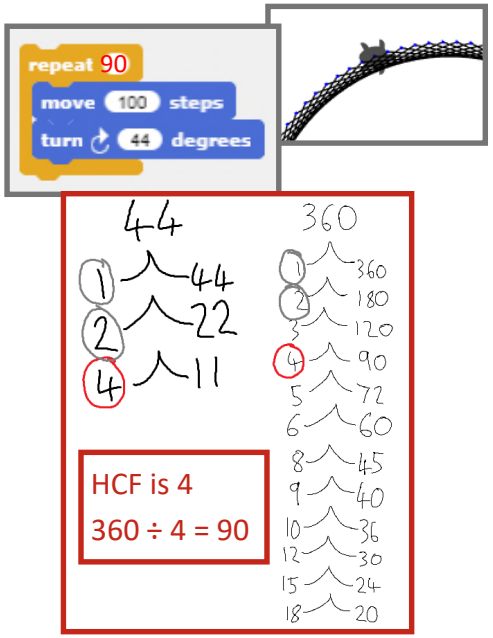
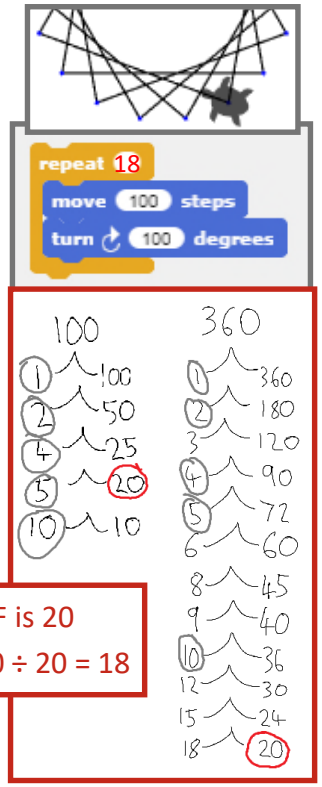
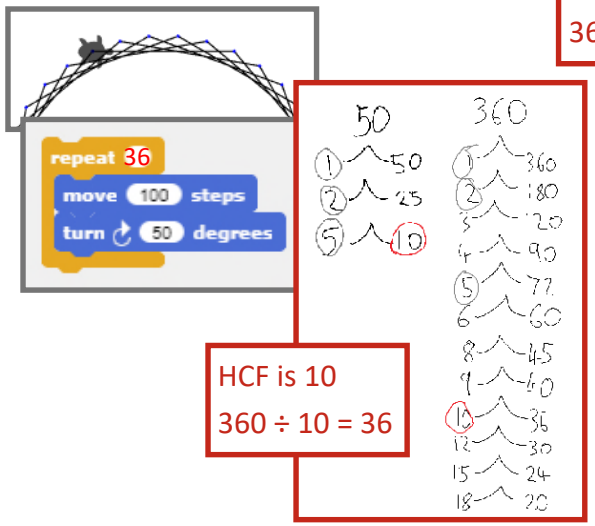
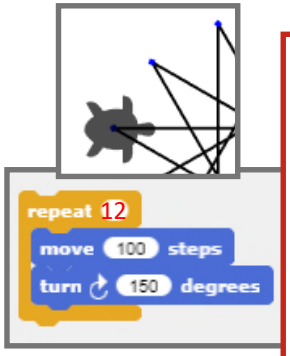






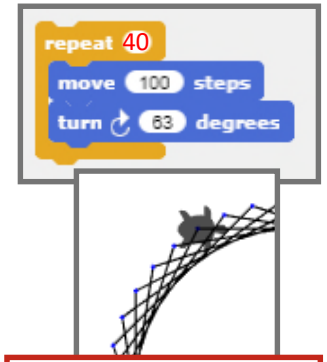


150: 1 150, 2 75, 3 50, 5 30, 6 25, 10 15

360: 1 360, 2 180, 3 120, 4 90, 5 72, 6 60, 8 45, 9 40, 10 36, 12 30, 15 24, 18 20

HCF is 30

360 ÷ 30 = 12

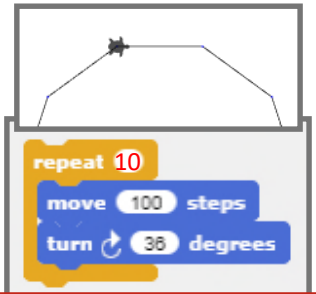


63: 1 63, 3 21, 7 9

360: 1 360, 2 180, 3 120, 4 90, 5 72, 6 60, 8 45, 9 40, 10 36, 12 30, 15 24, 18 20

HCF is 9

360 ÷ 9 = 40

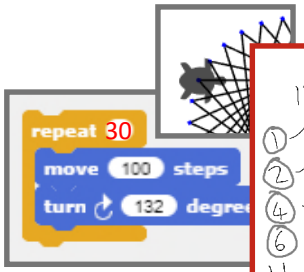


36: 1 36, 2 18, 3 12, 4 9, 6 6

360: 1 360, 2 180, 3 120, 4 90, 5 72, 6 60, 8 45, 9 40, 10 36, 12 30, 15 24, 18 20

HCF is 36

360 ÷ 36 = 10

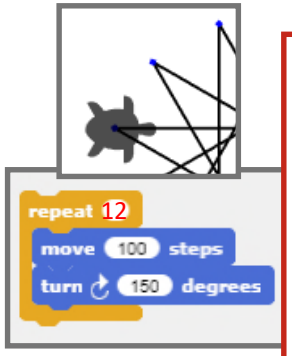


132: 1 132, 2 66, 4 33, 6 22, 11 12

360: 1 360, 2 180, 3 120, 4 90, 5 72, 6 60, 8 45, 9 40, 10 36, 12 30, 15 24, 18 20

HCF is 12

360 ÷ 12 = 30



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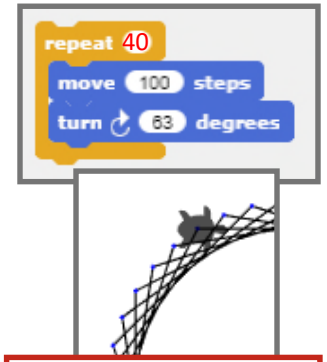

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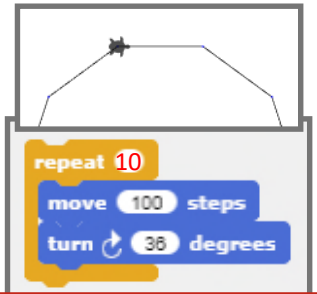

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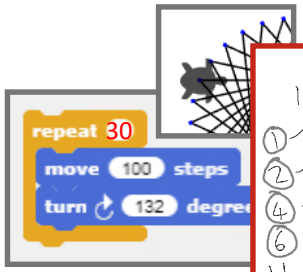

132: 1 132, 2 66, 4 33, 6 22, 11 12

360: 1 360, 2 180, 3 120, 4 90, 5 72, 6 60, 8 45, 9 40, 10 36, 12 30, 15 24, 18 20

HCF is 12

360 ÷ 12 = 30

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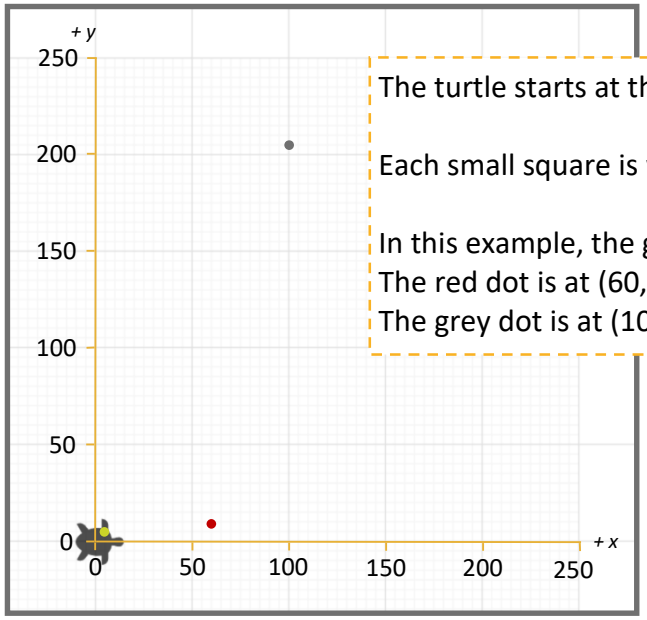
Turtlestitch Maths

Coordinates in four quadrants

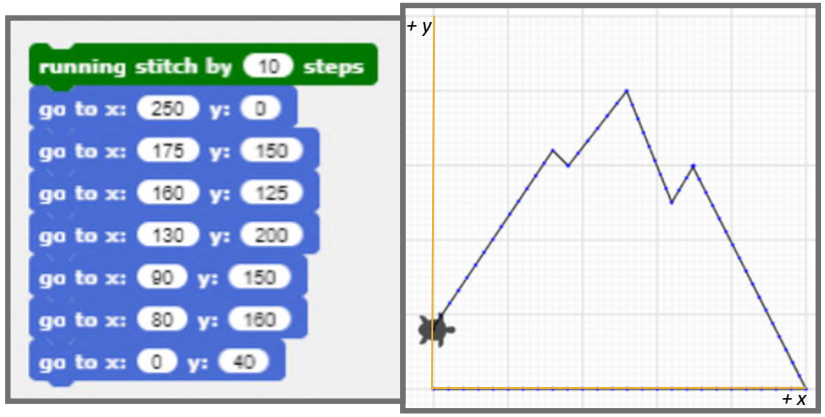
An alternative to using move and turn commands is to instruct the turtle to move to a location by giving a coordinate.



The turtle starts at the coordinate (0, 0).

Each small square is worth 5.

In this example, the green dot is at (5, 5).
The red dot is at (60, 10).
The grey dot is at (100, 205).



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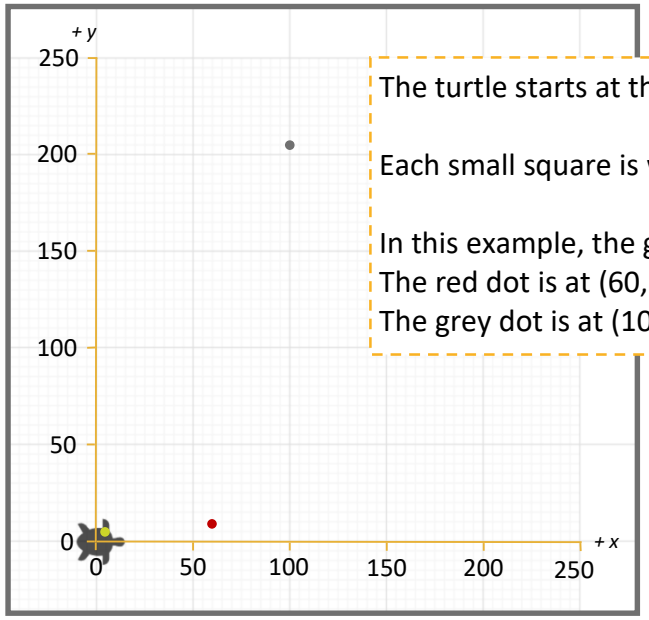

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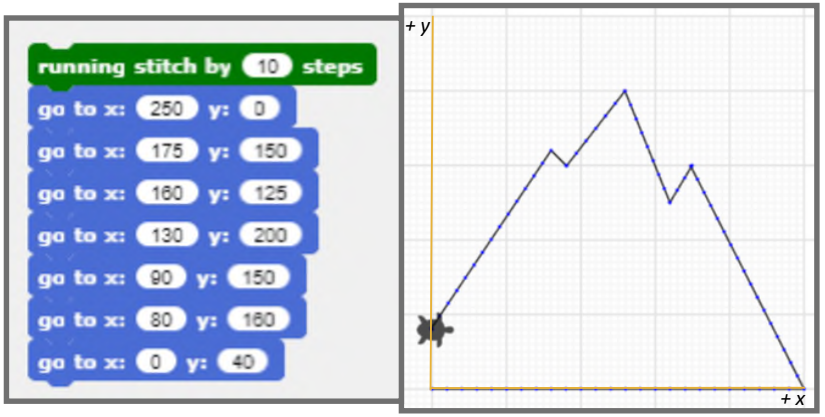
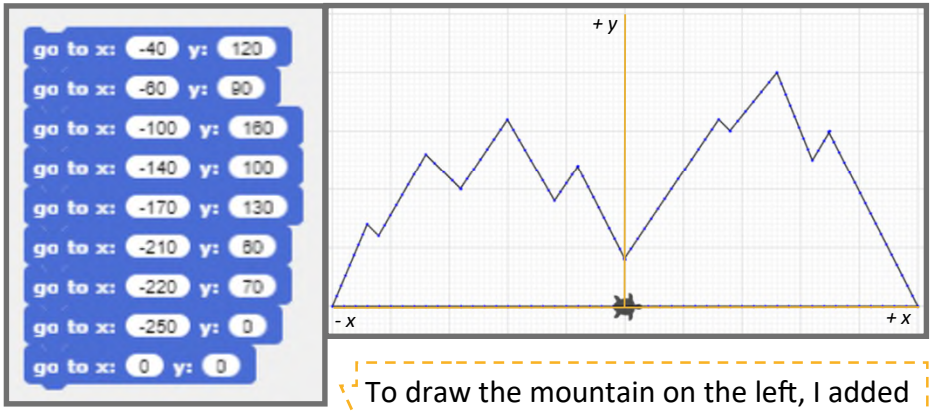
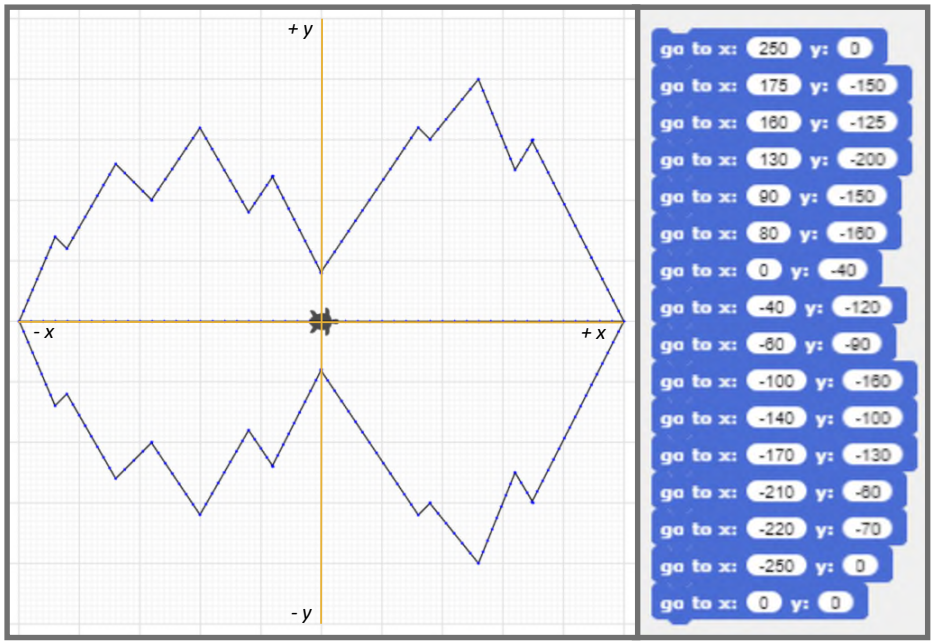




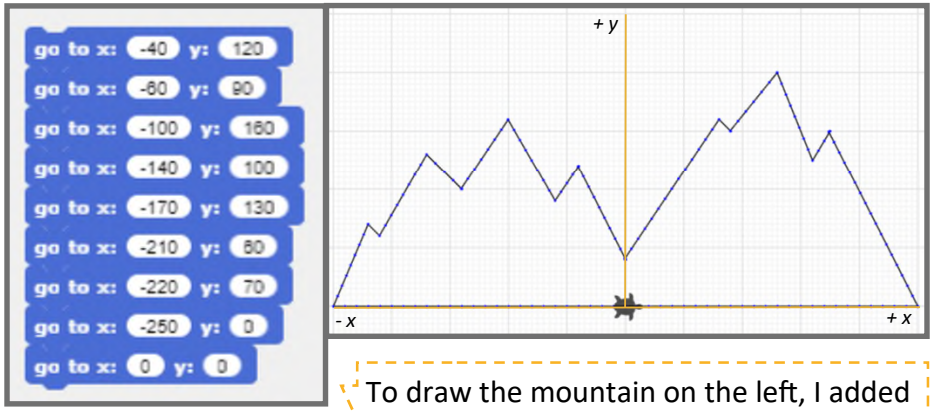
To draw the mountain on the left, I added these instructions. The drawing has moved into the negative part of the *x* axis.



To reflect the mountains, I added this code. To write it, I duplicated (copied) the existing code and made the *y* numbers negative.

Taking it further...

When is it more useful to use coordinates than move and turn?



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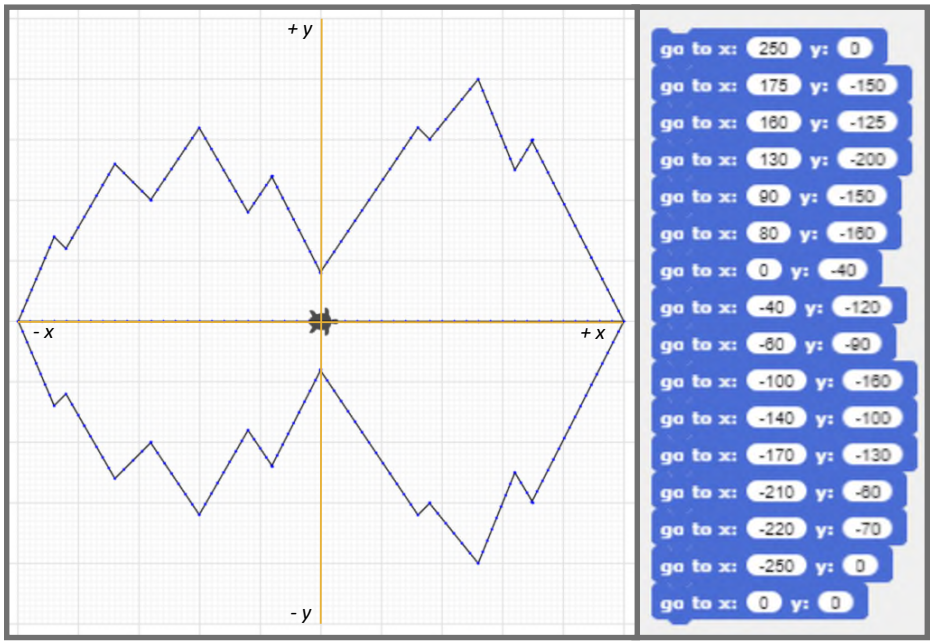

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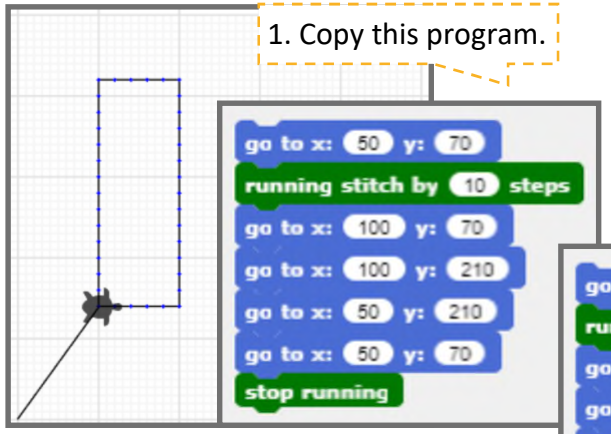
Turtlestitch Maths

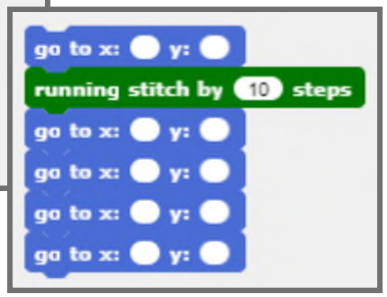
Translation using coordinates

Read the coordinates card before you start.

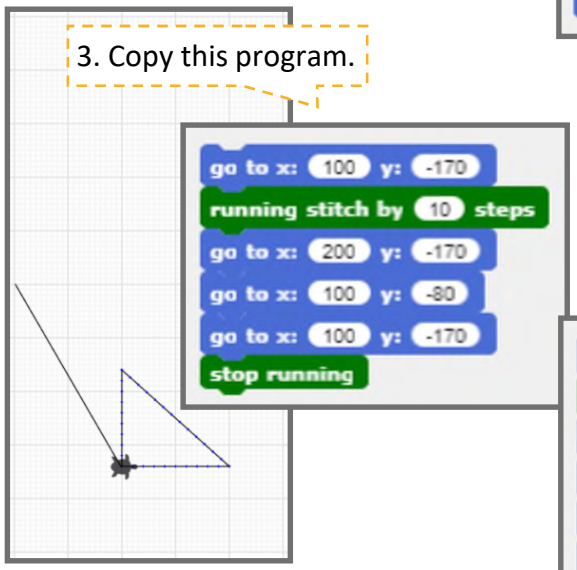
1. Copy this program.



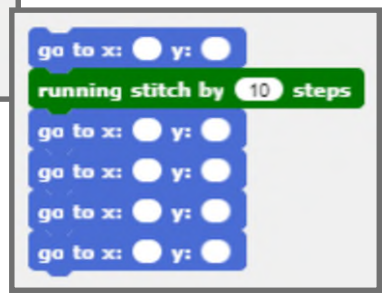
2. Add these blocks to the program. Fill in the coordinates to redraw the shape, moving it by 100 to the right.



3. Copy this program.



4. Add these blocks to the program. Fill in the coordinates to redraw the shape, moving it up 130.



CATAPULT High Value Manufacturing

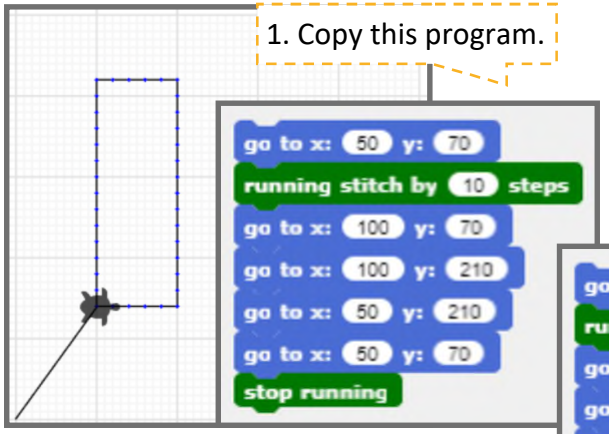
WMG THE UNIVERSITY OF WARWICK

Turtlestitch Maths

Translation using coordinates

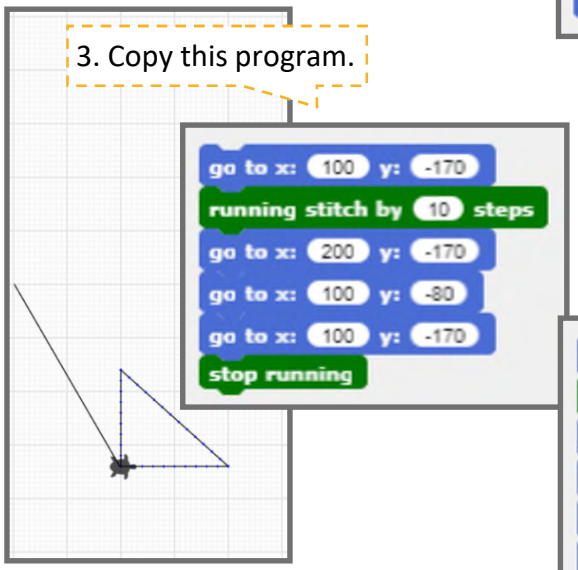
Read the coordinates card before you start.

1. Copy this program.

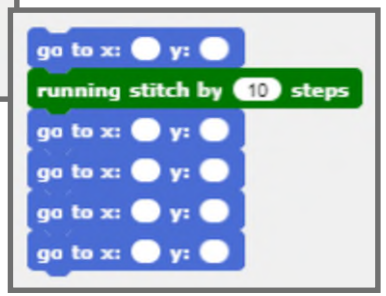


2. Add these blocks to the program. Fill in the coordinates to redraw the shape, moving it by 100 to the right.

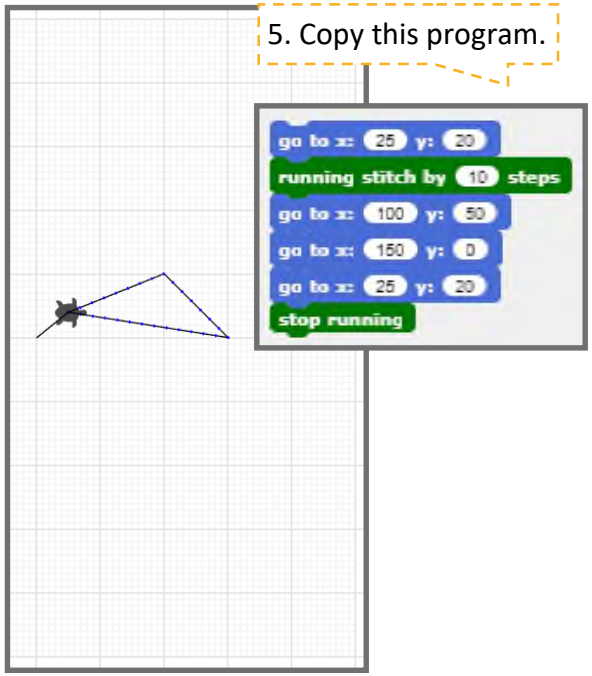
3. Copy this program.



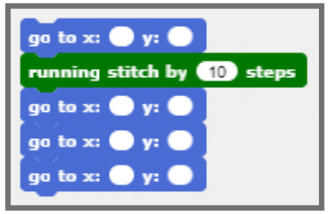
4. Add these blocks to the program. Fill in the coordinates to redraw the shape, moving it up 130.



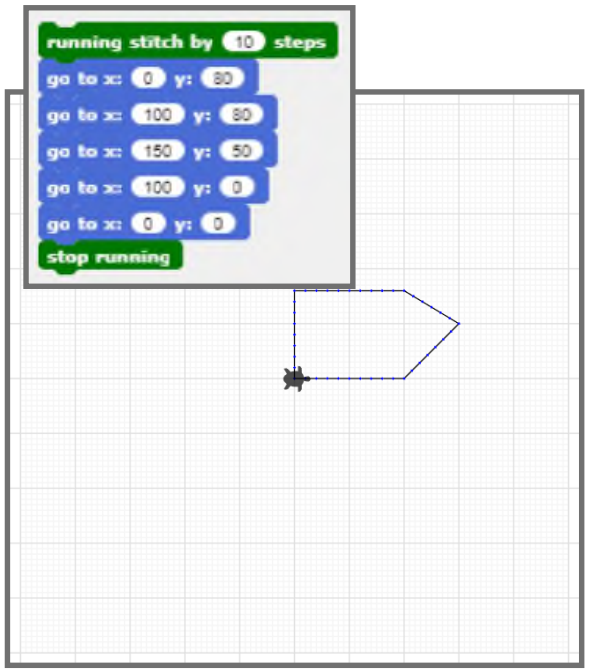
5. Copy this program.



6. Add these blocks to the program. Fill in the coordinates to redraw the shape, moving it right 70 and down 40.

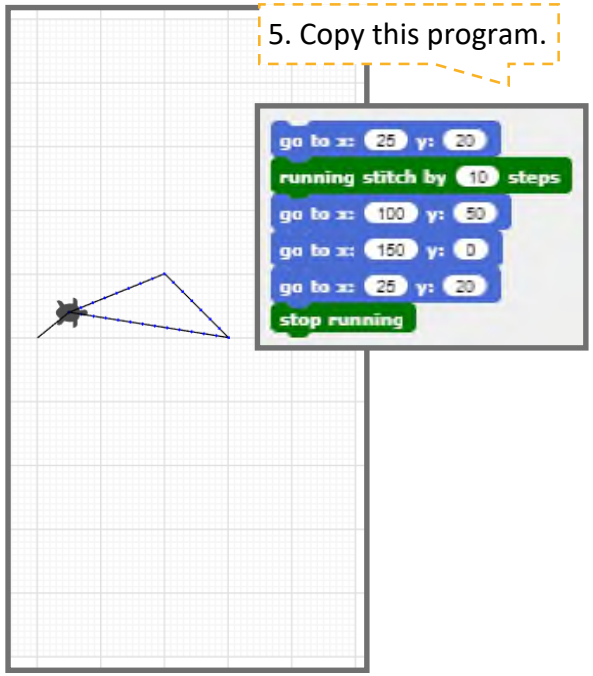


7. Copy this program.

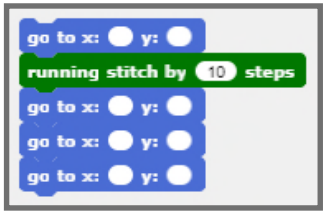


8. Add these blocks to the program. Fill in the coordinates to redraw the shape, moving left 250 and down 80.

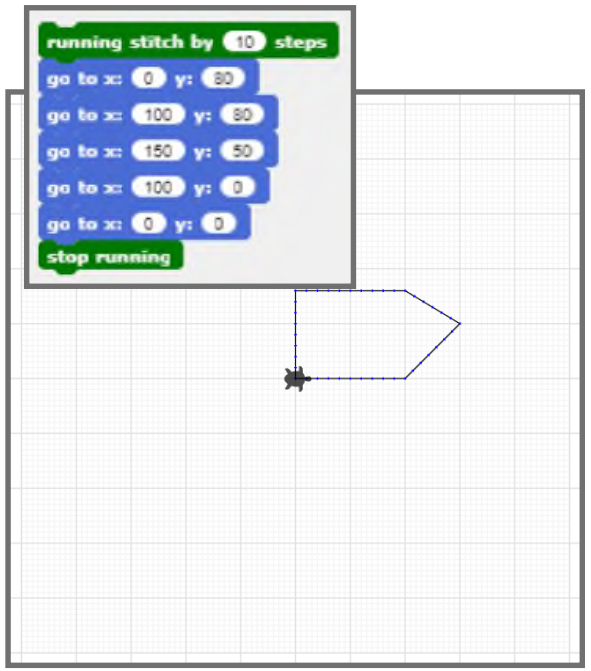
5. Copy this program.



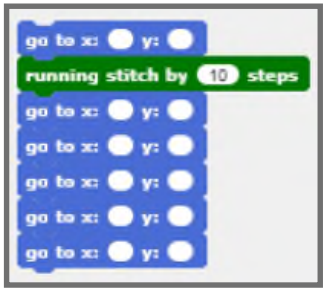
6. Add these blocks to the program. Fill in the coordinates to redraw the shape, moving it right 70 and down 40.



7. Copy this program.



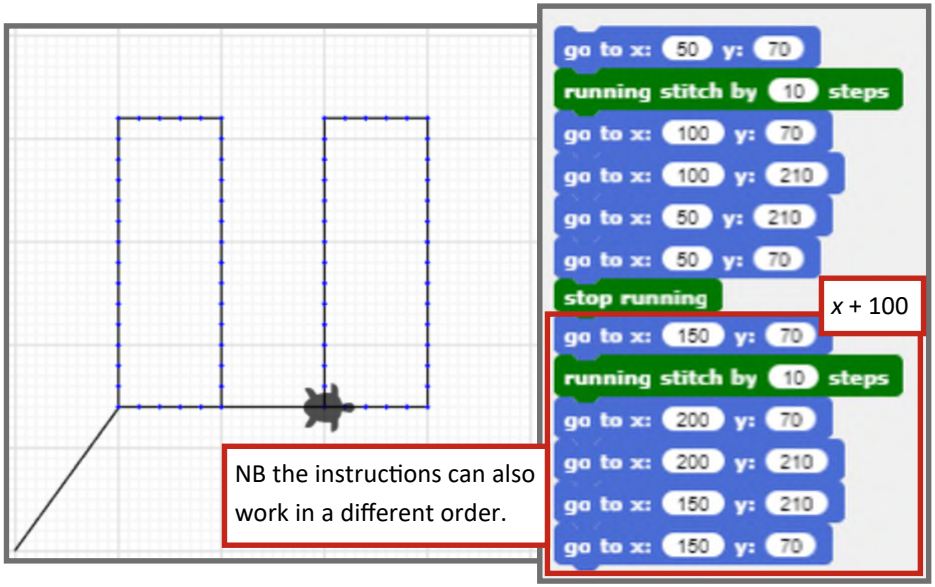
8. Add these blocks to the program. Fill in the coordinates to redraw the shape, moving left 250 and down 80.

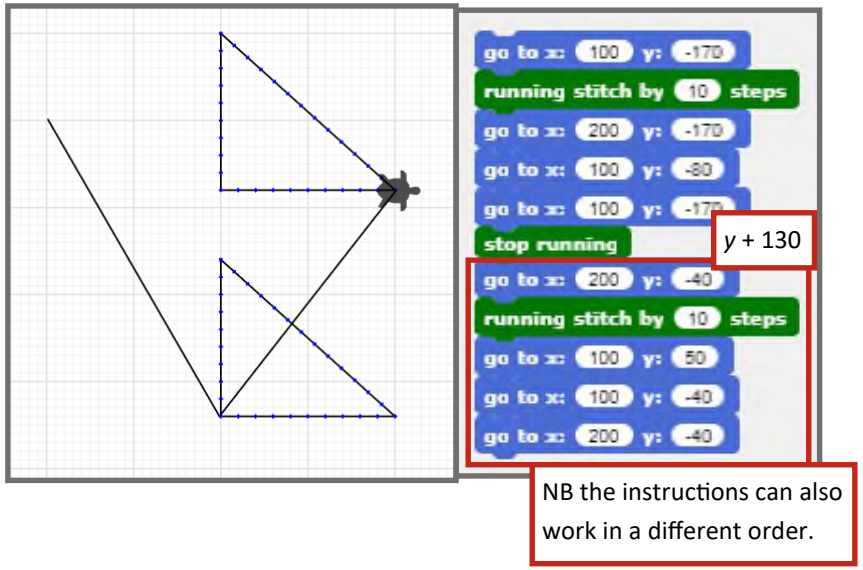


www.warwick.ac.uk/wmgoutreach www.warwick.ac.uk/turtlestitch

Turtlestitch Maths Answers

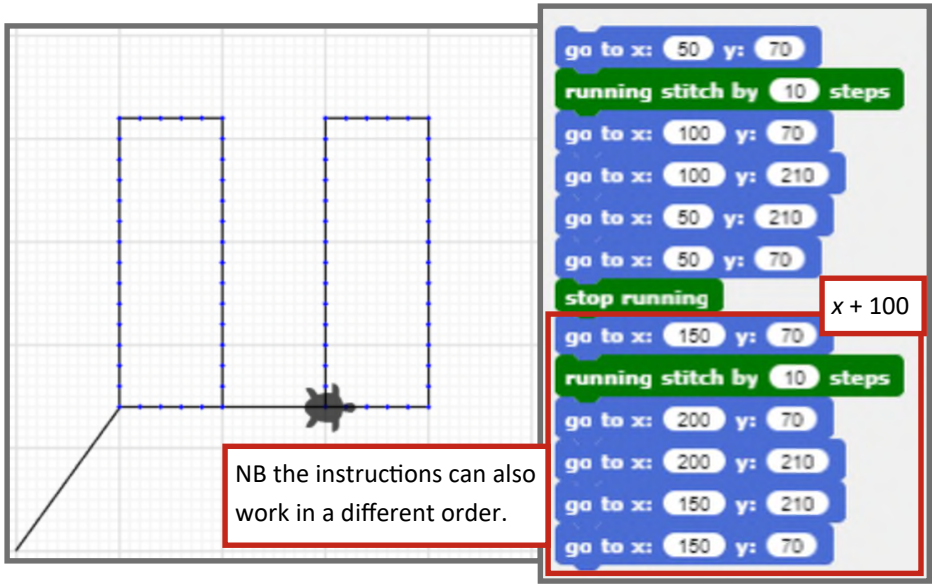
Translation using coordinates

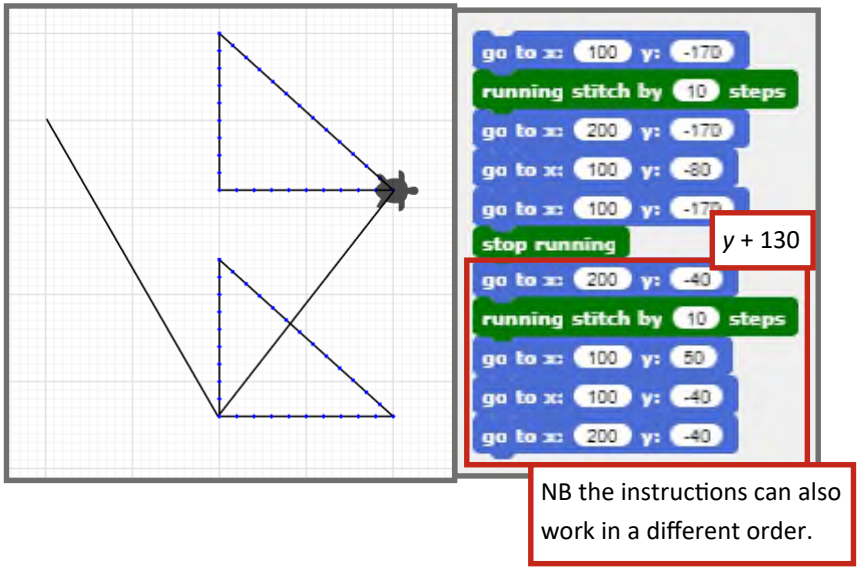


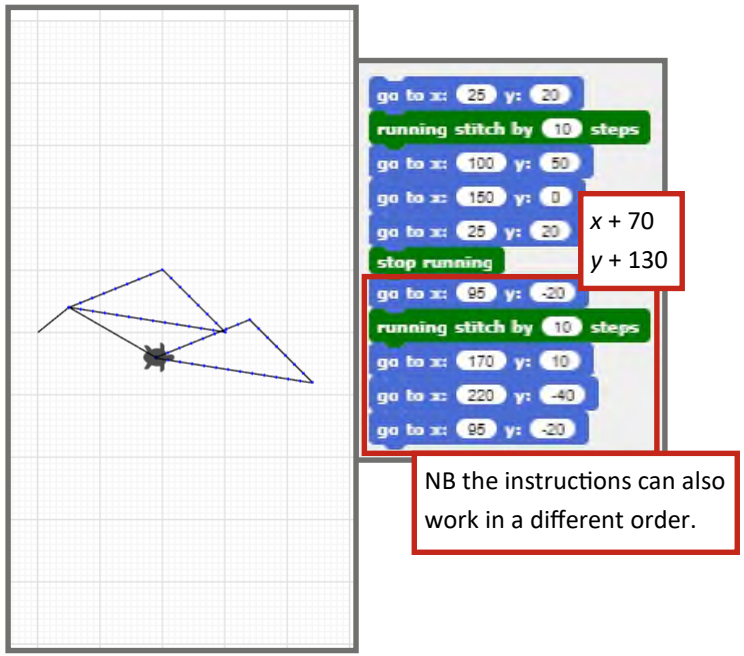


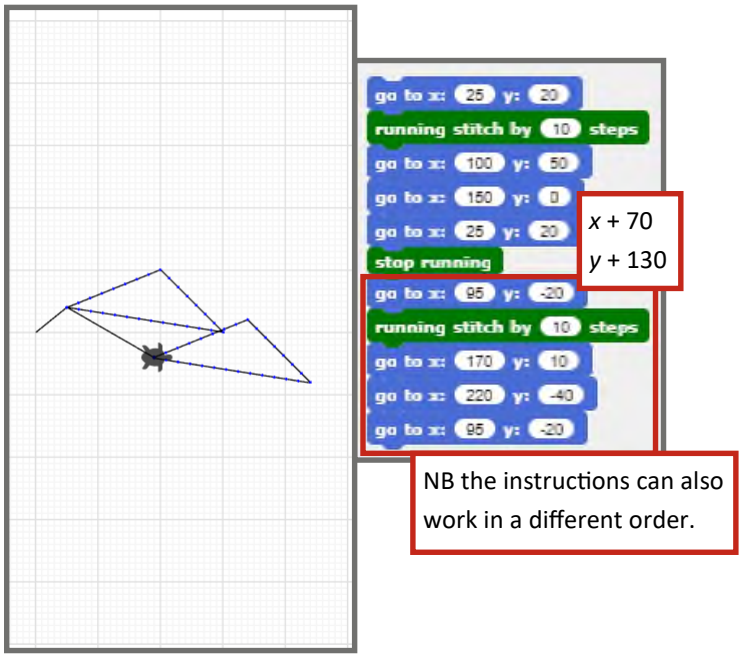
Turtlestitch Maths Answers

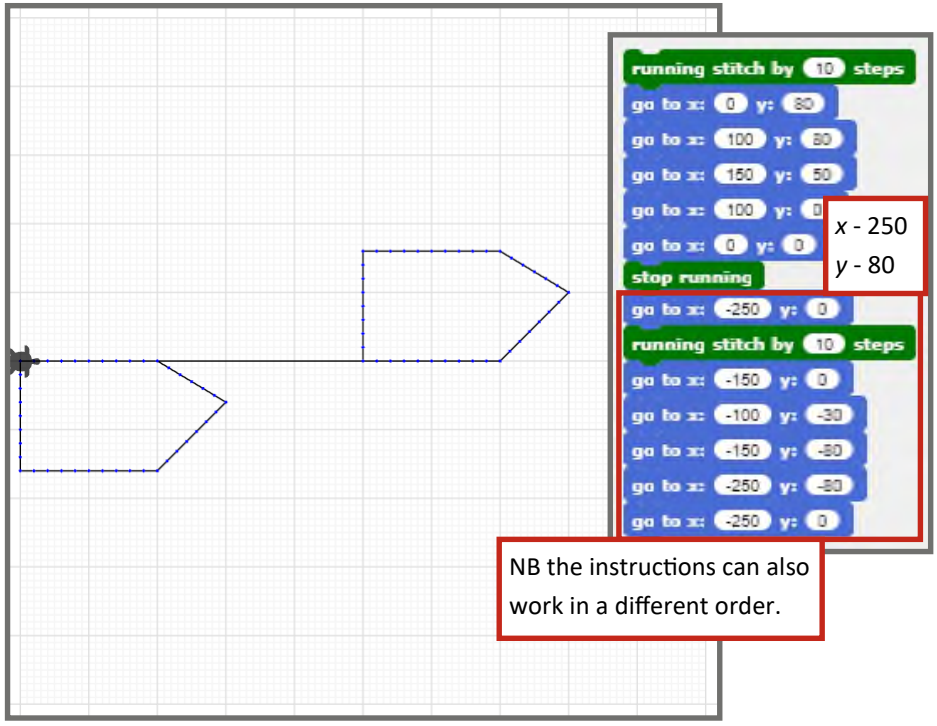
Translation using coordinates

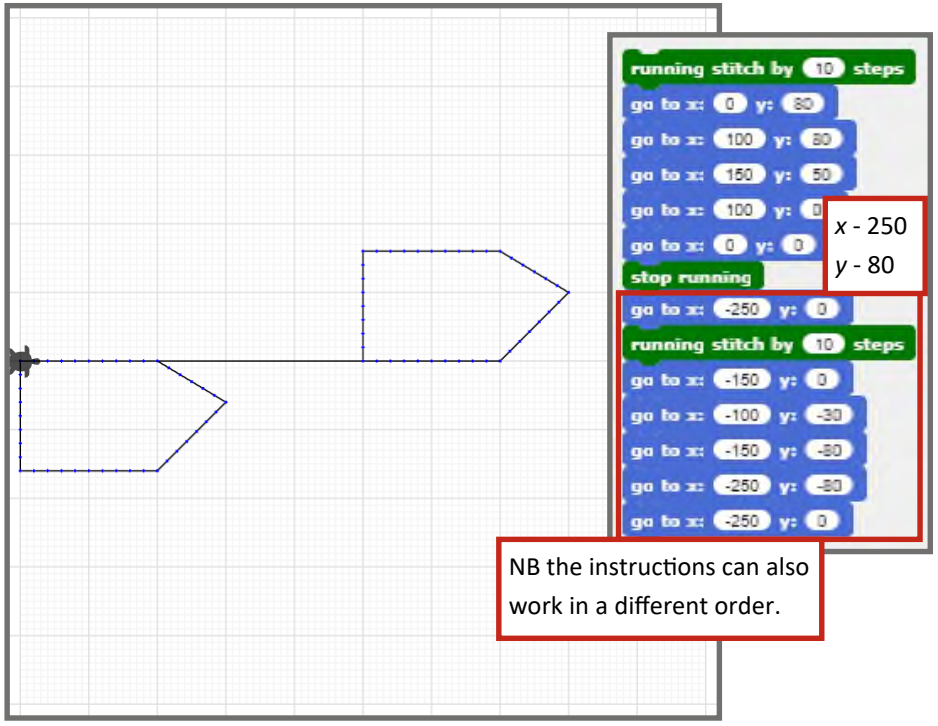





go to x: 25 y: 20
running stitch by 10 steps
go to x: 100 y: 50
go to x: 150 y: 0
go to x: 25 y: 20
stop running
go to x: 95 y: -20
running stitch by 10 steps
go to x: 170 y: 10
go to x: 220 y: -40
go to x: 95 y: -20
x + 70
y + 130
NB the instructions can also work in a different order.


go to x: 25 y: 20
running stitch by 10 steps
go to x: 100 y: 50
go to x: 150 y: 0
go to x: 25 y: 20
stop running
go to x: 95 y: -20
running stitch by 10 steps
go to x: 170 y: 10
go to x: 220 y: -40
go to x: 95 y: -20
x + 70
y + 130
NB the instructions can also work in a different order.


running stitch by 10 steps
go to x: 0 y: 80
go to x: 100 y: 80
go to x: 150 y: 50
go to x: 100 y: 0
go to x: 0 y: 0
stop running
go to x: -250 y: 0
running stitch by 10 steps
go to x: -150 y: 0
go to x: -100 y: -30
go to x: -150 y: -80
go to x: -250 y: -80
go to x: -250 y: 0
x - 250
y - 80
NB the instructions can also work in a different order.


running stitch by 10 steps
go to x: 0 y: 80
go to x: 100 y: 80
go to x: 150 y: 50
go to x: 100 y: 0
go to x: 0 y: 0
stop running
go to x: -250 y: 0
running stitch by 10 steps
go to x: -150 y: 0
go to x: -100 y: -30
go to x: -150 y: -80
go to x: -250 y: -80
go to x: -250 y: 0
x - 250
y - 80
NB the instructions can also work in a different order.