Problem Solving – A Guide to Using Bar Modelling

The Bar Model – information from the NCETM website

The bar model is used in Singapore and other countries, such as Japan and the USA, to support children in problem solving. It is not a method for solving problems, but a way of revealing the mathematical structure within a problem and gaining insight and clarity as to how to solve it. It supports the transformation of real life problems into a mathematical form and can bridge the gap between concrete mathematical experiences and abstract representations. It should be preceded by and used in conjunction with a variety of representations, both concrete and pictorial, all of which contribute to children's developing number sense. It can be used to represent problems involving the four operations, ratio and proportion. It is also useful for representing unknowns in a problem and as such can be a pre-cursor to more symbolic algebra.

Addition and Subtraction

The bar model supports understanding of the relationship between addition and subtraction in that both can be seen within the one representation and viewed as different ways of looking at the same relationships.

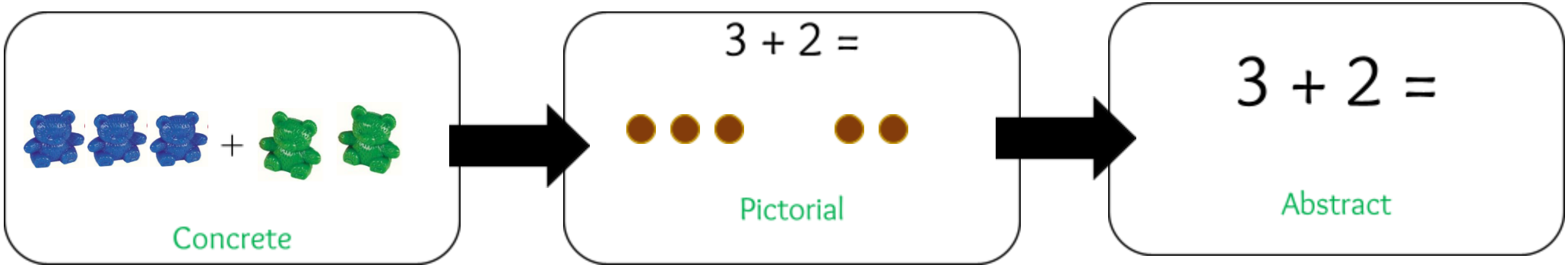
This diagram encapsulates all of the following relationships;

a = b + c ; a = c + b ; a – b = c ; a – c = b

Multiplication, Division, Fractions, and Ratio

All of these concepts involve proportional and multiplicative relationships and the bar model is particularly valuable for representing these types of problems and for making the connections between these concepts visible and accessible.

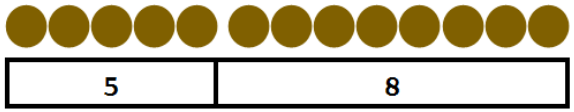
Problem solving should move from practical equipment to abstract numbers and symbols:

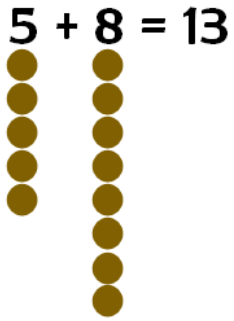


NCETM question examples Year 1:

Ebony has 5p and Daniel has 8p.

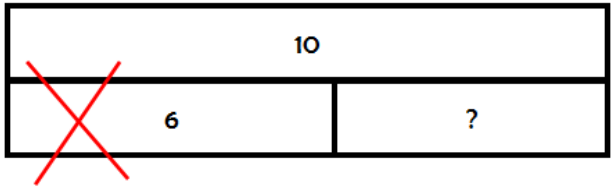
How much do they have altogether?

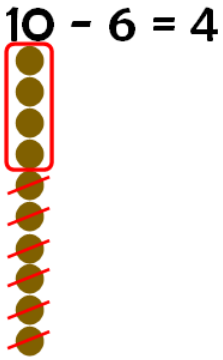




A Lolly costs 6p. Armit pays with a 10p coin.

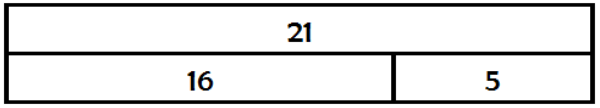
How much change does he get?

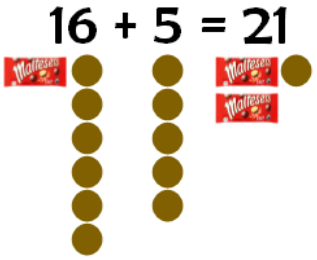




Michael says that 16 + 5 = 21

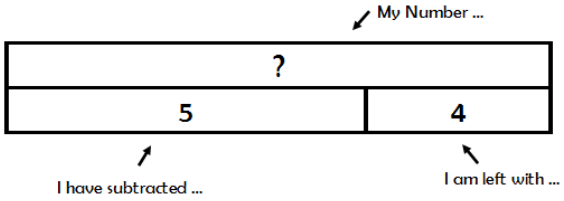
Is he correct?

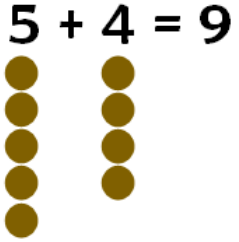




I think of a number. I subtract 5. The answer is 4.

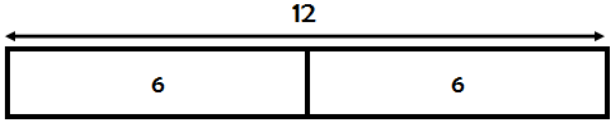
What is my number?

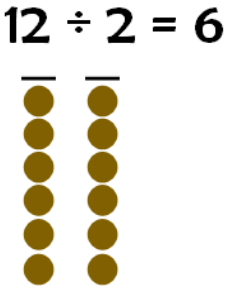




Twelve people are split into two groups.

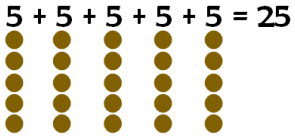
How many are in each group?

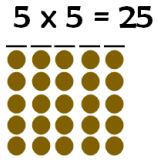




Mrs Morton puts five 5p coins in her purse.

How much is in her purse altogether?

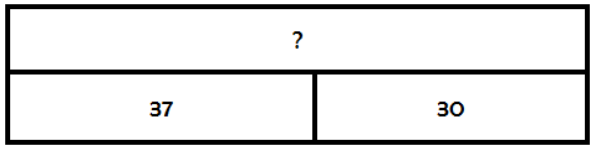


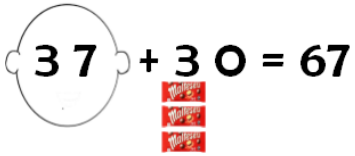


Year 2:

Dylan has 37 coloured pencils and he buys 30 more.

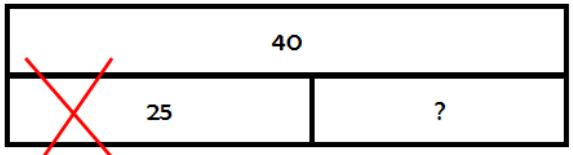
How many does he have now?

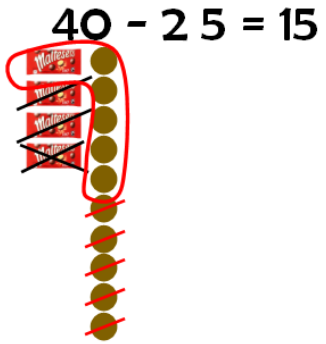




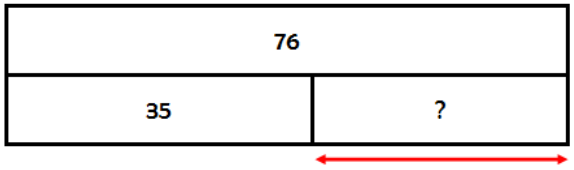
Janie has 40 beads. She loses 25 of them.

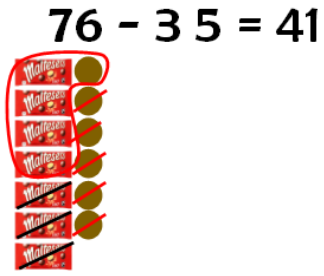
How many does she have now?





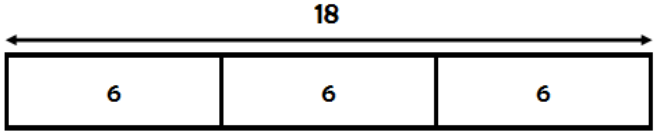
What is the difference between seventy-six and thirty-five?





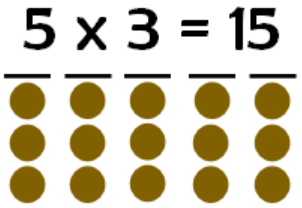
Mr Siddique shares £18 equally between his three sons.

How much does each son get?



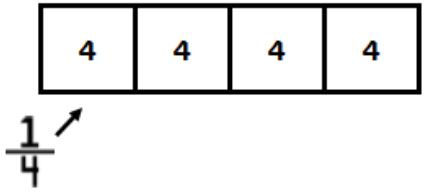
Amelia writes the calculation below as a multiplication calculation? What might she write?

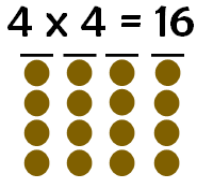
3 + 3 + 3 + 3 + 3 = 15



Charlotte-May had to find a $\frac{1}{4}$ of a number.

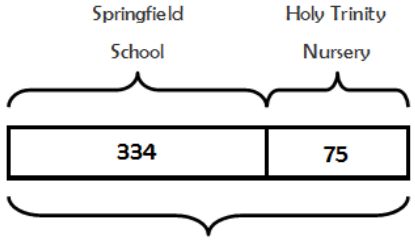
Her answer was 4. What number did she start with?





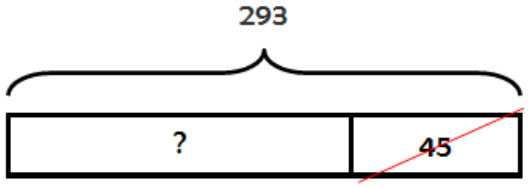
Year 3:

There are 334 children at Springfield School and 75 at Holy Trinity Nursery. How many children are there altogether?



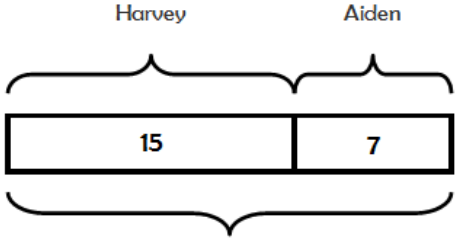
334 + 75 = 409

Gemma collected 293 badges but she gave 45 of them to her friend, Rebecca. How many badges did she have left?



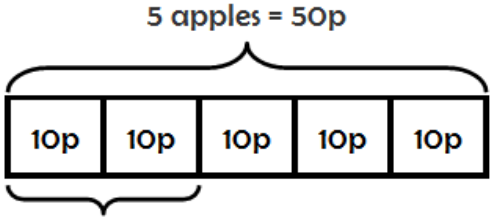
293—45 = 248

Aiden has seven marbles and Harvey has fifteen. They decide to share them equally between them. How many do they get each?



15 + 7 = 22

If five apples cost fifty pence, how much would two apples cost?

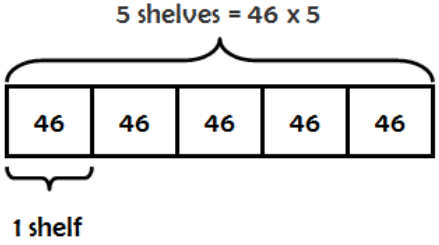


50 ÷ 5 = 10

$$5\overline{)50} = 10$$

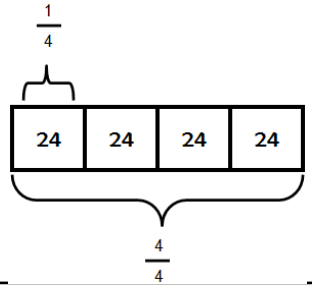
2 x 10p = 20p

A bookcase in the library holds 5 shelves with 46 books on each shelf. How many books are there in the bookcase altogether?



$$\begin{array}{r} 46 \\ \times \quad 5 \\ \hline 230 \end{array}$$

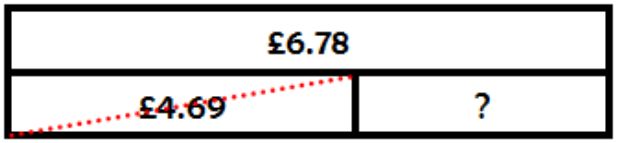
A computer game is £24 in the sale. This is one quarter off its original price. How much did it cost before the sale?



$$\frac{1}{4} = 24 \qquad \frac{4}{4} = \begin{array}{r} 24 \\ \times \ 4 \\ \hline 96 \end{array}$$

Year 4:

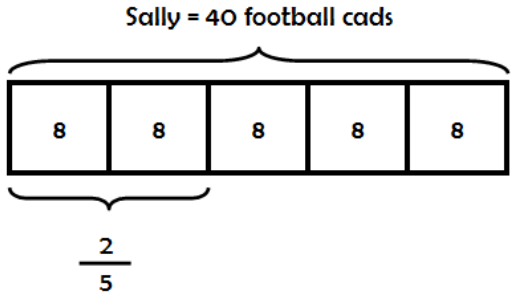
Martin has saved £6.78 and spends £4.69. How much does he have left?



£6.78 - £4.69 = £2.09

Sally has 40 football cards. She gives 2/5 of them away.

How many does she gives away?

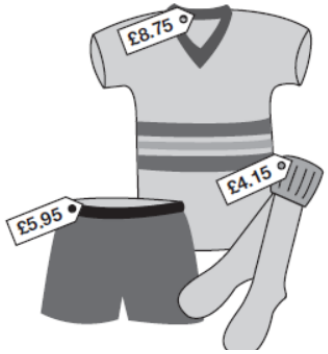


40 ÷ 5 = 8

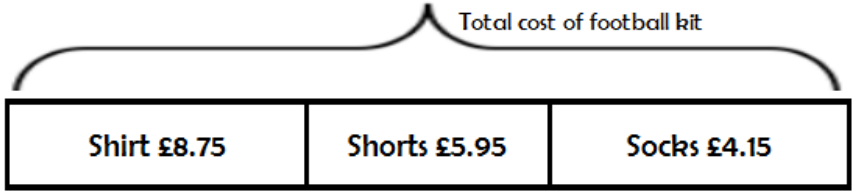
2 x 8 = 16 cards

The table shows the cost of a new football kit:

Item	Cost
Shirt	£8.75
Shorts (1 pair)	£5.95
Socks (1 pair)	£4.15



Altogether, how much does the complete football kit cost?

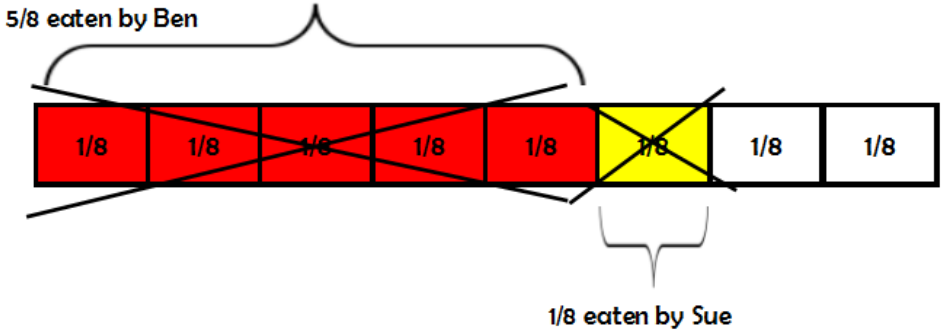


Total cost of football kit = £8.75 + £5.95 + £4.15 = £18.85

Ben cuts a pizza into 8 equal pizzas.

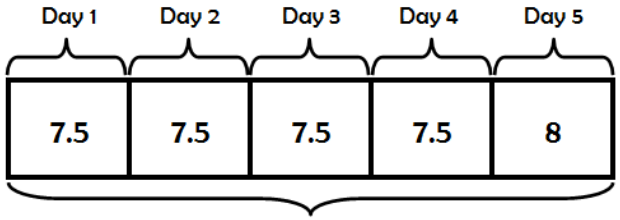
Ben eats $\frac{5}{8}$ and Sue eats $\frac{1}{8}$ of the pizza.

What fraction of the pizza is left?



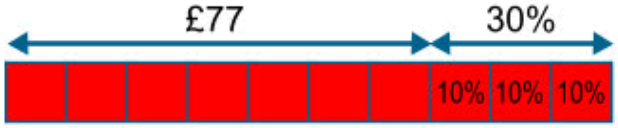
Year 5:

Every day for 4 days Helen scored 7.5 in a test. On the fifth day she scored 8. What was her total score?



Total score = 7.5 + 7.5 + 7.5 + 7.5 + 8 = 38

A computer game is reduced in a sale by 30%. Its reduced price is £77. How much was the original price?



£77 ÷ 7 = £11

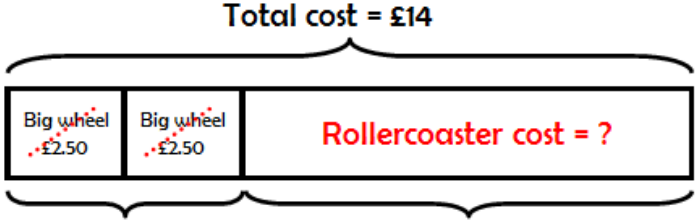
£11 x 10 = £110.00

Big Wheel £2.50 each ride	Rollercoaster £1.50 each ride

Liam spends £14 altogether on the Big Wheel and the Rollercoaster.

He goes on the Big Wheel twice.

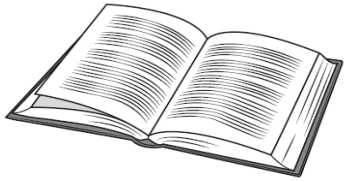
How many times does he go on the Rollercoaster?



Big Wheel:
£2.50 x 2
= £5.00

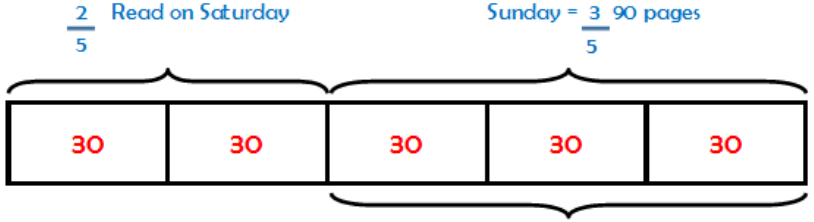
Money spent on the Rollercoaster:
£14.00 - £5.00 = £9.00
£9.00 ÷ £1.50 = 6 rides on the rollercoaster

On Saturday Lara read $\frac{2}{5}$ of her book.



On Sunday she read the **other** 90 pages to finish the book.

How many pages are there in Lara's book?



So 90 ÷ 3 = 30

Therefore 1/5 = 30

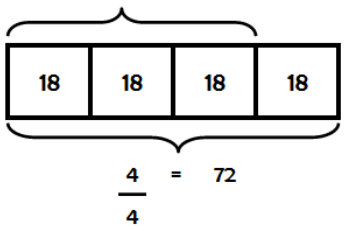
In total, Lara read the whole book (5/5).

Therefore ... 30 x 5 = 150 pages

Year 6:

Three quarters of a number is 54. What is the number?

$\frac{3}{4} = 54$



$\frac{4}{4} = 72$

Step 1 =

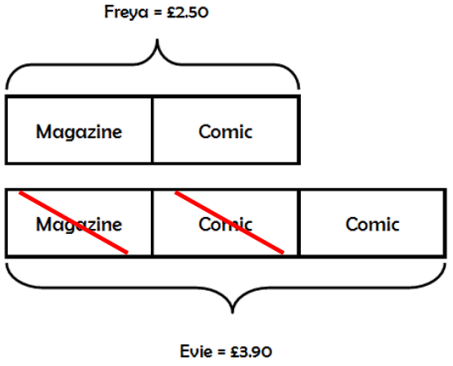
$\frac{3}{4} = 54$

$3\overline{)54} = 18$

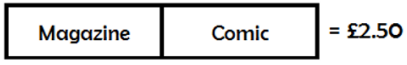
Step 2 =

$18 \times 4 = 72$

A shop sells magazines and comics. Freya buys a magazine and a comic. She pays £2·50. Evie buys a magazine and two comics. She pays £3·90. How much does a comic cost? How much does a magazine cost?



£3.90 − £2.50 = £1.40 = 1 comic



= £2.50

? + £1.40 = £2.50

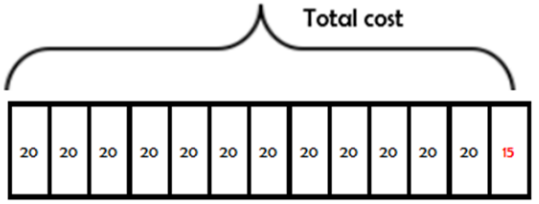
£2.50 − £1.40 = £1.10 = 1 Magazine

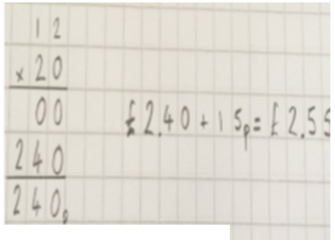
Maria bakes cakes and sells them in bags.

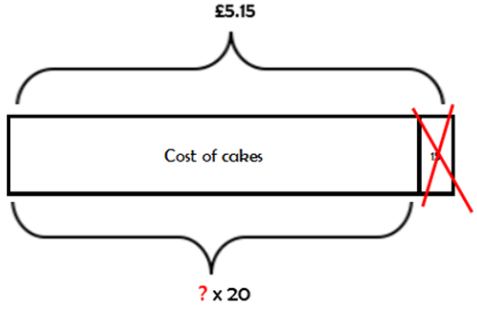
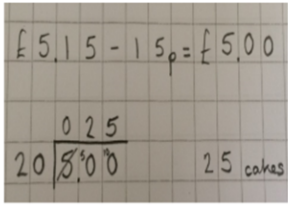
She uses this formula to work out how much to charge for one bag of cakes.

Cost = number of cakes × 20p + 15p for the bag

How much will a bag of 12 cakes cost?





Olivia buys a bag of cakes for £5.15.

Use the formula to calculate how many cakes are in the bag.