
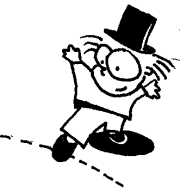




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NUMBER PATTERNS

You will find that patterns occur in almost every topic in maths! They often help us to make sense of things and, most of all, we learn to think!

The National Curriculum Statement says of Patterns . . .

**“The mastery of maths depends on being able to:
investigate/explain/recognise/extend patterns;
formulate conjectures (“have a guess at how it works”);
prove or disprove your conjecture;
generate a “rule” i.e. generalise;
see links within and across topics and real life.”**



Patterns (or sequences) are fun and we will cover a wide range of examples. Try to do these on your own as much as possible. Various approaches will, however, also be suggested to help you get the idea. Enjoy the challenge!

GUIDED INVESTIGATION 1

- encouraging recognition of standard sequences !

Some examples - try these . . .

- (1) 2 ; 4 ; 6 ; 8 ; . . .
- (2) 3 ; 6 ; 9 ; 12 ; . . .
- (3) 2 ; 4 ; 8 ; 16 ; . . .
- (4) 1 ; 4 ; 9 ; 16 ; . . .



These are “sequences” of numbers and we refer to the numbers as **TERMS** and use the symbol **T** as follows:

T₁ = 2 means : the first term is 2
T₂ = 4 means: the second term is 4

In each case, say what

(a) the next number would be, (b) the tenth, (c) the 100th and (d) the nth ?

Answers to Guided Investigation 1

	(a) Next number	(b) 10 th number	(c) 100 th number	(d) n th number
(1)	10	2(10) = 20	2(100) = 200	2n
(2)	15	3(10) = 30	3(100) = 300	3n
(3)	32 (= 2 ⁵)	2 ¹⁰ (= 1 024)	2 ¹⁰⁰ (= 1,26 × 10 ³⁰)	2 ⁿ
(4)	25	10 ² (= 100)	100 ² (= 10 000)	n ²

How have you done ?

Do you see how necessary it is to think? You can develop the skills to analyse, predict and generalise. So, let’s discuss some possible approaches . . .

Discussion

There was more than one way to see what the next number would be . . .

If you said: We just add 2 each time, that was fine, but, if you *recognise* that this is the set of *even numbers*, and that

the 1st number is 2 × 1, i.e. T₁ = 2(1) ;

the 2nd number is 2 × 2, i.e. T₂ = 2(2) ;

the 3rd number is 2 × 3, i.e. T₃ = 2(3)



then, you could say: the 5th number is 2 × 5, i.e. T₅ = 2(5)

the 10th number is 2 × 10, i.e. T₁₀ = 2(10)

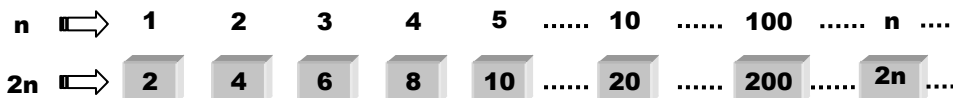
the 100th number is 2 × 100, i.e. T₁₀₀ = 2(100)

In general: ∴ the nth number is 2 × n, i.e. T_n = 2n

2n is the GENERAL TERM for the set of EVEN numbers or, we say **2n** is the STANDARD FORM of an EVEN number (because an even number is always 2 × a natural number).

Imagine a row of lockers numbered 1; 2; 3 . . .

Let’s place the even numbers inside:



The term (number) in the locker depends entirely on the locker number, not so?

If the locker number is **n**, the term is **T_n**

and, in this case, **T_n = 2n**

Repeat the ‘discussion’ above for : the MULTIPLES of 3 in e.g. (2)

the POWERS of 2 in e.g. (3)

the SQUARES of natural numbers in e.g. (4)



The final GENERALISATIONS (“rules”):

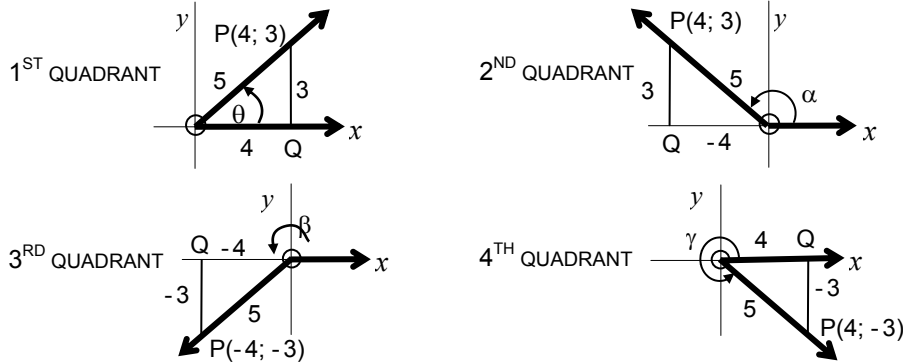
(1) T_n = 2n

(2) T_n = 3n

(3) T_n = 2ⁿ

(4) T_n = n²

SUMMARY OF OUR FINDINGS



1 ST QUADRANT	2 ND QUADRANT	3 RD QUADRANT	4 TH QUADRANT
$\sin \theta = \frac{3}{5}$	$\sin \alpha = \frac{3}{5}$	$\sin \beta = -\frac{3}{5}$	$\sin \gamma = -\frac{3}{5}$
$\cos \theta = \frac{4}{5}$	$\cos \alpha = -\frac{4}{5}$	$\cos \beta = -\frac{4}{5}$	$\cos \gamma = \frac{4}{5}$
$\tan \theta = \frac{3}{4}$	$\tan \alpha = -\frac{3}{4}$	$\tan \beta = \frac{3}{4}$	$\tan \gamma = -\frac{3}{4}$

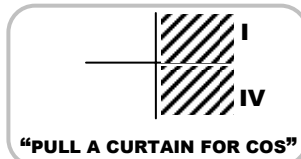
Examine these results and use them to know and understand . . .

SIGNS of your trig ratios IN A FLASH!

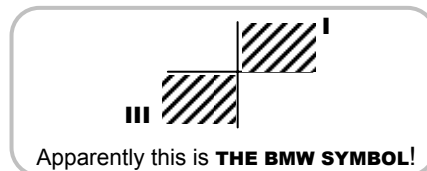
$\sin \theta = \frac{y}{r}$ and **y is positive** in **I** and **II**
 \therefore **sin theta is POSITIVE** in quadrants 1 & 2
 (and negative in 3 & 4)



$\cos \theta = \frac{x}{r}$ and **x is positive** in **I** and **IV**
 \therefore **cos theta is POSITIVE** in quadrants 1 & 4
 (and negative in 2 & 3)



$\tan \theta = \frac{y}{x}$ and **x & y have the same sign** in **I** and **III**
 \therefore **tan theta is POSITIVE** in quadrants 1 & 3
 (and negative in 2 & 4)

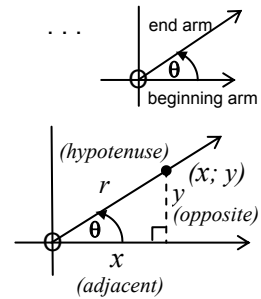


It is really easy to get these PICTURES into your head so that you know the SIGNS of your trig ratios IN A FLASH! NO MORE CAST RULE !!!

How to find the trig ratios of ANY angle: 4 STEPS !

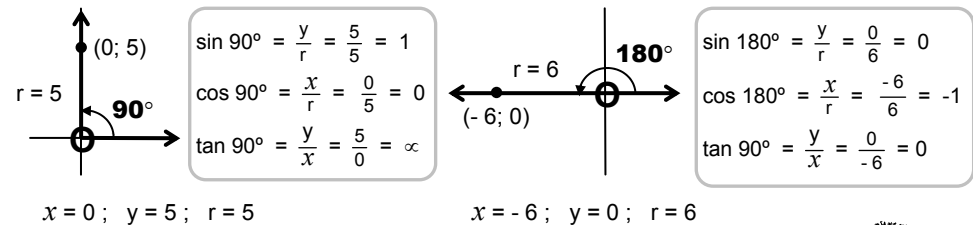
- Place the **L** in **STANDARD POSITION** (starting at \vec{OX})
- Pick a point **(x; y)** on the ‘end arm’ of the **L**
- we’ll call its distance from the origin **r**
- Write down **x =** **y =** **r =**
- Apply the **DEFINITIONS**

$\sin \theta = \frac{y}{r}$ $\cos \theta = \frac{x}{r}$ $\tan \theta = \frac{y}{x}$



The Trig ratios of multiples of 90°

Use this procedure to find the trig ratios of 0°; 90°; 180°; 270° & 360°



Do 0°, 270° and 360° too. Check your answers below.

SUMMARY

$\theta:$	0°	→	90°	→	180°	→	270°	→	360°
$\sin \theta:$	0	---	1	---	0	---	-1	---	0
$\cos \theta:$	1	---	0	---	-1	---	0	---	1
$\tan \theta:$	0	---	∞	---	0	---	$\pm \infty$	---	0

As $\theta: 0^\circ \rightarrow 360^\circ$

