

SHARP

Number Patterns Investigation Memo

Grade 9 Maths

1. Using the table on your calculator complete the table given below:

X	Ans
1	5
2	7
3	9
5	13
10	23
x	$2x + 3$

- a) What does the x stand for?

The x stands for the position of the pattern, or the independent variable. It causes the change in the ANS column.

- b) What happens to the ANS column as the X changes?

The answer in the ANS column increases by 2 each time the x changes.

- c) Where does a pattern begin?

The pattern starts at position 1 (that is, when $x = 1$) and when the ANS column is 5.

- d) What is the pattern?

Starting at 5, we add 2 to each consecutive term

- e) Can you write this pattern algebraically? (Use x for X and y for ANS).

$$y = 2x + 3$$

- f) What type of pattern is this?

This pattern is a constant difference pattern.

2. Using the table on your calculator complete the table given below:

X	Ans
1	2
2	4
3	8
5	32
10	1 024
x	2^x

a) What does the x stand for?

The x stands for the position of the pattern, or the independent variable. It causes the change in the ANS column.

b) What happens to the ANS column as the X changes?

The answer in the ANS column is multiplied by 2 for each consecutive term.

c) Where does a pattern begin?

The pattern begins at position 1 ($x = 1$) and when the ANS is 2.

d) What is the pattern?

Starting at 2, we multiply each consecutive term by 2.

e) Can you write this pattern algebraically? (Use x for X and y for ANS).

$$y = 2^x$$

f) What type of pattern is this?

This is an exponential pattern, so we call it a pattern with a constant ratio.

3. Look at the table given below:

x	1	2	3	4	5	10	15	v)	n
y	2	9	16	i)	ii)	iii)	iv)	142	vi)

a) Fill in the missing values i) and ii)

i) $16 + 7 = 23$

ii) $23 + 7 = 30$

b) What is the pattern?

Starting at 2, we add 7 to each consecutive term.

c) Write this pattern algebraically using x and y .

$$y = 7x + (2 - 7)$$

$$y = 7x - 5$$

d) Use the algebraic formula from c) to fill in iii), iv) and v).

iii) $y = 7(10) - 5$

$$y = 65$$

iv) $y = 7(15) - 5$

$$y = 100$$

v) $142 = 7x - 5$

$$147 = 7x$$

$$x = 21$$

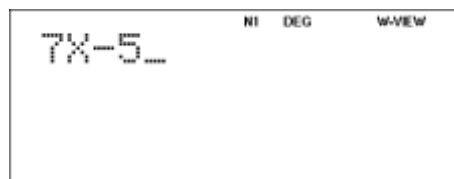
e) Rewrite the algebraic formula where $x = n$ and $y = T_n$

We have $y = 7x - 5$, so substituting in from above we have:

$$T_n = 7n - 5$$

f) Use your calculator to check that your pattern is correct.

Type in $\boxed{7}$ $\boxed{\text{RCL}}$ $\boxed{\text{RCL}}$ $\boxed{-}$ $\boxed{5}$ into Function 1 in Table mode.



Press $\boxed{=}$ four times:

X	ANS
0	-5
1	2
2	9

X	ANS
3	16
4	23
5	30

X	ANS
20	135
21	142
22	149

We can see that the pattern is the same as the one given in the table, so we know we are correct.

4. Look at the table given below:

x	1	2	3	4	5	10	15	v)	n
y	116	107	98	i)	ii)	iii)	iv)	-100	vi)

a) Fill in the missing values i) and ii)

i) $98 - 9 = 89$

ii) $89 - 9 = 80$

b) What is the pattern?

Starting at 116 we subtract 9 from each consecutive term.

c) Write this pattern algebraically using x and y .

$$y = (116 + 9) - 9x$$

$$y = 125 - 9x$$

d) Use the algebraic formula from c) to fill in iii), iv) and v).

iii) $y = 125 - 9(10)$

$$y = 35$$

iv) $y = 125 - 9(15)$

$$y = -10$$

v) $-100 = 125 - 9x$

$$-225 = -9x$$

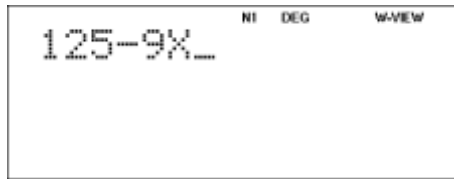
$$x = 25$$

e) Rewrite the algebraic formula where $x = n$ and $y = T_n$

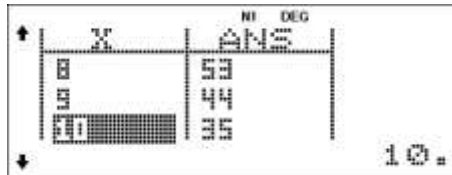
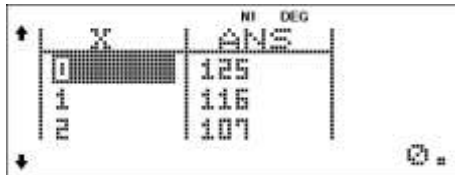
$$T_n = 125 - 9n$$

f) Use your calculator to check that your pattern is correct.

Type in $\boxed{1}$ $\boxed{2}$ $\boxed{5}$ $\boxed{-}$ $\boxed{9}$ $\boxed{\text{RCL}}$ $\boxed{\text{RCL}}$ into Function 1 in Table mode.



Press  four times:



We can see that the pattern is the same as the one given in the table, so we know we are correct.

5. Look at the table given below:

x	1	2	3	4	5	8	10	v)	n
y	$\frac{1}{5}$	1	5	i)	ii)	iii)	iv)	9 765 625	vi)

a) Fill in the missing values i) and ii)

i) $5 \times 5 = 25$

ii) $25 \times 5 = 125$

b) What is the pattern?

Starting at $\frac{1}{5}$ and multiplying each consecutive term by 5.

c) Write this pattern algebraically using x and y .

$$y = \frac{1}{25} \times 5^x$$

d) Use the algebraic formula from c) to fill in iii), iv) and v).

iii) $y = \frac{1}{25} \times 5^8$

$$y = 15\,625$$

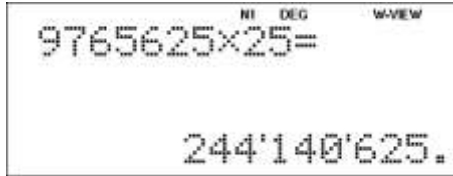
iv) $y = \frac{1}{25} \times 5^{10}$

$$y = 390\,625$$

v) $9\ 765\ 625 = \frac{1}{25} \times 5^x$

$244\ 140\ 625 = 5^x$

(Press **2ndF** **Exp**):



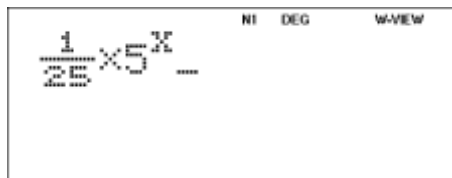
$\therefore x = 12$

e) Rewrite the algebraic formula where $x = n$ and $y = T_n$

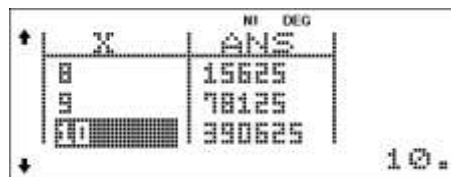
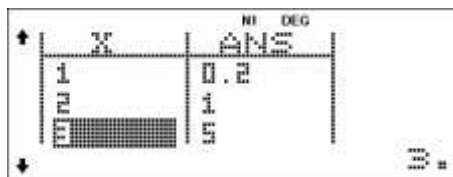
$T_n = \frac{1}{25} \times 5^n$

f) Use your calculator to check that your pattern is correct.

Type in **1** **a/b** **2** **5** **→** **×** **5** **xy^x** **RCL** **RCL** into
Function 1 in Table mode.



Press **=** four times:



We can see that the pattern is the same as the one given in the table, so we know we are correct.

6. Look at the table given below:

x	1	2	3	4	5	8	10	v)	n
y	1 000	500	250	i)	ii)	iii)	iv)	0.48828125	vi)

a) Fill in the missing values i) and ii)

$$i) \quad 250 \div 2 = 125 \qquad ii) \quad 125 \div 2 = 62\frac{1}{2}$$

b) What is the pattern?

Starting at 1 000 divide each consecutive term by 2.

c) Write this pattern algebraically using x and y .

$$y = 2000 \div 2^x$$

d) Use the algebraic formula from c) to fill in iii), iv) and v).

$$iii) \quad y = 2000 \div 2^8 \qquad iv) \quad y = 2000 \div 2^{10}$$

$$y = 7\frac{13}{16} = 7.8125 \qquad y = 1\frac{61}{64} = 1.953125$$

$$v) \quad 0.48828125 = \frac{2000}{2^x}$$

$$0.48828125 \times 2^x = 2000$$

$$2^x = 4096$$

(Press **2ndF** **Exp**):

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2000÷0.48828125=
4'096.

NI DEG W-VIEW
2000÷0.48828125=
2¹²

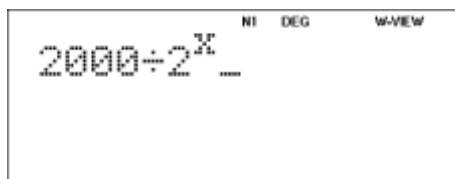
$$x = 12$$

e) Rewrite the algebraic formula where $x = n$ and $y = T_n$

$$T_n = 2000 \div 2^n \qquad \text{OR} \qquad T_n = \frac{2000}{2^n}$$

f) Use your calculator to check that your pattern is correct.

Type in $\boxed{2} \boxed{0} \boxed{0} \boxed{0} \boxed{\div} \boxed{2} \boxed{\frac{1}{x^2}} \boxed{\text{RCL}} \boxed{\text{RCL}}$ into Function 1 in Table mode.



Press $\boxed{=}$ four times:

X	ANS
1	1000
2	500
3	250

X	ANS
6	31.25
7	15.625
8	7.8125

We can see that the pattern is the same as the one given in the table, so we know we are correct.

7. From the patterns in questions 3 – 6, answer the following questions

- a) When we want to add the same number to the previous value in the pattern, how do we write this algebraically?

We can write this by putting the number in front of the x (that is, make the number the coefficient of x).

- b) What do we use to represent the term position algebraically?

n

- c) What do we use to represent the term value algebraically?

T_n

- d) Can we start counting patterns from position 0?

No

- e) Which position should we start our patterns from?

We start all patterns from position 1

- f) When we want to create a term where we multiply by the same amount each time, how do we write this algebraically?

We multiply by the term to the power of x or n .

- g) Create a pattern that starts at 50 and decreases by 3 each time.

$$T_n = 53 - 3n$$

- h) Create a pattern that starts at 500 and is divided by 5 each time.

$$T_n = 2500 \div 5^n$$

- i) Create your own patterns. For each pattern, write down the formula and complete a table with x or $n = 1, 2, 3, 4$ and 5 .

- i) Create a pattern that has something added to it each time

Necessary things:

A formula with n multiplied by a positive number.

A completed table with $n = 1, 2, 3, 4,$ and 5 .

- ii) Create a pattern that has something taken away from it each time.

Necessary things:

A formula with n multiplied by a negative number.

A completed table with $n = 1, 2, 3, 4,$ and 5 .

- iii) Create a pattern that is multiplied by the same amount each time.

Necessary things:

A formula with a number multiplied by a number raised to the power of n

A completed table with $n = 1, 2, 3, 4,$ and 5 .

- iv) Create a pattern that is divided by the same amount each time.

A formula with a number divided by a number raised to the power of n

A completed table with $n = 1, 2, 3, 4,$ and 5 .

- j) Create a pattern that doesn't follow any of the above rules, ie it doesn't not have a constant difference or constant ratio.

This pattern should not add or subtract a constant, or multiply or divide by a constant value.

Maths^{at} **SHARP**