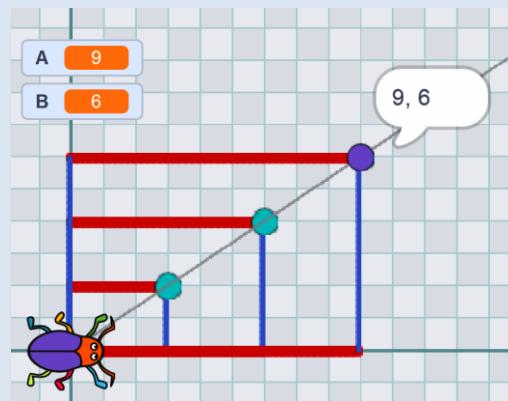
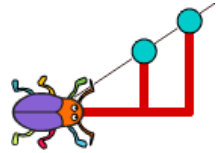


EXPLORING MATHEMATICAL RELATIONSHIPS

MODULE 5: INVESTIGATION 3

Grid World: For Exploring Similarity



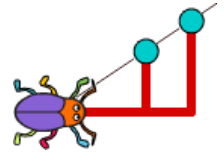


ACTIVITY 5.3.1

Enter the Grid World

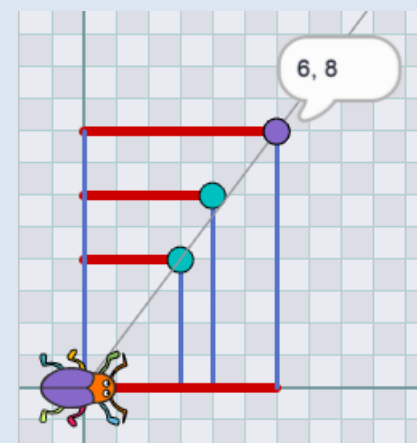
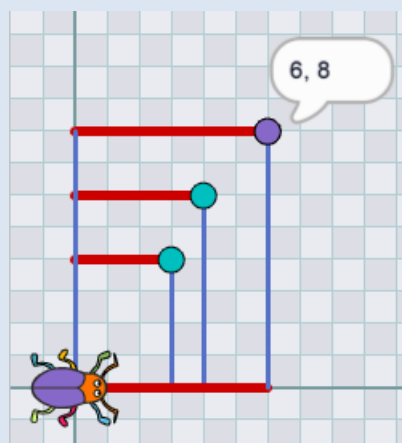
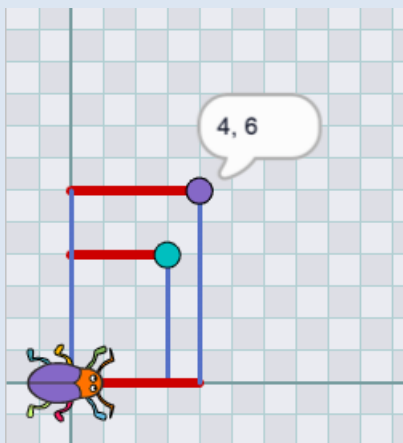
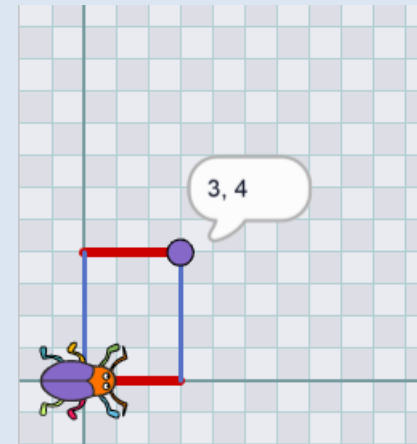
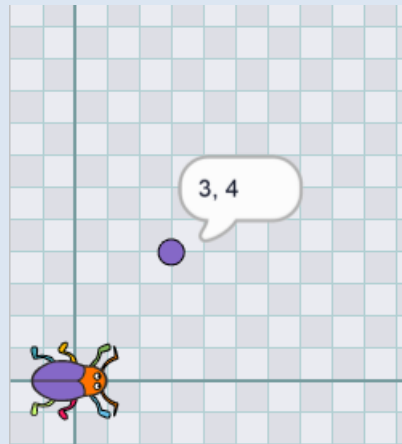
MODULE 5: INVESTIGATION 3

Activity 5.3.1 – Enter the Grid World



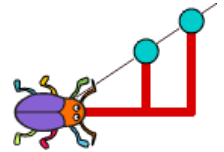
Open **53-Grid World FINAL** and explore the project as a class.

Click the green flag to initiate the project.
Press the arrow keys to move the Dot, click the Beetle, press the space bar.



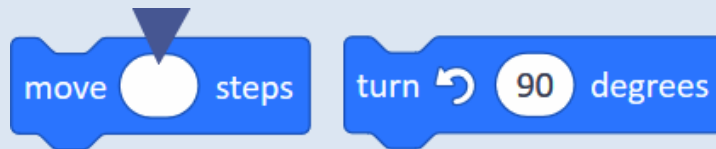
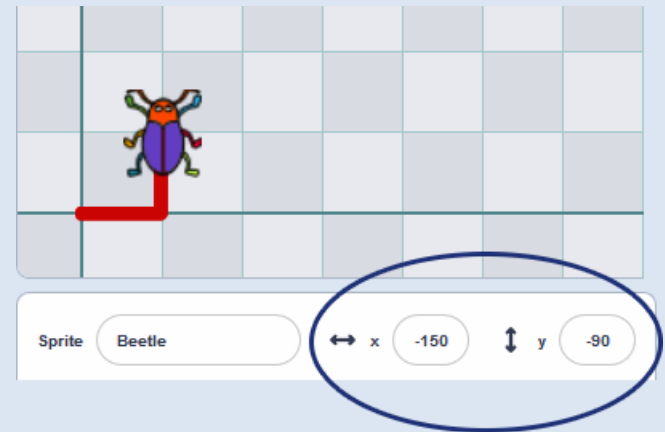
MODULE 5: INVESTIGATION 3

Activity 5.3.1 – Enter the Grid World

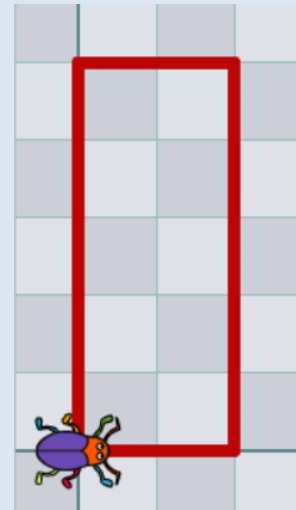


Open project **53-Grid World**.

- Read the *setup script*, **run it**.
- By moving or dragging the Beetle find out the *size* of a grid tile (in steps).
- Use the **move ...** block with your *size* conjecture as its input and a **turn left 90** block repeatedly and draw a 'grid world' rectangle.

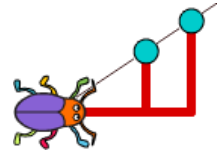


Make the **Beetle** finish the rectangle pointing towards 90 (right).

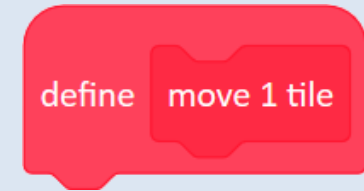


MODULE 5: INVESTIGATION 3

Activity 5.3.1 – Enter the Grid World



- Make your own block **move 1 tile** to make the **Beetle** move forward by one tile – independent of where it is pointing.



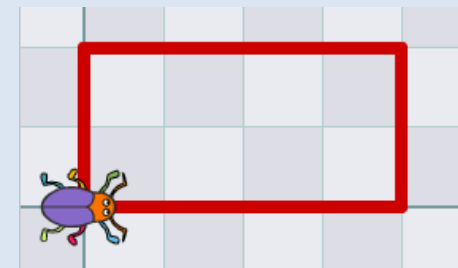
- Make two variables called **A** and **B**.



- Build a script: When the **Beetle** is clicked, it sets values of **A** and **B** (e.g. to 4 and 2) and draws a rectangle of **A** grid tiles horizontally and **B** grid tiles vertically.

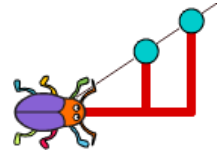
Make and use two new blocks to:

- **move horizontally** (by **A** tiles) and
- **move vertically** (by **B** tiles)



MODULE 5: INVESTIGATION 3

Activity 5.3.1 – Enter the Grid World



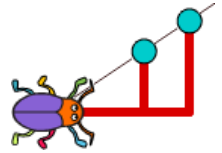
- Envisage a script to draw a rectangle which is **4 steps** wide and **3 steps** high using a pen size of 1.

- What exactly would be drawn on the screen?
- How big would it be? Explain your answer.

?

MODULE 5: INVESTIGATION 3

Activity 5.3.1 – Enter the Grid World



- Envisage a script to draw a rectangle which is **4 steps** wide and **3 steps** high using a pen size of 1.

- What exactly would be drawn on the screen?
- How big would it be? Explain your answer.

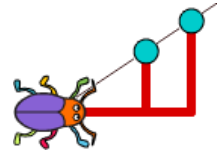
?



- How many steps would the Beetle move if it moved 4 grid tiles of size 50?

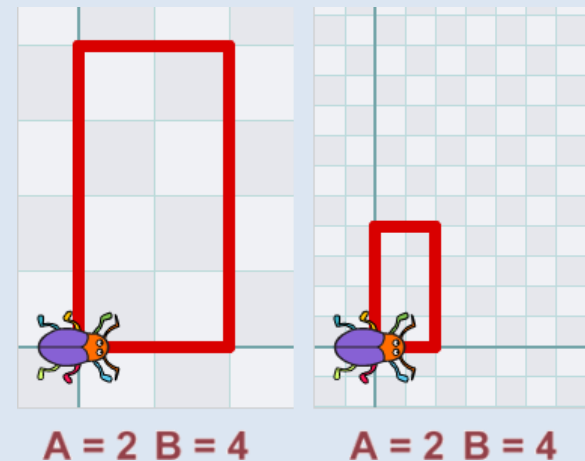
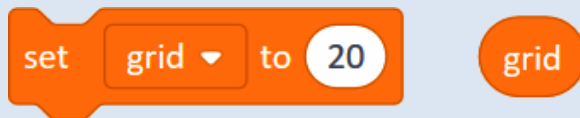
MODULE 5: INVESTIGATION 3

Activity 5.3.1 – Enter the Grid World

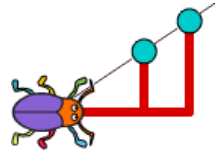


- Explore other backdrops, find out their names and grid tile sizes. Switch to *grid 20* and make all your scripts work correctly in this grid.

- Make a new variable called **grid**, set it to 20 and use it in the **move 1 tile** definition.

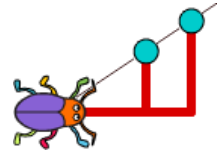


- [Extension]** Experiment with your **move 1 tile** definition to make the **Beetle** move quickly or slowly.



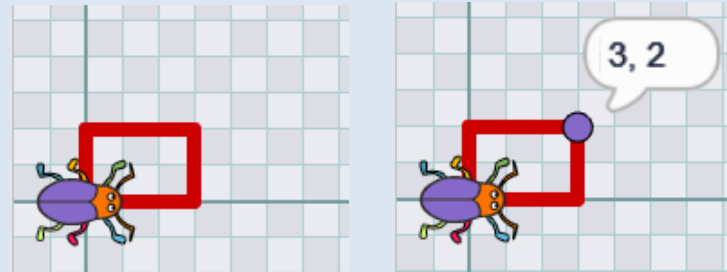
EXTENSION ACTIVITY 5.3.2

Connecting Corners

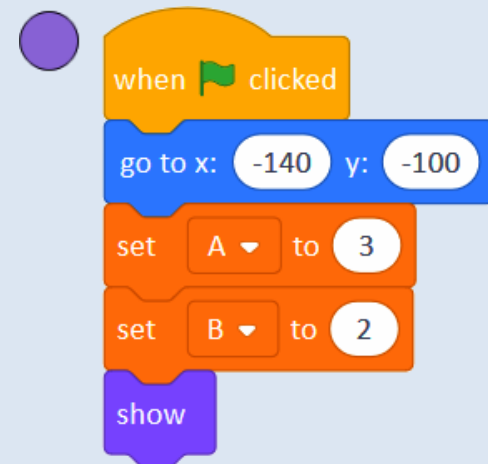


Continue in your **53-Grid World** project.

Now the **Dot** sprite will indicate the **opposite corner of the rectangle**. We will move it in the grid by the arrow keys.

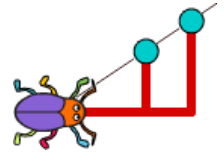


- Explore the **Dot** sprite. Delete its **hide** block, make the sprite visible.
- Delete the **set A ...** and **set B ...** blocks from the **Beetle** and move them into the *setup script* of the **Dot** sprite, with initial values e.g. 3 and 2.

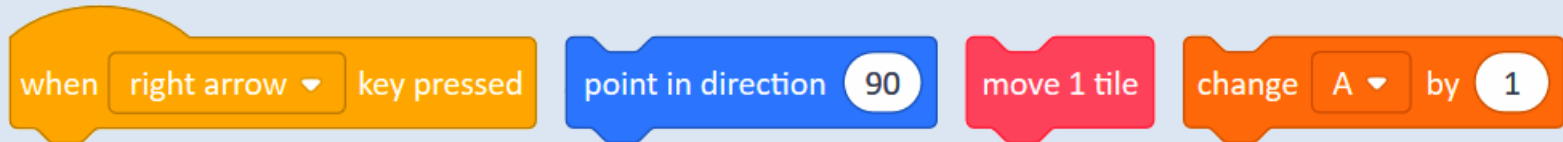


MODULE 5: INVESTIGATION 3

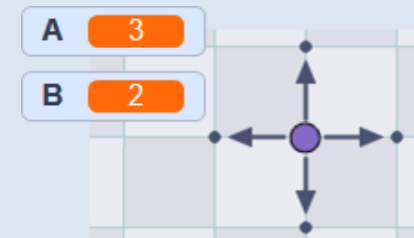
Ext. Activity 5.3.2 – Connecting Corners



- For the **Dot** sprite build a **when right arrow key pressed** event: it will **point in direction 90 (right)**, **move 1 tile** and **change A by 1** (i.e. increase **A** by 1).



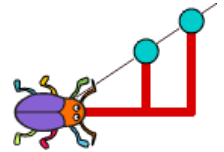
- Similarly build three more scripts for the **Dot** to react to the **left arrow**, **up arrow** and **down arrow**.



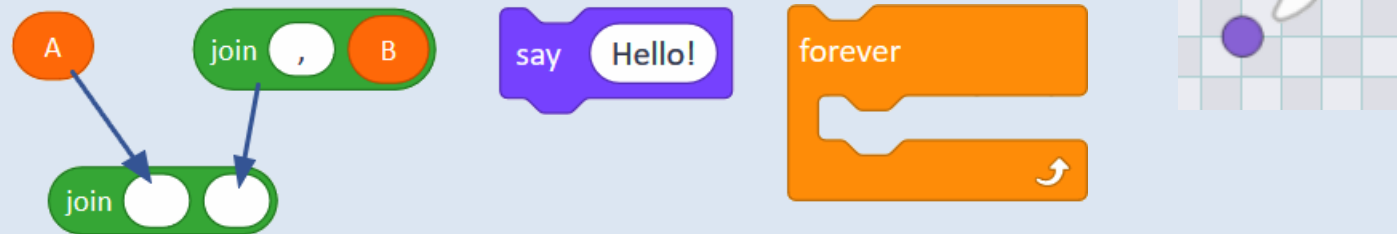
- What should happen with **A** when the **Dot** is moved one tile to the left?
- What should happen with **B** when the **Dot** is moved one tile up?
- What should happen with **B** when the **Dot** is moved one tile down?

MODULE 5: INVESTIGATION 3

Ext. Activity 5.3.2 – Connecting Corners



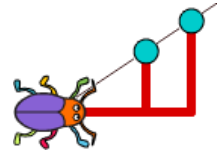
- Build one more script for the **Dot**: From the moment when the green flag is clicked it will forever say the actual values of **A** and **B**, e.g. **3, 2** or **9, 4** ...



- Switch the backdrop to *grid 10*, modify the variable **grid** and all scripts so that everything works correctly again.

MODULE 5: INVESTIGATION 3

Ext. Activity 5.3.2 – Connecting Corners



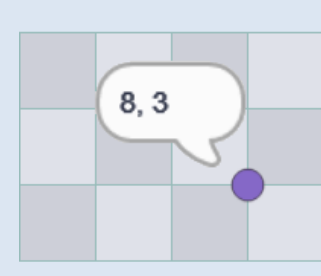
- **[Additional Extension]** Try to fully automatize switching from one grid to another – in one click!

● What exactly must change and how?

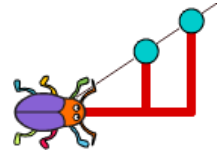


- **[Additional Extension]** Modify the **when ... arrow key pressed** scripts so that when the **Dot** is close to the edge, it will not react – to avoid the **Dot** from hitting the edge.

Firstly solve the problem separately
for the different backdrops *grid 10*, *grid 20*,
grid 50...



if we press the right arrow key
now, the Dot will not move

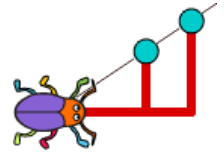


EXTENSION ACTIVITY 5.3.3

Meet the Magic Line

MODULE 5: INVESTIGATION 3

Ext. Activity 5.3.3 – Meet the Magic Line

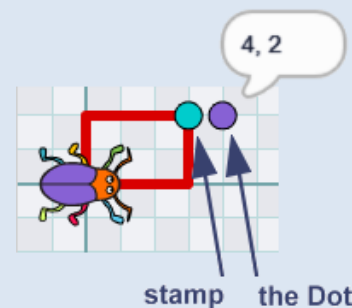
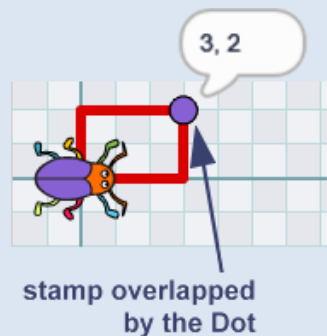


Continue in your **53-Grid World** project.

In this final step the **Beetle** will draw the magic line – connecting its own position with the **Dot**'s position.

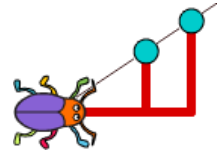
■ Extend the behaviour of both sprites:

- ▶ whenever the **Beetle** finishes drawing its rectangle, it broadcasts a message for the **Dot**,
- ▶ as its reaction, the **Dot** will stamp its second (turquoise) costume at its position then switch back to blue.



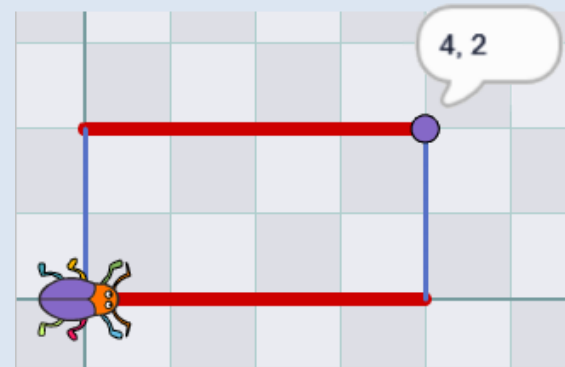
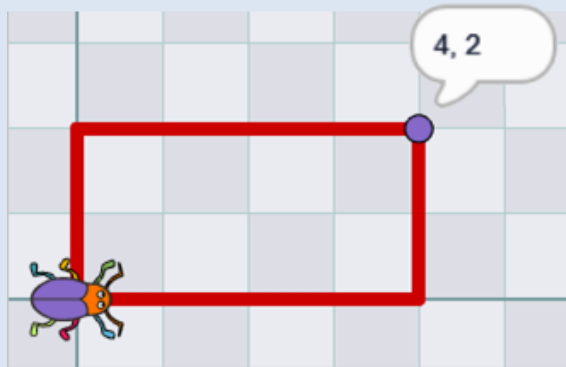
MODULE 5: INVESTIGATION 3

Ext. Activity 5.3.3 – Meet the Magic Line



■ To clearly see the difference between **A** and **B**, i.e. between two quantities we explore, let the Beetle draw:

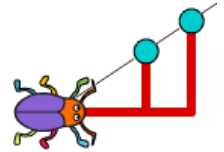
- ▶ horizontal lines in one **pen colour** and **pen size**, and
- ▶ vertical lines in another **pen colour** and **pen size**.



Modify the **move horizontally** and **move vertically** blocks.

MODULE 5: INVESTIGATION 3

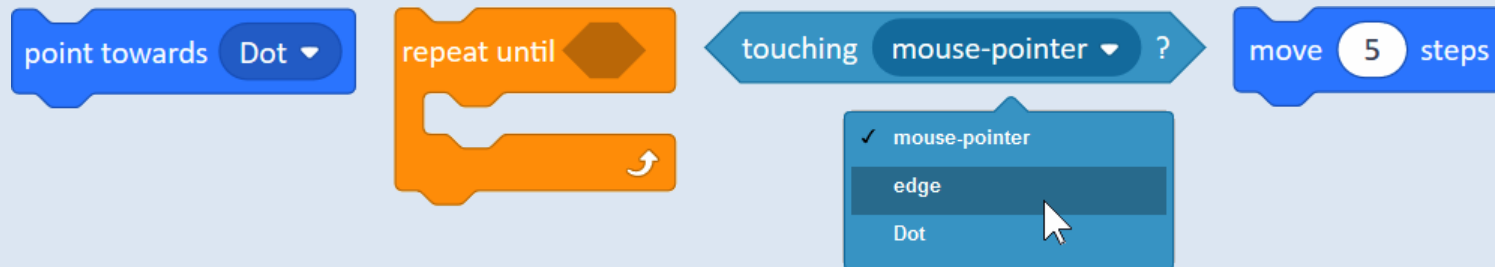
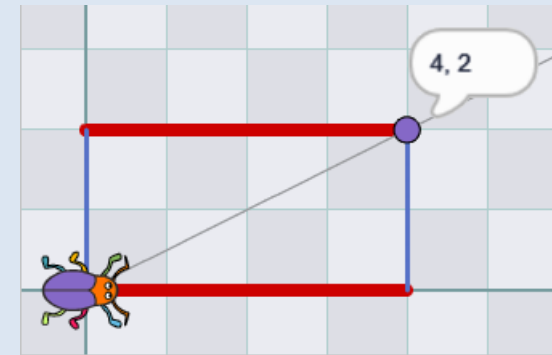
Ext. Activity 5.3.3 – Meet the Magic Line



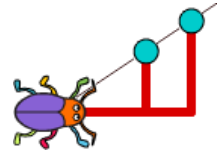
■ Build one more behaviour for the **Beetle**:

when space key pressed it will point towards the **Dot** and draw a line – repeating small steps until it touches the edge of the stage.

Then it will jump back home and **point in direction 90** again.



■ Finalise the whole project so that it also works in *grid 10*.

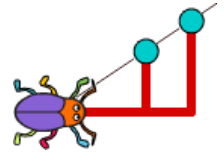


EXTENSION ACTIVITY 5.3.4

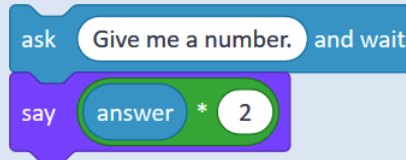
Unplugged: Module 5 Assessment

MODULE 5: INVESTIGATION 3

Ext. Activity 5.3.4 – Unplugged: Module 5 Assessment



1



When we run this script, **Beetle** will **ask** for a number. Note the number that the Beetle will **say** if we give the following answers:

If we answer **20** the Beetle will **say** _____

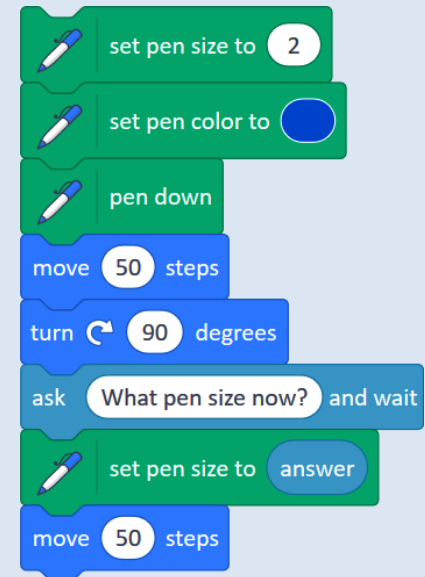
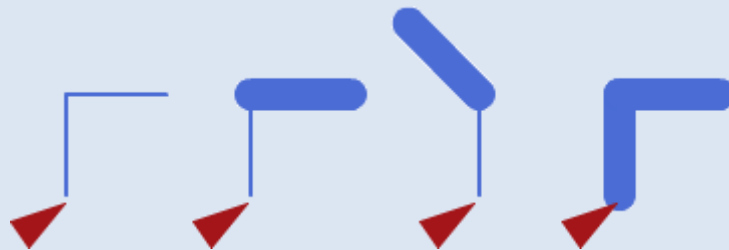
If we answer **1200** the Beetle will **say** _____

If we answer **45** the Beetle will **say** _____

*(note that * in Scratch means multiply)*

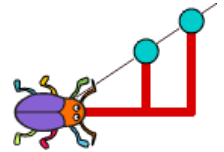
2

What will happen if we run this script and answer the question “*What pen size now?*” by typing in 20? Circle the correct drawing below.
(note the starting point is marked by the red arrow)



MODULE 5: INVESTIGATION 3

Ext. Activity 5.3.4 – Unplugged: Module 5 Assessment



3

```

ask [What side length?] and wait
repeat (8)
  move [answer] steps
  turn 45 degrees
  
```

If we run this script:

- How many times will the Beetle ask “*what side length*”?
- Describe what the Beetle will draw.
- If the perimeter of the polygon that the Beetle draws is 160, what number was typed in?

4 Circle the script that will produce the drawing below and explain why.

a

```

set [side length] to 30
repeat (7)
  square
  turn 90 degrees
  pen up
  move [side length] steps
  move 10 steps
  pen down
  turn 90 degrees
  change [side length] by 10
  
```

b

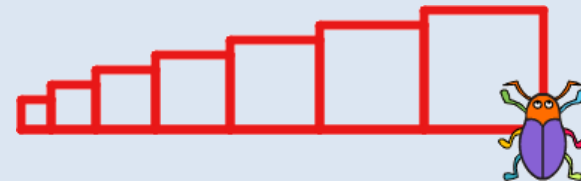
```

set [side length] to 30
repeat (7)
  square
  turn 90 degrees
  move [side length] steps
  move 10 steps
  turn 90 degrees
  change [side length] by 10
  
```

c

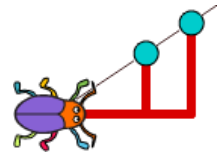
```

set [side length] to 30
repeat (7)
  square
  turn 90 degrees
  move [side length] steps
  turn 90 degrees
  
```

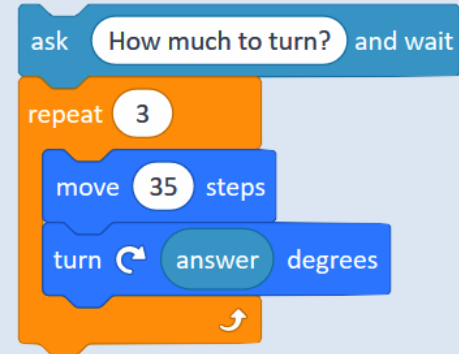


MODULE 5: INVESTIGATION 3

Ext. Activity 5.3.4 – Unplugged: Module 5 Assessment



- 5 For each of the following drawings decide whether it can be an outcome of the script on the right or not. Circle **Yes** or **No** and explain why.



Yes? No?

Why?



Yes? No?

Why?



Yes? No?

Why?

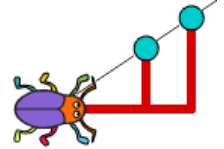


Yes? No?

Why?

MODULE 5: INVESTIGATION 3

Ext. Activity 5.3.4 – Unplugged: Module 5 Assessment



6 If we run this script of the **Beetle** – with its pen down, what kind of polygon can be the outcome?

Answer and explain your thinking:

```

set number to pick random 3 to 6
repeat number
  move 40 steps
  turn 360 / number degrees
  
```

7 For each of the following scripts 1 to 6 of the **Beetle** write down what what **side length** the resulting square will have:

```

define square
  repeat 4
    move side length steps
    turn 90 degrees
  
```

1

```

set side length to 20
square
  
```

2

```

set side length to 20
set side length to 40
square
  
```

3

```

set side length to 20
change side length by 30
square
change side length by 30
  
```

4

```

set side length to 80
square
change side length by 40
  
```

5

```

set side length to 35
square
set side length to 40
  
```

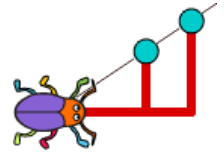
6

```

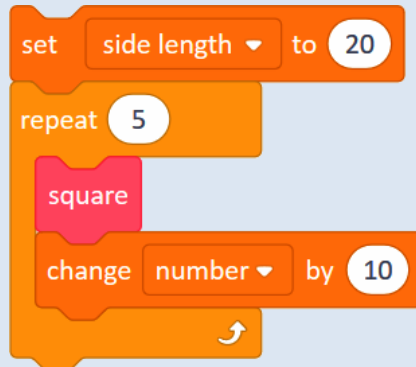
set side length to 20
change side length by 40
square
  
```

MODULE 5: INVESTIGATION 3

Ext. Activity 5.3.4 – Unplugged: Module 5 Assessment



8



If we run this script...

How many squares will the Beetle draw?

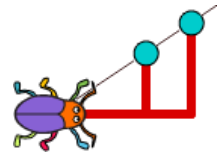
What will be the **side length** of the first one?

What will be the **side length** of the last one?

What will be the value of the **side length** variable after the script is run?

MODULE 5: INVESTIGATION 3

Ext. Activity 5.3.4 – Unplugged: Module 5 Assessment



9 Match the script to the picture which it could produce.

a

```

set height to 60
set base to 30
repeat 8
  rectangle
  change height by 10
  
```

b

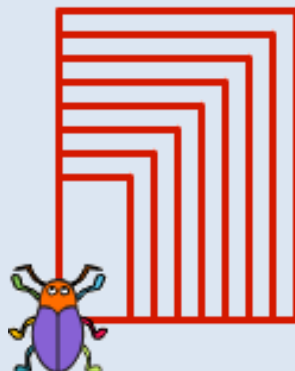
```

set height to 60
set base to 30
repeat 8
  rectangle
  change height by 10
  change base by 10
  
```

c

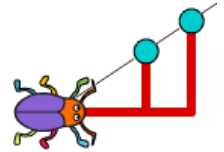
```

set height to 60
set base to 30
repeat 8
  rectangle
  change height by 10
  change base by 5
  
```



MODULE 5: INVESTIGATION 3

Ext. Activity 5.3.4 – Unplugged: Module 5 Assessment



10 [Extension] If we run script (A), the Beetle will draw the below rectangle.

Think of **two more pair of values** of the **height** and **base** variables that would output a mathematically similar **bigger** and **smaller** rectangle (i.e. fit on the magic line) and write the numbers in the empty holes on the right (marked by ?)

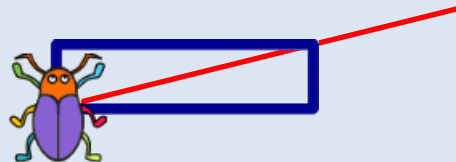
```

define rectangle
  repeat 2
    move height steps
    turn 90 degrees
    move base steps
    turn 90 degrees
  
```

A

```

set height to 20
set base to 80
rectangle
  
```



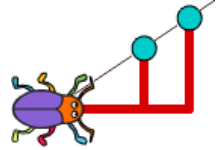
```

set height to ?
set base to ?
rectangle
  proportionally bigger
  
```

```

set height to ?
set base to ?
rectangle
  proportionally smaller
  
```

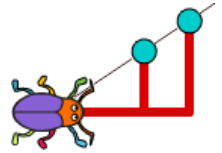
MODULE 5: INVESTIGATION 3



My **Investigation 3** check list:

- ☐ I correctly envisaged the sizes of the grid tiles on the different backdrops using the coordinates.
- ☐ I built a script which moves my sprite both horizontally and vertically by a specified number of 'tiles'.
- ☐ I adapted my script to work with different grid sizes.
- ☐ **[Extension]** I controlled my **Dot** sprite using the arrow keys.
- ☐ **[Extension]** I built a script which draws a "magic line" to connect the top right corners of my rectangles.
- ☐ **[Extension]** I used what I learned during Module 5 to envisage the outcome of different scripts.

MODULE 5 INVESTIGATION 3: Key Vocabulary



when right arrow ▼ key pressed

a hat block which runs the script connected to it when a specified key is pressed