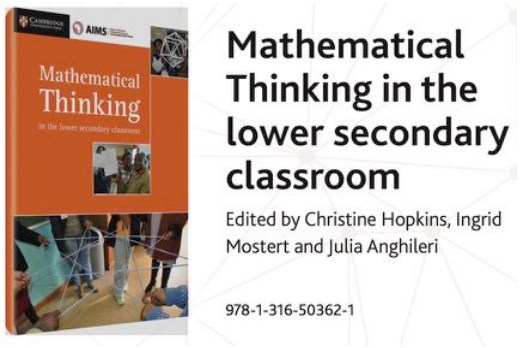
WORKHOP GUIDES FOR TEACHERS TO LEARN TOGETHER
LOWER SECONDARY N2 PLACE VALUE AND DECIMALS
Guide for your own self-help professional development workshop
and resources for inquiry based lessons.

MANAGE YOUR OWN PROFESSIONAL DEVELOPMENT WORKSHOP

These guides are designed to support teachers in developing a deep understanding of the mathematics they teach and in developing more effective ways of teaching.

You can use these guides on your own or as one of a group of teachers who meet together to talk about your mathematics lessons as part of your professional development. Maybe one of you will take the lead in organizing time, date and venue but once you are doing the activities together you will all participate on equal terms in the discussion and reflection.



These Lower Secondary Workshop Guides are chapters in the AIMSSEC Mathematical Thinking Book.

Buy the book online from Amazon or from http://www.cambridge.org/za/education Search for AIMSSEC or for ISBN 9781316503621. To order the book in South Africa go directly to http://www.cup.co.za

For reviews and curriculum map see https://aiminghigh.aimssec.ac.za/mathematical-thinking/

EACH WORKSHOP GUIDE HAS A SIMILAR FORMAT:

PAGE 1 **TITLE PAGE**
Teaching strategy.
Curriculum content and learning outcomes.
Summary of mathematical topic (FACT BOX.)

PAGES 2 & 3 WORKSHOP ACTIVITIES FOR TEACHERS
Two pages for you to work through with your colleagues. These are activities to be shared and discussed. For each activity there is a list of resources needed, how to organise the activity (e.g. individual, pairs, whole class), how long the activity will take, when to stop reading and work on the activity and when to record your work.

PAGES 4 & 5 CLASSROOM ACTIVITIES FOR LEARNERS
Two pages to help you plan your lesson. You are advised how long to allow for the activity, the resources you might need and the key questions to ask.

PAGES 6 TO 10 **CHANGES IN MY CLASSROOM PRACTICE**
Pages on implementing the teaching strategies with additional resources and activities for use during or after the workshop such as worksheets and templates.

Place value and Decimal Fractions

Teaching strategy: Discussion in pairs

Curriculum content: Understand number representation up to 2 places of decimals.
Add, subtract, multiply and divide numbers up to 2 places of decimals.

Prior knowledge needed: Ability to read any number including decimal numbers.

Intended Learning Outcomes At the end of this activity teachers and learners will:

- Know what the value of any digit in a decimal fraction represents
- Understand how numbers are constructed
- Be able to add, subtract, multiply and divide decimal fractions
- Appreciate the importance of being able to estimate answers
- Have experienced independent thinking

Fact box
The value of each digit in a given number depends on the position it has in the number.

Names of numbers:

500 000	– five hundred thousand
60 000	– sixty thousand
4 000	– four thousand
500	– five hundred
0.2	– nought point two (two tenths)
0.04	– nought point nought four (four hundredths)
0.007	– nought point nought nought seven (seven thousandths)

Note
*0.28 is read nought point two eight and **not** nought point twenty eight.*
Some countries use the decimal point others use the decimal comma writing 0,28 which is read as nought comma two eight. In thess workshop guides the more common decimal point will be used as teachers are familiar with this from bank accounts, calculators and computers.

Resources for this workshop: Calculator for each pair of teachers, dice or spinners.

Workshop Activities for Teachers

Activity 1: Wipe Out

Calculator for each pair. Pairs 30 minutes

Work in pairs
The first person writes down a 6 digit number.
The second person keys that number into their calculator.
The first person now says please change the digit 4 to the digit 0. You must use the digit keys and the [-] and [=] keys

	7 4 5 6 3 2
-	4 0 0 0 0
=	7 0 5 6 3 2

Example: enter the number 745 632 on the calculator and try to change it to 705 632
The first person now chooses the digit 3 or 2 or 5 until they have all been wiped out (changing the original number to 0). Try this now.

Now swop so that the second person chooses a number (can be more than 6 digits) and tells the first person which digits to eliminate.

Play the game again but this time the person choosing the number and the digits to be wiped out can choose 2 or more digits to be eliminated *at the same time.*
For example change 658 451 to 650 450.

Play the game again but this time choose numbers with a decimal point e.g. 4 529.39

Notes Topic: Place Value

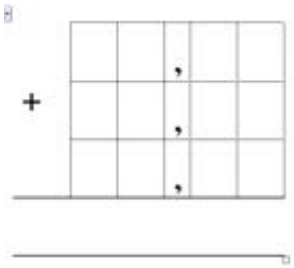
- This game is designed to consolidate the concept of place value. To eliminate the 4 in 142 you need to subtract 40 and so you can see that the 4 represents the value 40.
- There are many variations of this game. One variation is described in the Classroom Activity 1 where learners are asked to change one number to another number using only the digit keys and the [÷] and [+] keys or the [×] and [−] keys.

Activity 2: Place the digits

Dice or spinner for each pair with the numbers 1 to 6. See page 9 for how to make a spinner
Pairs 30 minutes

Divide into pairs and get a dice or spinner with the numbers 1, 2, 3, 4, 5 and 6. Start with Game 1.

Game 1: Addition
Each of you draw an addition grid like the one shown. Take turns to throw the dice or spin the spinner and each decide which of your cells to fill in. Once you have written in a digit you are **not** allowed to move it.



1st player	2nd player
2 6.6 1	6 3. 6 2
+ 3 5.1 2	+ 5 2.1 5
2 5.3 6	3 6. 2 1
8 7.0 9	1 5 1.9 8

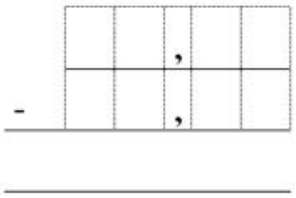
People use a decimal comma in some countries, in others a decimal point, so we use both here.

Throw the dice or spin the spinner twelve times until all the cells are full. Each player adds up their numbers. Whoever has the sum closest to 100 wins.

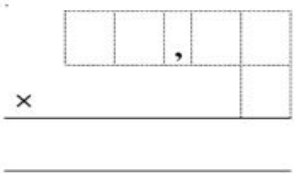
Here the 1st player wins as 87.09 is closer to 100 than 151.98

Scoring: A point for a win. The first person to reach 5 points wins the game. You can change the target to make it easier or more difficult.

Game 2: Subtraction
Same as Game 1 except now you work with a subtraction grid and your target is 1.



Game 3: Multiplication
Same as Game 1 and 2 except now you work with a multiplication grid and your target is 100.



Notes
The idea behind the game is not just to place the digits randomly but to try and place them in such a way that the answer of your addition, subtraction or multiplication sum is as close as possible to the target number. In this way you practice operations with decimal numbers and you practice estimation of calculations with decimal numbers. You will get better the more times you play the game.

Classroom Activities for Learners

Activity 1: Wipe-Out

Photocopies of the worksheet on page 7 (decimal point version) or page 8 (decimal comma version). Calculator for each pair.
Pairs 30 minutes

Write the number 142 on the board.
Tell learners to key the number on their calculators.
Learners must now subtract a number so that they wipe out the 4 and have 102 on their calculators. (142 - 40 =102). Now the learners must wipe out the 1 with a subtraction and finally the 2 giving 0. The number 142 has been wiped out.

Write the number 63 158.247 on the board.
Ask the learners to read the number aloud.
Tell learners to key the number on their calculators.
Ask learners to wipe out the digits one at a time using a subtraction so that they become 0 in the following order:
Wipe out 2 so the number becomes 63 158.047
then 1 followed in turn by 5, 3, 7, 6, 4, 8
Hand out the worksheet or write the instructions on the board and allow learners to work in pairs to complete the challenges.

Teaching ideas

- This game allows learners to use trial and error and any prior knowledge of place value to consolidate their knowledge of place value and to extend it to decimal digits.
- It is important that you make sure that the learners understand that because you had to subtract 40 to eliminate the 4 in 142, the value that the 4 is representing is 40.
- You can also use arrow cards (or flard cards) to help your learners understand place value. On pages 10 to 13 you will find a complete set of Flard decimal cards. Flard whole number cards are included for other place value activities. To make the number 0.473, for each digit there is a separate card that indicates the value represented by that one digit.

- You could start the wipe out game with the number 0.473 and ask your learners to wipe out the 7. If your learners struggle to realise that they need to subtract 0.07 you can show them the separate cards.
- Show them how the number is built up and then how it can be broken down. Show that the 7 represents 0.07 and then ask them to try again to use their calculator to wipe out the 7 in 0.473.

Activity 2: Place the Digits

Set of ten small cards with the digits 0 to 9
Paper and at least one calculator for each group Pairs 15 minutes

Make the biggest possible 4 digit number
Ask the learners to draw 4 squares in a row. Explain that you will choose 4 digits and that they must use these digits to make the **biggest** possible 4-digit number.
Without looking, choose a card from the set of 10 cards and show the learners the card.
DO NOT replace this card.
The learners must decide where to place the digit on the card. Once the digit is placed its position cannot be changed.
Repeat for three more cards.

If the digits are 5, 1, 3, 7, then two of the possible arrangements are:

Group A

5	7	1	3

Group B

7	1	5	3

Group B wins one point as they have the biggest number.
The first group with 5 points wins.

Make the smallest possible 5-digit number. This time the learners must draw 5 squares. The same rules apply as the first time. The group with the smallest number wins.
If the digits are 4, 6, 1, 2, 9, 3
Group 1 might write down: 12436
Group 2 might write down: 14269
In this case group 1 will win a point as they have the smallest number.
Some class discussion could lead to the learners saying that the smallest possible number is 12346.

Make the closest number to 0.5. This time learners must draw 4 squares with a decimal point between the first two columns and fill in a 0 in the first column. You must choose a card 3 times. The group with the number closest to 0.5 wins.

If the digits are 7, 2, 3:

0 .	2	3	7

Group 1 might write down: 0. 237 (the difference here is 0.263)
Group 2 might write down: 0. 723 (the difference here is 0.223)
In this case group 2 will win a point as they have the number closest to 0.5 (the smaller difference). Often a subtraction is needed to see which number is closest to 0.5

The first group to gain 5 points is the winner.

Teaching ideas

To let your learners get the idea of the game, let them try to get the biggest number possible a few times before moving onto the smallest number possible and then finally onto making a decimal fraction. You can make up your own numbers that you are aiming for.

Changes in my classroom

Implementing the teaching strategy

Games and some competition are motivating for learners. Whilst they are playing you will hear them discussing and talking about the mathematics. When you hear an interesting comment you can ask the pair to repeat it to the class. You have told them it is a useful comment so they can feel confident.

Their learning will be better if they can enjoy building up their skills. If learners keep a record of their scores they can compete against their own previous best work.

In the first activity a game is used to consolidate a concept. Games such as the one in the second activity are useful for practising important skills (such as operations with decimal fractions) that might otherwise be tedious to practice.

With any game it is important that at the end of the game the teacher makes sure that all the learners have understood the concept or mastered the skill that the game was designed for.

Key Questions to develop understanding

- What is the value of the 4 in 142? How can you use your calculator to show this?
- What is the value of the 4 in 156.249? How can you use your calculator to show this?
- Why is it incorrect to read 0.28 as nought point twenty eight?
- When playing the game - why did you choose to put that number in that cell?

Follow up Activity

Using People Maths to review multiplying and dividing by 10

You will need four chairs set out at the front of the room and showboards.

Hand out showboards to learners near the front and ask them each to write a digit on their board so you have 1, 2, 3, 4, 5, 6, 7, 8, 9 and four boards with 0.

Ask learners to come and sit on the chairs to show:
the number three thousand,
then move to show $3000 \div 10$, then $300 \div 10$, $30 \div 10$

How can we show $3 \div 10$?

Write a decimal point on a showboard and get a learner to stand to the right of the chairs (when you face the chairs) with the decimal point.

Place another chair to the right of the decimal point to show 0.3

Change the number to 4.32 and then start multiplying by 10 or 100 or 1000 adding more chairs as needed.

This is a useful demonstration that multiplying by 10 sends all digits one place to the left with the decimal point fixed. Vary the activity and discuss with the class until they are quite certain that 2.3 multiplied by 10 is NOT 2.30 but 23.

Wipe –Out: a calculator game

Alwyn Olivier, University of Stellenbosch

1. Key in 4 682.736 and by using the digit keys and only the [-] and [=], change the 8 into a 0, the 3 into a 0, the two sixes into zeroes and then the 7 and the 4 simultaneously into zeroes.

2. Key in 3 749.123 and change this number into 3 040.103 in **one** step using the digit keys and the [-] key.

3. Key in 513 245.87 and change it into 412 245,86 in one step by only using the digit keys and the [-] key.

4. Key in and change to the indicated amount by using the digit keys and the [x] and [-] keys on your calculator.
    a. Key in 58.76 and change to 170.08
    b. Key in 146.24 and change to 1310.08
    c. Key in 234.07 and change to 1205.30
    d. Key in 67.123 and change to 267.512

5. Key in and change to the indicated amount by using the digit keys and the [÷] and [+] keys on your calculator
    a. Key in 246.124 and change to 125.163
    b. Key in 2 468.128 and change to 717.134
    c. Key in 6 432.9 and change to 1 265.69
    d. Key in 67.99 and change to 6.18

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3 Key in 513 245,87 and change it into 412 245,86 in one step by only using the digit keys and the [-] key.

4 Key in and change to the indicated amount by using the digit keys and the [x] and [-] keys on your calculator.

e. Key in 58,76 and change to 170,08
f. Key in 146,24 and change to 1310,08
g. Key in 234,07 and change to 1205,30
h. Key in 67,123 and change to 267,512

5 Key in and change to the indicated amount by using the digit keys and the [÷] and [+] keys on your calculator

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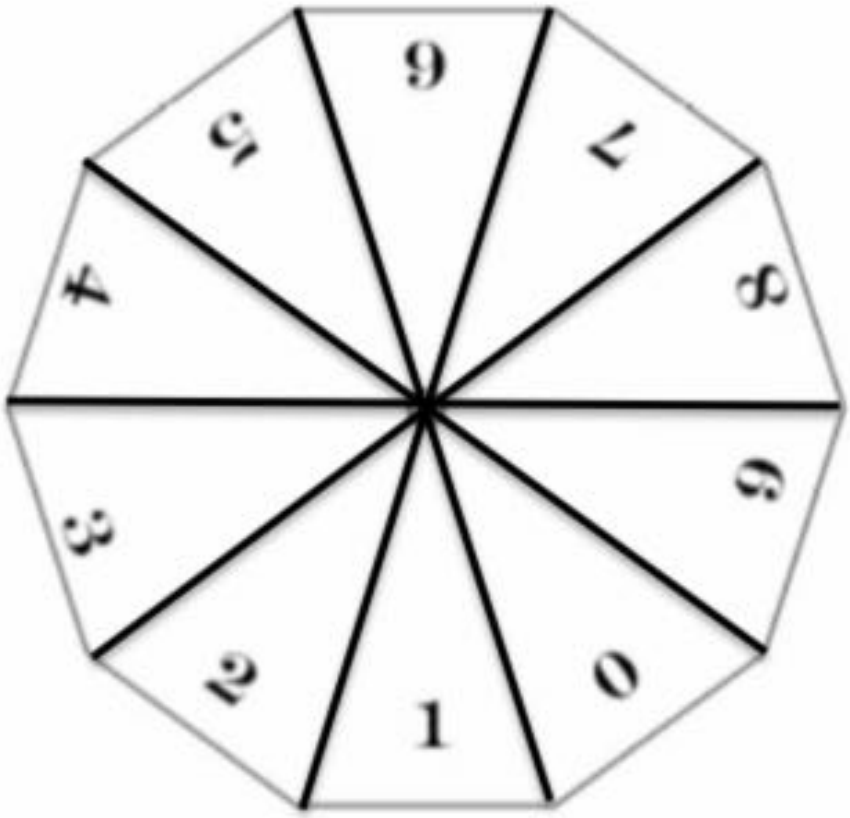
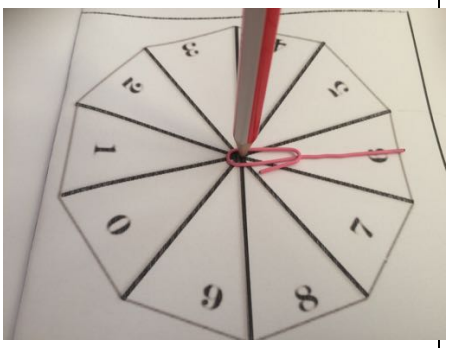
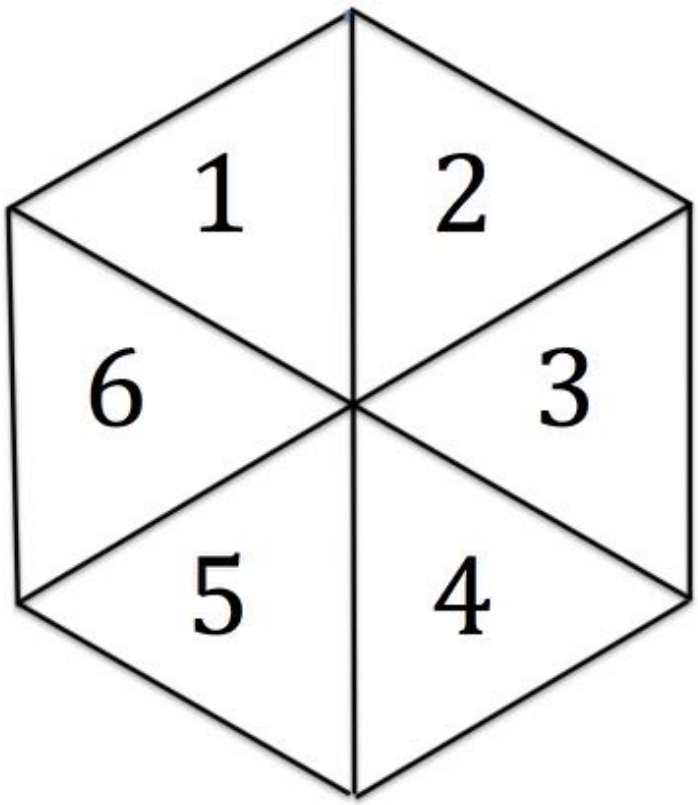


MAKING SPINNERS
You will need a paper clip opened out as shown.

Hold the paper clip down at the centre of the spinner using a pencil so that the paper clip spins freely.



Now you are ready to play the games.



0	. 0	0	1

DECIMAL FLARD CARDS THERE ARE 40 CARDS YOU WILL NEED TO CUT THEM OUT

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	1

FLARD CARDS

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	.	1	1

FLARD CARDS

0	.	2	2

0	.	3	3

0	.	4	4

0	.	5	5

0	.	6
0	.	7
0	.	8
0	.	9
0	.	
0	.	0
0	.	0	0
0	.	0	0	0

6
7
8
9

1	0	0	0

WHOLE NUMBER FLARD CARDS 36 CARDS YOU WILL NEED TO CUT THEM OUT

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

1	0	0

FLARD CARDS

2	0	0

3	0	0

4	0	0

5	0	0

6	0	0

7	0	0

8	0	0

9	0	0

1	0	1

FLARD CARDS

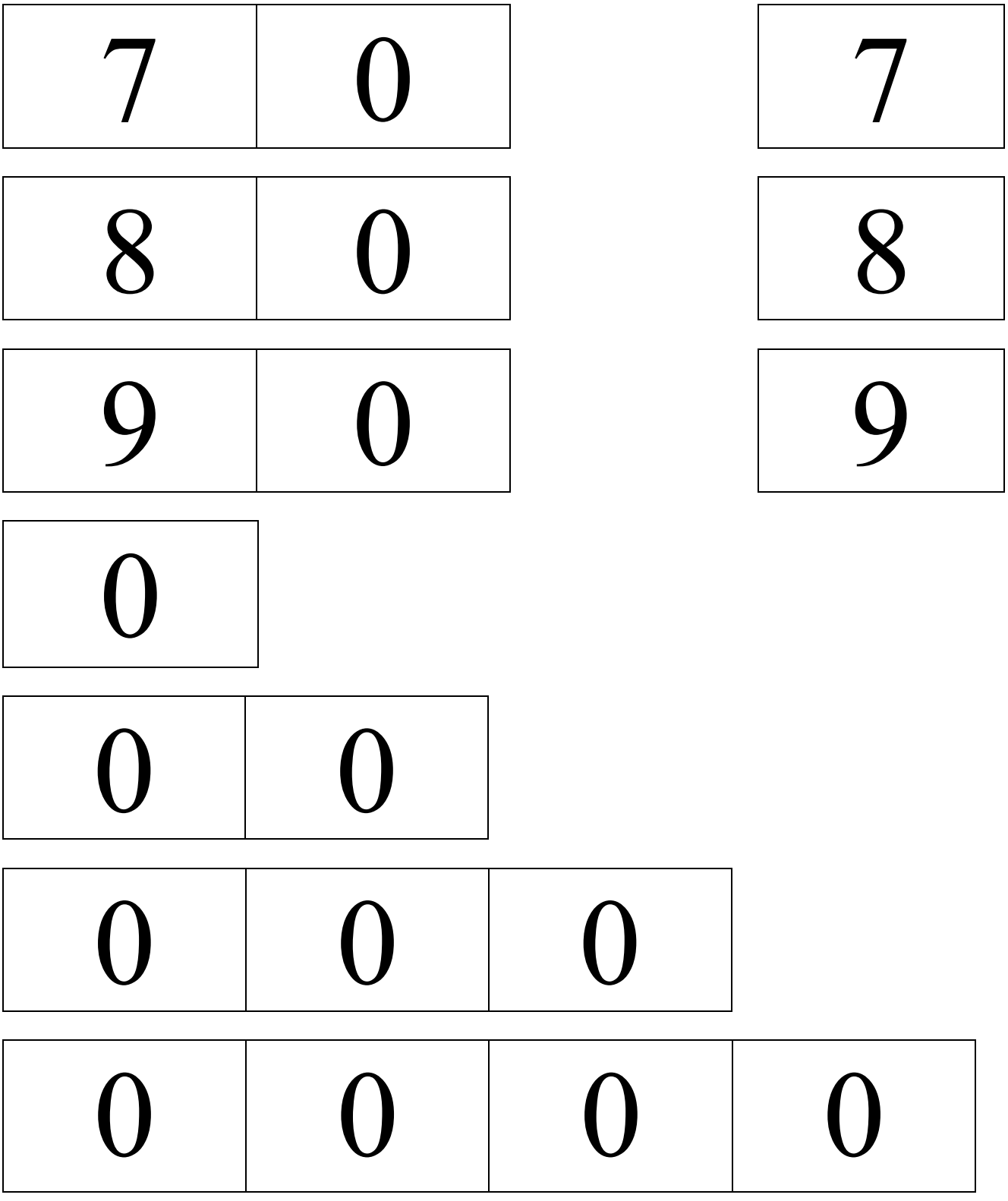
2	0	2

3	0	3

4	0	4

5	0	5

6	0	6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