Calculation Policy

2015

Steps taken to progress towards a standard written method of calculation.

Introduction

The New Maths Curriculum provides a structured and systematic approach to teaching number work and continues the emphasis on teaching mental calculation strategies. The principal focus of Maths teaching in Key Stage 1 is to develop confidence and mental fluency with whole numbers, counting and place value. This involves working with numerals, words and the four operations, including with practical resources.

The principal focus of Maths teaching in lower key stage 2 is to ensure that pupils become increasingly fluent with whole numbers, number facts and the concept of place value. More formal written methods are introduced when the child is able to use a wide range of mental calculation strategies. This should ensure that pupils develop efficient written and mental methods and perform calculations accurately with increasingly large numbers.

In upper key stage 2 the focus of Maths teaching is to ensure pupils extend their knowledge of the number system and place value to include larger integers and by the end of Year 6 they should be fluent in written methods for all four operations.

Reasons for Using Written Methods

- To partially assist mental calculation by writing down some of the numbers and answers involved.
- To make clear a mental procedure for the pupil.
- To replace mental calculation when the problem is too difficult to be done mentally.
- To help communicate methods and solutions.
- To provide a record of work done.
- To develop and refine a set of rules for calculations
- To pick up the "Show your working out" marks in tests.

When Are Children Ready For Written Calculations?

Informal Methods such as jottings, drawings, sorting and grouping should be attempted as soon as the child can count and make a mark on a surface.

The following are guides for the teacher to judge when a child is ready to move from informal to formal methods of written calculation.

For Addition and Subtraction

Does the child know addition and subtraction facts to 10?
Does the child understand place value?
Can they add two single digit numbers mentally?
Can they explain their mental strategies orally and record them using informal jottings?
Can they partition numbers?
Do they understand 0 as a place holder?

For Multiplication and Division

Do they understand the concept of multiplication as repeated addition?
Do they know at least the 2 times tables?
Do they know the result of multiplying by 0 and 1?
Do they understand 0 as a place holder?
Can they double single digit numbers mentally?
Do they understand what happens when we multiply a single digit number by 10?
Can they explain their mental strategies orally and record them using informal jottings?

Wordsley Learning Network - A Whole School Approach

In the Wordsley Learning Network, we have developed a consistent approach to the teaching of written calculation methods. This will establish continuity and progression throughout the school.

Place value will be taught mentally first from Nursery then continuing into Reception where number tracks are used progressing to number lines (to 10 then progress to 100) in years 1 and 2.

The empty number line will then be introduced to aid calculations. Addition and subtraction will be taught counting on when introducing the use of a number line.
When teaching subtraction, children need to be taught and reminded the difference between 'take away' and 'finding the difference'. This will be particularly important when problem solving later on.

Children should be taught to look carefully at a calculation and decide if it can be done mentally first, needs an informal jotting, or needs a formal written method.

In all cases make sure that the children always look out for special cases that can still be done entirely mentally e.g. 11+9,15+5 (number bonds to 20) or 350 – 125, 6000 – 5998 (counting on).

Children should also be taught to learn to estimate/approximate first e.g. 29+30 (round up to the nearest 10, the answer will be 60)

Stages in Addition

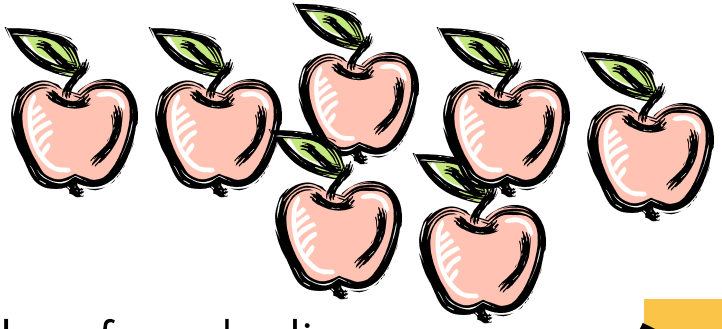
Informal Counting Methods

Guidance - Reception

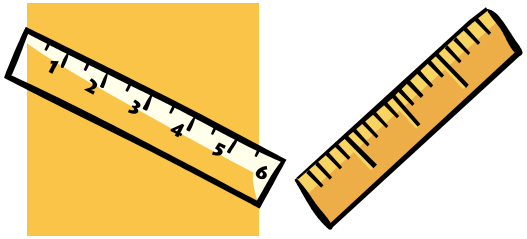
Step a. Counting songs/rhymes

Step b. Counting and moving objects

Step c. Pictorial addition

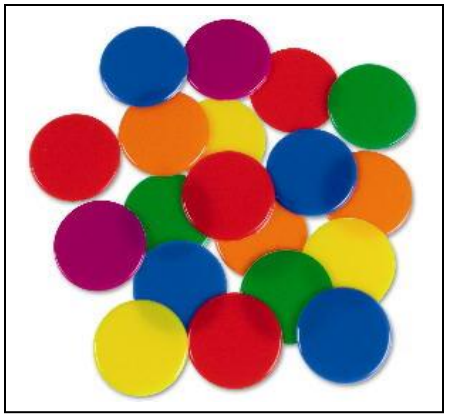


Step d. Use of numberlines



Steps in counting on

Use counters to count on.



OR use your fingers to be really quick

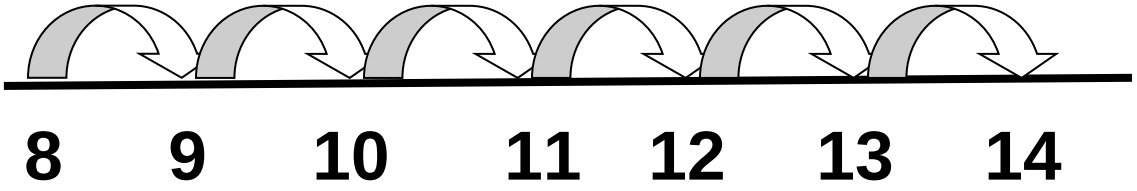
When ready, put the big number in your head

and count on the rest using your fingers.

Steps in use of Number lines

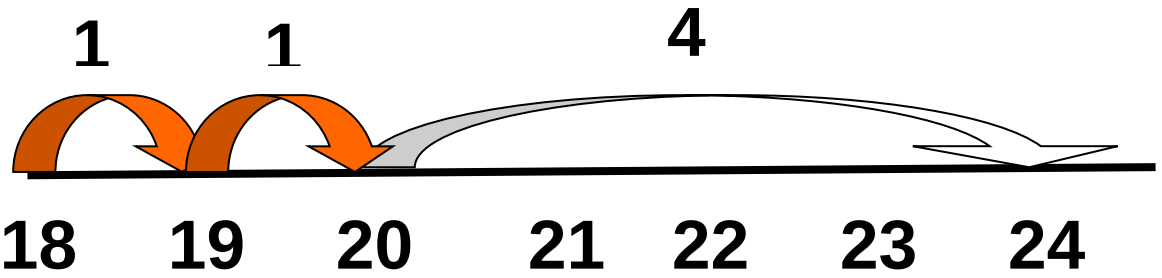
Guidance – Year 1

Step a. Count on one at a time.

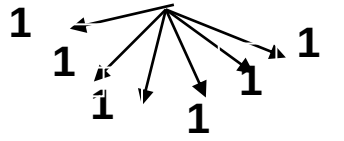


8 + 6 = 14

b. Count to the nearest landmark number then count on the rest.



18 + 6 = 24



c. Start with the largest number. (18)

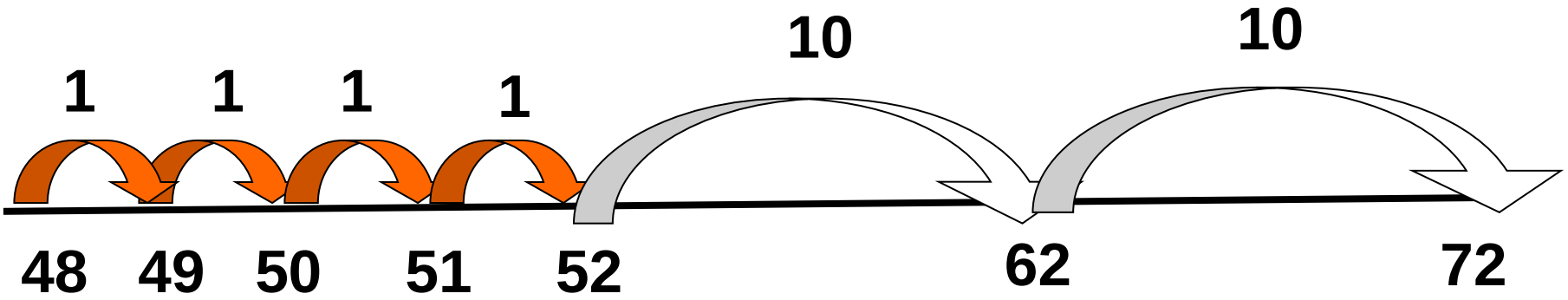
Break the second number (6) into blocks of 1.

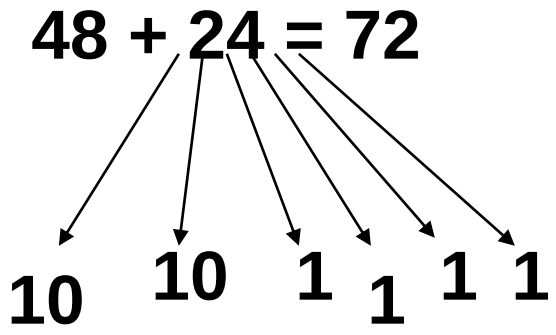
Count on some of the blocks of 1, one at a time until you get to next multiple of ten (number that ends in a zero).

Count on the blocks of 1 that you have still to use.

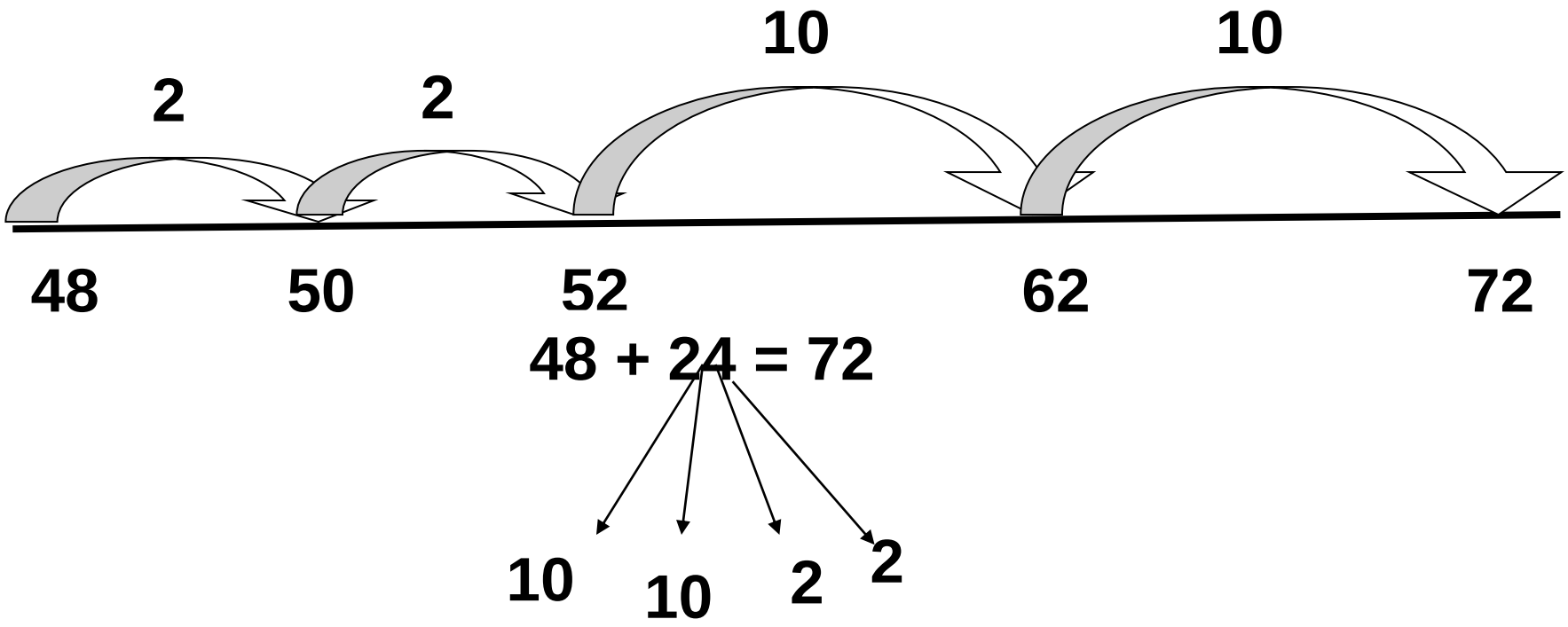
Use apparatus to keep a track of what is happening if needed

When children are able to count on in tens from any 2 digit number, then this is the next step for addition on number lines





d. Start with the largest number. (48)
Break the second number (24) into blocks of 10s and 1s.
Add on the 1s one at a time. **This **must be the first step** to support column addition later on.
Add on the blocks of 10 one at a time.

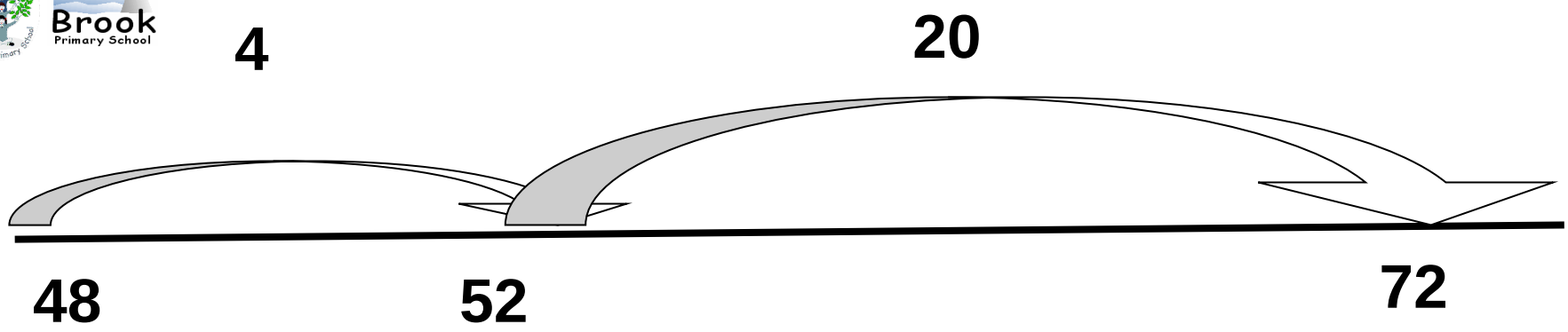


e. Start with the largest number. (48)

Break the second number (24) into blocks of 10 and any blocks of 2.

Add on the 2 ones, one at a time. **This **must be the first step** to support column addition later on.

Add on the 2 tens, one at a time.



48 + 24 = 72

20 **4**

f. Start with the largest number. (48)

Break the second number (24) into blocks of 20 and 4.

Add on the 4 ones.

Add on the 2 tens.

Steps in use of Partitioning

Guidance – Year 2 and early Year 3

76 + 47 =

70 6 40 7

70 6

40 7

110 + 13 = 123

a. Partition the numbers into tens and ones.

Add all the tens (mentally if possible) and then all the ones. If you want to make sure then add the tens and ones like this.

Recombine the answers to get one big number.

b. Partitioning can also be used for larger and smaller place values.

435 + 241 = 400 30 5 200 40 1 600 + 70 + 6 = 676	64.5 + 23.4 = 60 4 0.5 20 3 0.4 80 + 7 + 0.9 = 87.9

Steps in the use of Vertical Addition

Guidance –Year 4 onwards

Practice changing from horizontal to vertical using:

- just ones
- then numbers that do not bridge (go past ten)
- followed by bridging.

7 + 2 =

will become

7
+ 2
____
____

32 + 27 =

will become

32
+ 27
____
____

532 + 427 =

will become

532
+ 427
_____
_____

National Curriculum Example

789 + 642 becomes

	7	8	9
+	6	4	2
1	4	3	1
	1	1	

Answer: 1431

Bigger Numbers and Decimals

Use of the 'Snowman's buttons' to encourage ch to line the decimal points in the calculation.

The layout is extremely important!!

Set out decimal points underneath each other first then fit the numbers around the decimal points

7.65 + 0.32+ 12.5

•
•
•
•

7.65
0.32
12.5
•

use zero as a place holder

7.65
0.32
12.50
20.47
1

Stages in Subtraction

At a simple level subtraction calculations can be worked out in basically two different ways:

1. The counting **on** method
2. The **taking away** method

In The Foundation Stage children learn to subtract by counting on or taking away to find the answer. They record using marks they can interpret and explain. The counting on method is usually the easiest to do and should be used from Year 1. It is also important that the vocabulary of 'subtract' and 'subtraction' is used from Reception and not 'take away.' Take away and count on are strategies. Subtraction is the correct term.

Don't forget that with subtraction calculations, you are often just trying to find **how big the gap is between two numbers** and this is easily done with a numberline. This is sometimes called "find the difference".

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Informal Counting Methods

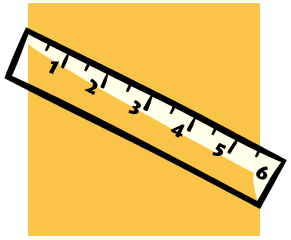
Guidance – Reception

Step a. Counting songs/rhymes

Step b. Taking objects away and counting what is left.

Step c. Pictorial subtraction

Step d. Use of numberlines to subtract

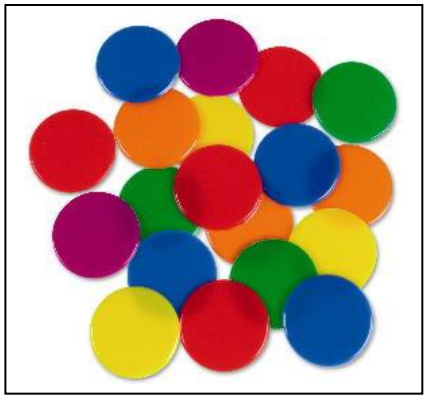


Subtraction – the take away method (practically)

Guidance - Reception

For 7 take away 2 (7-2)

Use counters – start with 7 and take 2 away.



OR use your fingers to be really quick

When ready, put the big number (7) on your fingers, put the little number (2) in your head and put down the small number of fingers one at a time to see what you are left with (5).

Subtraction – the take away method (pictorially)

Guidance - Reception

10 - 6 = 4

Objects and pictures can be used to support the "taking away" method of subtraction.

Children need to be aware and know that the process is called subtraction but the method is take away.

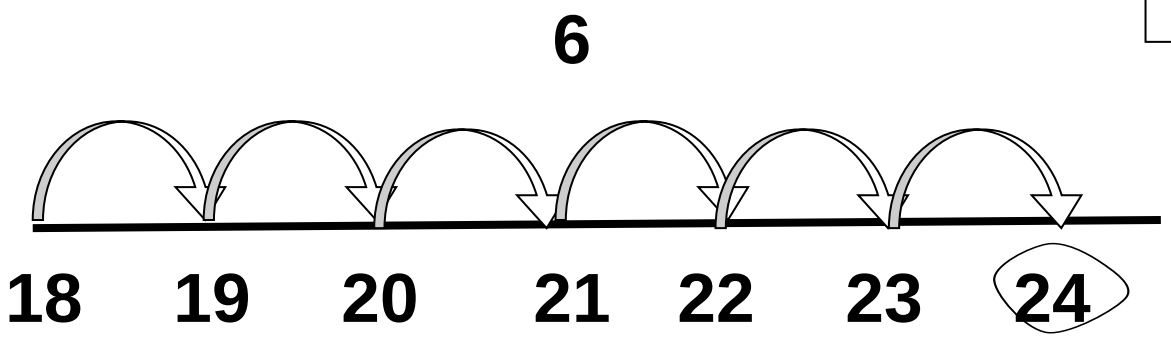
Eg. I have 10 and I want to subtract 6. What am I going to do? I can take away 6 (or cross out six). What does this mean? (10 subtract 6).

Steps in use of Numberlines

The counting on method for subtraction is a method for finding the difference.
Children should be taught to recognise the different between take away and finding the difference word problems.

The Counting on Method
Step a. Count on in ones
Guidance – Year 1

From this point, children and teachers need to use the term 'subtract' when reading a number sentence.
Eg. 24 subtract 18.



24 – 18= 6

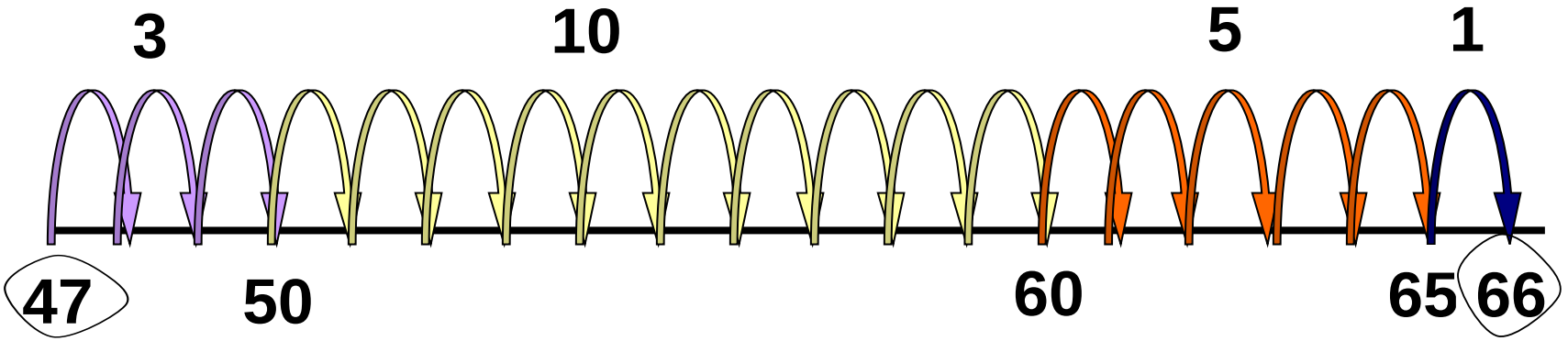
Start with the subtracting number. (18)
Place it on a numberline and count on in ones at a time until you get to the number you are subtracting from.
Use apparatus to keep a track of what is happening if needed.
N.B. Count in ones first, then progress to tens.

Step b. Count on to the nearest 10

Guidance – Year 2

66 – 47= 3+10+5+1

66 – 47= 19

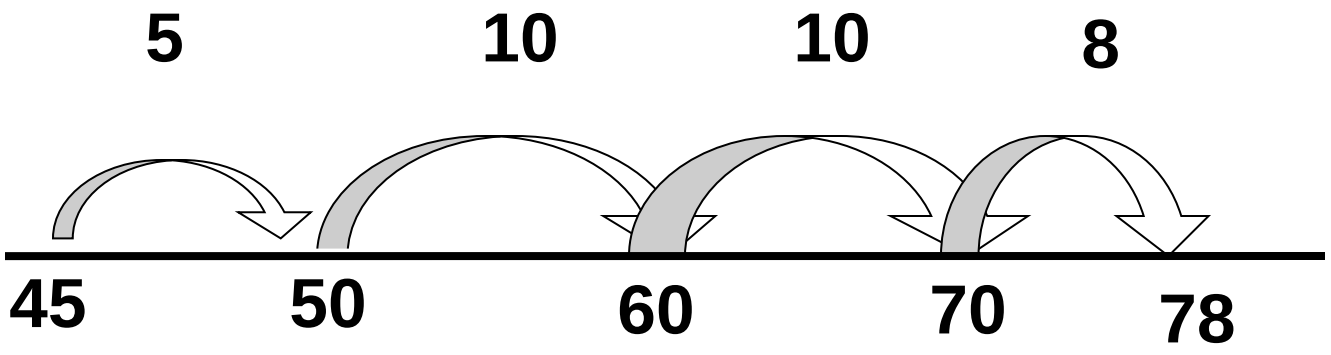


Use a numberline.
Find 66 and circle it.
Find 47 and circle it.
Count on from 47 to the nearest ten number (50).
Remember to write how much each big leap was above the numberline (+ 10 or + 5).
When you have got as close as possible to the last number using big leaps, finish off with little steps to hit the number exactly (+1).
Add up all the numbers above the line to see how big the gap between 47 and 66 is.
This is also called find the difference.

Step b. Count on to the nearest ten in larger jumps

Guidance – Year 2

78 – 45 = 33

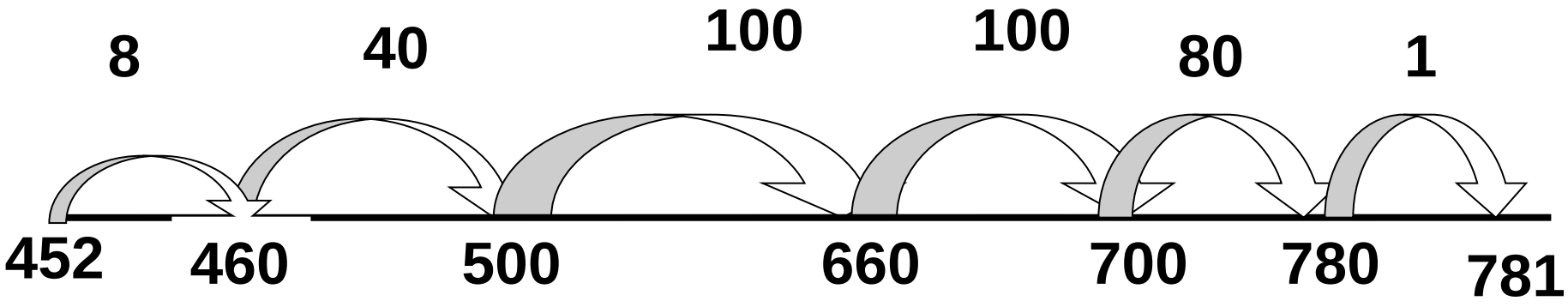


The next step is to count on to the nearest 10 first using bigger jumps.

The answer is the number of steps it takes to get from 45 to 78 by counting up:
5+10+10+8= 33

Step c. Even Bigger Numbers using numberlines

Guidance – Late Year 2 and Early Year 3



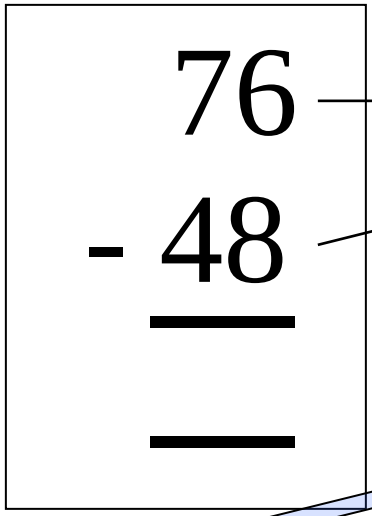
781 – 452 = 100 +100 + 80 +40 +8 + 1

= 329

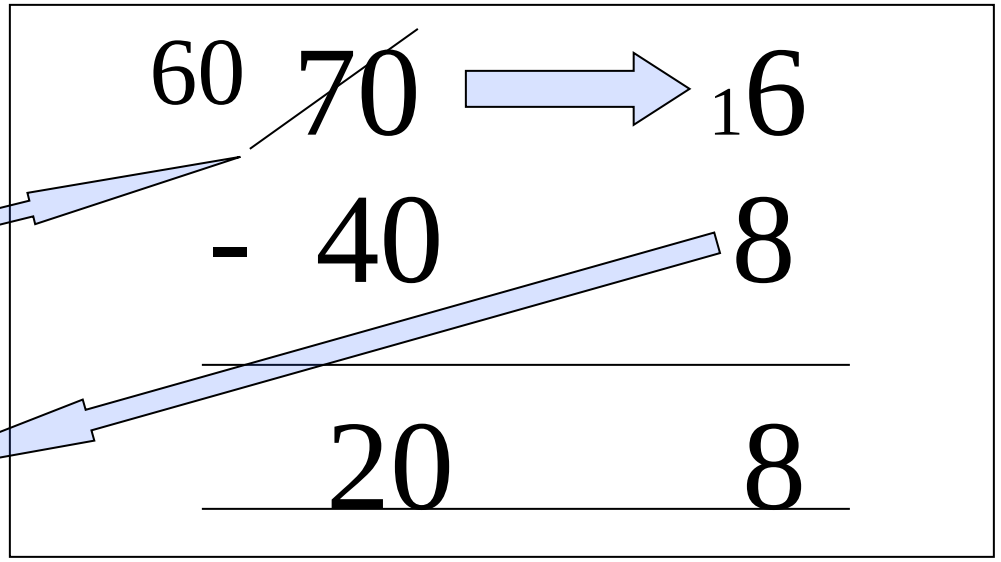
Partitioning- with decomposition

Guidance – Year 3

Partitioning of numbers can be used for subtraction but be careful when the number being subtracted has a large number of units.



76 can be partitioned into 70 and 6
48 can be partitioned into 40 and 8



Work out the units first:
6 subtract 8 can`t be done so a ten from the 70 needs to be made into units.

Vertical layout

Guidance – Year 4

First without exchange, then the decomposition method.

$^{6}\not{7}^{1}6$	$9^{2}\not{3}^{1}4$	$^{0}\not{1}^{11}\not{2}^{1}\not{0}^{9}0$
$-\ 4\ 8$	$-\ 4\ 1\ 8$	$-\ \ 7\ 4\ 2$
$2\ 8$	$5\ 1\ 6$	$4\ 5\ 8$

HARD

HARDER

EVEN HARDER

Vertical layout (decimals)

Guidance – Year 5 onwards

12.46 – 6.42 =

$$\begin{array}{r} {}^{0}\not{1}{}^{1}2.46 \\ -\ 6.42 \\ \hline 6.04 \end{array}$$

EVEN EVEN HARDER

212.31 – 27.42 =

$$\begin{array}{r} {}^{1}\ {}^{10}\ {}^{11}\ {}^{12}\ {}^{1} \\ \not{2}\not{1}\not{2}.\not{3}1 \\ -\ 27.42 \\ \hline 184.89 \end{array}$$

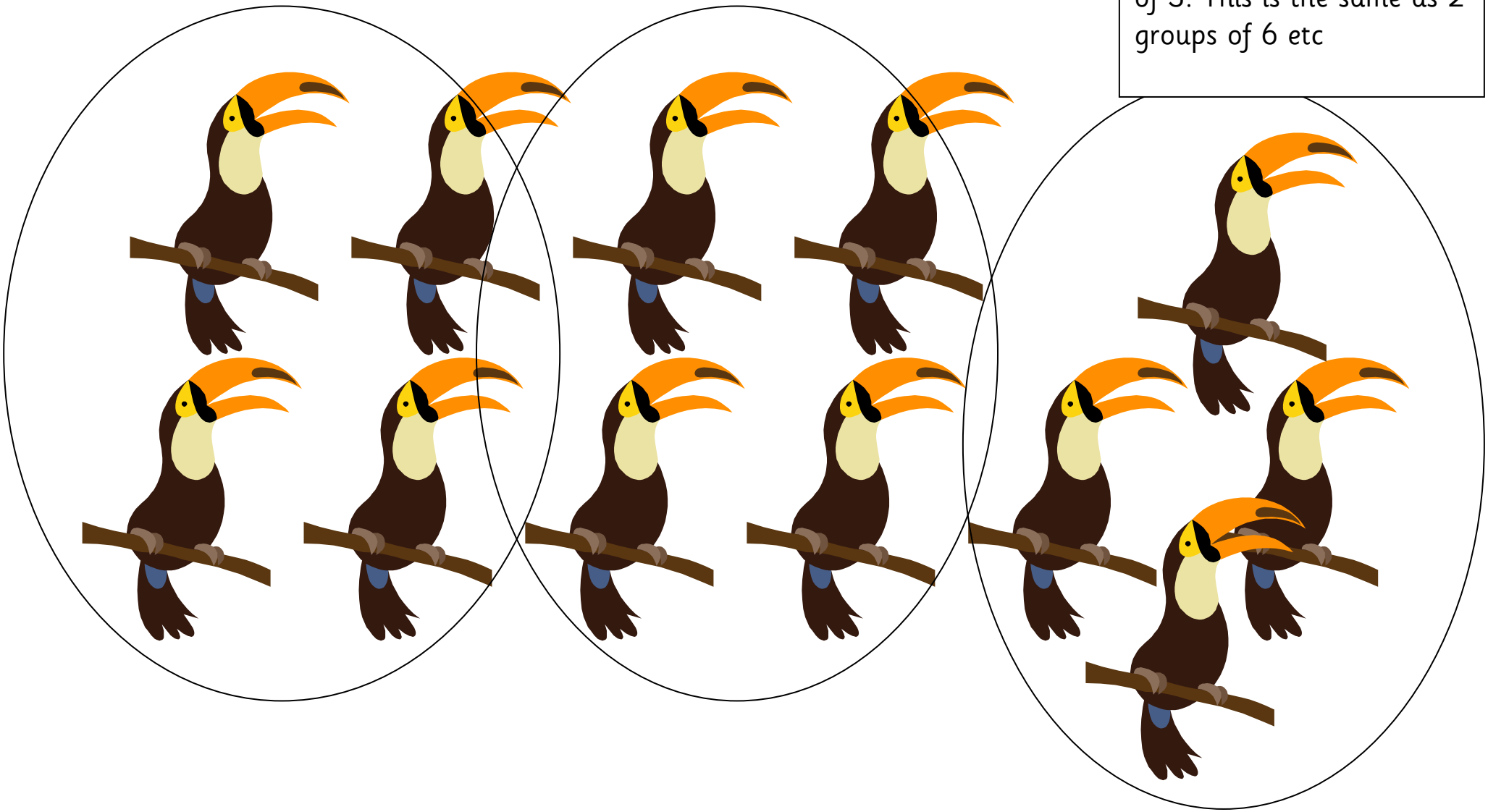
THE HARDEST

Use of the 'Snowman's buttons' to encourage children to line the decimal points in the calculation.

Steps In Multiplication

Guidance – Year 1

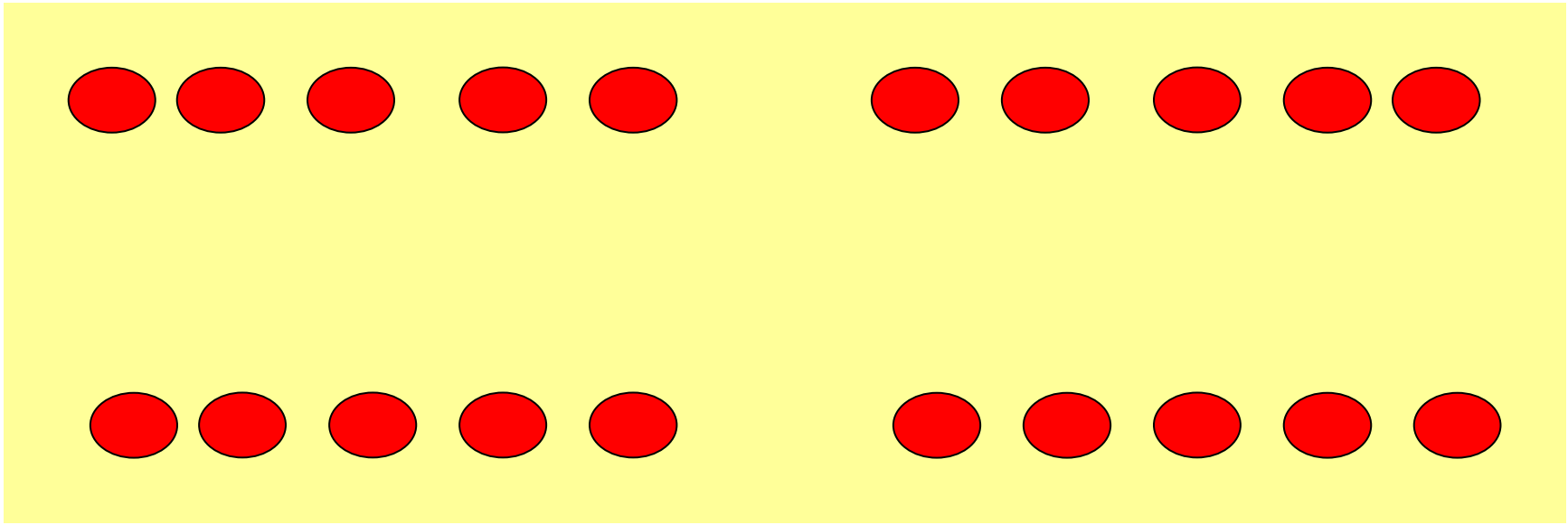
Use arrays to group items in different ways and compare. 3 groups of 4 is just as many as 4 groups of 3. This is the same as 2 groups of 6 etc



Visual multiplication

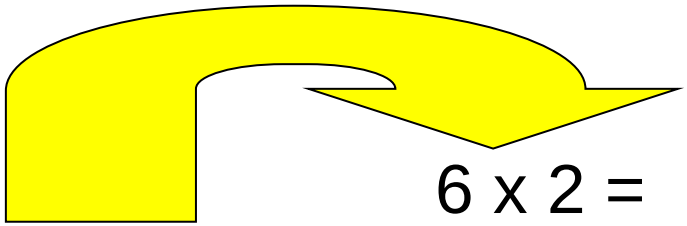
Guidance – Year 1

5 x 4 means 5, 4 times



Drawing using dots, crosses, stars or any apparatus initially to make thinking clear. Then count up the total.

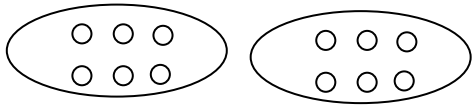
5 x 4 = 20



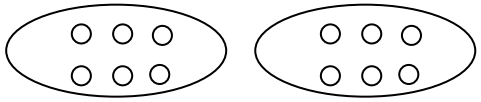
This sign has lots of different names, the easiest being "times". Try to use a few different names to make sure the vocabulary of the calculation does not hold you back:

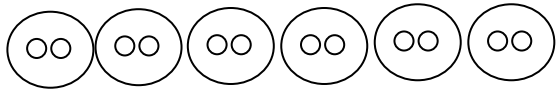
- Times
- Multiplied by
- Find the product of
- 6 x 2 =

6 times 2

6, 2 times 

<u>Do not use the term 'lots of'</u>

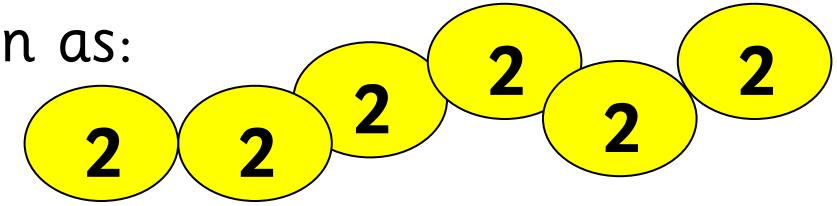
6 x 2 is 

NOT 6 lots of 2: 

As repeated addition using apparatus or a numberline (or both!)

Guidance – Year 2

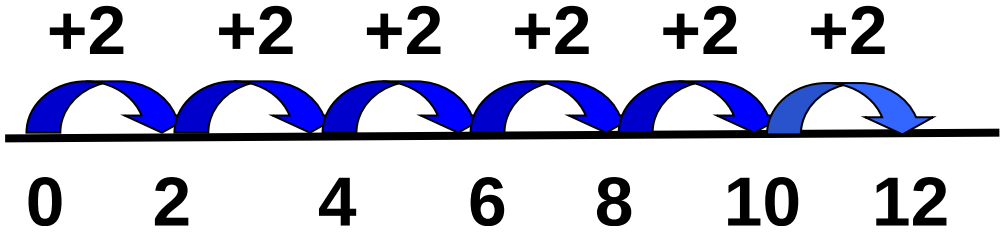
2 x 6 can be written as:



2, 6 times

or

2+2+2+2+2+2



Practise different ways of saying the same thing.

Grid Method

Guidance – Year 3

x	3
5	15

3 x 5 =

Answer = 15

2 Digit X 1 Digit Using Grid Method

Guidance – Year 4

38 x 5=

x	**30**	**8**
5	150	40

```
  1 5 0
+ 4 0
-------
  1 9 0
-------
```

Answer = 190

Vertical Method (expanded then compacted)

Guidance – End of Year 4

```
   38
X   7
  56
 210
 266
```

(7 x 8)
(7 x 30)

Teachers model this, but pupils don't include.

```
   38
X   7
  266
   5
```

```
   63.3
X   7
 443. 1
  2 2
```

From Year 4 Summer Term

Remember to multiply out by the smallest place value first!

Use of the 'Snowman's buttons' to encourage ch to line the decimal points in the calculation.

2 Digit X 2 Digit Using Grid Method

Guidance – Start of Year 5

38 x 56=

x	**30**	**8**
50	1500	400
6	180	48

```
  1 5 0 0
    4  0 0
+   1  8 0
       4 8

  ---------
    2 1 2 8

  ---------
    1
```

Answer = 2128

3 Digit X 2 Digit Using Grid Method

Guidance – start of year 5

298 x 47 =

x	**200**	**90**	**8**
40	8000	3600	320
7	1400	630	56

Answer = 14006

```
   8000
+  3600
    320
  -----
  11920
  -----
     1
```

```
   1400
+   630
     56
  -----
   2086
  -----
     1
```

```
  11920
+  2086
  -----
  14006
  -----
     11
```

Vertical Method (using TU)

Guidance -Year 5 onwards

Step 1 (layout)

```
    38
 X  17
 ------
      U
 +    0 T
 ------
```

Step 2 (complete)

```
    38
 X  17
 ------
   266 U
   5
 + 380 T
 ------
   646
 ------
```

Talk to the ch about ZUTA and get them to write this on the side first.

Z – Zero

U – Units to x out first

T – Tens second

A – Add at the end.

Division

Guidance – Reception

Early division work must, through plenty of practical activity and structured play, include 2 ways of "doing" division:

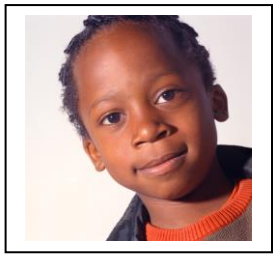
- ✓ ***Sharing:*** **Help to share out toys, equipment, pencils etc.**

- ✓ ***Grouping*** **:Help the teacher to make teams for Games, or groups in the classroom.**

Sharing

Requires secure counting skills

6 sweets are shared between 2 people. How many do they have each?



Practical activities involving sharing, distributing cards when playing a game, putting objects onto plates, into cups, hoops etc.

Developing Grouping

Guidance - Reception

Sorting objects into 2s / 3s/ 4s etc

How many pairs of socks are there?

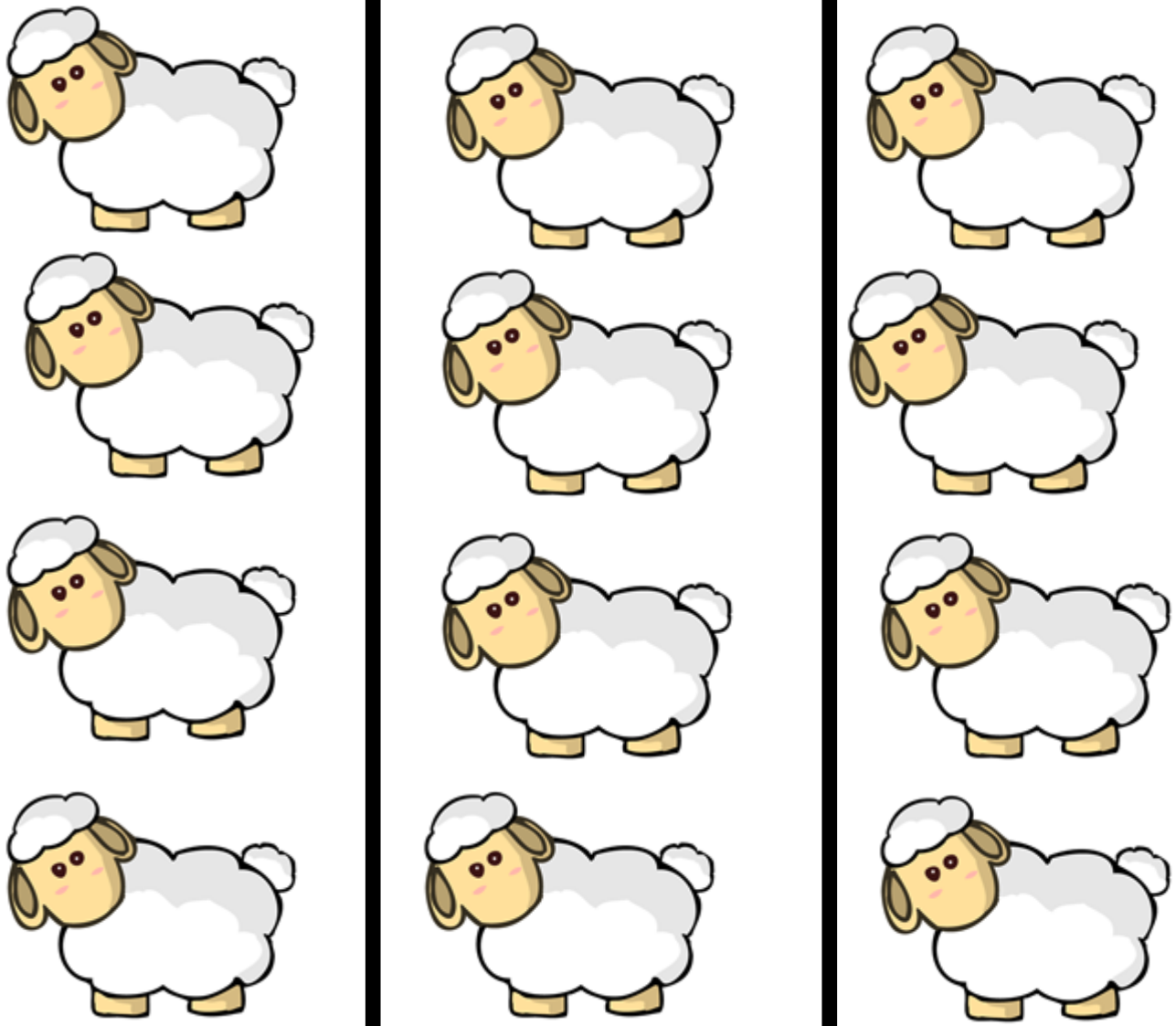



There are 12 seeds. Plant 3 in each pot. How many pots are there?

Begin to introduce the idea of **remainders**. There are 13 socks. Can we sort them in to pairs? What about the 13th sock?

Use Straight Lined Arrays To Show Grouping Clearly

Guidance – Year 1



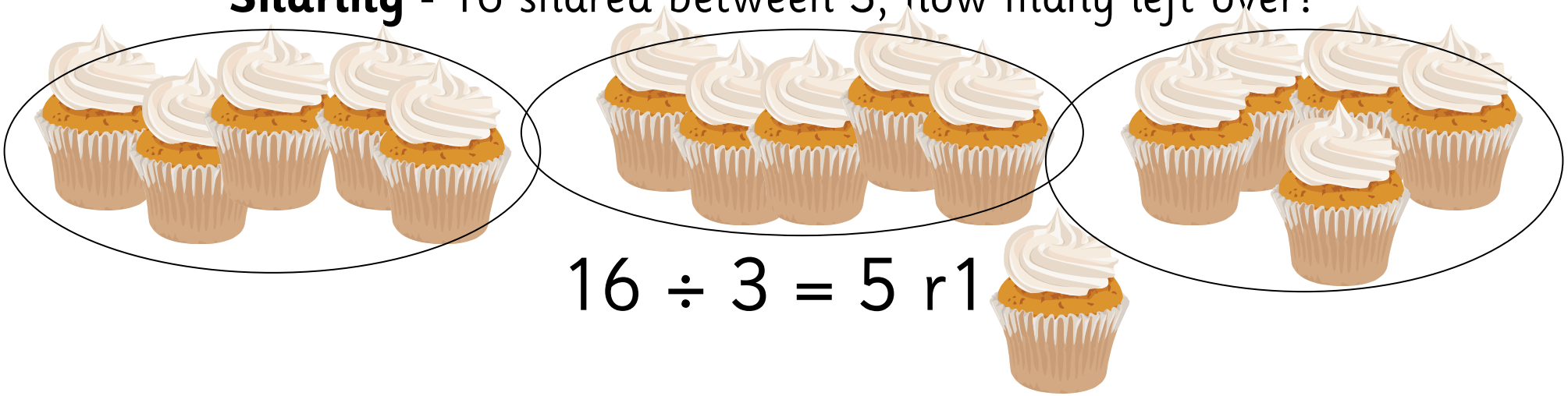
12 ÷ 3 = 4

By grouping in lines or in boxes, you can clearly see that there are **3 groups with 4 in each group.**
Another way of saying this is
4 x 3 or
4, 3 times.

Also include the idea of remainders.

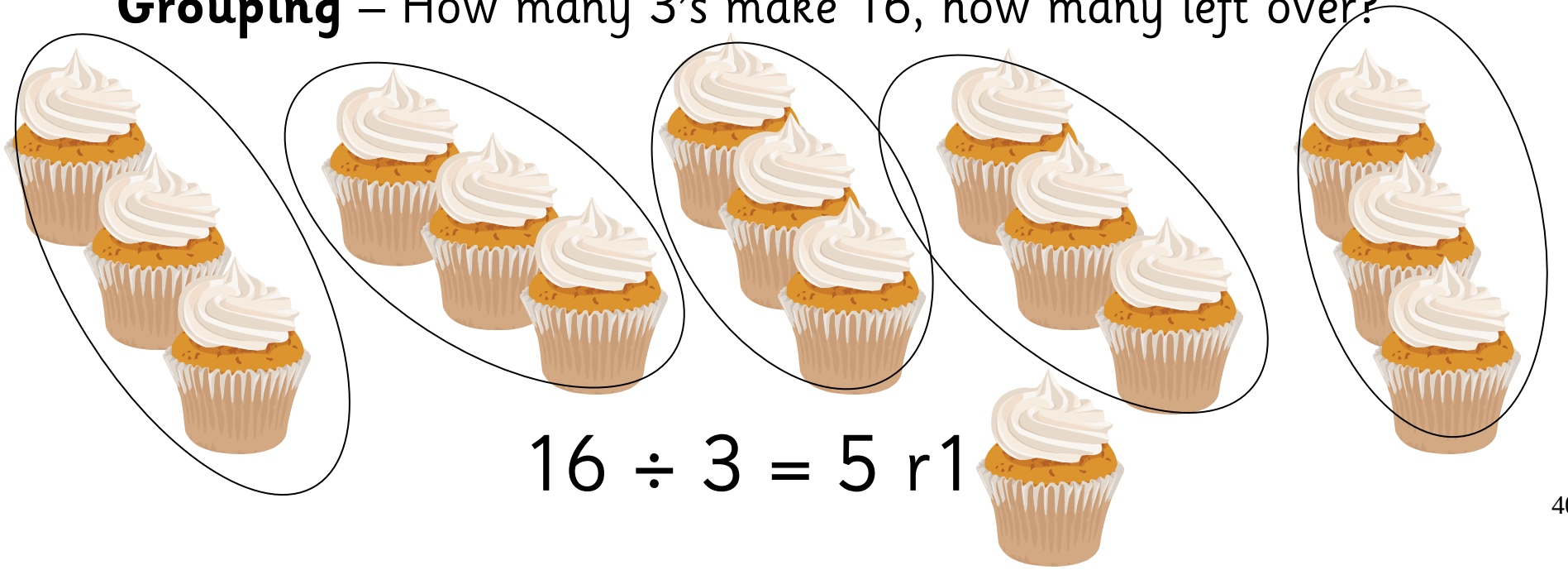
Remainders eg 16 ÷ 3

Sharing - 16 shared between 3, how many left over?



16 ÷ 3 = 5 r1

Grouping – How many 3's make 16, how many left over?

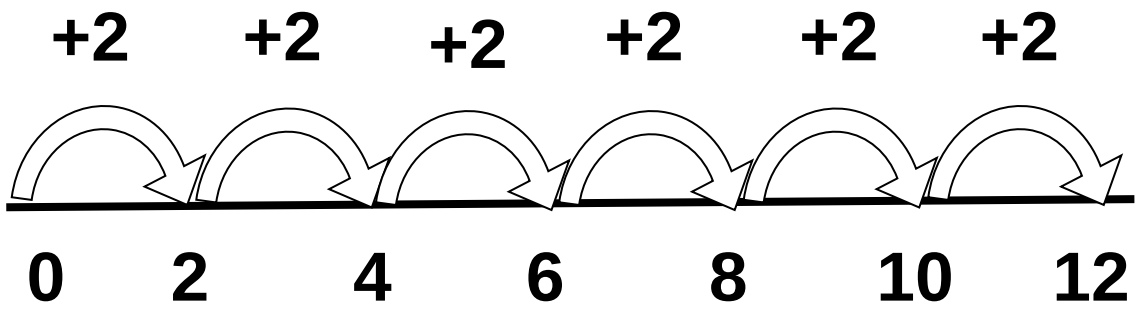


16 ÷ 3 = 5 r1

Using a number line

Guidance – Year 2

12 ÷ 2 can be modelled using a numberline:



Or in a number story:

There are 12 strawberries. How many people can have 2 each?

Or in a number sentence:

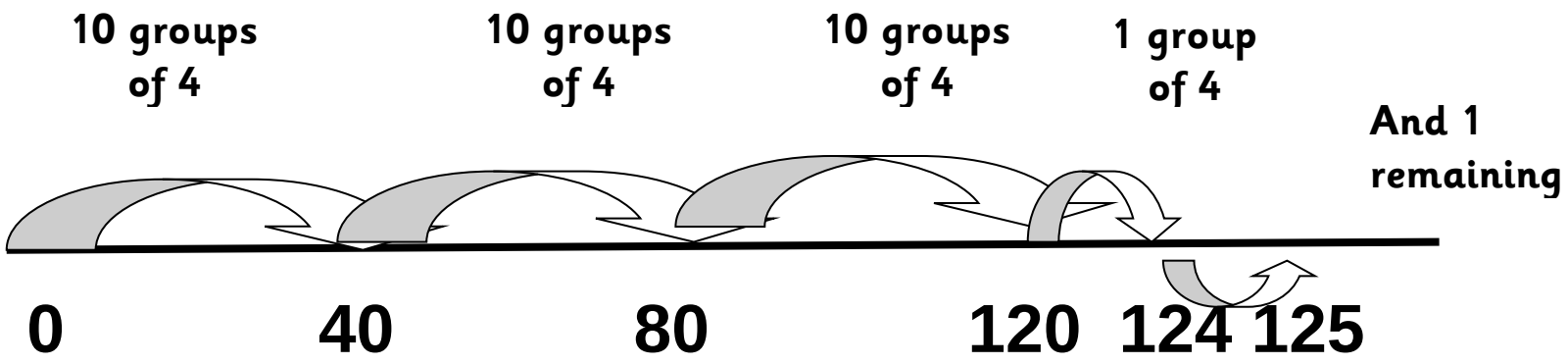
How many 2s make 12?

Don't forget to include the idea of remainders

Using a numberline (for larger amounts)

Guidance - Year 3

125 ÷ 4 can be modelled using a numberline:



Visualising remainders …

Support with practical equipment eg numicon, abacus etc

Remainder values should be shown with an arrow underneath the number line.

Remainder should be taught as a value (for example r 1) also as a fraction (1/4) and an equivalent decimal if appropriate (for example 31.25).

Bus Stop Method (Short division)

Guidance – End of Year 4

6 8 ÷ 2

Changes to

$$2\overline{)68}$$

Then cover the number on the inside of the calculation (68) with your hand to find out which times tables will help us (2).

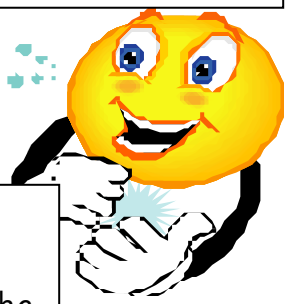
A

Slide your hand across the page until you can see the first number on the inside of the calculation.

$$2\overline{)6}$$

B

Count up in your 2 times tables until you reach 6 (2 multiplied by 3).



C

The 3 goes above the 6, here.

$$\begin{array}{r} 3 \\ 2\overline{)6} \end{array}$$

D

Then slide your hand across until you can see the next number (8).
Count up in your 2 times tables until you get to 8 (2 multiplied by 4).
Put the 4 above the 8, here.

$$\begin{array}{r} 3\ 4 \\ 2\overline{)6\ 8} \end{array}$$

ANSWER

So 68 divided by 2 is 34.

OR

If we share 68 sweets between you and your friend, (2 people), each person gets 34 sweets.

OR

2 lots of 34 make 68

Bus stop Division (Bigger Numbers)

145 ÷ 5 becomes $5\overline{)145}$

Then cover the number on the inside of the calculation (145) with your hand to find out which times tables will help you (5).

$5\overline{)1}$ 

A

When we count up in the 5 times tables, we pass 1 as soon as we start counting, so slide your hand along until you can see the next number (4).

$5\overline{)14}$ 

B

Now the number showing looks like 14.
Count up in your 5 times tables until you get as close as you can to 14 WITHOUT GOING OVER IT. (5 multiplied by 2).
Put the 2 above the 4, here.

$$\begin{array}{r} 2 \\ 5\overline{)\,1\,4^{\,4}} \end{array}$$

2 x 5 gets you to 10, **but** we are trying to get to 14, so we will use the 4 difference between 10 and 14 in the next bit of the calculation.
Write that 4 like this (a little smaller) by your little finger, before you slide your hand across to show the next number.

$$\begin{array}{r} 2\ 9 \\ 5\overline{)\,1\,4^{\,4}5} \end{array}$$

The next number (5) with the little 4 by the side of it, now says 45 (forty five), so we count up in the 5 times tables until we get as close as we can to 45 WITHOUT GOING OVER IT.
Luckily 5 multiplied by 9 is exactly 45 so write the 9 here, above the 5.

ANSWER

So 145 divided by 5 is 29.

OR

If we share 145 sweets between 5 people, each person gets 29 sweets.

OR

5 lots of 29 make 145

Bus Stop with remainders as fractions

149 ÷ 5 =

$$\begin{array}{r} 0 \\ 5\overline{)\,1} \end{array}$$

$$\begin{array}{r} 0\,2 \\ 5\overline{)\,1^{1}4} \end{array}$$

$$\begin{array}{r} 0\,2\,9\ \ r4 \\ 5\overline{)\,1^{1}4^{4}9} \end{array}$$

ANSWER

Your answer can then be written as;

29 r4 OR $29\frac{4}{5}$

OR, if the fraction has a know decimal equivalent, it could be written 29.8

Bus Stop with decimals

$68.1 \div 3 = 22.7$

$$3\overline{)68.^{2}1}$$
$$22.7$$

$24 \div 5 =$

$$5\overline{)2^{2}4.^{4}0}$$
$$04.8$$

Use of the 'Snowman's buttons' to encourage ch to line the decimal points in the calculation.

Finding a decimal remainder.

Ch to use 0 as a place holder, first to find numbers with a tenth, then hundredths and finally a recurring figure.

Ch to also know how to write the remainder as a fraction.

Even **Bigger** Division Calculations

1453 ÷ 52 becomes 52) 1 4 5 3

Then cover the number on the inside of the calculation (1453) with your hand to find out which times tables will help you (52).

It may be useful to write the 52 times tables to help with the calculation later.

52
104
156
204
260
312
364
416
468

52) 1 

0 0

52) 1 4 5 

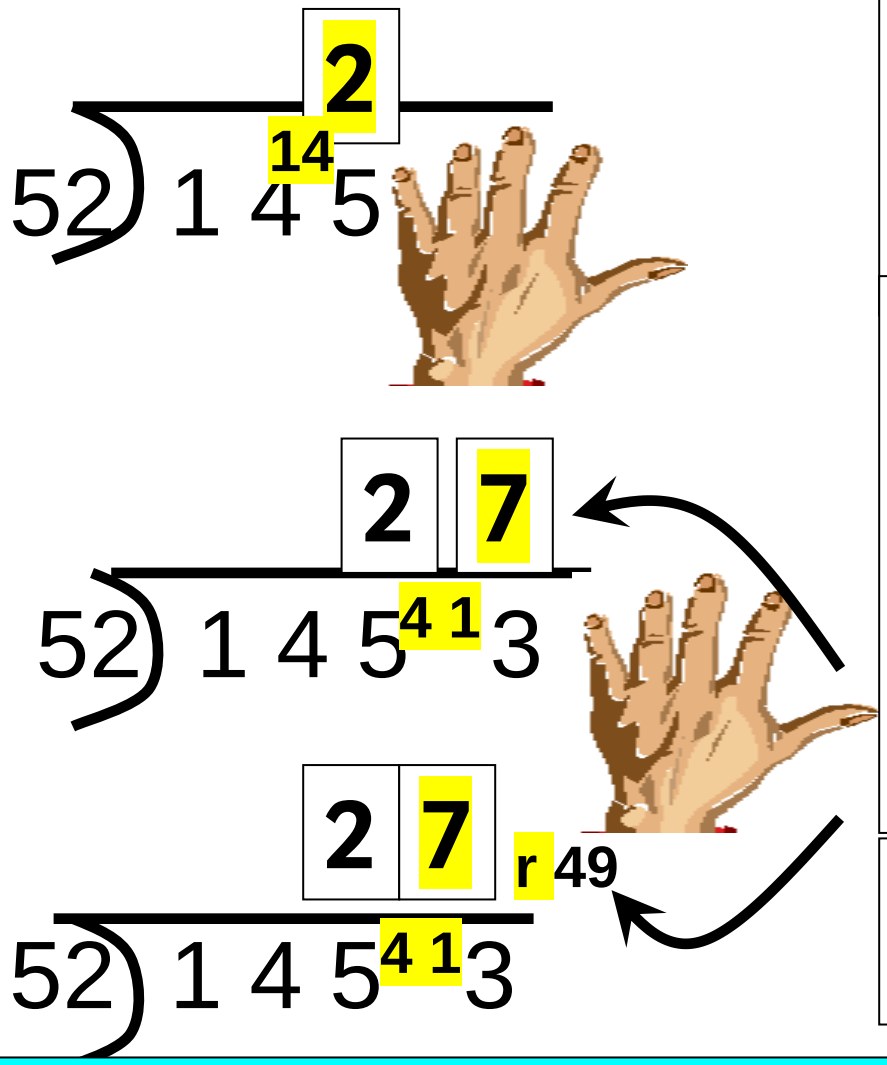
When we count up in the 52 times tables, we pass 1 as soon as we start counting, so slide your hand along until you can see the next number (4). This still does not help so slide your hand across until you see the next number (5). The number showing looks like 145. How many 52s can you count up to get as close as you can to 145 WITHOUT GOING PAST IT? (2 X 52)

0

52) 1 4 

0 0 2

52) 1 4 5 



2 x 52 gets you to 104, **but** we are trying to get to 145, so we will use the 41 difference between 104 and 145 in the next bit of the calculation.
Write that 41 like this (a little smaller) by your little finger, before you slide your hand across to show the next number.

Go back to the 52 times tables you wrote earlier to count up to as close as possible to 453 (7 x 52=364). Write the 7 here above the 3. **But** we are trying to get to 453, so we will use the 49 difference in the next bit of the calculation.
Write that 49 like this as the bit left over or the remainder.

You can now write your answer as 27 r49 or 27 $\frac{49}{52}$.

ANSWER:
If you shared 1453 sweets between 52 people, each person would get 27 sweets and there would be 49 sweets left over.
OR 1453 divided by 52 is 27 remainder 49
OR 52 lots of 27 and then add on 49 more equals 1453.