In Chapter 1 we work with the <u>whole numbers</u>

0, 1, 2, 3, 4, 5, 6, ...

Big whole numbers are written using the decimal place-value system. For example

72983

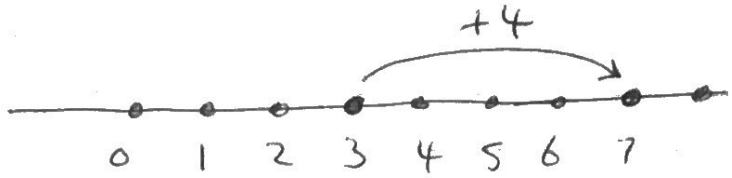
.. hundreds tens ones

(digit on right always represents ones)

so it means

$$7 \times 10000 + 2 \times 1000 + 9 \times 100 + 8 \times 10 + 3 \times 1.$$

1.1 Adding whole numbers



On the number line, adding means moving right. Here we see $3+4=7$

Simple properties:

addition is <u>commutative</u>, eg. $3+4=4+3$

the <u>identity</u> for addition is 0, eg. $9+0=9$ (no change) $=0+9$

addition is <u>associative</u>, eg

$$\underbrace{(3+5)+2}_{8+2} = \underbrace{3+(5+2)}_{3+7}$$

To add big numbers by hand we write them vertically above each other with the ones places lined up, and all the other places lined up too. Any column addition that gets bigger than nine means we must "carry" into the next column.

Example ①. Find $3185 + 862$

$$\begin{array}{l} \ \ 3185 \\ +\,862 \\ \hline \end{array} \qquad \begin{array}{l} \ \ 3\ 1\ 8\ 5 \\ +\,8\ 6\ 2 \\ \hline \end{array}$$

No

$$\begin{array}{r} 3\ 1\ 8\ 5 \\ +\quad 8\ 6\ 2 \\ \hline \end{array}$$

Yes

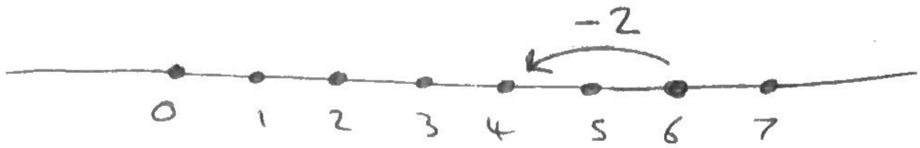
We see the answer is 4047.

More examples in the book p 12–14.

When we add numbers, the answer is called a sum.

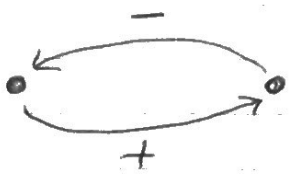
1.2 Subtracting whole numbers

On the number line, subtracting means moving left. Here is 6 - 2



So 6 - 2 = 4. We can say the <u>difference</u> of 6 and 2 is 4. Subtraction does not have the nice properties of being commutative, associative and with an identity.

Addition (moving right) and subtraction (moving left) are "opposite" or "inverse" operations.



To subtract two big numbers we set them up vertically, same as when adding:

$$\begin{array}{r} 3694 \\ -\ \ 274 \\ \hline \end{array}$$

So $3694 - 274 = 3420$

Check:

$$\begin{array}{r} 3420 \\ +\ \ 274 \\ \hline 3694 \end{array}$$

✓

If the digit on the bottom is too big to subtract then we need to "borrow" from the next column:

$$\begin{array}{r} 3694 \\ -\ \ 278 \\ \hline \end{array}$$

we borrow one from the 9 which is really 9 tens:

$$\begin{array}{rrrrr} & & & 8 & 14 \\ & 3 & 6 & \cancel{9} & \cancel{4} \\ - & & 2 & 7 & 8 \\ \hline & 3 & 4 & 1 & 6 \end{array}$$

So $3694 - 278 = 3416$ and we could check that $3416 + 278 = 3694$.

The only thing that can go wrong with borrowing is if there is a zero in the next column. Then you have to look at further columns to the left.

See Example 11 on page 17.

Common mistake when subtracting:

$$\begin{array}{r} 93 \\ -68 \\ \hline 35 \end{array}$$

Can you see the mistake?

1.3 Multiplying whole numbers

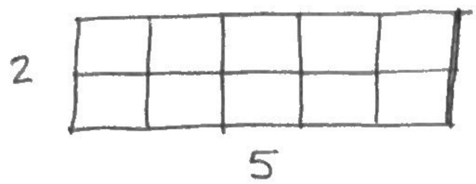
$$\underbrace{2+2+2+2+2}_{\text{five twos}} = 5 \times 2 = 10$$

We can think of multiplication as repeated addition. Notations

$$5 \times 2 \qquad 5 \cdot 2 \qquad 5 * 2 \qquad (5)(2)$$

all mean the product of 5 and 2.

We can use products to find areas of rectangles. For example



area = 10 square units.

Properties:

Multiplication is commutative, eg $2 \times 5 = 5 \times 2$

The identity for multiplication is 1,

eg $8 \times 1 = 8 = 1 \times 8$

Multiplication is associative:

eg. $(3 \times 5) \times 2 = 3 \times (5 \times 2)$

$15 \times 2 \qquad 3 \times 10$

We multiply two big numbers using the same vertical format. Put the smaller number on the bottom and start by multiplying with the digit in its ones-place. Carry any numbers that get too big. Then multiply with the digit in the tens-place and shift the answer to start in the tens.

Example: find the product 28×149.

write
$$\begin{array}{cccc} & 1 & 4 & 9 \\ \times & & 2 & 8 \\ \hline \end{array}$$

first multiply by 8

$$\begin{array}{cccc} & 3 & 7 & \\ & 1 & 4 & 9 \\ \times & & 2 & 8 \\ \hline 1 & 1 & 9 & 2 \end{array}$$

Then by the 2

$$\begin{array}{cccc} & & 1 & \\ & 1 & 4 & 9 \\ \times & & 2 & 8 \\ \hline 1 & 1 & 9 & 2 \\ 2 & 9 & 8 & \end{array}$$

Then add

$$\begin{array}{ccccc} & 1 & 1 & & \\ & 1 & 1 & 9 & 2 \\ + & 2 & 9 & 8 & \\ \hline & 4 & 1 & 7 & 2 \end{array}$$

So the answer is 4172.