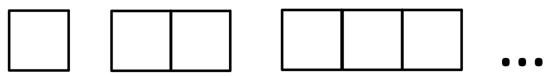
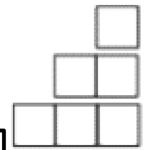
M9 - 6.1 - Find Equation Toothpick Notes

The following diagrams are made out of toothpicks. Create a Table of Values.



$n = 1$ $n = 2$ $n = 3$ …



n	t
1	4
2	7
3	10

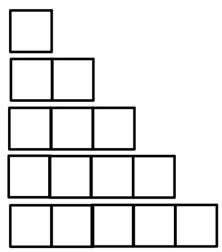
Words Problems
1) Let Statements
2) Table of Values
3) Equation (Logic)
4) Substitute
5) Solve (Algebra)
6) Answer in English!
7) Check Answer!

Let Statements

Let $n =$ the diagram number
Let $t =$ the number of toothpicks $\boxed{t \neq +}$

Find the number of toothpicks of the 4th and 5th diagram. ($n = 4, 5$) Then $n = 0$.

	0	1	-3
	n	t	
	1	4	
$+1$	2	7	$+3$
$+1$	3	10	$+3$
$+1$	4	13	$+3$
$+1$	5	16	$+3$



$t = \frac{3}{1}n + 1$ → $\boxed{t = 1, n = 0}$

Find the Equation of the Table (TOV)

$t = n + 3$ Try for $n = 1$

$\cancel{t = n + 3}$

$\cancel{t = 4n}$ See if pattern works for $n = 2,3$ ...

$\cancel{t = 2n + 2}$ If not cross it off

$t = 3n + 1$ Repeat until works for all n.

How many toothpicks in the 10th diagram?

$\boxed{n = 10}$

$t = 3n + 1$ Start with Equation
$t = 3(10) + 1$ Substitute
$t = 30 + 1$ Solve

$t = 31$

The 50th diagram has 31 toothpicks.

Which diagram has 37 toothpicks?

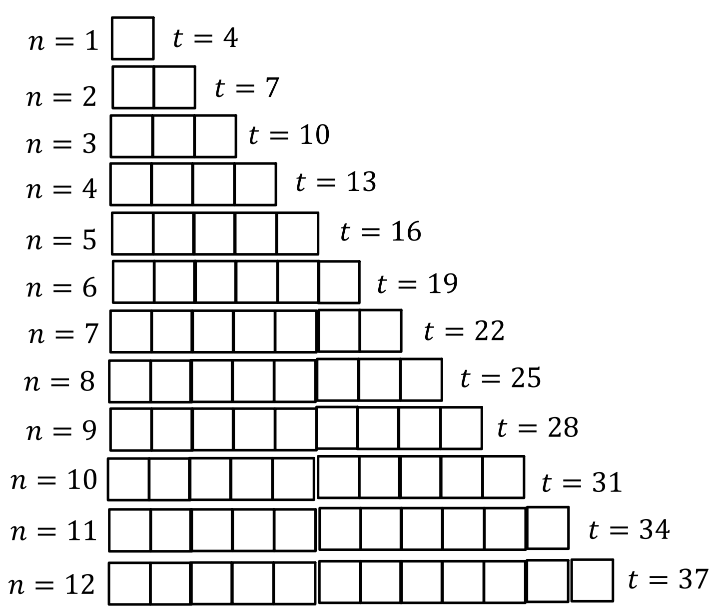
$\boxed{t = 37}$

$t = 3n + 1$ Start with Equation
$(37) = 3n + 1$ Substitute
$-1 \quad -1$ Solve

$$36 = 3n$$
$$\frac{36}{3} = \frac{3n}{3}$$
$$12 = n$$

$n = 12$

The 12th diagram has 37 toothpicks.



M9 - 6.2 - Equation TOV Notes

Find the equation from the Table of Values (TOV).

$\boxed{\text{Right Letter} = 1{,}2{,}3 \text{ Letter}}$

n	t
1	3
2	4
3	5

$\cancel{t = 3n}$

$t = n + 2$

1) Try for $n = 1$ (Logic)
2) See if pattern works for $n = 2{,}3$ ... by Substitution
3) If not cross it off
4) Repeat until works for all n.

Check Answer

$\boxed{\text{Do this in your head!}}$ $\boxed{\text{Substitute with Brackets}}$

$\cancel{t = 3n}$
$\cancel{(3) = 3(1)}$
$\cancel{3 = 3}$ ✓

$\cancel{t = 3n}$
$(4) \neq 3(2)$
$3 \neq 3$ ✗

$t = n + 2$
$(3) = (1) + 2$
$3 = 3$ ✓

$t = n + 2$
$(4) = (2) + 2$
$4 = 4$ ✓

$t = n + 2$
$(5) = (3) + 2$
$5 = 5$ ✓

Simple Patterns

	0	2	
-1	n	t	-1
	1	3	
$+1$	2	4	$+1$
$+1$	3	5	$+1$

$t = \frac{1}{1}n + 2 \rightarrow \boxed{t = 2, n = 0}$

Sideways Tables

n	1	2	3
t	3	4	5

As Blanks

$\underline{\ 3\ }, \underline{\ 4\ }, \underline{\ 5\ }$

$Term\ 1{,}2{,}3$

$\underline{t = 3}, \underline{t = 4}, \underline{t = 5}$

$n = 1,\quad n = 2,\quad n = 3$

$$\text{Right Letter} = \frac{\textit{Change on Right letter}}{\textit{Change in Left letter}}\ \text{Left Letter} \pm \text{Value of Right Letter when Left Letter} = 0$$

Simple Patterns (Lines)

n	t
1	2
2	5
3	8

$t = 3n - 1$

n	t
1	0
2	-1
3	-2

$t = -n + 1$

	0	1	
-1	n	t	$-\frac{3}{2}$
	1	$\frac{5}{2}$	
$+1$	2	4	$+\frac{3}{2}$
$+1$	3	$\frac{11}{2}$	$+\frac{3}{2}$
$+1$	4	7	$+\frac{3}{2}$
$+1$	5	$\frac{17}{2}$	$+\frac{3}{2}$
$+1$	6	10	$+\frac{3}{2}$

$t = \frac{3}{2}x + 1$

	0	1	
-2	n	t	-3
$+2$	2	4	$+3$
$+2$	4	7	$+3$
	6	10	

$t = \frac{3}{2}x + 1$

Complex Patterns (Curves)

n	t
1	2
2	5
3	10

$t = n^2 + 1$

n	t
1	1
2	8
3	27

$t = n^3$

n	t_n
1	0
2	2
3	6

$t = n^2 - n$

n	t_n
1	1
4	2
9	3

$t = \sqrt{n}$