Progression in Bar Modelling Policy

Siobhan McBrien April 2020

This is the 'Progression in Bar Modelling Policy' for St. Oswald's Catholic Primary School and is set within the context of the whole school aims and Mission Statement:

Together with Jesus, we will learn and grow in faith.

Introduction

Bar modelling is used widely as an effective part of the Concrete, Pictorial, Abstract approach to the mastery of mathematics. Concrete materials are embedded alongside pictorial representations and abstract expressions to ensure procedural fluency and conceptual understanding are developed together.

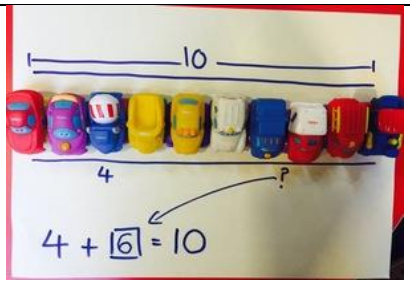
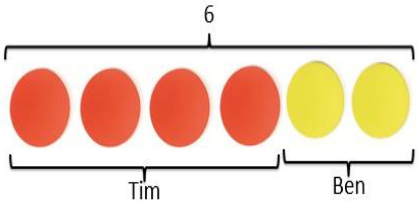
Bar models are pictorial representations of problems or concepts that can be used for any of the 4 operations. They are also helpful for fractions, percentages, ratio and algebra. It is not a method for problem solving but does reveal the mathematical structure beneath the problem and mathematical relationships between its component parts. Bar models can help children decide which operations to use or to visualise problems. By using the bar method to visualise problems, pupils are able to tackle number or complex problems.

The purpose of this policy is to outline the progression of use of the bar model across St. Oswald's Catholic Primary School and will run alongside the Calculation Policy, Maths Policy and the Liverpool Maths scheme.

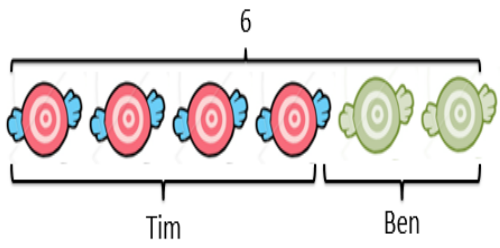
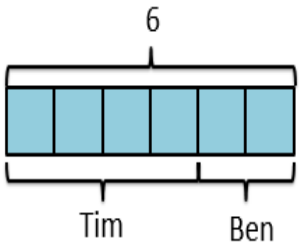
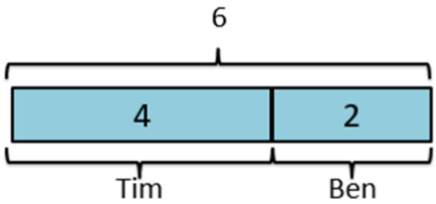
Although the use of the bar model is not statutory, **it is expected that all staff will teach and model this approach as a method that the children can draw upon where and when required. To be proficient at using this model, children need to be introduced to it early in their education.**

We are using this model in line with the Concrete, Pictorial, Abstract (CPA) approach.

5 step guide to bar modelling following the CPA approach

1. Concrete resources (real objects)		EYFS and Y1
2. Substituted concrete resources (counters, cubes, buttons etc)		EYFS and Y1

Siobhan McBrien April 2020

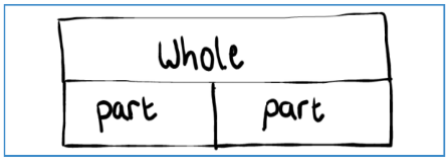
3. Pictorial representation		Y1
4. Discrete bar model		Y1 and Y2
5. Rectangular bars		Y2 and KS2

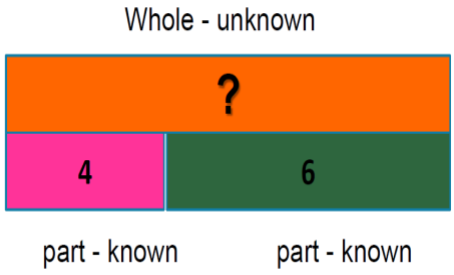
<u>Types of bar model</u>

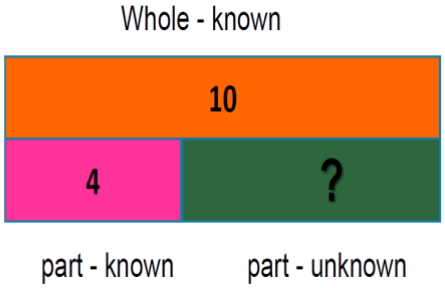
There are two types of bar model, 'part/whole' and 'comparison'.

<u>Part/Whole bar models</u>

Part/whole bar models are made up of parts and wholes, where the whole represents the sum of the parts.

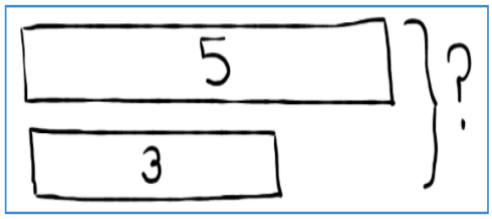


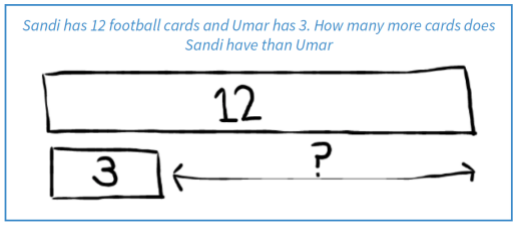




Comparison model

In a comparison model, two or more bars are drawn to help children to compare two or more amounts. Comparison models are particularly useful when finding differences between amounts, helping to reinforce the idea of using subtraction to find the difference.





For both the 'part/whole' and the 'comparison' models, the use of the question mark is important. If children consider where their answers should be on the diagram, (the unknown quantity marked '?'), then they are thinking about what the question is asking them to find out.

Although useful, bars don't need to be proportionally accurate although if a bar is representing 12 and another bar is representing 20, the 20 one should clearly be longer than the 12.

Importance of language when introducing bar models

The language of 'part' and 'whole' should be used consistently for a good success rate with bar models and the 'knowns' and 'unknowns' in different problem types must be emphasised.

Scaffolding questions to ask, to help visualise the problem using a bar model:

- What do we know – parts or whole?
- What is the unknown – parts or whole?
- If I know this, therefore I know……..
- Label the 'known' parts and/or the 'whole'
- Label the 'unknown' parts and/or the 'whole'
- Write the number sentence/equation

Ten Frames in EYFS

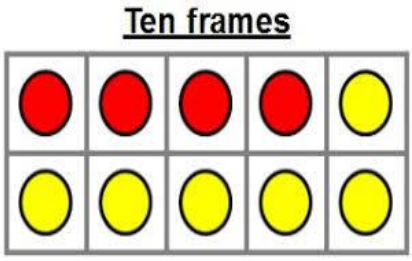
(Five Frames can be introduced in nursery)

Ten frames help children develop number sense. In EYFS, children should have lots of opportunities to use ten frames, as it teaches them to subitise and is a precursor to addition and subtraction and bar models.

They are a highly effective way to teach the skills required to recognise and understand number patterns that are essential for operational fluency in maths, including the ability to add and subtract mentally, to see relationships between numbers and to see patterns. It also allows children to become familiar with 'parts' and 'wholes', 'knowns' and 'unknowns' before using the bar model. They should be used to prompt different mental images of numbers and different mental strategies for manipulating these numbers.

It is important to follow the CPA approach when using ten frames.

Siobhan McBrien April 2020



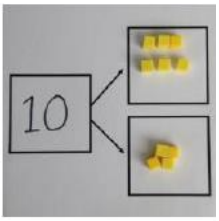
Part-Whole diagrams in EYFS and Y1

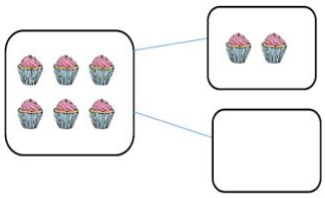
The part-whole model is the concept of how numbers can be split into parts. Children using this model will see the relationship between the whole number and the component parts, this helps learners make the connections between addition and subtraction.

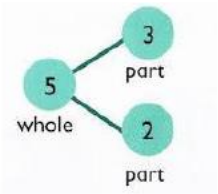
Part-whole reasoning also helps pupils to interpret, visualise and solve word problems.

Using the language of 'part' 'whole', 'known' and 'unknown', when using the part-whole diagram, is a pre-cursor to bar models.

The CPA approach will be followed when using the part-whole diagram.





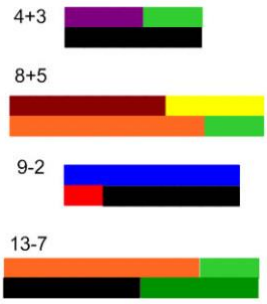


Cuisenaire Rods

All classes have a set of Cuisenaire rods and they can be used as an effective tool to develop children's understanding of the structure of mathematics from EYFS to Y6. They can be used for various topics such as fractions, ratio and algebra.

These are also a good tool for children to understand the structure of the bar model – what the bars represent, in terms of part, part, whole. Lots of practice should take place with these rods and once a numerical value is assigned to the rods, it supports children's understanding of calculations and the relationship of one number to another.

It is important that all children have the opportunity to access Cuisenaire rods to support conceptual understanding – particularly as a pre-requisite to and then, alongside bar modelling.



Siobhan McBrien April 2020

Bar Models

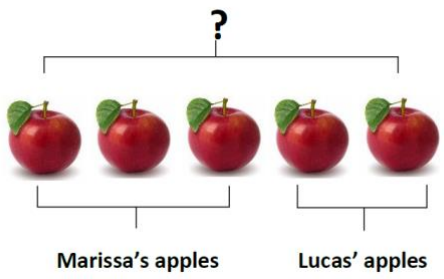
Addition

Example question for addition: Children will routinely come across calculations such as 3 + 2. Often, these calculations will be presented as word problems:

Marissa has 3 apples. Lucas has 2 apples. How many apples are there altogether?

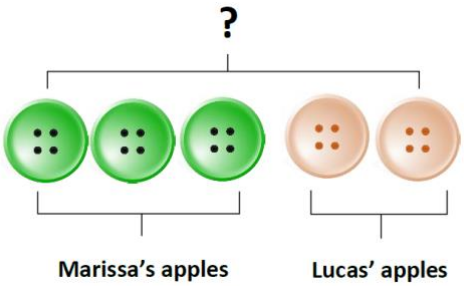
1. **Using concrete resources**

   With addition, subtraction and multiplication, to help children fully understand the later stages of bar modelling, it is crucial they begin with concrete representations.



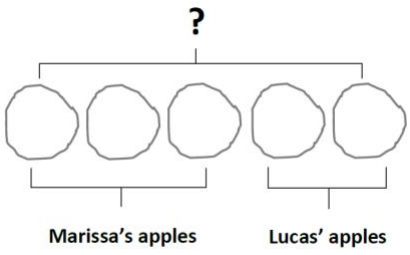
2. **Using substituted concrete resources**

Once they are used to the format and able to represent problems in this way themselves (assigning 'labels' verbally), the next stage is to replace the 'real' objects with resources that represent the object eg counters, cubes, multi-link, Cuisenaire rods.



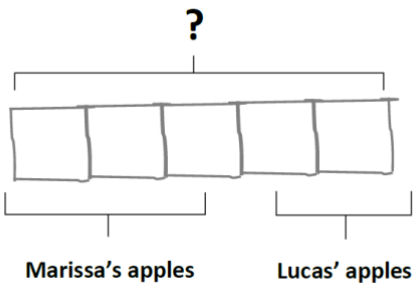
3. **Pictorial representations**

The next stage is to move away from the concrete to the pictorial.



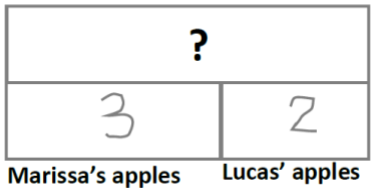
4. **Discrete Bar Model**

The next stage is to represent each object as part of a bar, in preparation for the final stage.



5. **Rectangular Bars**

The final stage stops the 1:1 representation and instead, each quantity is represented approximately as a rectangular bar.

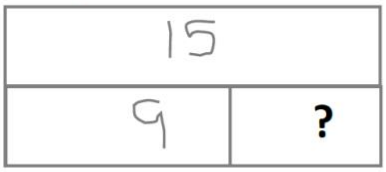


Subtraction

The same concrete to pictorial stages can be applied to subtraction. The method can be taught with the 'part/whole' bar model or the 'comparison' bar model.

Part/Whole model

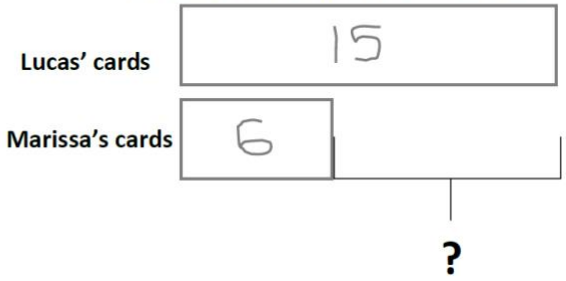
Lucas has 15 playing cards. He gives 9 to his sister. How many cards does he have left?



Or

Comparison bar model

Lucas has 15 playing cards. Marissa has 6 playing cards. How many more playing cards does Lucas have than Marissa?

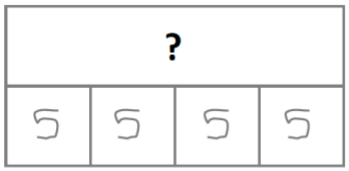


Multiplication

Bar models of multiplication start with the same 'real' and 'substituted' concrete resource stages as addition and subtraction. Then moves to its final stage, drawing rectangular bars to represent each group (it is necessary to understand multiplication as repeated addition).

Example question for multiplication: Children will routinely come across calculations such as 5 x 4. Often, these calculations will be presented as word problems:

Marissa buys 4 boxes of cookies. Each box contains 5 cookies. How many cookies does Marissa have?

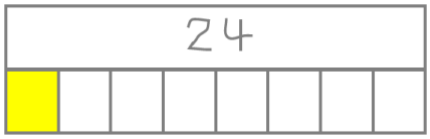


Division

For division it is recommended that children remain grouping and sharing until the final stage of bar modelling is understood. Then word problems can be introduced, using the final stage of rectangular bars.

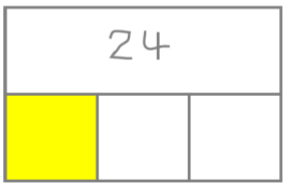
Sharing problem

Lucas has 24 lollies. He wants to share them into 8 party bags for his friends. How many lollies will go into each party bag?



Grouping problem

Lucas has 24 lollies for his party friends. He wants each friend to have 3 lollies. How many friends can he invite to his party?



Bar Modelling from KS1 to KS2

By the end of Year 2, the majority of children should be able to consistently represent a one-step problem with a bar model.

As children move into KS2, they will learn to apply the bar model across the broader maths curriculum and use the bar model to answer multi-step problems and more complex problems. As they move through KS2, bar models will be used for the four operations, fractions, percentages, time, ratio and algebra.

Appendix

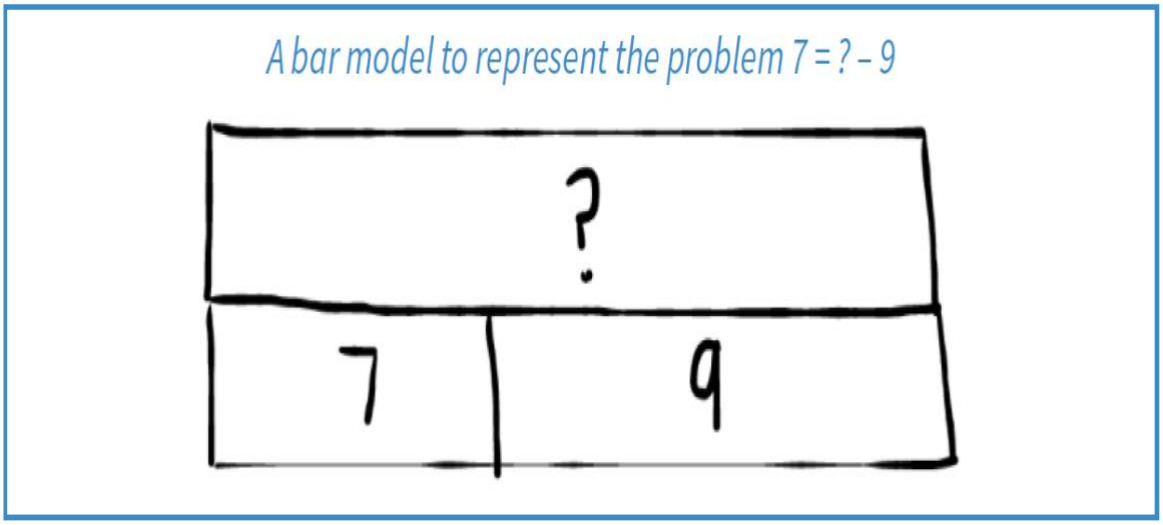
Using the bar model across the maths curriculum

Here are some examples of how bar models can be used across a wide range of mathematical topics.

Missing number problems

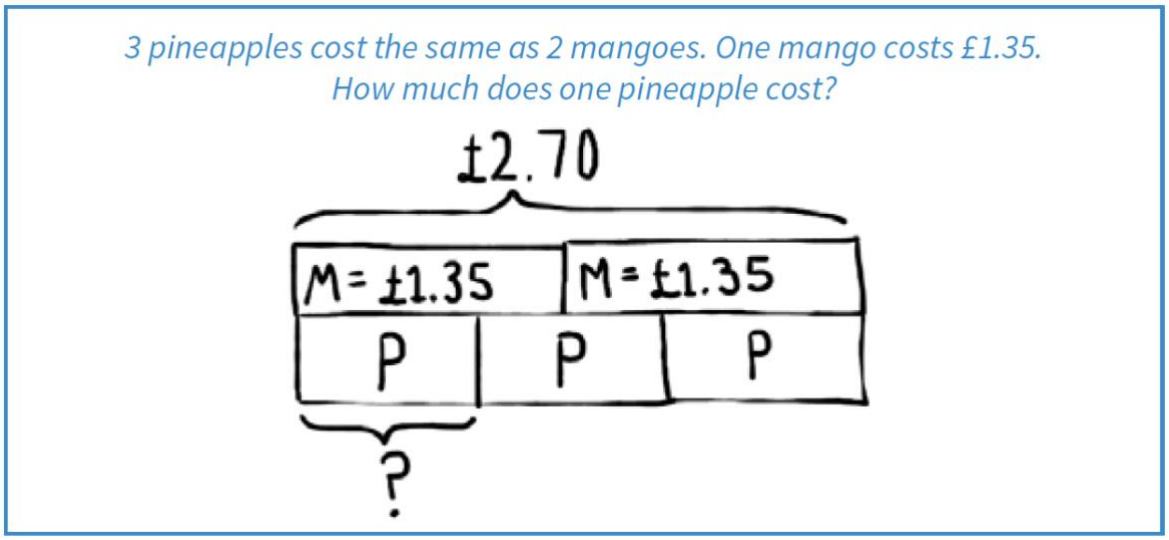
KS1

Example 1



KS2

Example 2



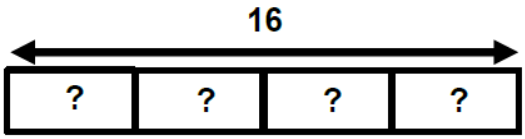
Siobhan McBrien April 2020

Fraction Problems

KS1

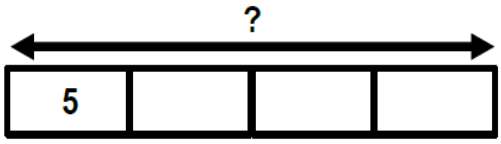
Example 1

What is one quarter of 16?
What is $\frac{3}{4}$ of 16?



Example 2

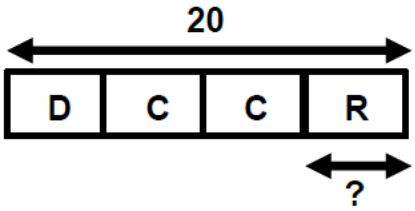
One quarter of a number is 5, what is the number?



KS2

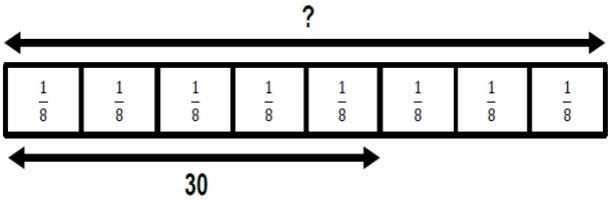
Example 3

Sally has 20 stickers on her page. One quarter of them are dog stickers. One half of them are cat stickers. The rest are rabbit stickers. How many rabbit stickers are on the page?



Example 4

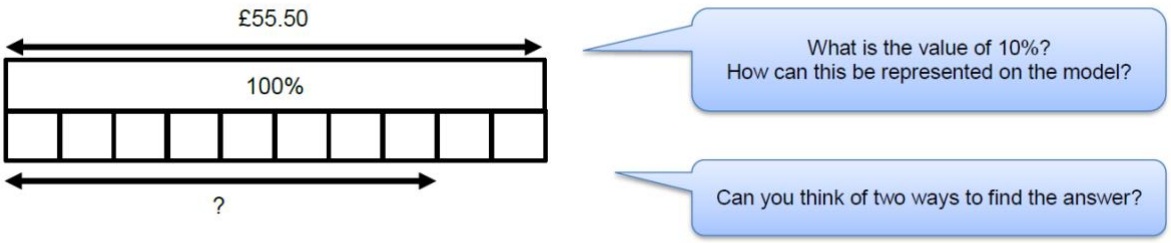
30 is $\frac{5}{8}$ of a number. What is the number?



Percentage Problems

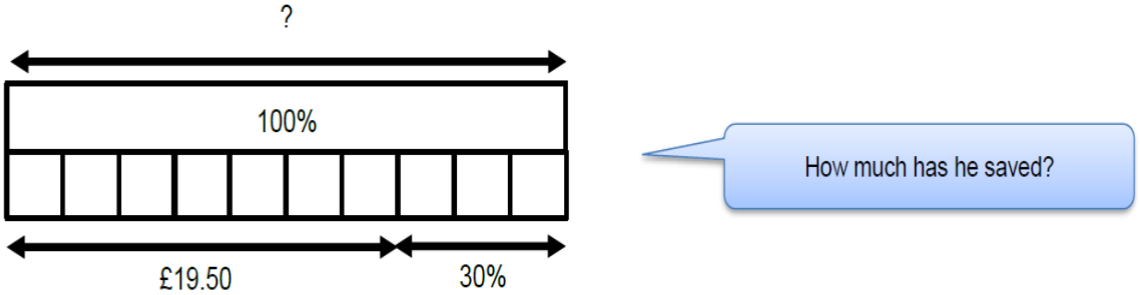
Example 1

The normal price for a tracksuit is £55.50. How much will it cost in a '20% off' sale?



Example 2

In a '30% off' sale, Carl pays £19.50 for a T-shirt. How much was the T-shirt before the sale?

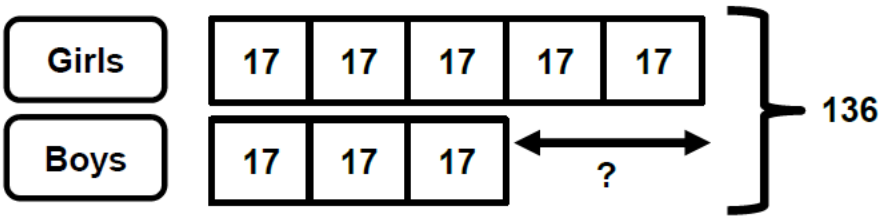


Ratio Problems

Bar modelling is very useful for ratio and scaling problems and should be used when teaching these type of questions.

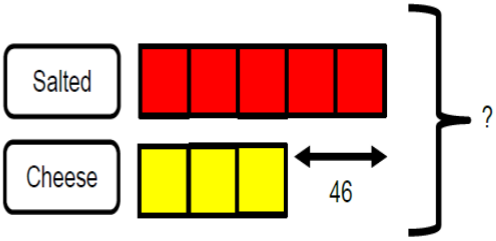
Example 1

At the school disco, there are 5 girls, to every 3 boys. If there are 136 children at the disco, how many more girls than boys are there?



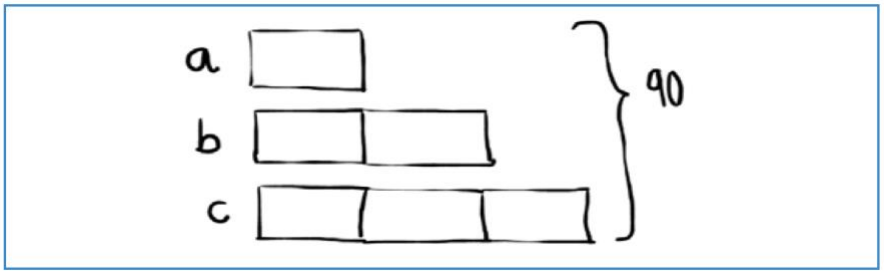
Example 2

In a survey, the ratio of the number of people who preferred 'ready-salted' to 'cheese and onion' crisps was 5:3. Forty-six more people preferred ready-salted. How many people took part in the survey?



Example 3

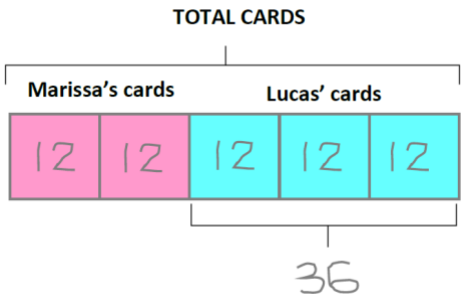
90 sweets are shared between bowls A, B and C. Bowl B contains twice the amount that bowl A contains. Bowl C contains three times the amount that bowl A contains. How many more sweets does bowl B have than bowl A?



Siobhan McBrien April 2020

Example 4

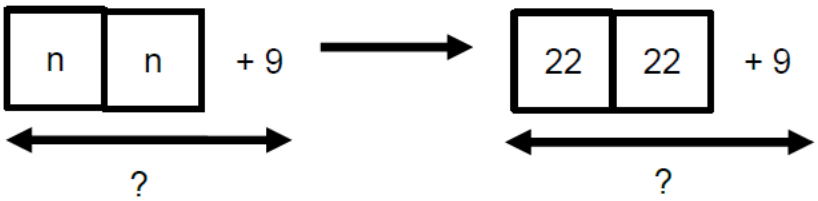
Marissa and Lucas share some Lego cards in the ratio of 2 :3. If Lucas has 36 Lego cards, how many cards are there altogether?



Algebra

Example 1

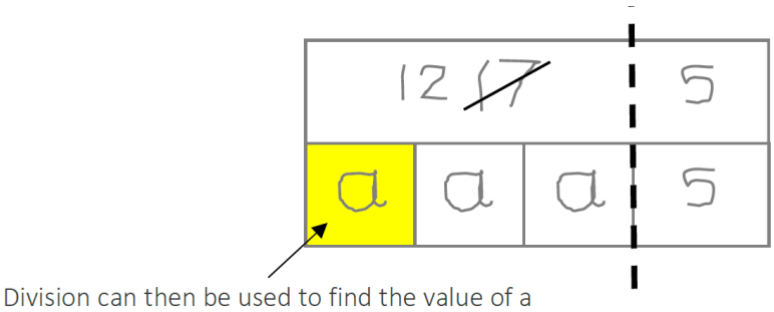
What is 2n + 9 when n = 22



Example 2

3a + 5 = 17

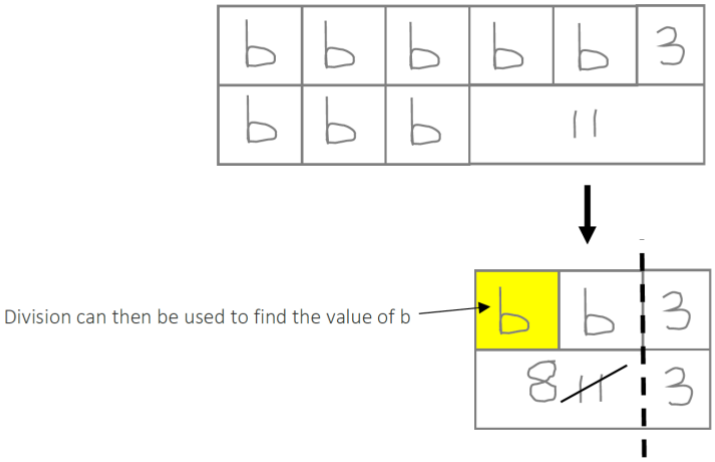
What is the value of a?



Example 3

5b + 3 = 3b + 11

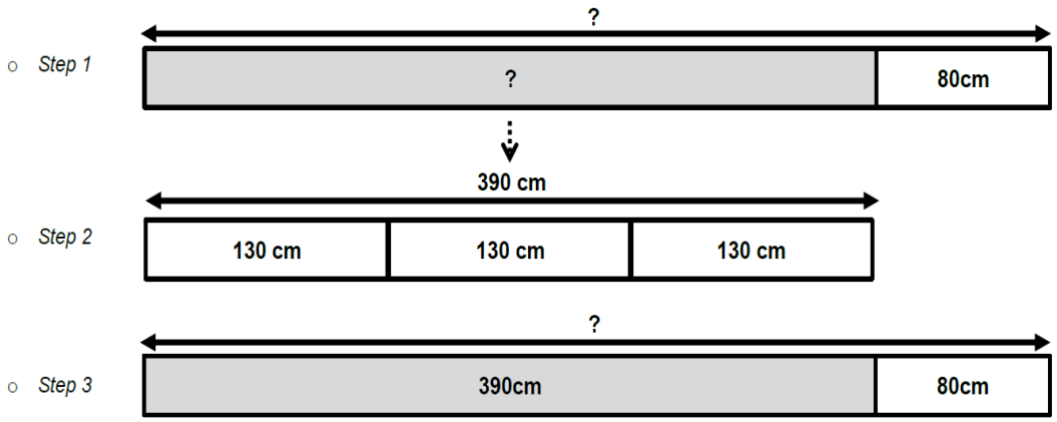
What is the value of b?



Multi-step Problems

Example 1

I cut 80cm from a length of ribbon and shared the remainder between 3 friends. Each friend now has 1.3m of ribbon. How much did I start with?

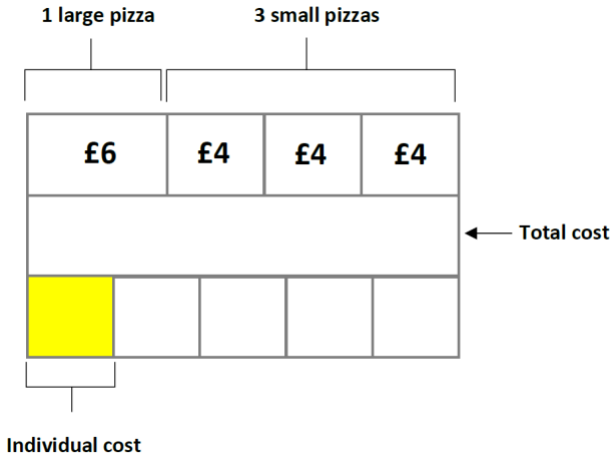


Example 2

Five friends are having a pizza party. They buy one large pizza and three small pizzas. They share the cost equally. How much does each person pay?

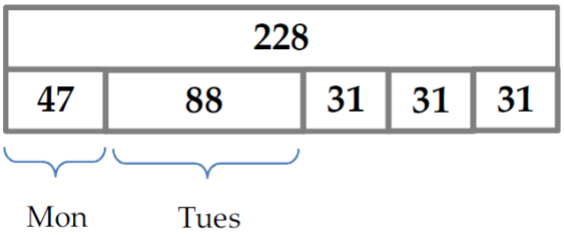
Small pizza £4

Large pizza £6



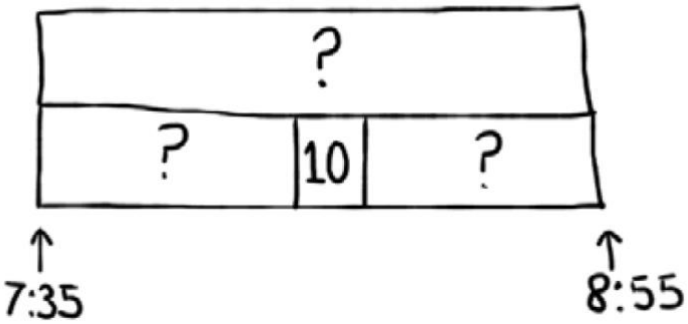
Example 3

On Monday, Gita reads 47 pages of her book. She reads 88 pages the next day. If the book has 228 pages, and she splits the remaining pages between the next 3 days, how many pages does she read on these days?



Time Problems

A film starts at 7:35 pm and ends at 8:55 pm. There is an ice cream break of 10 minutes halfway through. How long is the film?



Key Questions to ask

What do we know? – parts or whole?

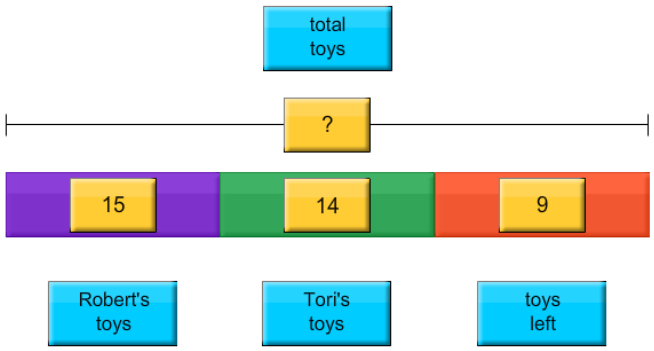
What is the unknown? – parts or whole?

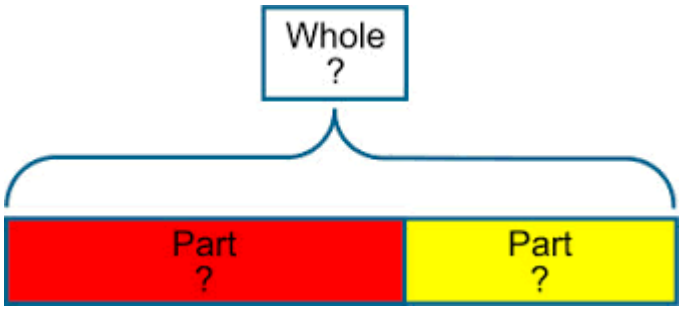
If I know this, therefore I know…….

Label the 'known' parts and/or wholes

Label the 'unknown' parts and/or wholes

Write the number sentence/equation





Siobhan McBrien April 2020