GCSE Mathematics

ITERATION

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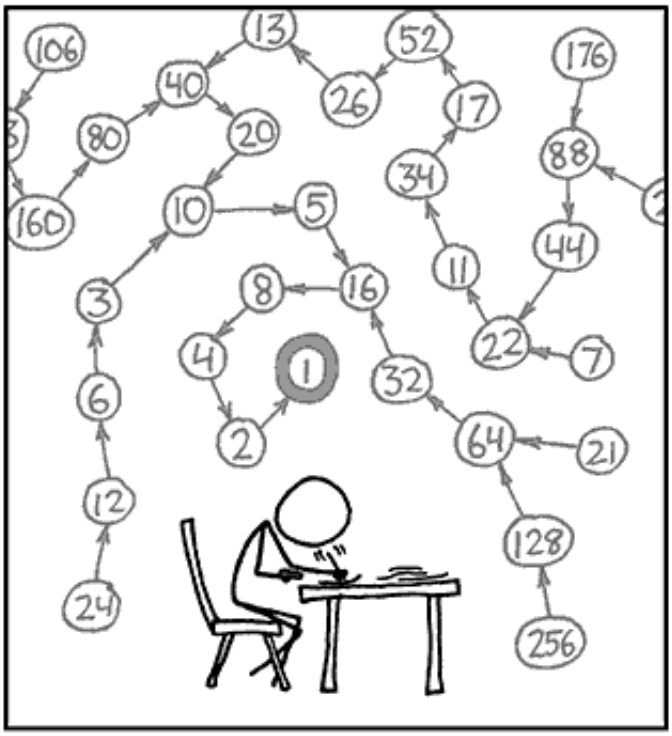


THE COLLATZ CONJECTURE STATES THAT IF YOU PICK A NUMBER, AND IF IT'S EVEN DIVIDE IT BY TWO AND IF IT'S ODD MULTIPLY IT BY THREE AND ADD ONE, AND YOU REPEAT THIS PROCEDURE LONG ENOUGH, EVENTUALLY YOUR FRIENDS WILL STOP CALLING TO SEE IF YOU WANT TO HANG OUT.

I T E R A T I O N

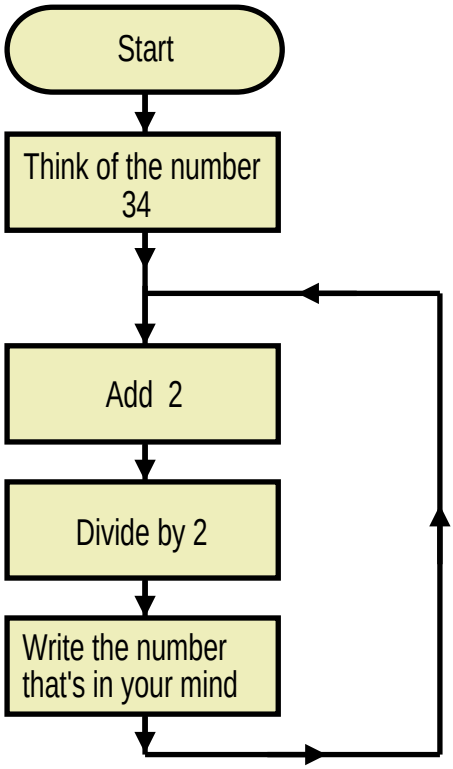
Lesson 1

1.1 What is a Iteration ?

An iterative process is one in which you repeatedly carry out the same set of instructions. The idea of iteration has been around for over two hundred years but it is only since the invention of the desktop computer in the 1980s that the subject has become mainstream mathematics. A flowchart provides a convenient way of describing an iteration.

1.2 Example

Consider the following flowchart,



This flowchart generates a sequence of numbers.
We can give the sequence a name; sequence *U*.
The first term in sequence *U* is denoted U_1
The second term in sequence *U* is denoted U_2
And so on...
Complete this table to show the first eight terms in sequence *U*

U_1	U_2	U_3	U_4	U_5	U_6	U_7	U_8
34							

[6 marks]

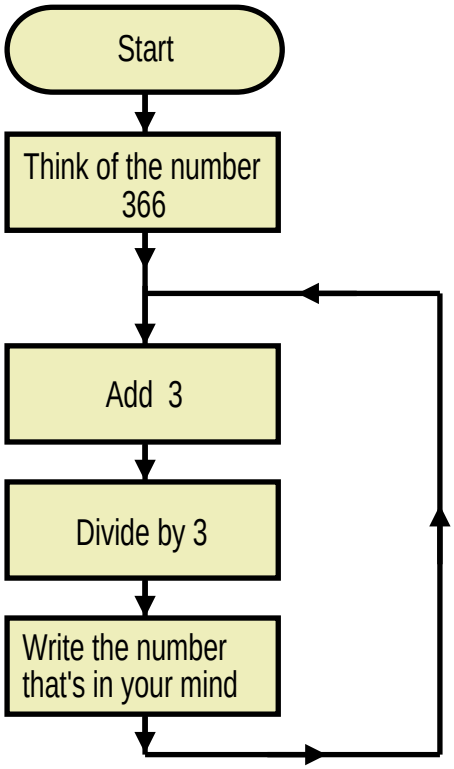
1.3 Exercise

Non-Calculator

Marks Available : 40

Question 1

Consider the following flowchart,



This flowchart generates a sequence of numbers.
We can give the sequence a name; sequence V
The first term in sequence V is denoted V_1
The second term in sequence V is denoted V_2
And so on...
Complete this table to show the first seven terms in sequence V

V_1	V_2	V_3	V_4	V_5	V_6	V_7
366						

[6 marks]

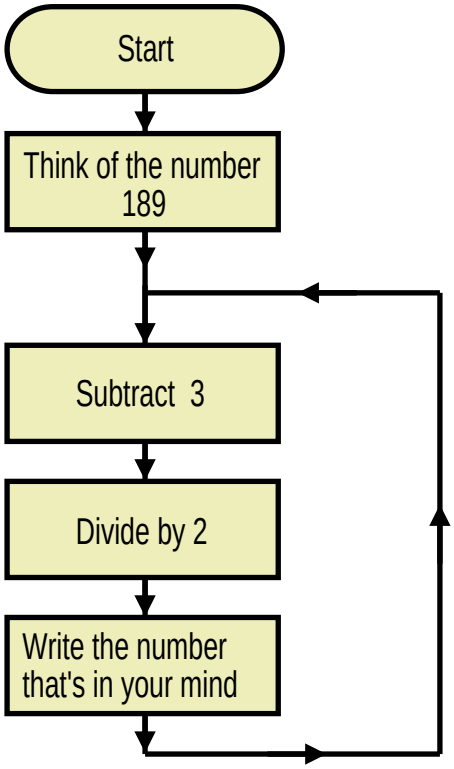
Question 2

This question will tell you how to get terms in sequence Q.
Start with the number 1, that is $Q_1 = 1$
To get a next term, double the previous term.
What is Q_6 ?

[2 marks]

Question 3

Consider the following flowchart,



This flowchart generates the sequence of numbers *D*.

Complete this table to show the first seven terms in sequence *D*

D_1	D_2	D_3	D_4	D_5	D_6	D_7
189						

[6 marks]

Question 4

This question will tell you how to get terms in sequence *A*.

Start with the number one million, that is $A_1 = 1000000$

To get a next term, divide the previous term by 10.

(i) What is the value of A_2 ?

[1 mark]

(ii) What is the value of A_3 ?

[1 mark]

(iii) What is the value of A_7 ?

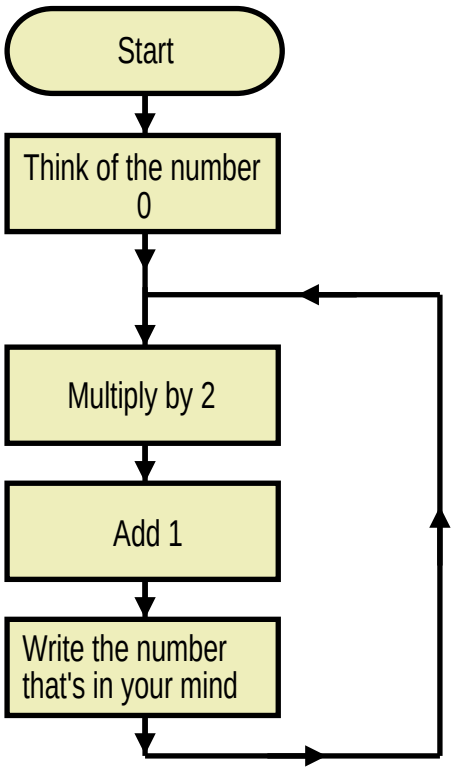
[1 mark]

(iv) What is the value of A_9 ?

[2 marks]

Question 5

Consider the following flowchart,



This flowchart generates the sequence of numbers P

Complete this table to show the first ten terms in sequence P

P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	P_{10}
			7						

[6 marks]

Question 6

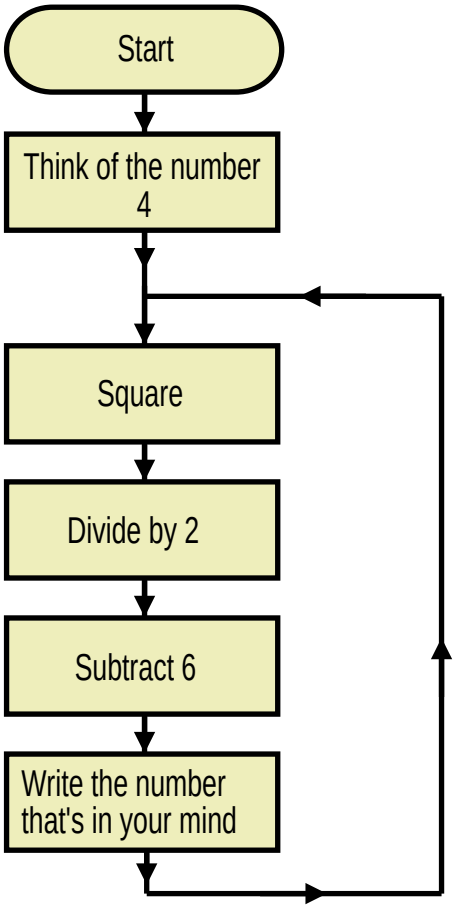
In my garden on Monday at noon there are 100 snails.

At noon each day, there are 20% more snails than at noon the day before.

How many snails are in my garden at noon on Wednesday that week ?

[3 marks]

Question 7



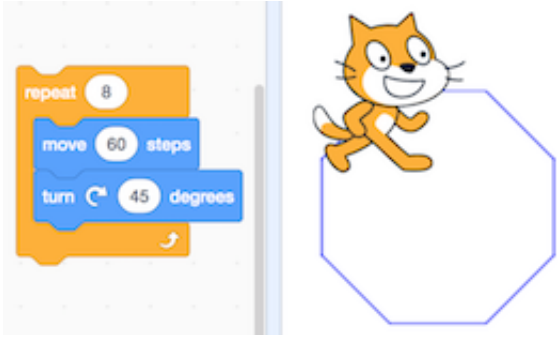
This flowchart which behaves in a different manner to the others in this exercise.
Call the sequence of numbers generated by this flowchart *Z*
Complete this table to show the first ten terms in sequence *Z*

Z_1	Z_2	Z_3	Z_4	Z_5	Z_6	Z_7	Z_8	Z_9	Z_{10}

[6 marks]

Question 8

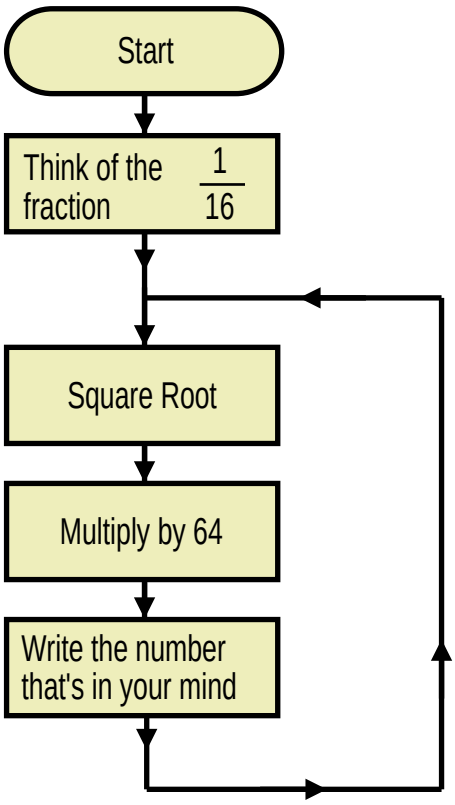
Explain how to modify this “scratch” programming loop to draw a hexagon.



[2 marks]

Question 9

See if you can you handle this question without using a calculator.
(It's all to do with powers of 2)



This flowchart generates the sequence of numbers C
Complete this table to show the first five terms in sequence C

P_1	P_2	P_3	P_4	P_5
$\frac{1}{16}$				

[4 marks]