EQUITY
LEARNING PLACE

Elementary Math Topical (Number Pattern)

Question 1:

Consider the sequence 5 , 7, 9, 11, 13 , …

a) Write down the sixth term in the sequence.

b) Write down an expression, in terms of n , for the n th term of the sequence.

Question 2:

The first four terms of a sequence are as follows:

78 75 72 69

a) Write down the tenth term of the sequence.

b) Write down an expression, in terms of n, for the nth term of the sequence.

Question 3:

The first four terms in a sequence are 45, 41, 37 and 33.

a) Find an expression, in terms of *n*, for the *n*th term, of this sequence.

b) Evaluate the 25^{th} term in the sequence.

c) Determine whether the number, −11, is a term of this sequence

Question 4:

These are the first four terms in a sequence.

3, 6, 11, 18, …

a) Write down the eighth term in the sequence.

b) Write down an expression, in terms of *n*, for the *n*th term in the sequence.

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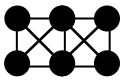
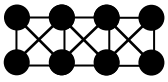
Question 5:

The following diagrams show the number of sticks and dots required to form a series of patterns.

Step 1



Step 2



Step 3

i) Complete the table below:

Step Number (n)	Number of stick (S)	Number of dots (D)
1	6	4
2	11	6
3	16	8
4		
5		

ii) Without drawing further, determine the number of sticks in Step 10.

iii) Without drawing further, determine the value of n that will result in 48 dots.

iv) Derive a formula for finding the number of sticks (S) for step n.

Question 6:

$$3^2 + 4^2 = x^2$$

$$3^3 + 4^3 + 5^3 = y^3$$

a) Find the values of x and y in the above equations.

b) Alan commented that he is able to write down the next line following the above pattern. Write down the next line of this pattern.

c) By considering powers of even and odd numbers, explain, without calculating the exact value of each term, why Alan's conjecture in **(b)** is not true.

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Question 7:

Consider the following pattern.

$$1-\frac{1}{2} = \frac{1}{2}$$
$$\frac{1}{2}-\frac{1}{3} = \frac{1}{6}$$
$$\frac{1}{3}-\frac{1}{4} = \frac{1}{12}$$
$$\frac{1}{4}-\frac{1}{5} = a$$

a) State the value of a.

b) Write down the 10^{th} line of the pattern.

c) Write down the n^{th} line of the pattern.

d) Use the pattern to find the sum of $\frac{1}{2}+\frac{1}{6}+\frac{1}{12}+...+\frac{1}{9900}$.

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Question 8:

Sticks of equal length are used to form the patterns as shown.

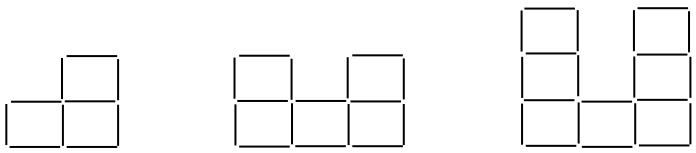

Figure Figure Figure

a) Draw Figure 5.

b) The table below shows the relationship between the figure, the number of squares formed and the number of sticks used. Complete the table for $n = 5$ and $n = 6$.

Figure (n)	No. of squares formed (Q)	No. of sticks used (T)
1	3	10
2	5	16
3	7	22
4	9	28
5		
6		

c) Express T in terms of n.

d) Hence, find the number of sticks used for Figure 30.

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Question 9:

The first three terms in a sequence of numbers, T_1, T_2, T_3, … are given below.

$$T_1 = 1^2 + 7 = 8$$

$$T_2 = 2^2 + 14 = 18$$

$$T_3 = 3^2 + 21 = 30$$

a) Find T_4.

b) Find an expression, in terms of *n*, for T_n.

c) Evaluate T_{50}.

The first four terms in a different sequence of numbers, P_1, P_2, P_3, … are

$$8,\ 13,\ 18,\ 23, \ldots$$

d) Find an expression, in terms of *n*, for the *n*th term, P_n, of this sequence.

e) Explain why the number 102 is not in this sequence.

f) By forming an equation in terms of *n*, find the value(s) of *n* such that $\frac{T_n}{P_n} = 1$.

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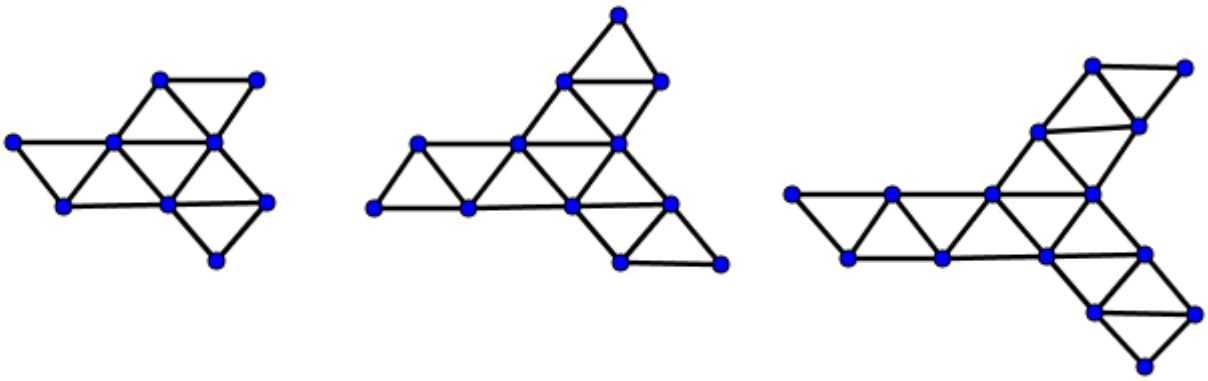
Question 10:



1st pattern 2nd pattern 3rd pattern

Pattern	Number of triangles, T	Number of straws, S	Number of thumbtacks, t
1st	7	15	9
2nd	10	21	12
3rd	13	27	15
4th	16	33	18
5th	x	y	z
n^{th}	...	...	...

(a) Write down the value of x, of y and of z.

(b) In the n^{th} pattern, express in terms of n,

(i) the number of triangles formed,

(ii) the number of straws used.

(c) In which pattern would 108 thumbtacks be used?

(d) Explain why the value of 605 could not appear in Column S of the table.

(e) Write down an expression connecting

(i) S and T,

(ii) S, T and t.

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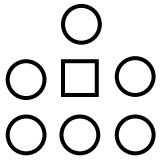
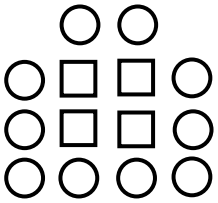
Question 11:

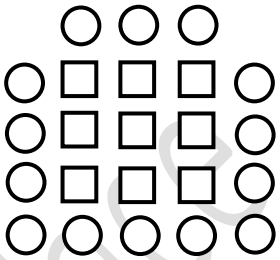
Alice arranges tables and chairs according to the number of people attending the meeting in the following arrangement.



Layout 1



Layout 2



Layout 3

The number of tables and chairs are recorded in the table below.

Layout Number (n)	Number of tables (t)	Number of chairs (c)
1	1	6
2	4	10
3	9	14
⋮	⋮	⋮
7	a	b

(a) Write down the values of a and b.]

(b) Write down an equation connecting n and t.

(c) Write down an equation connecting n and c.

(d) Is it possible for the value of c to be 50? Explain your answer.

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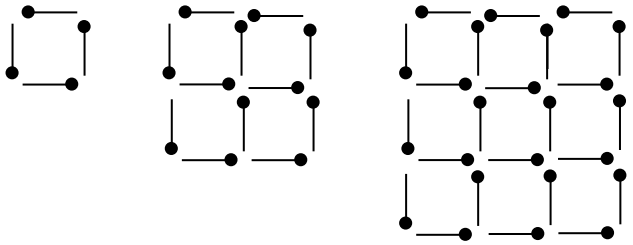
Question 12:

14) John used match sticks to make a series of squares. The first three squares he constructed are as shown below.



n = 1 $n = 2$ $n = 3$

For each square, *T* represents the number of match sticks used, *S* the total number of small squares formed and *P* the number of points at which 2 or more match sticks meet.

The values of *T*, *S* and *P* are tabulated as shown in the following.

n	Number of match sticks used T_n	Number of small squares formed S_n	Number of points at which 2 or more match sticks meet P_n
1	4	1	4
2	12	4	9
3	24	9	16
4	*x*	*y*	*z*

(a) Write down the values of *x*, *y* and *z*.

(b) Find an expression, in terms of *n*, for S_n and P_n.

(c) Find the value of *P* when *S* = 36.

(d) Write down the formula connecting T_n, S_n and P_n.

(e) Hence or otherwise, find the value of *P* when *T* = 364 and *S* = 169.

(f) Give a reason why the number 112 cannot appear in column *S*.

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Question 13:

The first four terms in a sequence of numbers, T_1, T_2, T_3 and T_4 are given below.

$$T_1 = 2(1)^2 + 1 = 3$$
$$T_2 = 2(2)^2 + 3 = 11$$
$$T_3 = 2(3)^2 + 5 = 23$$
$$T_4 = 2(4)^2 + 7 = 39$$

(a) Write down an expression for T_5 and evaluate it.

(b) Evaluate T_{25}.

(c) Find an expression, in terms of *n*, for T_n.

(d) What term will the number 2811 be in the sequence?

(e) Explain why the number in the sequence cannot be an even number.

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Question 14:

The first four terms in a sequence of numbers are given below.

$$T_1 = 4 - 3 = 1$$
$$T_2 = 9 - 6 = 3$$
$$T_3 = 16 - 9 = 7$$
$$T_4 = 25 - 12 = 13$$

a) Find T_5.

b) Show that the *n*th term of the sequence T_n , is given by $T_n = n^2 - n + 1$.

c) T_p and T_{p+1} are consecutive terms in the sequence. Find and simplify an expression, in terms of *p*, for $T_{p+1} - T_p$.

Question 15:

Consider the number pattern.

$$1 = 1^2$$
$$1 + 3 = 2^2$$
$$1 + 3 + 5 = 3^2$$
$$1 + 3 + 5 + 7 = 4^2$$
$$\vdots$$
$$\vdots$$

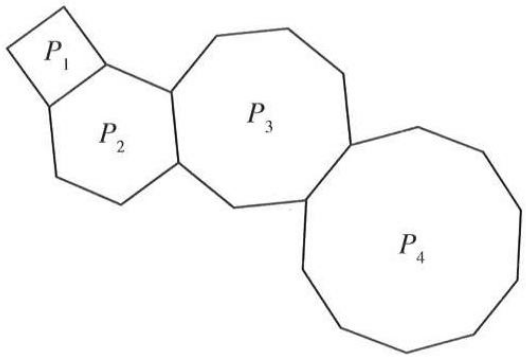
a) Write down the 5th and 6th lines of the pattern.

Given that the n^{th} line is $1 + 3 + 5 + \ldots + (2n - 1) = 484$,

b) find the number of terms which are added in the n^{th} line,

c) find the value of the last term added in the n^{th} line.

Question 16:



The diagram above shows the first four polygons P_1, P_2, P_3 and P_4 in a sequence of connected polygons. The table below shows the number of sides each polygon has.

Polygon	P_1	P_2	P_3	P_4
No. of sides	4	6	8	10

(i) How many sides does polygon P_6 have?

(ii) Find the size of one interior angle of polygon P_7.

(iii) Write down an expression, in terms of n, for the number of sides P_n has.

(b) The nth term of a sequence is given by $T_n = \frac{n(n+1)}{2}$.

(i) Find the first three terms of the sequence.

(ii) Which term of the sequence has a value 210?

(iii) Explain why 100 cannot be a term of the sequence.

Question 17:

The first four terms in a sequence of numbers, $a_1, a_2, a_3, a_4, \ldots$, are given below.

$$a_1 = 3 - 3^0 = 2$$
$$a_2 = 5 - 3^1 = 2$$
$$a_3 = 7 - 3^2 = -2$$
$$a_4 = 9 - 3^3 = -18$$

a) Find an expression, in terms of n, for the nth term, a_n, of the sequence.

b) Explain why the value a_n will always be divisible by 2.

Question 18:

Consider the pattern

$$2^2 - 1^2 = 3$$
$$3^2 - 2^2 = 5$$
$$4^2 - 3^2 = 7$$
$$5^2 - 4^2 = 9$$
$$\vdots$$
$$x^2 - y^2 = 321$$
$$\vdots$$

a) Write down the seventh line in the pattern.

b) Find the value of $150^2 - 149^2$.

c) Find integer values of x and y which satisfy the equation $x^2 - y^2 = 321$.