

Additive reasoning



"I know the whole is six. I know one of the part that has been taken away is two. I don't know the other part. I need to subtract the known part, two, from the whole, six, to find the remaining part."

Non-standard

First there were some plates in the cupboard. Then Kieran took two out for dinner. Now there are four left. How many plates were in the cupboard to start with?



"I know the part that has been taken away is two and the part that is left is four. I don't know the whole. I can find the whole by adding the parts of four and two."

Non-standard

First there were six plates in the cupboard. Then Kieran took some out for dinner. There are <u>now</u> four plates left in the cupboard. How many did Kieran take out?

"I know the whole is six and the remaining part is four.

I don't know the part that was taken away. To find the part that was taken away I can add on from four to make six or I could subtract four from six."

> 6 - ? = 46 - 4 = ?





where an existing value has been added to

Standard

First there were 12 people on the bus. <u>Then</u> three more people got on. How many people are on the bus now?

"I know both parts. My first part is twelve and my second part is three. I don't know the whole. I need to add the parts of twelve and three to find the whole."

Non-standard

First there were 12 people on the bus and then some more people got on at the school. <u>Now</u> there are 15 people on the bus. How many people got on at the school?



15

stopped

atthe

"I know my first part is twelve and I know the whole is 15. I don't know the value of the second part. To find the second part, I could add on from 12 to make 15 or I could subtract 12 from 15."

Non-standard

First there were some people on the bus then it stopped to pick up three more passengers at the bank. Altogether now there are 15 people on the bus. How many were people were on the bus before it bank?

"I know the value of the second part is three and that the whole is 15. I don't know the value of the first part. To find the first part. I could add on from three to 15 or I could subtract three from 15."



can be removed, and question construction can be changed to expose pupils to a greater range of nuance in interpreting problems. For example, the second and third reduction problems could be reworded as follows:

Kieran took two plates out of his cupboard for dinner. There were four left. How many plates were in the cupboard to begin with?

There were six plates in the cupboard before Kieran took some out for dinner. If there were four plates left in the cupboard, how many did Kieran take out?

These present the same knowns and unknowns, and therefore the same bar models and resulting equations to solve the problems; however, the change in wording makes them more challenging to pupils who have only worked with a 'first... then... now' structure so far.



Note: all part-whole contexts are considered to be 'standard', as the language of part-whole is unambiguous.



Comparison structures

Comparison structures involve a relationship between two quantities; their relationship is expressed as a difference. The structures vary by which of the values are known/unknown (the larger quantity, the smaller quantity and/or their difference). Part-whole language is not used here because the context contains not one single 'whole', but instead two separate quantities and it is the relationship between them being considered. Comparison bar models are therefore used to model these structures, which are known to be the most challenging for pupils to interpret.

Smaller quantity and larger quantity are known (comparative difference)

Standard

Navin has saved £19 from his pocket money. Sara has saved £31 from her pocket money. How much **more** has Sara saved than Navin? **or** How much **less** has Navin saved than Sara?

"I know one quantity is 19 and the other quantity is 31. I don't know the difference. To find the difference I could add on from 19 to make 31 or I could subtract 19 from 31." 19 + ? = 31 31 - 19 = ?



Smaller quantity and difference are known (comparative addition)

Standard

Ella has six marbles. Robin has three **more** than Ella. How many marbles does Robin have?

"I know the smaller quantity is six. I know the difference is three. I don't know the larger quantity. To find the larger quantity I need to add three to six."

6 + 3 = ?

Non-standard

Samir and Lena are baking shortbread but Lena's recipe uses 15g **less** butter than Samir's. If Lena needs to use 25g of butter, how much does Samir need? "I know the smaller quantity is 25. I know the difference between the quantities is 15. I don't know the larger quantity. To find the larger quantity I need to add 15 to 25." ? - 15 = 25 25 + 15 = ?

Larger quantity and difference are known (comparative subtraction)

Non-standard

Ella has some marbles. Robin has three **more** than Ella and he has nine marbles in total. How many marbles does Ella have?

"I know the larger quantity is nine. I know the difference between the quantities is three. I don't know the smaller quantity. To find the smaller quantity I need to add on from three to make nine or subtract three from nine."

? + 3 = 9 9 - 3 = ?

Standard

Samir's shortbread recipe uses 40g of butter. Lena's recipe uses 15g **less** butter. How much butter does Lena need?

"I know one quantity is 40. I know the difference between the quantities is 15. I don't know the smaller quantity but I know it is 15 less than 40. To find the smaller quantity, I need to subtract 15 from 40."

40 - 15 = ? ? + 15 = 40



6

3







Multiplicative reasoning



calculating the number of unique combinations that can be created from two (or more) sets

Robin has three different hats and four different tops. How many different outfits can he create, that combine one hat and one top?





"I know how many hats there are, and I know how many tops there are. I don't know the number of different outfits that can be created. To find the number of outfits, I need to find how many different tops can be worn with each hat or how many different hats can be worn with each top."

 $4 \times 3 = ?$ $3 \times 4 = ?$





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