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The P-Value models with its mathematical formulas and solution-boxes

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ABSTRACT

The P-Value models were designed by the researcher to teach Place Values in mathematics. The P-Value models are tools which is methodology in nature. It depicts yet another / alternative practical way of teaching Place Values in Mathematics to the usual / known method (Appendix A; Appendix B) of teaching Place Value (Kumassah, 2012; Price 2002; Price, 2001). The mathematical formulas of the P-Value models shows the step (s) / movement (s) involved in arriving at a specific number (s) / figure (s) and also the total / sum / overall number (s) / figure (s) in each P-Value models. The mathematical formulas of the P-Value models can be employed in teaching and used at the industry level. The researcher is of the view that the use of the P-Value models may help teachers teach Place Value effectively and students learn meaningfully of Place Values in mathematics. The P-Value model solution-boxes serve as a calculator to the actual calculators. It gives the same answers as that of the actual calculators and also shows and reveals the hidden mathematical operations of the actual calculator. Instead of a student manipulating the hidden operations of an actual calculator, with the P-Value model solution-box he/she practically sees and manipulates that hidden operations of a calculator.

Introduction

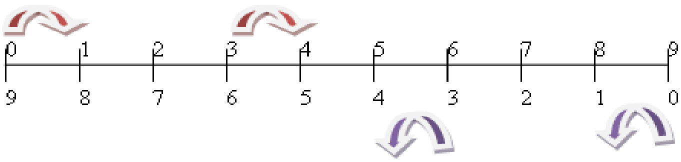
The P-Value Models

The One's (1's) Place Value Concept

NB:

- The word 'and' = Addition (+)
- The movement on each place value is from both 'right' to 'left' and vice versa.
- A straight line is divided into nine (9) equal parts
- The One's (1's) Place Value starts from zero (0) and ends at nine (9)

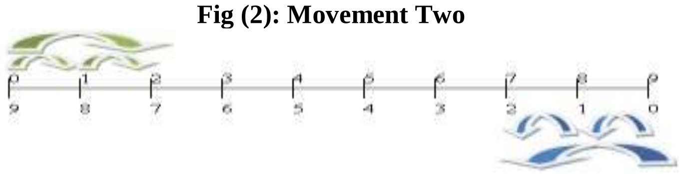
Fig (1): Movement One



Movement One (Jump one step from zero to the right and or vice versa)

0 to 1 = 1
1 to 2 = 1
2 to 3 = 1
3 to 4 = 1
4 to 5 = 1
5 to 6 = 1
6 to 7 = 1
7 to 8 = 1
8 to 9 = 1

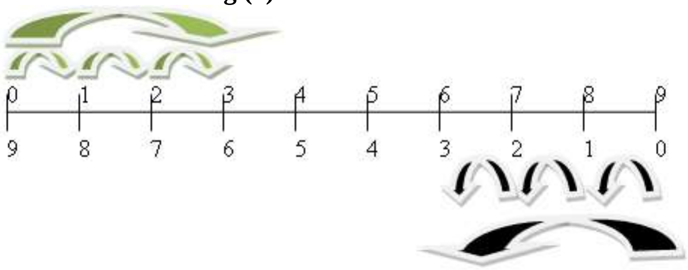
Fig (2): Movement Two



Movement Two (Jump two steps from zero to the right and or vice versa)

0 to 2 = 0 to 1 and (+) 1 to 2 = 1 + 1 = 2×1 = 2
1 to 3 = 1 to 2 and (+) 2 to 3 = 1 + 1 = 2×1 = 2
2 to 4 = 2 to 3 and (+) 3 to 4 = 1 + 1 = 2×1 = 2
3 to 5 = 3 to 4 and (+) 4 to 5 = 1 + 1 = 2×1 = 2
4 to 6 = 4 to 5 and (+) 5 to 6 = 1 + 1 = 2×1 = 2
5 to 7 = 5 to 6 and (+) 6 to 7 = 1 + 1 = 2×1 = 2
6 to 8= 6 to 7 and (+) 7 to 8 = 1 + 1 = 2×1 = 2
7 to 9 = 7 to 8 and (+) 8 to 9 = 1 + 1 = 2×1 = 2
NB: 2×1= 1 + 1, means one (1) has been repeated two times.

Fig (3): Movement Three



Movement Three (Jump three steps from zero to the right and or vice versa)

0 to 3 = 0 to 1 and 1 to 2 and 2 to 3 = 1 + 1 + 1 = 3×1 = 3
1 to 4 = 1 to 2 and 2 to 3 and 3 to 4 = 1 + 1 + 1 = 3×1 = 3
2 to 5 = 2 to 3 and 3 to 4 and 4 to 5 = 1 + 1 + 1 = 3×1 = 3
3 to 6 = 3 to 4 and 4 to 5 and 5 to 6 = 1 + 1 + 1 = 3×1 = 3
4 to 7 = 4 to 5 and 5 to 6 and 6 to 7 = 1 + 1 + 1 = 3×1 = 3
5 to 8 = 5 to 6 and 6 to 7 and 7 to 8 = 1 + 1 + 1 = 3×1 = 3
6 to 9= 6 to 7 and 7 to 8 and 8 to 9 = 1 + 1 + 1 = 3×1 = 3
NB: 3×1= 1 + 1 + 1, means one (1) has been repeated three times.

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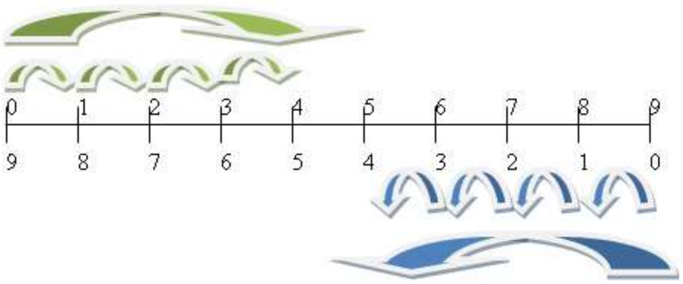
Fig (4): Movement Four



Movement Four (Jump four steps from zero to the right and or vice versa)

0 to 4 = 0 to 1 and 1 to 2 and 2 to 3 and 3 to 4 = 1 + 1 + 1 + 1 = 4×1 = 4

1 to 5 = 1 to 2 and 2 to 3 and 3 to 4 and 4 to 5 = 1 + 1 + 1 + 1 = 4×1 = 4

2 to 6 = 2 to 3 and 3 to 4 and 4 to 5 and 5 to 6 = 1 + 1 + 1 + 1 = 4×1 = 4

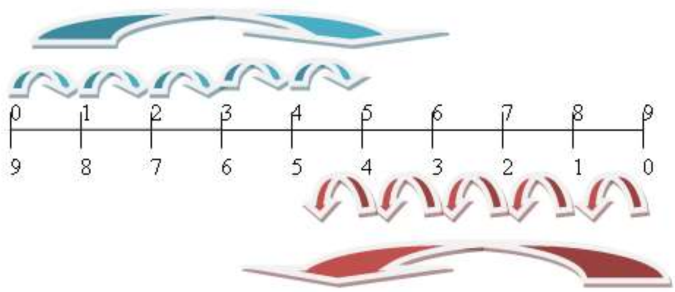
3 to 7 = 3 to 4 and 4 to 5 and 5 to 6 and 6 to 7 = 1 + 1 + 1 + 1 = 4×1 = 4

4 to 8 = 4 to 5 and 5 to 6 and 6 to 7 and 7 to 8 = 1 + 1 + 1 + 1 = 4×1 = 4

5 to 9 = 5 to 6 and 6 to 7 and 7 to 8 and 8 to 9 = 1 + 1 + 1 + 1 = 4×1 = 4

NB: 4×1= 1 + 1 + 1 + 1, means one (1) has been repeated four times.

Fig (5): Movement Five



Movement Five (Jump five steps from zero to the right and or vice versa)

0 to 5 = 0 to 1 and 1 to 2 and 2 to 3 and 3 to 4 and 4 to 5 = 1 + 1 + 1 + 1 +1 = 5×1 = 5

1 to 6 = 1 to 2 and 2 to 3 and 3 to 4 and 4 to 5 and 5 to 6 = 1 + 1 + 1 + 1 +1 = 5×1 = 5

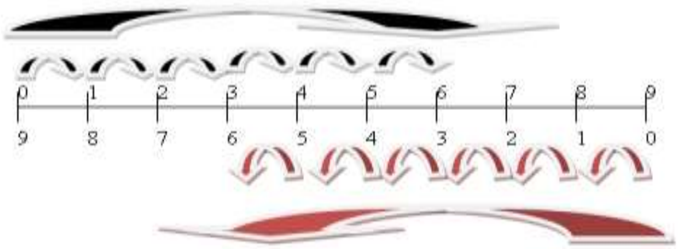
2 to 7 = 2 to 3 and 3 to 4 and 4 to 5 and 5 to 6 and 6 to 7 = 1 + 1 + 1 + 1 +1 = 5×1 = 5

3 to 8 = 3 to 4 and 4 to 5 and 5 to 6 and 6 to 7 and 7 to 8 = 1 + 1 + 1 + 1 +1 = 5×1 = 5

4 to 9 = 4 to 5 and 5 to 6 and 6 to 7 and 7 to 8 and 8 to 9 = 1 + 1 + 1 + 1 +1 = 5×1 = 5

NB: 5×1= 1 + 1 + 1 + 1 +1, means one (1) has been repeated five times

Fig (6): Movement Six



Movement Six (Jump six steps from zero to the right and or vice versa)

0 to 6 = 0 to 1 and 1 to 2 and 2 to 3 and 3 to 4 and 4 to 5 and 5 to 6 = 1 + 1 + 1+ 1 +1 + 1 = 6×1 = 6

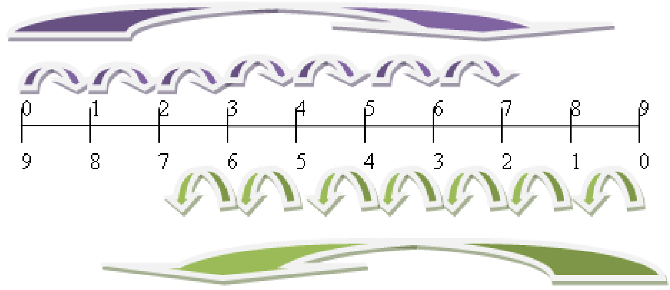
1 to 7 = 1 to 2 and 2 to 3 and 3 to 4 and 4 to 5 and 5 to 6 and 6 to 7 = 1 + 1 + 1+ 1 +1 + 1 = 6×1 = 6

2 to 8 = 2 to 3 and 3 to 4 and 4 to 5 and 5 to 6 and 6 to 7 and 7 to 8 = 1 + 1 + 1+ 1 +1 + 1 = 6×1 = 6

3 to 9 = 3 to 4 and 4 to 5 and 5 to 6 and 6 to 7 and 7 to 8 and 8 to 9 = 1 + 1 + 1+ 1 +1 + 1 = 6×1 = 6

NB: 6×1= 1 + 1 + 1 + 1 +1+ 1, means one (1) has been repeated six times

Fig (7): Movement Seven



Movement Seven (Jump seven steps from zero to the right and or vice versa)

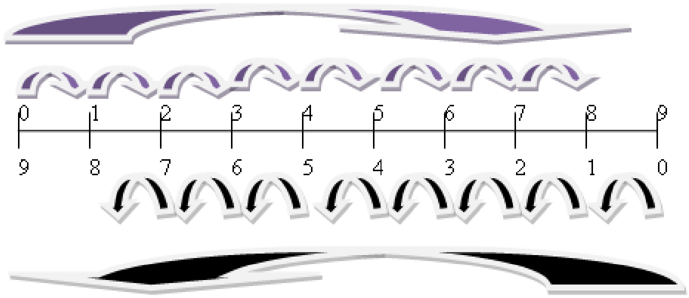
0 to 7 = 0 to 1 and 1 to 2 and 2 to 3 and 3 to 4 and 4 to 5 and 5 to 6 and 6 to 7 = 1 + 1 + 1 + 1 +1 + 1 +1 = 7×1 = 7

1 to 8 = 1 to 2 and 2 to 3 and 3 to 4 and 4 to 5 and 5 to 6 and 6 to 7 and 7 to 8 = 1 + 1 + 1 + 1 +1 + 1 +1 = 7×1 = 7

2 to 9 = 2 to 3 and 3 to 4 and 4 to 5 and 5 to 6 and 6 to 7 and 7 to 8 and 8 to 9 = 1 + 1 + 1 + 1 +1 + 1 +1 = 7×1 = 7

NB: 7×1= 1 + 1 + 1 + 1 +1+ 1 + 1, means one (1) has been repeated seven times

Fig (8): Movement Eight



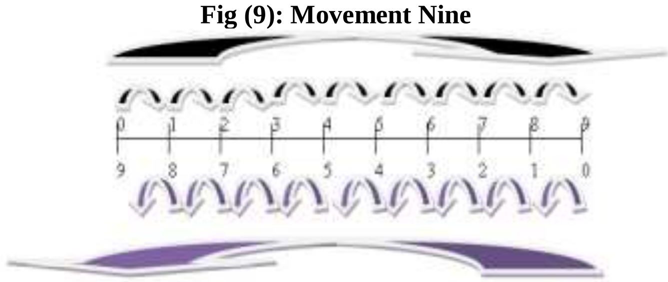
Movement Eight (Jump eight steps from zero to the right and or vice versa)

0 to 8 = 0 to 1 and 1 to 2 and 2 to 3 and 3 to 4 and 4 to 5 and 5 to 6 and 6 to 7 and 7 to 8 = 1 + 1 + 1 + 1 +1 + 1 +1 + 1= 8×1 = 8

1 to 9 = 1 to 2 and 2 to 3 and 3 to 4 and 4 to 5 and 5 to 6 and 6 to 7 and 7 to 8 and 8 to 9 = 1 + 1 + 1 + 1 +1 + 1 +1 + 1= 8×1 = 8

NB: 8×1= 1 + 1 + 1 + 1 +1+ 1 + 1 + 1, means one (1) has been repeated eight times

Fig (9): Movement Nine



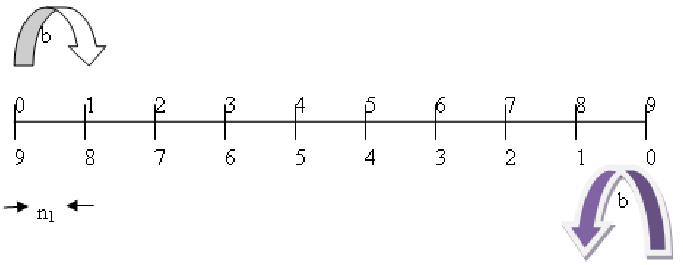
Movement Nine (Jump nine steps from zero to the right and or vice versa)

0 to 9 = 0 to 1 and 1 to 2 and 2 to 3 and 3 to 4 and 4 to 5 and 5 to 6 and 6 to 7 and 7 to 8 and 8 to 9 = 1 + 1 + 1 + 1 +1 + 1 +1 + 1 + 1 = 9×1 = 9

NB: 9×1= 1 + 1 + 1 + 1 +1+ 1 + 1 + 1 + 1, means one (1) has been repeated nine times

Mathematical proves of the One's (1's = n_1) Place Value

Fig 10: Diagram of Mathematical proves of the One's (1's = n_1) Place Value



Let

n_{th} = all Place Values,

y_{nth} = answer for all Place Values,

n_1 = 1 for One's (1's) Place value,

b = movement (s) within the One's (1's) Place Value

› $y_b = an_{(1)}$

For movement one on the One's ($n_{(1)}$) Place Value, › b_1 = 1 and $n_{(1)}$ = 1

› $y_b = an_{(1)} = y_b = y_1 = 1n_{(1)} = 1×1 = 1^2 = 1$

:. $y_1 = 1$

For movement two on the One's ($n_{(1)}$) Place Value, › b_2 = 2 and $n_{(1)}$ = 1

› $y_b = an_{(1)} = y_b = y_2 = 2n_{(1)} = 2×1 = 1 + 1 = 2$

:. $y_2 = 2$

For movement three on the One's ($n_{(1)}$) Place Value, › b_3 = 3 and $n_{(1)}$ = 1

› › $y_b = an_{(1)} = y_b = y_3 = 3n_{(1)} = 3×1 = 1 + 1 + 1 = 3$

:. $y_3 = 3$

For movement four on the One's ($n_{(1)}$) Place Value, › b_4 = 4 and $n_{(1)}$ = 1

› › $y_b = an_{(1)} = y_b = y_4 = 4n_{(1)} = 4×1 = 1 + 1 + 1 + 1 = 4$

:. $y_4 = 4$

For movement five on the One's ($n_{(1)}$) Place Value, › b_5 = 5 and $n_{(1)}$ = 1

› › $y_b = an_{(1)} = y_b = y_5 = 5n_{(1)} = 5×1 = 1 + 1 + 1 + 1 + 1 = 5$

:. $y_5 = 5$

For movement six on the One's ($n_{(1)}$) Place Value, › b_6 = 6 and $n_{(1)}$ = 1

› › $y_b = an_{(1)} = y_b = y_6 = 6n_{(1)} = 6×1 = 1 + 1 + 1 + 1 + 1 + 1 = 6$

:. $y_6 = 6$

For movement seven on the One's ($n_{(1)}$) Place Value, › b_7 = 7 and $n_{(1)}$ = 1

› › $y_b = an_{(1)} = y_b = y_7 = 7n_{(1)} = 7×1 = 1 + 1 + 1 + 1 + 1 + 1 + 1 = 7$

:. $y_7 = 7$

For movement eight on the One's ($n_{(1)}$) Place Value, › b_8 = 8 and $n_{(1)}$ = 1

› $y_b = an_{(1)} = y_b = y_8 = 8n_{(1)} = 8×1 = 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 = 8$

:. $y_8 = 8$

For movement nine on the One's ($n_{(1)}$) Place Value, › b_9 = 9 and $n_{(1)}$ = 1

› $y_b = an_{(1)} = y_b = y_8 = 9n_{(1)} = 9×1 = 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 = 9$

:. $y_9 = 9$

P-Value model solution-boxes

One Place Value Solution Boxes

Solution Box 1a: One's Place Values

0	1	2	3	4	5	6	7	8	9

Solution Box 1b: reverse One's Place Values

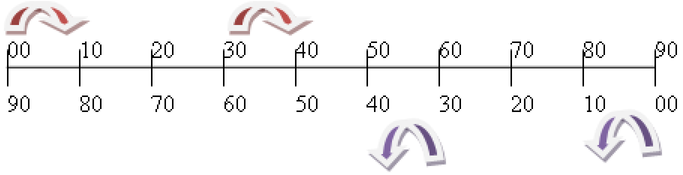
9	8	7	6	5	4	3	2	1	0

The Ten's (10's) Place Value Concept

NB:

- The word 'and' = Addition (+)
- The movement on each place value is from both 'right' to 'left' and vice versa.
- A straight line is divided into nine (9) equal parts
- The Ten's (10's) Place Value starts from zero (00) and ends at ninety (90)

Fig (11): Movement One



Movement One (Jump one step from zero to the right and or vice versa)

00 to 10 = 10

10 to 20 = 10

20 to 30 = 10

30 to 40 = 10

40 to 50 = 10

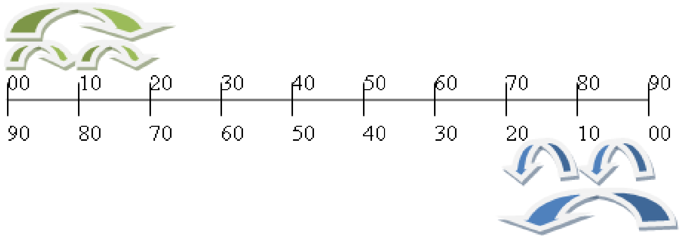
50 to 60 = 10

60 to 70 = 10

70 to 80 = 10

80 to 90 = 10

Fig (12): Movement Two



Movement Two (Jump two steps from zero to the right and or vice versa)

00 to 20 = 00 to 10 and (+) 10 to 20 = 10 + 10 = 2×10 = 20

10 to 30 = 10 to 20 and (+) 20 to 30 = 10 + 10 = 2×10 = 20

20 to 40 = 20 to 30 and (+) 30 to 40 = 10 + 10 = 2×10 = 20

30 to 50 = 30 to 40 and (+) 40 to 50 = 10 + 10 = 2×10 = 20

40 to 60 = 40 to 50 and (+) 50 to 60 = 10 + 10 = 2×10 = 20

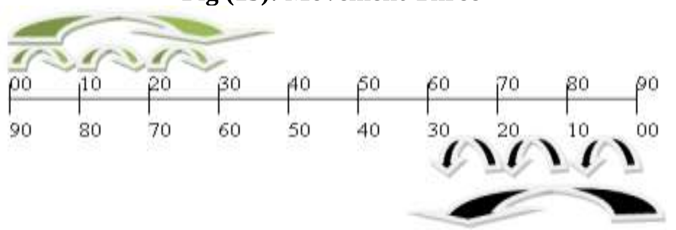
50 to 70 = 50 to 60 and (+) 60 to 70 = 10 + 10 = 2×10 = 20

60 to 80= 60 to 70 and (+) 70 to 80 = 10 + 10 = 2×10 = 20

70 to 90 = 70 to 80 and (+) 80 to 90 = 10 + 10 = 2×10 = 20

NB: 2×10= 10 + 10, means ten (10) has been repeated two times.

Fig (13): Movement Three



Movement Three (Jump three steps from zero to the right and or vice versa)

00 to 30 = 00 to 10 and 10 to 20 and 20 to 30 = 10 + 10 + 10 = 3×10 = 30

10 to 40 = 10 to 20 and 20 to 30 and 30 to 40 = 10 + 10 + 10 = 3×10 = 30

20 to 50 = 20 to 30 and 30 to 40 and 40 to 50 = 10 + 10 + 10 = 3×10 = 30

30 to 60 = 30 to 40 and 40 to 50 and 50 to 60 = 10 + 10 + 10 = 3×10 = 30

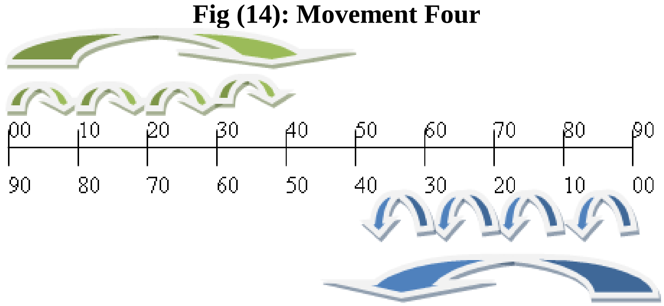
40 to 70 = 40 to 50 and 50 to 60 and 60 to 70 = 10 + 10 + 10 = 3×10 = 30

50 to 80 = 50 to 60 and 60 to 70 and 70 to 80 = 10 + 10 + 10 = 3×10 = 30

60 to 90 = 60 to 70 and 70 to 80 and 80 to 90 = 10 + 10 + 10 = 3×10 = 30

NB: 3×10= 10 + 10 + 10, means ten (10) has been repeated three times.

Fig (14): Movement Four



Movement Four (Jump four steps from zero to the right and or vice versa)

00 to 40 = 00 to 10 and 10 to 20 and 20 to 30 and 30 to 40 = 10 + 10 + 10 + 10 = 4×10 = 40

10 to 50 = 10 to 20 and 20 to 30 and 30 to 40 and 40 to 50 = 10 + 10 + 10 + 10 = 4×10 = 40

20 to 60 = 20 to 30 and 30 to 40 and 40 to 50 and 50 to 60 = 10 + 10 + 10 + 10 = 4×10 = 40

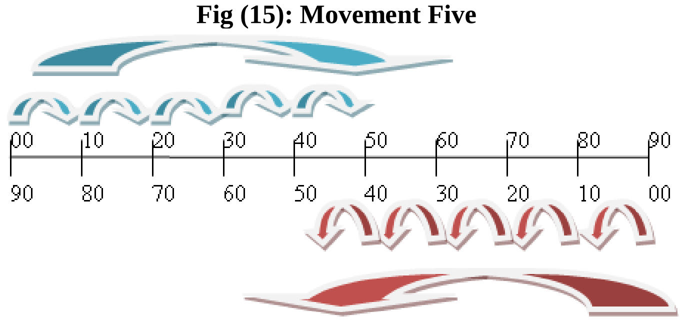
30 to 70 = 30 to 40 and 40 to 50 and 50 to 60 and 60 to 70 = 10 + 10 + 10 + 10 = 4×10 = 40

40 to 80 = 40 to 50 and 50 to 60 and 60 to 70 and 70 to 80 = 10 + 10 + 10 + 10 = 4×10 = 40

50 to 90 = 50 to 60 and 60 to 70 and 70 to 80 and 80 to 90 = 10 + 10 + 10 + 10 = 4×10 = 40

NB: 4×10= 10 + 10 + 10 + 10, means ten (10) has been repeated four times.

Fig (15): Movement Five



Movement Five (Jump five steps from zero to the right and or vice versa)

00 to 50 = 00 to 10 and 10 to 20 and 20 to 30 and 30 to 40 and 40 to 50 = 10 + 10 + 10 + 10 +10 = 5×10 = 50

10 to 60 = 10 to 20 and 20 to 30 and 30 to 40 and 40 to 50 and 50 to 60 = 10 + 10 + 10 + 10 +10 = 5×10 = 50

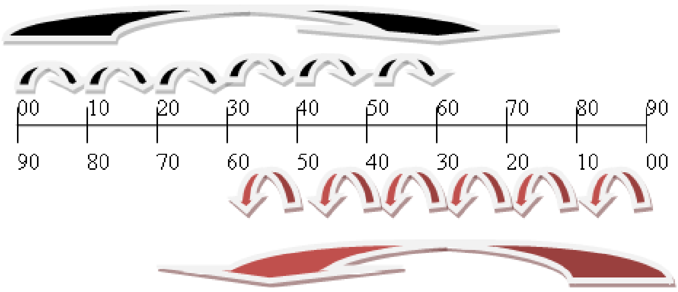
20 to 70 = 20 to 30 and 30 to 40 and 40 to 50 and 50 to 60 and 60 to 70 = 10 + 10 + 10 + 10 +10 = 5×10 = 50

30 to 80 = 30 to 40 and 40 to 50 and 50 to 60 and 60 to 70 and 70 to 80 = 10 + 10 + 10 + 10 +10 = 5×10 = 50

40 to 90 = 40 to 50 and 50 to 60 and 60 to 70 and 70 to 80 and 80 to 90 = 10 + 10 + 10 + 10 +10 = 5×10 = 50

NB: 5×10 = 10 + 10 + 10 + 10 +10, means ten (10) has been repeated five times

Fig (16): Movement Six



Movement Six (Jump six steps from zero to the right and or vice versa)

00 to 60 = 00 to 10 and 10 to 20 and 20 to 30 and 30 to 40 and 40 to 50 and 50 to 60 = 10 + 10 + 10 + 10 +10 + 10 = 6×10 = 60

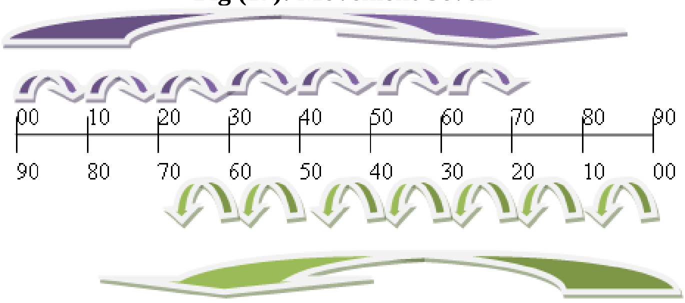
10 to 70 = 10 to 20 and 20 to 30 and 30 to 40 and 40 to 50 and 50 to 60 and 60 to 70 = 10 + 10 + 10 + 10 +10 + 10 = 6×10 = 60

20 to 80 = 20 to 30 and 30 to 40 and 40 to 50 and 50 to 60 and 60 to 70 and 70 to 80 = 10 + 10 + 10 + 10 +10 + 10 = 6×10 = 60

30 to 90 = 30 to 40 and 40 to 50 and 50 to 60 and 60 to 70 and 70 to 80 and 80 to 90 = 10 + 10 + 10 + 10 +10 + 10 = 6×10 = 60

NB: 6×10 = 10 + 10 + 10 + 10 +10+ 10, means ten (10) has been repeated six times

Fig (17): Movement Seven



Movement Seven (Jump seven steps from zero to the right and or vice versa)

00 to 70 = 00 to 10 and 10 to 20 and 20 to 30 and 30 to 40 and 40 to 50 and 50 to 60 and 60 to 70 = 10 + 10 + 10 + 10 +10 + 10 +10 = 7×10 = 70

10 to 80 = 10 to 20 and 20 to 30 and 30 to 40 and 40 to 50 and 50 to 60 and 60 to 70 and 70 to 80 = 10 + 10 + 10 + 10 +10 + 10 +10 = 7×10 = 70

20 to 90 = 20 to 30 and 30 to 40 and 40 to 50 and 50 to 60 and 60 to 70 and 70 to 80 and 80 to 90 = 10 + 10 + 10 + 10 +10 + 10 +10 = 7×10 = 70

NB: 7×10= 10 + 10 + 10 + 10 +10+ 10 + 10, means ten (10) has been repeated seven times.

Table 1: Summary of the One's (1's) Place Value

Movement 1	**Movement 2**	**Movement 3**	**Movement 4**	**Movement 5**	**Movement 6**	**Movement 7**	**Movement 8**	**Movement 9**
0 to 1 = 1	0 to 2 = 1 + 1 = 2×1 = 2	0 to 3 = 1 + 1 + 1 = 3×1 = 3	0 to 4 = 1 + 1 + 1 + 1 = 4×1 = 4	0 to 5 = 1 + 1 + 1 + 1 +1 = 5×1 = 5	0 to 6 = 1 + 1 + 1 + 1 +1 + 1 = 6×1 = 6	0 to 7 = 1 + 1 + 1 + 1 +1 + 1 +1 = 7×1 = 7	0 to 8 = 1 + 1 + 1 + 1 +1 + 1 +1 + 1= 8×1 = 8	0 to 9 = 1 + 1 + 1 + 1 +1 + 1 +1 + 1 + 1 = 9×1 = 9
1 to 2 = 1	1 to 3 = 1 + 1 = 2×1 = 2	1 to 4 = 1 + 1 + 1 = 3×1 = 3	1 to 5 = 1 + 1 + 1 + 1 = 4×1 = 4	1 to 6 = 1 + 1 + 1 + 1 +1 = 5×1 = 5	1 to 7 = 1 + 1 + 1 + 1 +1 + 1 = 6×1 = 6	1 to 8 = 1 + 1 + 1 + 1 +1 + 1 +1 = 7×1 = 7	1 to 9 = 1 + 1 + 1 + 1 +1 + 1 +1 + 1= 8×1 = 8	
2 to 3 = 1	2 to 4 = 1 + 1 = 2×1 = 2	2 to 5 = 1 + 1 + 1 = 3×1 = 3	2 to 6 1 + 1 + 1 + 1 = 4×1 = 4	2 to 7 = 1 + 1 + 1 + 1 +1 = 5×1 = 5	2 to 8 = 1 + 1 + 1 + 1 +1 + 1 = 6×1 = 6	2 to 9 = 1 + 1 + 1 + 1 +1 + 1 +1 = 7×1 = 7		
3 to 4 = 1	3 to 5 = 1 + 1 = 2×1 = 2	3 to 6 = 1 + 1 + 1 = 3×1 = 3	3 to 7 = 1 + 1 + 1 + 1 = 4×1 = 4	3 to 8 = 1 + 1 + 1 + 1 +1 = 5×1 = 5	3 to 9 = 1 + 1 + 1 + 1 +1 + 1 = 6×1 = 6			
4 to 5 = 1	4 to 6 = 1 + 1 = 2×1 = 2	4 to 7 = 1 + 1 + 1 = 3×1 = 3	4 to 8 = 1 + 1 + 1 + 1 = 4×1 = 4	4 to 9 = 1 + 1 + 1 + 1 +1 = 5×1 = 5				
5 to 6 = 1	5 to 7 = 1 + 1 = 2×1 = 2	5 to 8 = 1 + 1 + 1 = 3×1 = 3	5 to 9 = 1 + 1 + 1 + 1 = 4×1 = 4					
6 to 7 = 1	6 to 8 = 1 + 1 = 2×1 = 2	6 to 9 = 1 + 1 + 1 = 3×1 = 3						
7 to 8 = 1	7 to 9 = 1 + 1 = 2×1 = 2							
8 to 9 = 1								

Table 2: Summary of the Ten's (10's) Place Value

Movement 1	Movement 2	Movement 3	Movement 4	Movement 5	Movement 6	Movement 7	Movement 8	Movement 9
00 to 10 = 10	00 to 20 = 10 + 10 = 2×10 = 20	00 to 30 = 10 + 10 + 10 = 3×10 = 30	00 to 40 = 10 + 10 + 10 + 10 = 4×10 = 40	00 to 50 = 10 + 10 + 10 + 10 + 10 = 5×10 = 50	00 to 60 = 10 + 10 + 10 + 10 + 10 + 10 = 6×10 = 60	00 to 70 = 10 + 10 + 10 + 10 + 10 + 10 + 10 = 7×10 = 70	00 to 80 = 10 + 10 + 10 + 10 + 10 + 10 + 10 + 10 = 8×10 = 80	00 to 90 = 10 + 10 + 10 + 10 + 10 + 10 + 10 + 10 + 10 = 9×10 = 90
10 to 20 = 10	10 to 30 = 10 + 10 = 2×10 = 20	10 to 40 = 10 + 10 + 10 = 3×10 = 30	10 to 50 = 10 + 10 + 10 + 10 = 4×10 = 40	10 to 60 = 10 + 10 + 10 + 10 + 10 = 5×10 = 50	10 to 70 = 10 + 10 + 10 + 10 + 10 + 10 = 6×10 = 60	10 to 80 = 10 + 10 + 10 + 10 + 10 + 10 + 10 = 7×10 = 70	10 to 90 = 10 + 10 + 10 + 10 + 10 + 10 + 10 + 10 = 8×10 = 80	
20 to 30 = 10	20 to 40 = 10 + 10 = 2×10 = 20	20 to 50 = 10 + 10 + 10 = 3×10 = 30	20 to 60 = 10 + 10 + 10 + 10 = 4×10 = 40	20 to 70 = 10 + 10 + 10 + 10 + 10 = 5×10 = 50	20 to 80 = 10 + 10 + 10 + 10 + 10 + 10 = 6×10 = 60	20 to 90 = 10 + 10 + 10 + 10 + 10 + 10 + 10 = 7×10 = 70		
30 to 40 = 10	30 to 50 = 10 + 10 = 2×10 = 20	30 to 60 = 10 + 10 + 10 = 3×10 = 30	30 to 70 = 10 + 10 + 10 + 10 = 4×10 = 40	30 to 80 = 10 + 10 + 10 + 10 + 10 = 5×10 = 50	30 to 90 = 10 + 10 + 10 + 10 + 10 + 10 = 6×10 = 60			
40 to 50 = 10	40 to 60 = 10 + 10 = 2×10 = 20	40 to 70 = 10 + 10 + 10 = 3×10 = 30	40 to 80 = 10 + 10 + 10 + 10 = 4×10 = 40	40 to 90 = 10 + 10 + 10 + 10 + 10 = 5×10 = 50				

Table 2 continued

Movement 1	Movement 2	Movement 3	Movement 4	Movement 5	Movement 6	Movement 7	Movement 8	Movement 9
50 to 60 = 10	50 to 70 = 10 + 10 = 2×10 = 20	50 to 80 = 10 + 10 + 10 = 3×10 = 30	50 to 90 = 10 + 10 + 10 + 10 = 4×10 = 40					
60 to 70 = 10	60 to 80 = 10 + 10 = 2×10 = 20	60 to 90 = 10 + 10 + 10 = 3×10 = 30						
70 to 80 = 10	70 to 90 = 10 + 10 = 2×10 = 20							
80 to 90 = 10								

Table 3: Summary of the Hundred's (100's) Place Value

Movement 1	Movement 2	Movement 3	Movement 4	Movement 5	Movement 6	Movement 7	Movement 8	Movement 9
000 to 100 = 100	000 to 200 = 100 + 100 = 2×100 = 200	000 to 300 = 100 + 100 + 100 = 3×100 = 300	000 to 400 = 100 + 100 + 100 + 100 = 4×100 = 400	000 to 500 = 100 + 100 + 100 + 100 + 100 = 5×100 = 500	000 to 600 = 100 + 100 + 100 + 100 + 100 + 100 = 6×100 = 600	000 to 700 = 100 + 100 + 100 + 100 + 100 + 100 + 100 = 7×100 = 700	000 to 800 = 100 + 100 + 100 + 100 + 100 + 100 + 100 = 8×100 = 800	000 to 900 = 100 + 100 + 100 + 100 + 100 + 100 + 100 + 100 + 100 = 9×100 = 900
100 to 200 = 100	100 to 300 = 100 + 100 = 2×100 = 200	100 to 400 = 100 + 100 + 100 = 3×100 = 300	100 to 500 = 100 + 100 + 100 + 100 = 4×100 = 400	100 to 600 = 100 + 100 + 100 + 100 = 5×100 = 500	100 to 700 = 100 + 100 + 100 + 100 + 100 + 100 = 6×100 = 600	100 to 800 = 100 + 100 + 100 + 100 + 100 + 100 + 100 = 7×100 = 700	100 to 900 = 100 + 100 + 100 + 100 + 100 + 100 + 100 + 100 = 8×100 = 800	
200 to 300 = 100	200 to 400 = 100 + 100 = 2×100 = 200	200 to 500 = 100 + 100 + 100 = 3×100 = 300	200 to 600 = 100 + 100 + 100 = 4×100 = 400	200 to 700 = 100 + 100 + 100 + 100 + 10 = 5×100 = 500	200 to 800 = 100 + 100 + 100 + 100 + 100 + 100 = 6×100 = 600	200 to 900 = 100 + 100 + 100 + 100 + 100 + 100 + 100 = 7×100 = 700		
300 to 400 = 100	300 to 500 = 100 + 100 = 2×100 = 200	300 to 600 = 100 + 100 + 100 = 3×100 = 300	300 to 700 = 100 + 100 + 100 + 100 = 4×100 = 400	300 to 800 = 100 + 100 + 100 + 100 + 100 = 5×100 = 500	300 to 900 = 100 + 100 + 100 + 100 + 100 + 100 = 6×100 = 600			
400 to 500 = 100	400 to 600 = 100 + 100 = 2×100 = 200	400 to 700 = 100 + 100 + 100 = 3×100 = 300	400 to 800 = 100 + 100 + 100 + 100 = 4×100 = 400	400 to 900 = 100 + 100 + 100 + 100 + 100 = 5×100 = 500				
500 to 600 = 100	500 to 700 = 100 + 100 = 2×100 = 200	500 to 800 = 100 + 100 + 100 = 3×10 0= 300	500 to 900 = 100 + 100 + 100 + 100 = 4×100 = 400					

Table 3 continued

Movement 1	**Movement 2**	**Movement 3**	**Movement 4**	**Movement 5**	**Movement 6**	**Movement 7**	**Movement 8**	**Movement 9**
600 to 700 = 100	600 to 800 = 100 + 100 = 2×100 = 200	600 to 900 = 100 + 100 + 100 = 3×100 = 300						
700 to 800 = 100	700 to 900 = 100 + 100 = 2×100 = 200							
800 to 900 = 100								

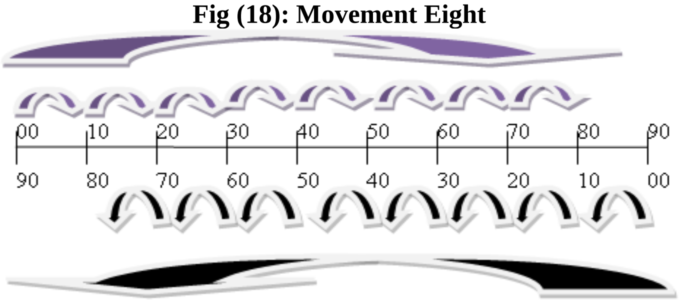
Table 4: Summary of the Thousand's (1000's) Place Value

Movement 1	**Movement 2**	**Movement 3**	**Movement 4**	**Movement 5**	**Movement 6**	**Movement 7**	**Movement 8**	**Movement 9**
0000 to 1000 = 1000	0000 to 2000 = 1000 + 1000 = 2×1000 = 2000	0000 to 3000 = 1000 + 1000 + 1000 = 3×1000 = 3000	0000 to 4000 = 1000 + 1000 + 1000 + 1000 = 4×1000 = 4000	0000 to 5000 = 1000 + 1000 + 1000 + 1000 + 1000 = 5×1000 = 5000	0000 to 6000 = 1000 + 1000 + 1000 + 1000 + 1000 + 1000 = 6×1000 = 6000	0000 to 7000 = 1000 + 1000 + 1000 + 1000 + 1000 + 1000 + 1000 = 7×1000 = 7000	0000 to 8000 = 1000 + 1000 + 1000 + 1000 + 1000 + 1000 + 1000 + 1000 = 8×1000 = 8000	0000 to 9000 = 1000 + 1000 + 1000 + 1000 + 1000 + 1000 + 1000 + 1000 + 1000 = 9×1000 = 9000
1000 to 2000 = 1000	1000 to 3000 = 1000 + 1000 = 2×1000 = 2000	1000 to 4000 = 1000 + 1000 + 1000 = 3×1000 = 3000	1000 to 5000 = 1000 + 1000 + 1000 + 1000 = 4×1000 = 4000	1000 to 6000 = 1000 + 1000 + 1000 + 1000 + 1000 = 5×1000 = 5000	1000 to 7000 = 100 0+ 1000 + 1000 + 1000 + 1000 + 1000 = 6×1000 = 6000	1000 to 8000 = 1000 + 1000 + 1000 + 1000 + 1000 + 1000 + 1000 = 7×1000 = 7000	1000 to 9000 = 1000 + 1000 + 1000 + 1000 + 1000 + 1000 + 1000 + 1000 = 8×1000 = 8000	
2000 to 3000 = 1000	2000 to 4000 = 1000 + 1000 = 2×1000 = 2000	2000 to 5000 = 1000 + 1000 + 1000 = 3×1000 = 3000	2000 to 6000 = 1000 + 1000 + 1000 + 1000 = 4×1000 = 4000	2000 to 7000 = 1000 + 1000 + 1000 + 1000 + 1000 = 5×1000 = 5000	2000 to 8000 = 1000 + 1000 + 1000 + 1000 + 1000 + 1000 = 6×1000 = 6000	2000 to 9000 = 1000 + 1000 + 1000 + 1000 + 1000 + 1000 + 1000 = 7×1000 = 7000		
3000 to 4000 = 1000	3000 to 5000 = 1000 + 1000 = 2×1000 = 2000	3000 to 6000 = 1000 + 1000 + 1000 = 3×1000 = 3000	3000 to 7000 = 1000 + 1000 + 1000 + 1000 = 4×1000 = 4000	3000 to 8000 = 1000 + 1000 + 1000 + 1000 + 1000 = 5×1000 = 5000	3000 to 9000 = 1000 + 1000 + 1000 + 1000 + 1000 + 1000 = 6×1000 = 6000			

Table 4 continued

Movement 1	Movement 2	Movement 3	Movement 4	Movement 5	Movement 6	Movement 7	Movement 8	Movement 9
4000 to 5000 = 1000	4000 to 6000 = 1000 + 1000 = 2×1000 = 2000	4000 to 7000 = 1000 + 1000 + 1000 = 3×1000 = 3000	4000 to 8000 = 1000 + 1000 + 1000 + 1000 = 4×1000 = 4000	4000 to 9000 = 1000 + 1000 + 1000 + 1000 + 1000 = 5×1000 = 5000				
5000 to 6000 = 1000	5000 to 7000 = 1000 + 1000 = 2×1000 = 2000	5000 to 8000 = 1000 + 1000 + 1000 = 3×1000 = 3000	5000 to 9000 = 1000 + 1000 + 1000 + 1000 = 4×1000 = 4000					
6000 to 7000 = 1000	6000 to 8000 = 1000 + 1000 = 2×1000 = 2000	6000 to 9000 = 1000 + 1000 + 1000 = 3×1000 = 3000						
7000 to 8000 = 1000	7000 to 9000 = 1000 + 1000 = 2×1000 = 2000							
8000 to 9000 = 1000								

Fig (18): Movement Eight



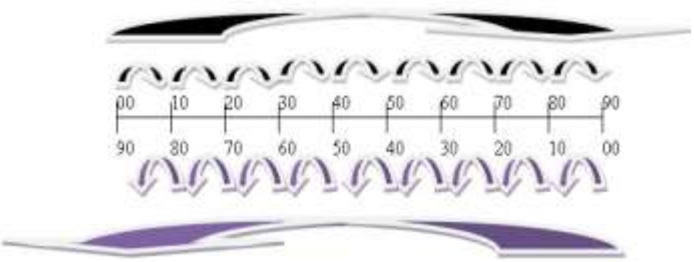
Movement Eight (Jump eight steps from zero to the right and or vice versa)

00 to 80 = 00 to 10 and 10 to 20 and 20 to 30 and 30 to 40 and 40 to 50 and 50 to 60 and 60 to 70 and 70 to 80 = 10 + 10 + 10 + 10 +10 + 10 +10 + 10 = 8×10 = 80

10 to 90 = 10 to 20 and 20 to 30 and 30 to 40 and 40 to 50 and 50 to 60 and 60 to 70 and 70 to 80 and 80 to 90 = 10 + 10 + 10 + 10 +10 + 10 +10 + 10 = 8×10 = 80

NB: 8×10= 10 + 10 + 10 + 10 +10+ 10 + 10 + 10, means ten (10) has been repeated eight times

Fig (19): Movement Nine



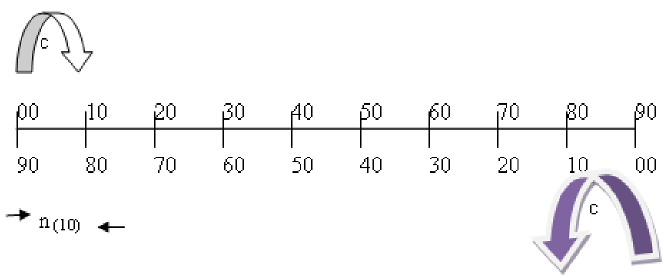
Movement Nine (Jump nine steps from zero to the right and or vice versa)

00 to 90 = 00 to 10 and 10 to 20 and 20 to 30 and 30 to 40 and 40 to 50 and 50 to 60 and 60 to 70 and 70 to 80 and 80 to 90 = 10 + 10 + 10 + 10 +10 + 10 +10 + 10 + 10 = 9×10 = 90

NB: 90 = 10 + 10 + 10 + 10 +10 + 10 +10 + 10 + 10 = 9×10 = 90, means ten (10) has been repeated nine times

Mathematical proves of the Ten(10's = n $_{\#10}$) Place Value

Fig 20: Diagram of Mathematical proves of the Ten's (10's = n_{10}) Place Value



Let

n_{th} = all Place Values,

y_{nth} = answer for all Place Values,

n $_{(10)}$ = 10 for Ten's (10's) Place value,

c= movement (s) within the Ten's (10's) Place Value

› y_c= an $_{(10)}$

› y_c= cn $_{(10)}$, fig 10

For movement one on the Ten's (n $_{(10)}$) Place Value, › a_1= 1and n $_{(10)}$ = 10

› y_c= cn $_{(10)}$ = y_c= y_1= 1n $_{(10)}$ = 1×10 = 10

:. y_1= 10

For movement two on the Ten's (n $_{(10)}$) Place Value, › a_2= 2 and

$n_{(10)} = 10$
$› y_c= cn_{(10)} = y_c= y_2= 2n_{(10)} = 2×10 = 10 + 10 = 20$
$:. y_2= 20$
For movement three on the Ten's ($n_{(10)}$) Place Value, › $a_3= 3$ and $n_{(10)} = 10$
$› y_c= cn_{(10)} = y_c= y_3= 3n_{(10)} = 3×10 = 10 + 10 + 10 = 30$
$:. y_3 = 30$
For movement four on the Ten's ($n_{(10)}$) Place Value, › $a_4= 4$and $n_{(10)} = 10$
$› y_c= cn_{(10)} = y_c= y_4= 4n_{(10)} = 4×10 = 10 + 10 + 10 + 10 = 40$
$:. y_4= 40$
For movement five on the Ten's ($n_{(10)}$) Place Value, › $a_5= 5$and $n_{(10)} = 10$
$› y_c= cn_{(10)} = y_c= y_5= 5n_{(10)} = 5×10 = 10 + 10 + 10 + 10 + 10 = 50$
$:. y_5= 50$
For movement six on the Ten's ($n_{(10)}$) Place Value, › $a_6= 6$and $n_{(10)} = 10$
$› y_c= cn_{(10)} = y_c= y_6= 6n_{(10)} = 6×10 = 10 + 10 + 10 + 10 + 10 + 10 = 60$
$:. y_6= 60$
For movement seven on the Ten's ($n_{(10)}$) Place Value, › $a_8= 8$and $n_{(10)} = 10$
$› y_c= cn_{(10)} = y_c= y_8 = 8n_{(10)} = 8×10 = 10 + 10 + 10 + 10 + 10 + 10 + 10 = 70$
$:. y_7= 70$
For movement eight on the Ten's ($n_{(10)}$) Place Value, › $a_7= 7$and $n_{(10)} = 10$
$› y_c= cn_{(10)} = y_c= y_8 = 8n_{(10)} = 8×10 = 10 + 10 + 10 + 10 + 10 + 10 + 10 + 10$
$= 80$
$:. y_8 = 80$
For movement nine on the One's ($n_{(10)}$) Place Value, › $b_9 = 9$ and $n_{(10)} = 10$
$› y_c = cn_{(1)} = y_c = y_8 = 9n_{(1)} = 9×1 = 10 + 10 + 10 + 10 + 10 + 10 + 10 + 10 +$
$10 = 90$
$:. y_9 = 90$

Ten Place Value Solution-Boxes

Solution Box 2a: Ten's Place Value

0	0	1	0	2	0	3	0	4	0	5	0	6	0	7	0	8	0	9	0

Solution Box 2b: reverse Ten's Place Value

9	0	8	0	7	0	6	0	5	0	4	0	3	0	2	0	1	0	0	0

Example 1

How will you demonstrate 89 to; (1) a Classes (4-6) pupil and (JHS) Junior High School (1-3) pupil using the P-Value Solution-Box?

Solution 1A

Demonstrating 89 by the use of P-Value Solution-Box to Classes (4-6)

(1) Mathematical, 89 can be broken into 80, and 9 i.e. 89 = 80 + 9.

(2) Here, 89 = 80 + 9 = Hundreds + Tens + Ones. This implies that, one has to use two (2) P Value Solution-Boxes i.e. Ten's P Value Solution-Box, and One's P Value Solution-Box.

(3)

Ten's P-Value Solution-Box

1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0		

+

One's P-Value Solution-Box

1	1	1	1	1	1	1	1	1

89 = 80 + 9 = (10 + 10 + 10 + 10 + 10 + 10 + 10 + 10) + (1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1) = 8×10 + 1×9 = 80 + 9 = 89.

Solution 1B

Demonstrating 89 by the use of P-Value Solution-Box to JHS (1-3)

(4) Mathematical, 89 can be broken into 80, and 9 i.e. 89 = 80 + 9.

(5) Here, 89 = 80 + 9 = Tens + Ones. This implies that, one has to use two (2) P Value Solution-Boxes i.e. Ten's P Value Solution-Box, and One's P Value Solution-Box.

(6)

Ten's P-Value Solution-Box

														8	0		

+

One's P-Value Solution-Box

								9

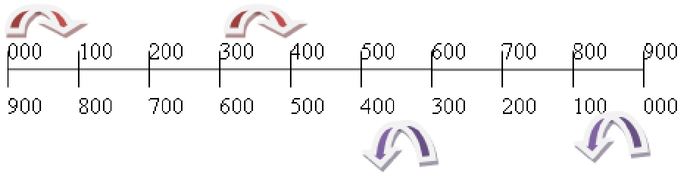
89 = 80 + 9 = (80) + (9) = 8×10 + 1×9 = 80 + 9 = 89.

The Hundred's (100's) Place Value Concept

NB:

- The word 'and' = Addition (+)
- The movement on each place value is from both 'right' to 'left' and vice versa.
- A straight line is divided into nine (9) equal parts
- The Hundred's (100's) Place Value starts from zero (000) and ends at nine (900)

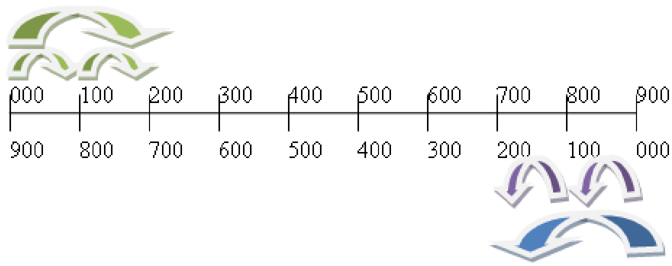
Fig (21): Movement One



Movement One (Jump one step from zero to the right and or vice versa)

000 to 100 = 100
100 to 200 = 100
200 to 300 = 100
300 to 400 = 100
400 to 500 = 100
500 to 600 = 100
600 to 700 = 100
700 to 800 = 100
800 to 900 = 100

Fig (22): Movement Two



Movement Two (Jump two steps from zero to the right and or vice versa)

000 to 200 = 000 to 100 and (+) 100 to 200= 100 + 100 = 2×100 = 200
100 to 300 = 100 to 200 and (+) 200 to 300= 100 + 100 = 2×100 = 200
200 to 400 = 200 to 300 and (+) 300 to 400= 100 + 100 = 2×100 = 200
300 to 500 = 300 to 400 and (+) 400 to 500= 100 + 100 = 2×100 = 200

400 to 600 = 400 to 500 and (+) 500 to 600= 100 + 100 = 2×100 = 200

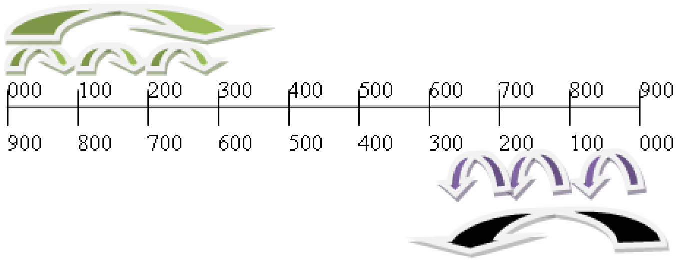
500 to 700 = 500 to 600 and (+) 600 to 700= 100 + 100 = 2×100 = 200

600 to 800 = 600 to 700 and (+) 700 to 800 = 100 + 100 = 2×100 = 200

700 to 900 = 700 to 800 and (+) 800 to 900 = 100 + 100 = 2×100 = 200

NB: 2×10= 10 + 10, means one hundred (100) has been repeated two times.

Fig (23): Movement Three



Movement Three (Jump three steps from zero to the right and or vice versa)

000 to 300 = 000 to 100 and 100 to 200 and 200 to 300 = 100 + 100 + 100 = 3×100 = 300

100 to 400 = 100 to 200 and 200 to 300 and 300 to 400 = 100 + 100 + 100 = 3×100 = 300

200 to 500 = 200 to 300 and 300 to 400 and 400 to 500 = 100 + 100 + 100 = 3×100 = 300

300 to 600 = 300 to 400 and 400 to 500 and 500 to 600 = 100 + 100 + 100 = 3×100 = 300

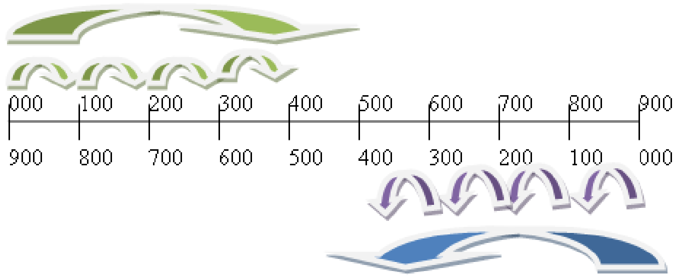
400 to 700 = 400 to 500 and 500 to 600 and 600 to 700 = 100 + 100 + 100 = 3×100 = 300

500 to 800 = 500 to 600 and 600 to 700 and 700 to 800 = 100 + 100 + 100 = 3×100 = 300

600 to 900 = 600 to 700 and 700 to 800 and 800 to 900 = 100 + 100 + 100 = 3×100 = 300

NB: 3×100= 100 + 100 + 100, means one hundred (100) has been repeated three times

Fig (24): Movement Four



Movement Four (Jump four steps from zero to the right and or vice versa)

000 to 400 = 000 to 100 and 100 to 200 and 200 to 300 and 300 to 400 = 100 + 100 + 100 + 100 = 4×100 = 400

100 to 500 = 100 to 200 and 200 to 300 and 300 to 400 and 400 to 500 = 100 + 100 + 100 + 100 = 4×100 = 400

200 to 600 = 200 to 300 and 300 to 400 and 400 to 500 and 500 to 600 = 100 + 100 + 100 + 100 = 4×100 = 400

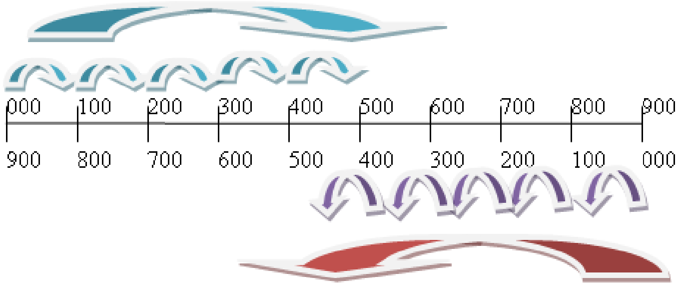
300 to 700 = 300 to 400 and 400 to 500 and 500 to 600 and 600 to 700 = 100 + 100 + 10 + 100 = 4×100 = 400

400 to 800 = 400 to 500 and 500 to 600 and 600 to 700 and 700 to 800 = 100 + 100 + 100 + 100 = 4×100 = 400

500 to 900 = 500 to 600 and 600 to 700 and 700 to 800 and 800 to 900 = 100 + 100 + 100 + 100 = 4×100 = 400

NB: 4×100= 100 + 100 + 100 + 100, means one hundred (100) has been repeated four times.

Fig (25): Movement Five



Movement Five (Jump five steps from zero to the right and or vice versa)

000 to 500 = 000 to 100 and 100 to 200 and 200 to 300 and 300 to 400 and 400 to 500 = 100 + 100 + 100 + 100 +100 = 5×100 = 500

100 to 600 = 100 to 200 and 200 to 300 and 300 to 400 and 400 to 500 and 500 to 600 = 100 + 100 + 100 + 100 +100 = 5×100 = 500

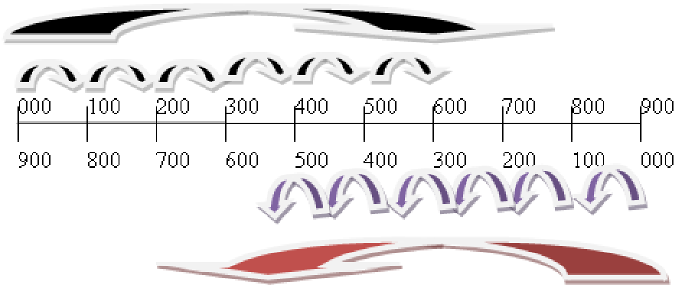
200 to 700 = 200 to 300 and 300 to 400 and 400 to 500 and 500 to 600 and 600 to 700 = 100 + 100 + 100 + 100 +100 = 5×100 = 500

300 to 800 = 300 to 400 and 400 to 500 and 500 to 600 and 600 to 700 and 700 to 800 = 100 + 100 + 100 + 100 +100 = 5×100 = 500

400 to 900 = 400 to 500 and 500 to 600 and 600 to 700 and 700 to 800 and 800 to 900 = 100 + 100 + 100 + 100 +100 = 5×100 = 500

NB: 5×100 = 100 + 100 + 100 + 100 +100, means one hundred (100) has been repeated five times.

Fig (26): Movement Six



Movement Six (Jump six steps from zero to the right and or vice versa)

000 to 600 = 000 to 10 0and 100 to 200 and 200 to 300 and 300 to 400 and

400 to 500 and 500 to 600 = 100 + 100 + 100 + 100 +100 + 100 = 6×100 = 600

100 to 700 = 100 to 200 and 200 to 300 and 300 to 400 and 400 to 500 and

500 to 600 and 600to 700 = 100 + 100 + 100 + 100 +100 + 100 = 6×100 = 600

200 to 800 = 200 to 300 and 300 to 400 and 400 to 500 and 500 to 600 and

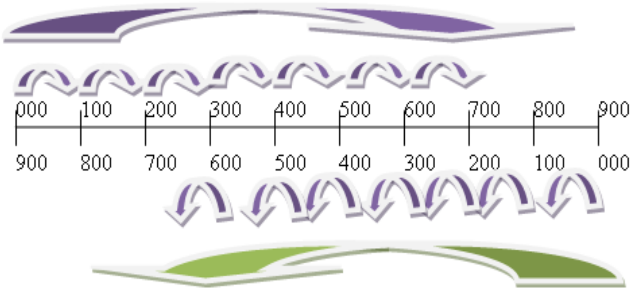
600 to 700 and 700 to 800 = 100 + 100 + 100 + 100 +100 + 100 = 6×100 = 600

300 to 900 = 300 to 400 and 400 to 500 and 500 to 600 and 600 to 700 and

700 to 800 and 800 to 900 = 100 + 100 + 100 + 100 +100 + 100 = 6×100 = 600

NB: 6×100 = 100 + 100 + 100 + 100 +100+ 100, means one hundred (100) has been repeated six times

Fig (27): Movement Seven



Movement Seven (Jump seven steps from zero to the right and or vice versa)

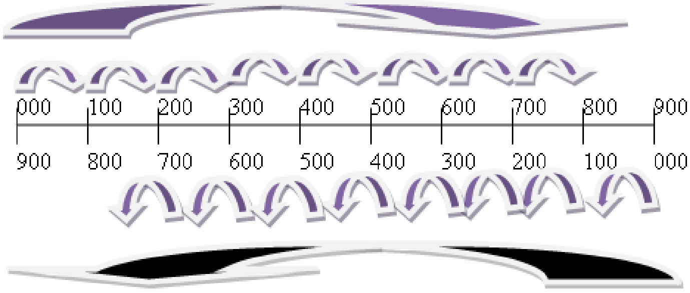
000 to 700 = 000 to 100 and 100 to 200 and 200 to 300 and 300 to 400 and 400 to 500 and 500 to 600 and 600 to 700 = 100 + 100 + 100 + 100 +100 + 100 +100 = 7×100 = 700

100 to 800 = 100 to 200 and 200 to 300 and 300 to 400 and 400 to 500 and 500 to 600 and 600 to 700 and 700 to 800 = 100 + 100 + 100 + 100 +100 + 100 +100 = 7×100 = 700

200 to 900 = 200 to 300 and 300 to 400 and 400 to 500 and 500 to 600 and 600 to 700 and 700 to 800 and 800 to 900 = 100 + 100 + 100 + 100 +100 + 100 +100 = 7×100 = 700

NB: 7×100= 100 + 100 + 100 + 100 +100+ 100 + 100, means one hundred (100) has been repeated seven times.

Fig (28): Movement Eight



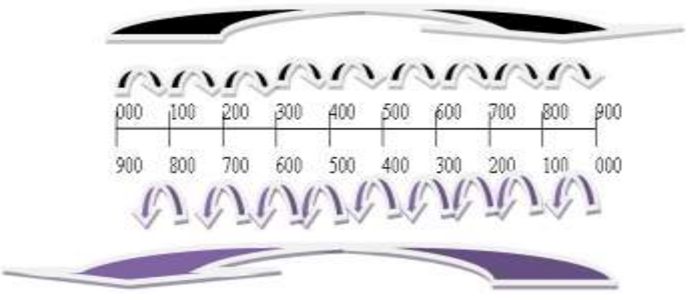
Movement Eight (Jump eight steps from zero to the right and or vice versa)

000 to 800 = 000 to 100 and 100 to 200 and 200 to 300 and 300 to 400 and 400 to 500 and 500 to 600 and 600 to 700 and 700 to 800 = 100 + 100 + 100 + 100 +100 + 100 +100 + 100 = 8×100 = 800

100 to 900 = 100 to 200 and 200 to 300 and 300 to 400 and 400 to 500 and 500 to 600 and 600 to 700 and 700 to 800 and 800 to 900 = 100 + 100 + 100 + 100 +100 + 100 +100 + 100 = 8×100 = 800

NB: 8×100= 100 + 100 + 100 + 100 +100+ 100 + 100 + 100, means one hundred (100) has been repeated eight times

Fig (29): Movement Nine



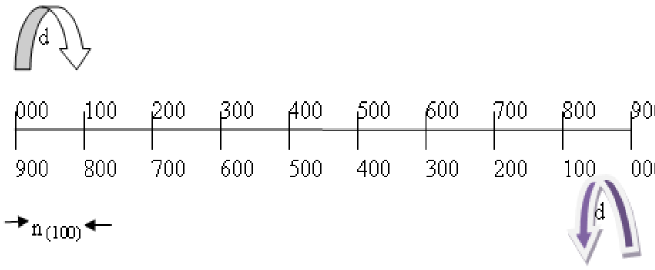
Movement Nine (Jump nine steps from zero to the right and or vice versa)

000 to 900 = 000 to 100 and 100 to 200 and 200 to 300 and 300 to 400 and 400 to 500 and 500 to 600 and 600 to 700 and 700 to 800 and 800 to 900 = 100 + 100 + 100 + 100 +100 + 100 +100 + 100 + 100 = 9×100 = 900

NB: 900 = 100 + 100 + 100 + 100 +100 + 100 +100 + 100 + 100 = 9×100 = 900, means one hundred (100) has been repeated nine times

<u>Mathematical proves of the Hundred's (100's = $n_{\#100}$) Place Value</u>

Fig 30: Diagram of Mathematical proves of the Hundred's (100's = n_{100}) Place Value



Let

n_{th} = all Place Values,

y_{nth} = answer for all Place Values,

n $_{(100)}$ = 100, for Hundred's (100's) Place value,

d = movement (s) within the Hundred's (100's) Place Value

› $y_d = dn_{(100)}$

› $y_d = dn_{(100)}$

For movement one on the Hundred's ($n_{(100)}$) Place Value, › d_1= 1 and $n_{(100)}$ = 100

› $y_d = dn_{(100)} = y_c= y_1= 1n_{(100)}$ = 1×100 = 100

:. y_1= 100

For movement two on the Hundred's ($n_{(100)}$) Place Value, › d_2= 2 and $n_{(100)}$ = 100

› $y_d = dn_{(100)} = y_d= y_2= 2n_{(100)}$ = 2×100 = 100 + 100 = 200

:. y_2= 200

For movement three on the Hundred's ($n_{(100)}$) Place Value, › d_3= 3 and $n_{(100)}$ = 100

› $y_d = dn_{(100)} = y_d= y_3 = 3n_{(100)}$ = 3×100 = 100 + 100 + 100 = 300

:. y_3 = 300

For movement four on the Hundred's ($n_{(100)}$) Place Value, › d_4= 4 and $n_{(100)}$ = 100

› $y_d = dn_{(100)} = y_d = y_4= 4n_{(100)}$ = 4×100 = 100 + 100 + 100 + 100 = 400

:. y_4= 40

For movement five on the Hundred's ($n_{(100)}$) Place Value, › d_5= 5 and $n_{(100)}$ = 100

› $y_d = dn_{(100)} = y_d = y_5= 5n_{(100)}$ = 5×100 = 100 + 100 + 100 + 100 + 100 = 500

:. y_5= 500

For movement six on the Hundred's ($n_{(100)}$) Place Value, › d_6 = 6 and $n_{(100)}$ = 100

› $y_d = dn_{(100)} = y_d = y_6 = 6n_{(100)}$ = 6×100 = 10 + 100 + 100 + 100 + 100 + 100 = 600

:. y_6= 60

For movement seven on the Hundred's ($n_{(100)}$) Place Value, › d_7 = 7 and $n_{(100)}$
= 100

› $y_d = dn_{(100)} = y_d = y_7 = 7n_{(100)}$ = 7×100 = 100 + 100 + 100 + 100 + 100 + 100 + 100 = 700

:. y_7= 700

For movement eight on the Hundred's ($n_{(100)}$) Place Value, › d_8= 8 and $n_{(100)}$ = 100

› $y_d = dn_{(100)} = y_d = y_8 = 8n_{(100)}$ = 8×100 = 100 + 100 + 100 + 100 + 100 +

100 + 100 + 100 = 800

:. y_8 = 800

For movement nine on the One's ($n_{(100)}$) Place Value, › b_9 = 9 and $n_{(100)}$ = 100

› $y_d = dn_{(1)} = y_d = y_9 = 9n_{(100)}$ = 9×100 = 100 + 100 + 100 + 100 + 100 + 100 + 100 + 100 + 100 = 900

:. y_9 = 900

Hundred Place Value Solution-Boxes

Solution Box 3a: Hundred's Place Value

0	0	0	1	0	0	2	0	0	3	0	0	4	0	0	5	0	0	6	0	0	7	0	0	8	0	0	9	0	0

Solution Box 3b: Reverse Hundred's Place Value

9	0	0	8	0	0	7	0	0	6	0	0	5	0	0	4	0	0	3	0	0	2	0	0	1	0	0	0	0	0

Example 1

How will you demonstrate 589 to; (1) a Classes (4-6) pupil and (JHS) Junior High School (1-3) pupil using the P-Value Solution-Box?

Solution 1A

Demonstrating 589 by the use of P-Value Solution-Box to Classes (4-6)

(1) Mathematical, 589 can be broken into 500, 80, and 9 i.e. 589 = 500 + 80 + 9.

(2) Here, 589 = 500 + 80 + 9 = Hundreds + Tens + Ones. This implies that, one has to use three (3) P Value Solution-Boxes i.e. Hundred's P Value Solution-Box, Ten's P Value Solution-Box, and One's P Value Solution-Box.

(3)

Hundred's P-Value Solution-Box

1	0	0	1	0	0	1	0	0	1	0	0	1	0	0											

+

Ten's P-Value Solution-Box

1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0		

+

One's P-Value Solution-Box

1	1	1	1	1	1	1	1	1

589 = 500 + 80 + 9 = (100 + 100 + 100 + 100 + 100) + (10 + 10 + 10 + 10 + 10 + 10 + 10 + 10) + (1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1) = 5×100 +8×10 + 1×9 = 500 + 80 + 9 = 589.

Solution 1B

Demonstrating 589 by the use of P-Value Solution-Box to JHS (1-3)

(1) Mathematical, 589 can be broken into 500, 80, and 9 i.e. 589 = 500 + 80 + 9.

(2) Here, 589 = 500 + 80 + 9 = Hundreds + Tens + Ones. This implies that, one has to use three (3) P Value Solution-Boxes i.e. Hundred's P Value Solution-Box, Ten's P Value Solution-Box, and One's P Value Solution-Box.

(3)

Hundred's P-Value Solution-Box

												5	0	0											

+

Ten's P-Value Solution-Box

														8	0		

+

One's P-Value Solution-Box

								9

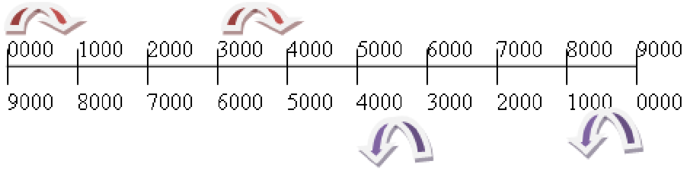
589 = 500 + 80 + 9 = (500) + (80) + (9) = 5×100 +8×10 + 1×9 = 500 + 80 + 9 = 589.

The Thousand's (1000's) Place Value Concept

NB:

- The word 'and' = Addition (+)
- The movement on each place value is from both 'right' to 'left' and vice versa.
- A straight line is divided into nine (9) equal parts
- The Thousand's (1000's) Place Value starts from zero (0000) and ends at nine (9000)

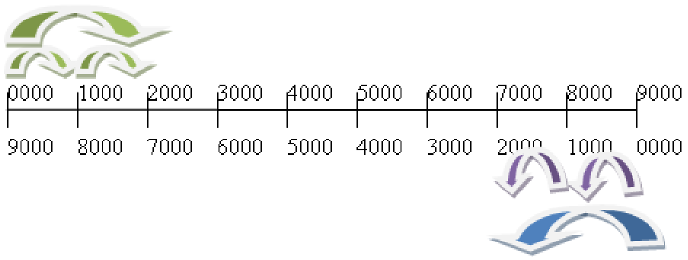
Fig (31): Movement One



Movement One (Jump one step from zero to the right and or vice versa)

0000 to 1000 = 1000
1000 to 2000 = 1000
2000 to 3000 = 1000
3000 to 4000 = 1000
4000 to 5000 = 1000
5000 to 6000 = 1000
6000 to 7000 = 1000
7000 to 8000 = 1000
8000 to 9000 = 1000

Fig (32): Movement Two



Movement Two (Jump two steps from zero to the right and or vice versa)

0000 to 2000 = 0000 to 1000 and (+) 1000 to 2000 = 1000 + 1000 = 2×1000 = 2000

1000 to 3000 = 1000 to 2000 and (+) 2000 to 3000 = 1000 + 1000 = 2×1000 = 2000

2000 to 4000 = 2000 to 3000 and (+) 3000 to 4000 = 1000 + 1000 = 2×1000 = 2000

3000 to 5000 = 3000 to 4000 and (+) 4000 to 5000 = 1000 + 1000 = 2×1000 = 2000

4000 to 6000 = 4000 to 5000 and (+) 5000 to 6000 = 1000 + 1000 = 2×1000 = 2000

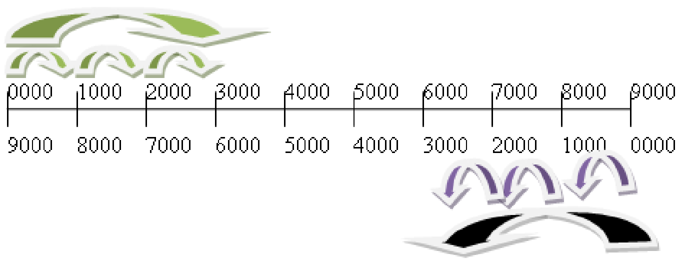
5000 to 7000 = 5000 to 6000 and (+) 6000 to 7000 = 1000 + 1000 = 2×1000 = 2000

6000 to 8000 = 6000 to 7000 and (+) 7000 to 8000 = 1000 + 1000 = 2×1000 = 2000

7000 to 9000 = 7000 to 8000 and (+) 8000 to 9000 = 1000 + 1000 = 2×1000 = 2000

NB: 2×1000 = 1000 + 1000, means one thousand (1000) has been repeated two times.

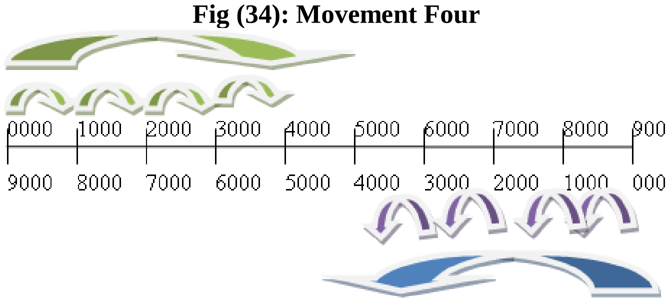
Fig (33): Movement Three



Movement Three (Jump three steps from zero to the right and or vice versa)

0000 to 3000 = 0000 to 1000 and 1000 to 2000 and 2000 to 3000 = 1000 + 1000 + 1000 = 3×1000 = 3000
1000 to 4000 = 1000 to 2000 and 2000 to 3000 and 3000 to 4000 = 1000 + 1000 + 1000 = 3×1000 = 3000
2000 to 5000 = 2000 to 3000 and 3000 to 4000 and 4000 to 5000 = 1000 + 1000 + 1000 = 3×1000 = 3000
3000 to 6000 = 3000 to 4000 and 4000 to 5000 and 5000 to 6000 = 1000 + 1000 + 1000 = 3×100 = 3000
4000 to 7000 = 4000 to 5000 and 5000 to 6000 and 6000 to 7000 = 1000 + 1000 + 1000 = 3×1000 = 3000
5000 to 8000 = 5000 to 6000 and 6000 to 7000 and 7000 to 8000 = 1000 + 1000 + 1000 = 3×1000 = 3000
6000 to 9000 = 6000 to 7000 and 7000 to 8000 and 8000 to 9000 = 1000 + 1000 + 1000 = 3×1000 = 3000
NB: 3×1000= 1000 + 1000 + 1000, means one thousand (1000) has been repeated three times.

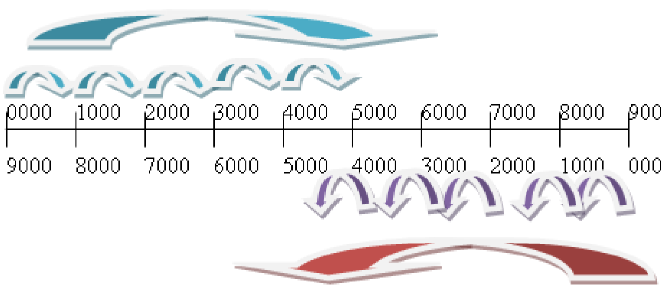
Fig (34): Movement Four



Movement Four (Jump four steps from zero to the right and or vice versa)

0000 to 4000 = 0000 to 1000 and 1000 to 2000 and 2000 to 3000 and 3000 to 4000 = 1000 + 1000 + 1000 + 1000 = 4×1000 = 4000
1000 to 5000 = 1000 to 2000 and 2000 to 3000 and 3000 to 4000 and 4000 to 5000 = 1000 + 1000 + 1000 + 1000 = 4×1000 = 4000
2000 to 6000 = 2000 to 3000 and 3000 to 4000 and 4000 to 5000 and 5000 to 6000 = 1000 + 1000 + 1000 + 1000 = 4×1000 = 4000 3000 to 7000 = 3000 to 4000 and 4000 to 5000 and 5000 to 6000 and 6000 to 7000 = 1000 + 1000 + 1000 + 1000 = 4×1000 = 4000
4000 to 8000 = 4000 to 5000 and 5000 to 6000 and 6000 to 7000 and 7000 to 8000 = 1000 + 1000 + 1000 + 1000 = 4×1000 = 4000
5000 to 9000 = 5000 to 6000 and 6000 to 7000 and 7000 to 8000 and 8000 to 9000 = 1000 + 1000 + 1000 + 1000 = 4×1000 = 4000
NB: 4×1000= 1000 + 1000 + 1000 + 1000, means one thousand (1000) has been repeated four times.

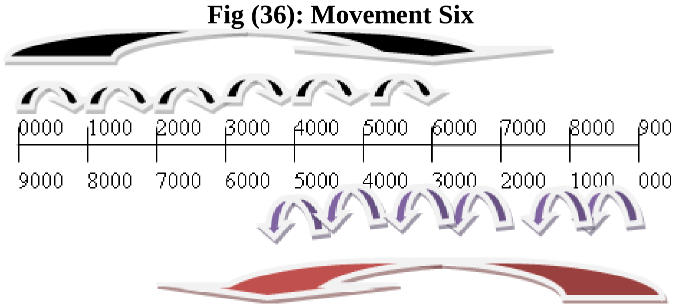
Fig (35): Movement Five



Movement Five (Jump five steps from zero to the right and or vice versa)

0000 to 5000 = 0000 to 1000 and 1000 to 2000 and 2000 to 3000 and 3000 to 4000 and 4000 to 5000 = 1000 + 1000 + 1000 + 1000 +1000 = 5×1000 = 5000
1000 to 6000 = 1000 to 2000 and 2000 to 3000 and 3000 to 4000 and 4000 to 5000 and 5000 to 6000 = 1000 + 1000 + 1000 + 1000 +1000 = 5×1000 = 5000
2000 to 7000 = 2000 to 3000 and 3000 to 4000 and 4000 to 5000 and 5000 to 6000 and 6000 to 7000 = 1000 + 1000 + 1000 + 1000 +1000 = 5×1000 = 5000
3000 to 8000 = 3000 to 4000 and 4000 to 5000 and 5000 to 6000 and 6000 to 7000 and 7000 to 8000 = 1000 + 1000 + 1000 + 1000 +1000 = 5×1000 = 5000
4000 to 9000 = 4000 to 5000 and 5000 to 6000 and 6000 to 7000 and 7000 to 8000 and 8000 to 9000 = 1000 + 1000 + 1000 + 1000 +1000 = 5×1000 = 5000
NB: 5×1000 = 1000 + 1000 + 1000 + 1000 +1000, means one thousand (1000) has been repeated five times

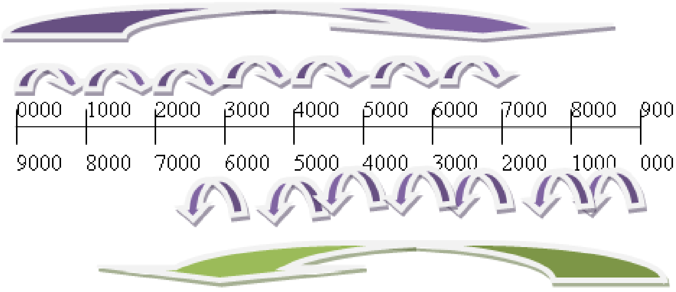
Fig (36): Movement Six



Movement Six (Jump six steps from zero to the right and or vice versa)

0000 to 6000 = 0000 to 1000 and 1000 to 2000 and 2000 to 3000 and 3000 to 4000 and 4000 to 5000 and 5000 to 6000 = 1000 + 1000 + 1000 + 1000 +1000 + 1000 = 6×1000 = 6000
1000 to 7000 = 1000 to 2000 and 2000 to 3000 and 3000 to 4000 and 4000 to 5000 and 5000 to 6000 and 6000 to 7000 = 1000 + 1000 + 1000 + 1000 +1000 + 1000 = 6×1000 = 6000
2000 to 8000 = 2000 to 3000 and 3000 to 4000 and 4000 to 5000 and 5000 to 6000 and 6000 to 7000 and 7000 to 8000 = 1000 + 1000 + 1000 + 1000 +1000 + 1000 = 6×1000 = 6000
3000 to 9000 = 3000 to 4000 and 4000 to 5000 and 5000 to 6000 and 6000 to 7000 and 7000 to 8000 and 8000 to 9000 = 1000 + 1000 + 1000 + 1000 +1000 + 1000 = 6×1000 = 6000
NB: 6×1000 = 1000 + 1000 + 1000 + 1000 +1000+ 1000, means one thousand (1000) has been repeated six times

Fig (37): Movement Seven



Movement Seven (Jump seven steps from zero to the right and or vice versa)

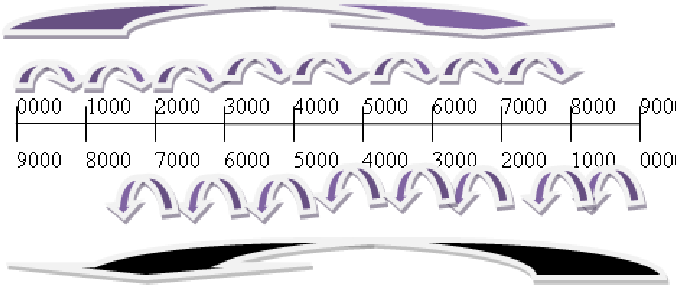
0000 to 7000 = 0000 to 1000 and 1000 to 2000 and 2000 to 3000 and 3000 to 4000 and 4000 to 5000 and 5000 to 6000 and 6000 to 7000 = 1000 + 1000 + 1000 + 1000 +1000 + 1000 +1000 = 7×1000 = 7000

1000 to 8000 = 1000 to 2000 and 2000 to 3000 and 3000 to 4000 and 4000 to 5000 and 5000 to 6000 and 6000 to 7000 and 7000 to 8000 = 1000 + 1000 + 1000 + 1000 +1000 + 1000 +1000 = 7×1000 = 7000

2000 to 9000 = 2000 to 3000 and 3000 to 4000 and 4000 to 5000 and 5000 to 6000 and 6000 to 7000 and 7000 to 8000 and 8000 to 9000 = 1000 + 1000 + 1000 + 1000 +1000 + 1000 +1000 = 7×1000 = 7000

NB: 7×1000= 1000 + 1000 + 1000 + 1000 +1000+ 1000 + 1000, means one thousand (1000) has been repeated seven times.

Fig (38): Movement Eight



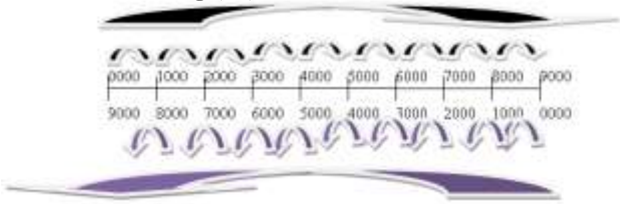
Movement Eight (Jump eight steps from zero to the right and or vice versa)

0000 to 8000 = 0000 to 1000 and 1000 to 2000 and 2000 to 3000 and 3000 to 4000 and 4000 to 5000 and 5000 to 6000 and 6000 to 7000 and 7000 to 8000 = 1000 + 1000 + 1000 + 1000 +1000 + 1000 +1000 + 1000 = 8×1000 = 8000

1000 to 9000 = 1000 to 2000 and 2000 to 3000 and 3000 to 4000 and 4000 to 5000 and 5000 to 6000 and 6000 to 7000 and 7000 to 8000 and 8000 to 9000 = 1000 + 1000 + 1000 + 1000 +1000 + 1000 +1000 + 1000 = 8×1000 = 8000

NB: 8×1000= 1000 + 1000 + 1000 + 1000 +1000+ 1000 + 1000 + 1000, means one thousand (1000) has been repeated eight times

Fig (39): Movement Nine



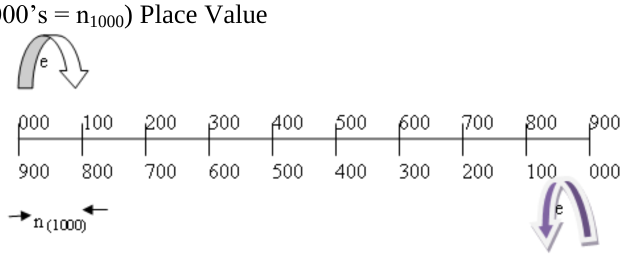
Movement Nine (Jump nine steps from zero to the right and or vice versa)

0000 to 9000 = 0000 to 1000 and 1000 to 2000 and 2000 to 3000 and 3000 to 4000 and 4000 to 5000 and 5000 to 6000 and 6000 to 7000 and 7000 to 8000 and 8000 to 9000 = 1000 + 1000 + 1000 + 1000 +1000 + 1000 +1000 + 1000 + 1000 = 9×1000 = 9000

NB: 9000 = 1000 + 1000 + 1000 + 1000 +1000 + 1000 +1000 + 1000 + 1000 = 9×100 = 900, means one thousand (1000) has been repeated nine times

Mathematical proves of the Thousand's (1000's = $n_{\#1000}$) Place Value

Fig 40: Diagram of Mathematical proves of the Thousand's (1000's = n_{1000}) Place Value



Let

n_{th} = all Place Values,

y_{nth} = answer for all Place Values,

n $_{(1000)}$ = 1000, for Thousand's (1000's) Place value,

e = movement (s) within the Thousand's (1000's) Place Value

› y_b = bn $_{(1000)}$

› y_e = en $_{(1000)}$

For movement one on the Thousand's (n $_{(1000)}$) Place Value, › e_1= 1 and n $_{(1000)}$ = 1000

› y_e = en $_{(1000)}$ = y_e= y_1= 1n $_{(1000)}$ = 1×1000 = 1000

:. y_1= 1000

For movement two on the Thousand's (n $_{(1000)}$) Place Value, › e_2= 2 and n $_{(1000)}$ = 1000

› y_e = en $_{(1000)}$ = y_e= y_2= 2n $_{(1000)}$ = 2×1000 = 1000 + 1000 = 2000

:. y_2= 2000

For movement three on the Thousand's (n $_{(100)}$) Place Value, › e_3= 3 and n $_{(1000)}$ = 1000

› y_e = en $_{(1000)}$ = y_e= y_3 = 3n $_{(1000)}$ = 3×1000 = 1000 + 1000 + 1000 = 3000

:. y_3 = 3000

For movement four on the Thousand's (n $_{(1000)}$) Place Value, › e_4= 4 and n $_{(1000)}$ = 1000

› y_e = en $_{(1000)}$ = y_e = y_4= 4n $_{(1000)}$ = 4×1000 = 1000 + 1000 + 1000 + 1000 = 4000

:. y_4= 4000

For movement five on the Thousand's (n $_{(1000)}$) Place Value, › e_5= 5 and n $_{(1000)}$ = 1000

› y_e = en $_{(1000)}$ = y_e = y_5= 5n $_{(100)}$ = 5×1000 = 1000 + 1000 + 1000 + 1000 + 1000 = 5000

:. y_5= 5000

For movement six on the Thousand's (n $_{(1000)}$) Place Value, › e_6 = 6 and n $_{(1000)}$ = 1000

› y_e = en $_{(1000)}$ = y_e = y_6 = 6n $_{(100)}$ = 6×1000 = 1000 + 1000 + 1000 + 1000 + 1000 + 1000 = 6000

:. y_6= 6000

For movement seven on the Thousand's (n $_{(1000)}$) Place Value, › e_7 = 7 and n $_{(1000)}$ = 1000

› y_e = en $_{(1000)}$ = y_e = y_7 = 7n $_{(100)}$ = 7×1000 = 1000 + 1000 + 1000 + 1000 + 1000 + 1000 + 1000 = 7000

:. y_7= 7000

For movement eight on the Thousand's (n $_{(1000)}$) Place Value, › e_8= 8 and n $_{(1000}$= 1000

› y_e = en $_{(1000)}$ = y_e = y_8 = 8n $_{(1000)}$ = 8×1000 = 1000 + 1000 + 1000 + 1000 + 1000 + 1000 + 1000 + 1000 = 8000

:. y_8 = 8000

For movement nine on the One's (n $_{(1000)}$) Place Value, › e_9 = 9 and n $_{(1000)}$ = 1000

› y_e = en $_{(1000)}$ = y_e = y_9 = 9n $_{(1000)}$ = 9×1000 = 1000 + 1000 + 1000 + 1000 + 1000 + 1000 + 1000 + 1000 + 1000 = 9000

:. y_9 = 9000

Thousand Place Value Solution-Boxes

Solution Box 3a: Thousand's Place Value

0	0	0	0	1	0	0	0	2	0	0	0	3	0	0	0	4	0	0	0	5	0	0	0	6	0	0	0	7	0	0	0	8	0	0	0	9	0	0	0

Solution Box 3b: Reverse Thousand's Place Value

9	0	0	0	8	0	0	0	7	0	0	0	6	0	0	0	5	0	0	0	4	0	0	0	3	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0

Example 1

How will you demonstrate 5589 to; (1) a Classes (4-6) pupil and (JHS) Junior High School (1-3) pupil using the P-Value Solution-Box?

Solution 1A

Demonstrating 5589 by the use of P-Value Solution-Box to Classes (4-6)

(7) Mathematical, 5589 can be broken into 5000, 500, 80, and 9 i.e. 5589 = 5000 + 500 + 80 + 9.

(8) Here, 5589 = 5000 + 500 + 80 + 9 = Thousands + Hundreds + Tens + Ones. This implies that, one has to use four (4) P Value Solution-Boxes i.e. thousand's P Value Solution-Box, Hundred's P Value Solution-Box, Ten's P Value Solution-Box, and One's P Value Solution-Box.

(9)

Thousand's P-Value Solution-Box

1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0									

+

Hundred's P-Value Solution-Box

1	0	0	1	0	0	1	0	0	1	0	0	1	0	0												

+

Ten's P-Value Solution-Box

1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0		

+

One's P-Value Solution-Box

1	1	1	1	1	1	1	1	1

5589 = 1000 + 500 + 80 + 9 = (1000 + 1000 + 1000 + 1000 + 1000) + (100 + 100 + 100 + 100 + 100) + (10 + 10 + 10 + 10 + 10 + 10 + 10 + 10) + (1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1) = 5×1000 + 5×100 +8×10 + 1×9 = 5000 + 500 + 80 + 9 = 5589.

Solution 1B

Demonstrating 5589 by the use of P-Value Solution-Box to JHS (1-3)

(10) Mathematical, 5589 can be broken into 5000, 500, 80, and 9 i.e. 5589 = 5000 + 500 + 80 + 9.

(11) Here, 5589 = 1000 + 500 + 80 + 9 = Thousands + Hundreds + Tens + Ones.

This implies that, one has to use four (4) P Value Solution-Boxes i.e. thousand's P Value Solution-Box, Hundred's P Value Solution-Box, Ten's P Value Solution-Box, and One's P Value Solution-Box.

(12)

Thousand's P-Value Solution-Box

						5	0	0	0									

+

Hundred's P-Value Solution-Box

												5	0	0									

+

Ten's P-Value Solution-Box

												8	0		

+

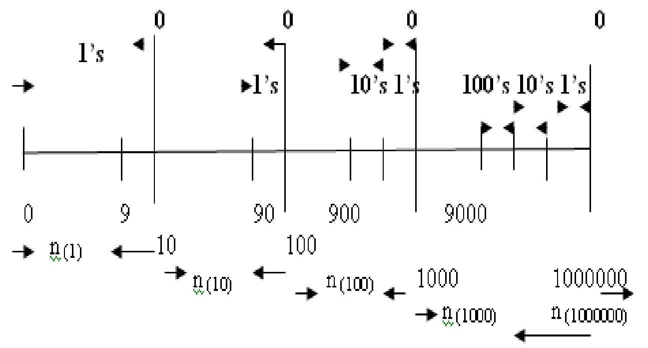
One's P-Value Solution-Box

								9

5589 = 1000 + 500 + 80 + 9 = (5000) + (500) + (80) + (9) = 5×1000 + 5×100 +8×10 + 1×9 = 5000 + 500 + 80 + 9 = 5589.

Combination of some P-Value Models

Fig 41: Diagram of some P-Values Models (i.e. One's, Ten's, Hundred's, Thousand's and Million's)



Combination of Formulas of the P-Value Models

n_j = all Place Values,

y_j = answer for all Place Values

$y_b = an_{(1)}$; a = number of movement (s) in One's (1's) Place Value

$y_c = bn_{(10)}$; b = number of movement (s) in Ten's (10's) Place Value

$y_d = cn_{(100)}$; c = number of movement (s) in Hundred's (100's) Place Value

$y_e = dn_{(1000)}$; d = number of movement (s) in Thousand's (1000's) Place Value

$y_f = en_{(1000000)}$; e = number of movement (s) in Million's (1000000's) Place Value

$y_g = fn_{(1000000000)}$; f = number of movement (s) in Billion's (1000000000's) Place Value

$y_h = gn_{(1000000000000)}$; g = number of movement (s) in Trillion's (1000000000000's) Place Value

$y_i = gn_{(1000000000000)}$; i = number of movement (s) in Quintillion's (1000000000000000's) Place Value

$y_{nth} = Dn_{(j)}$; j = number of movement (s) in Infinity's (j's) Place Value

Let

$y_{n(x)} = Dn_{(x)}$; x = specific place value i.e. one, ten, hundred, thousand, million etc

For place values from one's to Quintillion's

$$y_{n(x)} = \sum_{j=1}^{n} Dn_j = y_{n(1)} + y_{n(10)} + y_{n(100)} + y_{n(1000)} + y_{n(1000000)} + .. + y_{n(1000000000000000)}$$

For place values from one's to infinity's

$$y_j = \sum_{j=1}^{n} Dn_j = y_{n(1)} + y_{n(10)} + y_{n(100)} + y_{n(1000)} + y_{n(1000000)} + \ldots\ldots\ldots\ldots + y_{nj}$$

$$y_j = \sum_{j=1}^{n} Dn_j = an_{(1)} + bn_{(10)} + cn_{(100)} + dn_{(1000)} + en_{(1000000)} + \ldots\ldots\ldots\ldots + y_{nj}$$

Where, D = a, b, c, d, e, ……… z depending on the place value (s) used.

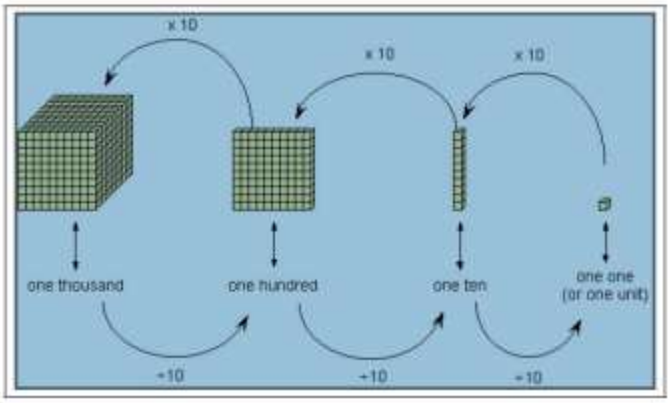
Reference

Kumassah, E. K (2012). *The dtml-conversion models with its mathematical formulas for colleges of education (ed 1)*. Jasikan: Jasikan College of Education.

Price, P.S (2002). Using place-value blocks or a computer to teach place-value concepts. *European Research in Mathematics Education, group 2*

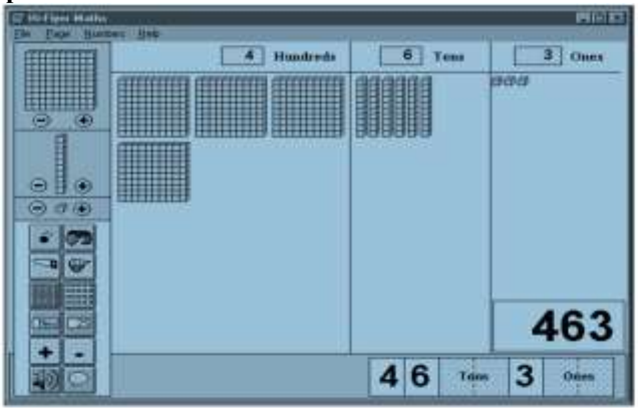
Price, P.S (2001). *The development of year 3 students' place value understanding: representations and concepts*. Queensland: Unpublished PhD Thesis submitted to Centre for Mathematics and Science Education, School of Mathematics, Science and Technology Education of the Faculty of Education, Queensland University of Technology

Appendix A



(Refer to Price, 2011, p 41)

Appendix B



(Refer to Price 2012, p 263)