WTS TUTORING

2019 WTS

NUMBER PATTERNS

GRADE : 12

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2019 WTS TUTORING

TERM 1 CAMP

SUBJECTS : MATHS, MATHS LIT, PHYSICS& ACCOUNTING

VENUE : MZINGAZI PRIMARY SCH

GRADE : 08 TO 12

DATE : 03 TO 07 JANUARY 2019

TIME : 08:00 TO 20:00

WE ALSO PROVIDE ONE ON ONE, CROSSNIGHTS AND WEEKEND LESSONS

FOR MORE INFO. CONTACT: 082 672 7928 / 076 091 1957

➢ NUMBER PATTERNS

- ✓ A number relation shows a relationship between two variables, usually x and y.
- ✓ In other words, we can describe a particular number pattern by means of a mathematical formula.

➢ KEY WORDS:

1. **Sum** : the result of addition
2. **Difference** : the result of subtraction
3. **Product** : the result of multiplication
4. **Natural numbers** : whole numbers greater than or equal to 1
5. **Integer** : a positive or negative whole number or zero.
6. **Even numbers** : any integer that can be divided exactly by 2
7. **Odd numbers** : any integer that cannot be divided exactly by 2
8. **Factor** : a number that divides exactly into a whole number with no remainder
9. **Divisible by** : a number is divisible if, after diving, there is no remainder.
10. **Prime number** : numbers that have only two factors, the number itself and 1.
11. **Multiple** : the product of two natural numbers
12. **Perfect squares;** are rational numbers which can example end with 1;4;16 ;….but never end in a 3 or an 8 etc
13. **Non-Perfect squares**; are irrational numbers which can example end with 3 or 8 but never end in a 4 or an 16 etc
14. **Which term:** that is a number of terms
15. **nth term:** that is general term
16. **determine the 10 th term;** same as T_{10}
17. **existence of the sequence or series;** the common ratio is between -1 and 1 or
18. **greater than;** the first term to be greater then : $T_n >$ a if a is the given nth term
19. **less than;** the first term to be less then : $T_n <$ a if a is the given nth term

20. never contain a positive or negative term; calculate the maximum value of the nth term (y value of turning point)

21. converging series; if and only if $-1 < r < 1$

A. ARTHMETIC SEQUENCE

- ✓ An arithmetic sequence or series is a linear number pattern in which the first difference is constant.
- ✓ The general term formula allows you to determine any specific term of an arithmetic sequence.
- ✓ And the sum of formula determines the sum of a specific number of terms of an arithmetic series.
- ✓ The formulae are as follows:

❖ GENERAL / N-TERM/ LAST TERM (T_n)

- ➢ First common difference : $d = T_n - T_{n-1} = T_2 - T_1 = T_3 - T_2$ (more useful if variables are given / and if the unknown must be calculated)
- ➢ General term: $T_n = a + (n-1)d$
- ➢ Given the last term: implies that T_n is given and u can calculate the first term or number of terms
- ➢ If other terms are not given use the following: $T_1 = a, T_2 = a + d\ , T_3 = a + 2d$

  NB: hence solving simaltenouesly
- ➢ T_n : the value of the specific term
- ➢ n: number of the term in a sequence and is a counting number (the position of n-th term in the sequence)

➢ SERIES

When we add the terms of a sequence together, we form a series. We use the symbol S_n to show the sum of the first n terms of a series. So $S_n = T_1 + T_2 + T_3 + T_4 + \dots\dots.. + T_n$

PROOF:

The sum of the terms in an arithmetic series

We can also deduce a formula for the sum of the first n terms of an arithmetic series.

Suppose once again that we have an AS with $t_1 = a$, and a common difference of d.
Then:

$$S_n = t_1 + t_2 + \dots + t_{n-1} + t_n$$

$$= a + (a + d) + \dots (a + (n-2)d) + (a + (n-1)d)$$

Now let's rewrite the equation for the sum of the series, but this time writing the terms in the reverse order. In other words, we start with the last term $(a + (n-1)d)$, and finish with the first term. When we add all the terms in the second equation, then the sum will still be S_n.

Therefore, in the second equation, we have:

$$S_n = (a + (n-1)d) + (a + (n-2)d) + \dots + (a + d) + a$$

Now, let's add the two equations together. The left-hand side is easy, because we just need to add $S_n + S_n$, which equals $2S_n$.

Adding the two sets of values on the right-hand side is a bit more complicated.

However, if we group the terms so that we add the first term of each equation together, then add the second terms together, and so on, then the result is as follows:

$$
\begin{array}{lllll}
a & + \ a + d & + \ . . . & + \ a + (n-2)d & + \ a + (n-1)d \\
a + (n-1)d & + \ a + (n-2)d & + \ . . . & + \ a + d & + \ a \\
\hline
2a + (n-1)d & + \ 2a + (n-1)d & + \ . . . & + \ 2a + (n-1)d & + \ 2a + (n-1)d \\
\hline\hline
\end{array}
$$

Therefore, the result of adding the two equations together is:

$$2S_n = (2a + (n-1)d) + (2a + (n-1)d) + . . . + (2a + (n-1)d) + (2a + (n-1)d)$$

On the right-hand side of the resulting equation, we see something remarkable. There are n terms between the plus signs, and each term is equal to $2a + (n-1)d$! Therefore, we can rewrite this result as follows:

$$2S_n = n(2a + (n-1)d)$$

Now, remember that the value that we actually want is the sum of the terms in the series. In other words, we want the value of S_n. We can obtain this by dividing both sides of the equation by 2.

Therefore, the general formula for the sum of the terms in an arithmetic series is:

FORMULA :
$$S_n = \frac{n}{2}(2a + (n-1)d)$$

However, we're still not finished! There is one other form that we can use to express the formula for the sum of an arithmetic series. Remember that the final term, (or *general term*) of the series is given by $a + (n-1)d$.

Therefore, if we represent this final term as l, then we can rewrite the formula as:

FORMULA:
$$S_n = \frac{n}{2}(a + l)$$

where l is the final term in the series.

KWV 1

Prove that: $S_n = \frac{n}{2}[2a + (n-1)d]$

KWV 2

The sequence 3; 5; 7; ... is given.

a. Determine the general term

b. Which term is equal to 71?

c. Which first term will be greater than 41?

d. Determine the sum of the first n terms

e. Hence , calculate the sum of the first 40 terms.

KWV 3

How many terms of the series 3 + 8 + 13 + … must be added to give a sum of 2265?

KWV 4

The following arithmetic sequence is given: 20 ; 23 ; 26; 29 ;………..;101

a. How many terms are there in this sequence?
b. The even numbers are removed from the sequence. Calculate the sum of the terms of the remaining sequence.

KWV 5

Consider the following pattern:

$$1 + 2 + 3 = 6$$
$$4 + 5 + 6 = 15$$
$$7 + 8 + 9 = 24$$
$$10 + 11 + 12 = 33$$

Calculate the sum of the terms in the 2010^{th} row.

KWV 6

Consider an arithmetic sequence which has the second term equal to 8 and the T5 = 10

a. Determine the first term and common difference of this sequence

b. Determine the n^{th} term.

c. Determine the sum of the first 50 terms

KWV 7

Given the finite arithmetic sequence: 5 ; 1 ; –3 ; ... ; –83 ; –87

a. Write down the fourth term (T4) of the sequence.

b. Calculate the number of terms in the sequence.

c. Calculate the sum of all the negative numbers in the sequence.

d. Consider the sequence: 5 ; 1 ; –3 ; ... ; –83 ; –87 ; … ; –4 187.

e. Determine the number of terms in this sequence that will be exactly divisible by 5

KWV 8

The following is an arithmetic sequence:

$1-k; 2k-3; k+5$

a. Calculate the value of k

b. Write down the value of a and d

c. Explain why none of the numbers in this sequence are perfect squares.

KWV 9

Determine the value(s) of x in the interval $x \in [0°; 90°]$ for which the sequence

-1 ; 2sin3x ; 5 ;..... will be arithmetic.

B. GEOMETRIC SEQUENCE

- ✓ A geometric sequence or series is an exponential number pattern in which the ratio is constant.
- ✓ The general term formula allows you to determine any specific term of a geometric sequence.
- ✓ You have also learnt formulae to determine the sum of a specific number of terms of a geometric series.
- ✓ The formulae are as follows:

- **GENERAL / N-TERM/ LAST TERM (T_n)**

- Common ratio: (more useful if variables are given / and if the unknown must be calculated, hence applying **orlando pirates sign : kwv rule**)

To find r, we can use the following formula:

$$r = \frac{T_n}{T_{n-1}} = \frac{T_{n+1}}{T_n}$$

For example:

$$r = \frac{T_2}{T_1} = \frac{T_3}{T_2}$$

- General term: $T_n = ar^{n-1}$
- Given the last term :implies that T_n is given and u can calculate the first term or number of terms
- If few terms are given: $T_1 = a, T_2 = ar$, $T_3 = ar^2$ NB: solving simaltenouesly
- Take notes of exponential and logarithms laws

- **SERIES**

When we add the terms of a sequence together, we form a series. We use the symbol S_n to show the sum of the first n terms of a series. So $S_n = T_1 + T_2 + T_3 + T_4 + \ldots\ldots\ldots + T_n$

PROOF:

The sum of the terms in a geometric series

The next step is to deduce a formula for the sum S_n of the first n terms of a GS. Once again, suppose that we have a GS with a first term (t_1) equal to a, and a common ratio of r.

We express the sum of the GS as follows:

$$S_n = t_1 + t_2 + \ldots + t_n$$

$$= a + ar + ar^2 \ldots + ar^{n-1}$$

Now, if we multiply S_n by r, we get:

$$r \times S_n = ar + ar^2 + \ldots + ar^{n-1} + ar^n$$

Finally, if we subtract $r \times S_n$ from S_n, then we have:

$$\begin{array}{rccccccccccccc} & a & + & ar & + & ar^2 & + & \ldots & + & ar^{n-1} & & \\ - & & & ar & + & ar^2 & + & \ldots & + & ar^{n-1} & + & ar^n \\ \hline & a & + & 0 & + & 0 & + & \ldots & + & 0 & - & ar^n \end{array}$$

Therefore:

$$S_n - r \times S_n = a - ar^n$$

$$S_n(1 - r) = a - ar^n$$

$$S_n = \frac{a(1-r^n)}{1-r}$$

Therefore, the general formula for the sum of n terms in a GS is:

$$S_n = \frac{a(1-r^n)}{1-r} \text{ or } S_n = \frac{a(r^n-1)}{r-1}, \qquad \text{since } \frac{a(1-r^n)}{1-r} = \frac{-a(r^n-1)}{-(r-1)}$$

- Take note there is no different between two formulae

➢ CONVERGES SERIES

- ✓ The sum of a convergent geometric series tends towards a particular value as the number of terms in the series increases.
- ✓ However, sum will never actually reach that value. We express this mathematically by using the concept of a limit.
- ✓ This is a very useful concept, because it enables us to define a second concept, namely the sum to infinity of the series, which we define as:
- ✓ Is for geometric pattern
- ✓ Note: $-1 < r < 1$ { r is a common ratio $r = \frac{T_2}{T_1} = \frac{T_3}{T_2}$ }
- ✓ Always work with inequalities
- ✓ Sum to infinity: $S_\infty = \frac{a}{1-r}$

➢ WHAT ABOUT GEOMETRIC SEQUENCES WITH R < −1 OR R > 1?

- ✓ In sequences in which r < −1 or r > 1, we find that n S does not approach a definite limit as n increases. In such a case, the sequence diverges (or the sequence is divergent).

KWV 1

Prove that: $a + ar + ar^2 + ...(to\ n\ terms) = \dfrac{a(r^n - 1)}{r - 1}; \quad r \neq 1$

KWV 2

Given: $16(x-2)^3 + 8(x-2)^4 + 4(x-2)^5 + \cdots$as a geometric sequence and $x \neq 2$

i) Determine the general term of the series in terms of x

ii. Calculate the value of x for which the sequence converges.

iii. Determine the sum to infinity of the series if $x = 2{,}5$.

KWV 3

Given the geometric series: $\frac{24}{x} + 12 + 6x + 3x^2 + \cdots$

i) If $x = 4$, then determine the sum to 15 terms of the sequence.

ii) Determine the values of x for which the original series converges.

iii) Determine the values of x for which the original series will be increasing.

KWV 4

Given: 2 and –1, as the first two terms of an infinite geometric series. Calculate the sum of this series.

KWV 5

The following information of a geometric pattern is given

$T_1 + T_2 = -1$ and $T_3 + T_4 = -4$

Determine the following:

i. numerical values of the first three term if r > 0

ii. n-term formula

KWV 6

Mr KWV bought a bonsai (tree) at a nursery, when he bought the tree, its height was 130 mm, thereafter the height of the tree increased each year respectively:

100mm ; 70mm ; 49mm; …

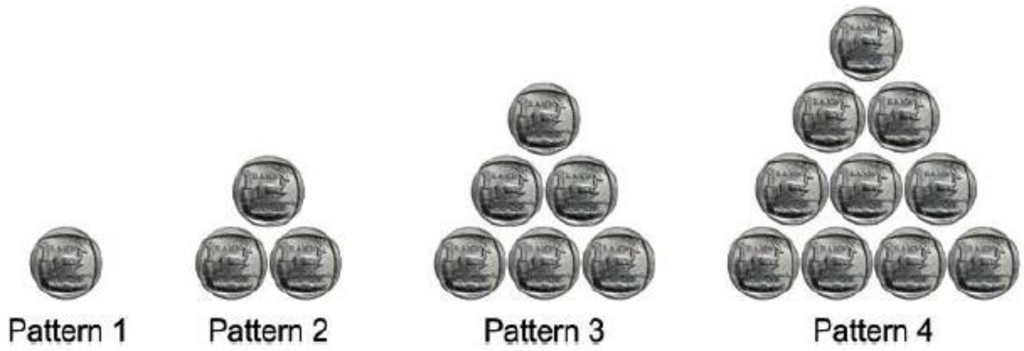
i. During which year will the height of the tree increase by approximately 11,76mm?

ii. Mr KWV plots a graph to represent the height $h(n)$ of the tree (in mm) in n years after he bought it. Determine a formula for $h(n)$.

iii) What height will the tree eventually reach?

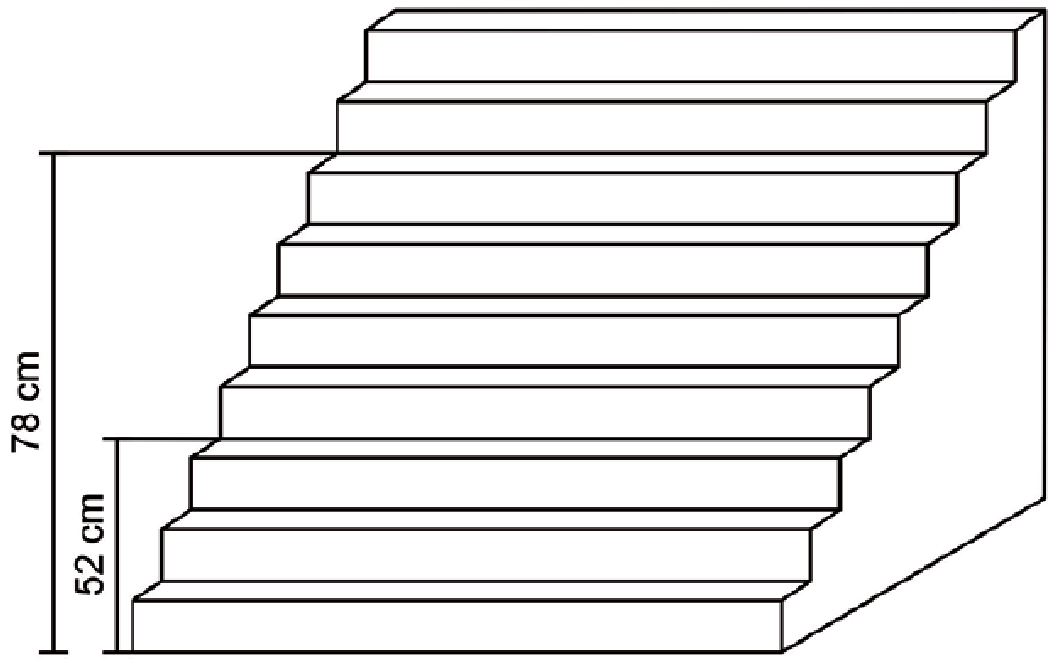
KWV 7

a) The first four patterns formed by the arrangement of coins are shown below:



(1) Show that the progression of patterns forms a quadratic sequence.

(2) Determine the *n*th term of this quadratic sequence.



(b) The heights above ground level of steps in a staircase form an arithmetic sequence.

The heights of the 3rd and 7th steps are 52 cm and 78 cm above the ground respectively.

Determine the height above ground level of the 43rd step.

KUTHI HUUUUUU!

If you are asked to find the general term (T_n) of a sequence, you must first determine whether it is:

- linear (arithmetic) – the *first difference* is a constant;
- quadratic – the *second difference* is a constant; or
- geometric – there is a common ratio.

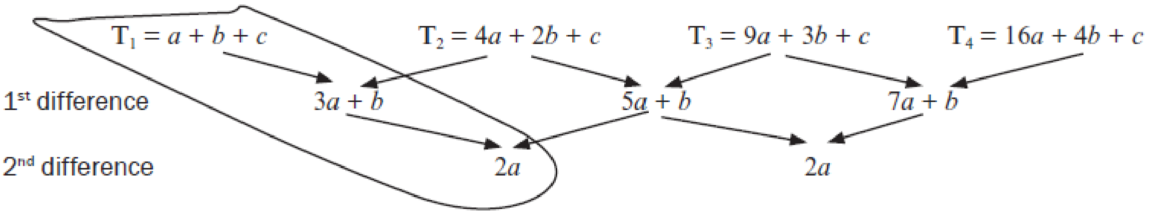
C. QUADRATIC PATTERN

It is a sequence whereby there is a constant second difference (d).

✓ GENERAL TERM

- Second common difference : $2a = d$
- If the unknown given workout the second difference using given variable and hence equate the second difference in order to solve the unknown.
- General term: $T_n = an^2 + bn + c$ (NB: substitute the values at the end)

KEY:



If the sequence is quadratic, $T_n = an^2 + bn + c$, we then use the formula:

$a + b + c$ = the first term of the sequence

$3a + b$ = the first value of the first difference

$2a$ = the second difference

- ✓ $a + b + c = T_1$
- ✓ $3a + b = T_2 - T_1$
- ✓ $2a = d$

- Given the T_n implies that you can calculate the number of terms
- If few terms are given substitute into: $T_n = an^2 + bn + c$ and hence solve simaltenouesly

❖ Determine between two consecutive terms

✓ **To calculate the first difference between given terms**

❖ Using linear nth term

- The term will always lies in the lowest number
- Firstly calculate the n term and substitute with : T_{n-1}

❖ Using quadratic nth term

- Simple substitute into the nth term by calculating the difference starting with lower number.

✓ **To calculate two terms between**

- Firstly calculate the number of terms and substitute into nth term and take note to increase the number for the difference.

NB: $d_n = T_n - T_{n+1}$

KWV 1

1. Given the quadratic sequence: $5; 7; 13; 23; ...$

i. Write down the next **TWO** terms.

ii. Calculate the n^{th} term of the quadratic sequence.

iii. Determine T_{10} of the above sequence.

iv. Which term in the sequence is equal to 55?

v. Determine between which two consecutive terms of the quadratic sequence the first difference will be equal to 2018.

vi. What is the value of the first term of the sequence that is greater than 77?

KWV 2

The quadratic pattern $-3; 4; x; 30; ...$ is given. Determine the value of x.

KWV 3

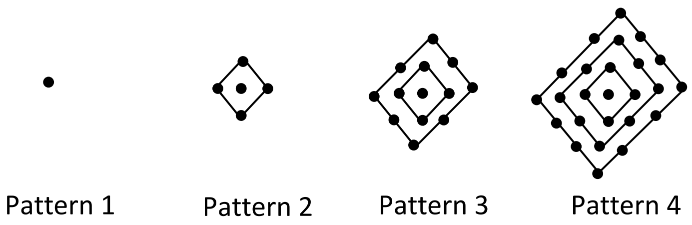
The first four terms of a quadratic number pattern are $-1; x; 3; x+8$

i. Calculate the value (s) of x.

ii. If $x = 0$, determine the position of the first term in the quadratic number pattern for which the sum of the n first differences will be greater than 250.

KWV 4

Dots are arranged to form a sequence of patterns as shown below:



i. If the pattern behaves consistently, write down the number of dots in pattern 5

ii. Determine a formula for the number of dots in the n^{th} pattern.

iii. Use your formula to calculate which pattern number has 1 985 dots in it?

KWV 5

The following sequence of numbers forms a quadratic sequence:

-3 ; -2 ; -3 ; -6 ; -11 ;……………………………

a. The first differences of the above sequence also form a sequence. Determine an expression for the general term of the first differences.

b. Calculate the first difference between the 35^{th} and 36^{th} terms of the quadratic pattern

c. Determine an expression for the nth term of the quadratic sequence.

d. Explain why the sequence will never contain a positive term.

KWV 6

A quadratic sequence is defined with the following properties

$T_2 - T_1 = 7$, $T_3 - T_2 = 13$, $T_4 - T_3 = 19$

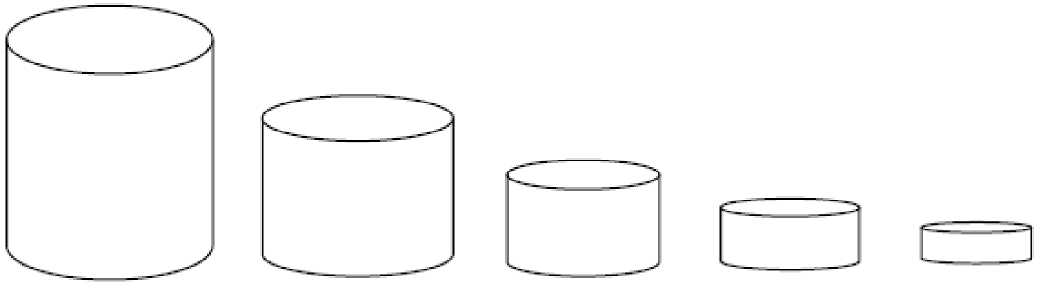
a. Write down the value of:

1. $T_5 - T_4$
2. $T_{70} - T_{69}$

b. Calculate the value of T_{69} if $T_{89} = 23\ 594$

KWV 7

Twenty water tanks are decreasing in size in such a way that the volume of each tank is $\frac{1}{2}$ the volume of the previous tank. The first tank is empty, but the other 19 tanks are full of water.



Would it be possible for the first water tank to hold all the water from the other 19 tanks? Motivate your answer.

a. The nth term of a sequence is given by : $T_n = -2(n-5)^2 + 8$.

1. Write down the first THREE terms of the sequence.
2. Which term of the sequence will have the greatest value?
3. What is the second difference of this quadratic sequence?
4. Determine ALL values of n for which the terms of the sequence will be less than -110.

KWV 8

a) Given the quadratic sequence; 2 ; 3; 10 ; 23 ; ...

1. Write down the next term of the sequence

2. Determine the n^{th} term of the sequence.

3. Calculate the 20^{th} term of the sequence.

b) Given the arithmetic sequence: 35 ; 28 ; 21 ; ….

Calculate which term of the sequence will have a value of -140.

c) For which value of n will the sum of the first n terms of the arithmetic sequence in b) be equal to the n^{th} term of the quadratic sequence in a).1.

D. COMBINATION OF AP & GP

- Separate the sequence into two
- Divide the number of terms in a counting number form and consider the odd and even position.
- The constant sequence will be given by : $S_n = n \,.\, c$
- The number of terms : $T_n = T_n - T_{n-1}$

KWV 1

Given the combined arithmetic and constant sequence:

3 ; 2 ; 6 ; 2 ; 9 ; 2 ; ...

i. Write down the next **TWO** terms in the sequence.

ii. Calculate the sum of the first 100 terms of the sequence.

iii. Calculate the sum of the first 45 terms of the sequence.

iv. Determine the 85^{th} term

KWV 2

Consider the sequence: $\frac{1}{2}$; 4 ; $\frac{1}{4}$; 7; $\frac{1}{8}$; 10 ;……

a. If the pattern continues in the same way, write down the next TWO terms in the sequence.

b. Calculate the sum of the first 50 terms of the sequence

KWV 3

Given the sequence: $4; x; 32$

Determine the value(s) of x if the sequence is:

i. Arithmetic

ii. Geometric

KWV 4

The following is an arithmetic sequence:

$1 - p\ ;\ 2p - 3\ ;\ p + 5$

a. Calculate the value of p
b. Write down the value of:
   1. The first term of the sequence.
   2. The common difference.
c. Explain why none of the numbers in this arithmetic sequence are perfect squares.

KWV 5

Given the geometric series: 256 + p + 64 – 32 + ……….

a. Determine the value of p
b. Calculate the sum of the first 8 terms of the series.
c. Why does the sum to infinity for this series exist.
d. Calculate s_∞

KWV 6

Log 2 and log 4 are the first 2 terms of arithmetic as well as a geometric sequence. Determine an expression for the nth term of each sequence. Simplify each answer to one term

E.GIVEN SUM FORMULA

- Take note of the formula of calculating the term : $T_n = S_n - S_{n-1}$
- Be in position to calculate the first three terms from the given sum formula, hence general term

KWV 1

The sum to *n* terms of a sequence of numbers is given as: $S_n = \frac{n}{2}(5n+9)$

i. Calculate the first 3 terms
ii. Determine the nth tern
iii. Calculate the sum to 23 terms of the sequence.
iv. Hence, calculate the 23rd term of the sequence.

KWV 2

The sum of the first n terms of a series is given by the formula $S_n = 3^{n-1} + 9$

a. Determine the sum of the first 6 terms
b. Determine the first 3 terms of the sequence.

F.INTERPRETATIONS

KEY:

- Given the last term: implies that T_n is given and you can calculate the first term or number of terms
- If other terms are omitted use the following key : $T_1 = a$, $T_2 = a + d$, $T_3 = a + 2d$ and or : $T_1 = a$, $T_2 = ar$, $T_3 = ar^2$

NB: hence solving simaltenouesly

KWV 1

The first two terms of a geometric sequence and an arithmetic sequence are the same. The first term is 12. The sum of the first three terms of the geometric sequence is 3 more than the sum of the first three terms of the arithmetic sequence. Determine TWO possible values for the common ratio, *r*, of the geometric sequence

KWV 2

The first two terms of an infinite geometric sequence are 8 and $\frac{8}{\sqrt{2}}$. Prove, without the use of a calculator, that the sum of the series to infinity is $16+8\sqrt{2}$.

KWV 3

Three numbers form a geometric sequence. Their sum is 21 and their product is 64.

Find the numbers (show all working)

KWV 4

The first two terms of a geometric sequence are the same as the first two terms of an arithmetic sequence. The first term is 8 and is greater than the second term. The sum of the first three terms of the arithmetic sequence is 1,125 less than the sum of the first three terms of the geometric sequence. Determine the first three terms of each sequence.

G.SIGMA NOTATION

- ✓ Sigma notation offers a useful shorthand method to indicate the sum of a number of terms in a series.
- ✓ The symbol $\sum$ is the Greek capital letter S, and indicates sum.
- ✓ We use the symbol as follows

$$\sum_{i}^{n} T_n$$

- ➢ Means the sum of n-th terms
- ➢ n : stand for last value after substituting in the n-th terms
- ➢ i: stand for the first value after substituting in the n-th terms
- ➢ T_n: stand for the general term
- ➢ NB: always determine the first 3 terms in order to know the type of the pattern e.g. d-arithmetic or r-geometric
- ➢ Number of terms : $n = top - bottom + 1$
- ➢ Given the sum: you can calculate the number of terms
- ➢ If the question says evaluate or calculate it means determine the sum of n-th terms
- ➢ For the sum: First three terms-hence the pattern-no. of terms –the formula
- ➢ Writing in sigma notation: First three terms-hence the pattern-no. of terms –and lastly $i = 1$ for the first value

KWV 1

. The following geometric series is given: $-3 + 24 - 192 + \cdots$ up to 5 terms.

i. Write down the series in sigma notation.

ii. Calculate the sum to 5 terms of the series.

KWV 2

Given: $x + x\left(\frac{x-1}{2}\right) + x\left(\frac{x-1}{2}\right)^2 + \cdots$

i. For what values of x will the series converge?

ii. Hence, determine $\sum_{k=1}^{\infty} x\left(\frac{x-1}{2}\right)^{k-1}$ if $x = \frac{3}{4}$

KWV 3

Calculate the value of n if: $\sum_{k=1}^{n} 2(3)^{k-1} = 531440$

KWV 4

The following geometric series is given: $x = 5 + 15 + 45 + \ldots$ to 20 terms.

i. Write the series in sigma notation.

ii calculate the value of x

KWV 5

Evaluate:

$$\sum_{k=0}^{99}(3k-1)$$

KWV 6

For which values of x will :

$$\sum_{n=1}^{x} 4.3^n < 4400$$

KWV 7

Determine the value of p if:

$$\sum_{k=1}^{\infty} 27p^k = \sum_{t=1}^{12}(24-3t)$$

KWV 8

A convergent geometric series consisting of only positive terms has first term a, constant r

r and n^{th} term, T_n, such that $\sum_{n=3}^{\infty} T_n = \frac{1}{4}$.

i. If $T_1 + T_2 = 2$, write down an expression for a in terms of r

ii. Calculate the values of a and r

KWV 9

A geometric series has a constant ratio of $\frac{1}{2}$ and a sum to infinity of 6.

1 Calculate the first term of the series.

2 Calculate the 8^{th} term of the series.

3 Given: $\sum_{k=1}^{n} 3(2)^{1-k} = 5{,}8125$ Calculate the value of n.

4 If $\sum_{k=1}^{20} 3(2)^{1-k} = p$, write down $\sum_{k=1}^{20} 24(2)^{-k}$ in terms of p.

KWV 10

(a) Given: $\sum_{x=1}^{y} 5x + 2 = 36$. Determine y.

(b) An arithmetic sequence is given as: $(2p+14)\,;\,3p\,;\,(p+7)\,;...$

(1) Determine p.

(2) Hence determine the sum of the first 38 terms.

(c) The following sequence is given:

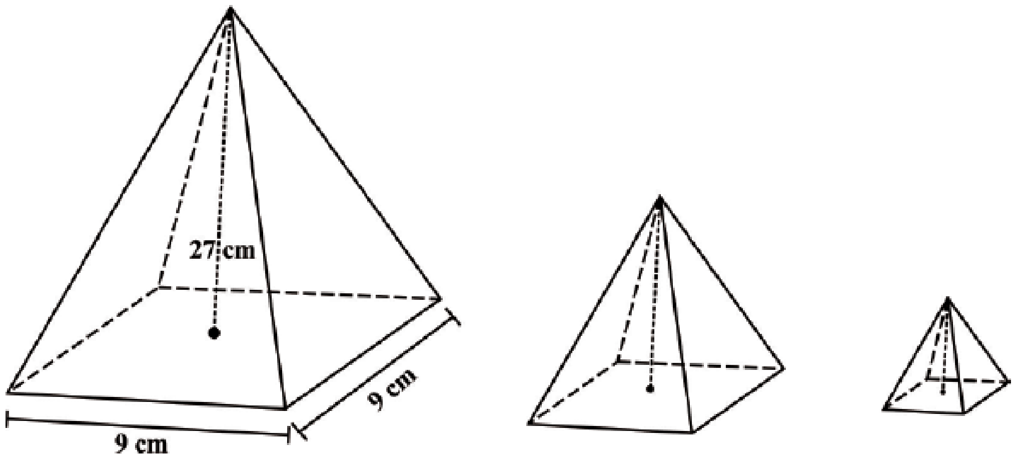
$$\frac{2^3-1}{1};\frac{3^3-1}{2};\frac{4^3-1}{3};\frac{5^3-1}{4}\ ...$$

Given that the sequence is quadratic, determine the n^{th} term. Simplify your answer as far as possible.

(d) The sum of the first n terms of a geometric sequence $9 + 6 + 4 + \ldots$ is greater than 25. Calculate the smallest value of n.

(e) A solid right pyramid with a square base has a perpendicular height of 27 cm. The base has a length of 9 cm. This pyramid is replicated under the following constraints:

The base area and perpendicular height of each replica is one third of the previous one.



Determine the total volume of all the pyramids replicated, if this replication continues indefinitely.

Useful formula: Volume of a pyramid $= \frac{1}{3}\ \text{A} \times \text{H}$.

MERCY!!!!!

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