Additive Reasoning

This document is part of a set that forms the subject knowledge content audit for Key Stage 1 and Key Stage 2 maths. Each document contains: audit questions with tick boxes that you can select to show how confident you are (1 = not at all confident, 2 = not very confident, 3 = fairly confident, 4 = very confident), exemplifications; explanations; and further support links. At the end of each document, there is space to type notes to capture your learning and implications for practice. The document can then be saved for your records.

Question 9

How confident are you that you understand and can support children to calculate with negative numbers?

1 ☑ 2 ☐ 3 ☐ 4 ☐

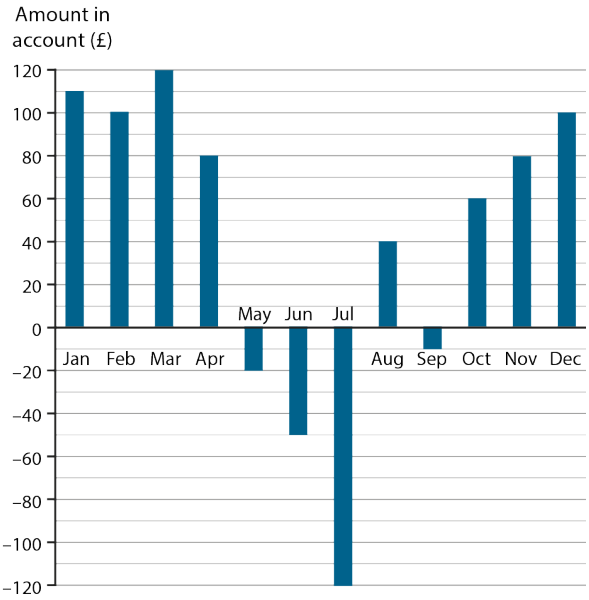
How would you respond …?

a. What representation could you use to support children when solving this problem? How would it develop their understanding?

A diver is below the surface of the water at –40 m. They go up 25m, then down 5m. Where are they now?

b. The bar chart shows the amount of money in the bank account at the end of each month.

Pose some questions that require children to show their understanding of calculating with negative numbers.



Responses

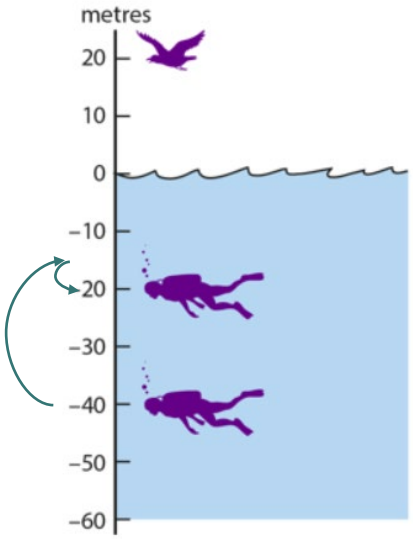
Note your responses to the questions here before you engage with the rest of this section:

Did you notice that…?

a. In part **a**, children are working within negative numbers, rather than calculating through zero. They will need to understand the relative position of the numbers and that if the diver is going up, he is getting closer to zero (surface level in this context).

A number line can be used to do each of the jumps.

–40 + 25 = –15
–15 – 5 = –20
The diver is now at –20m



b. *'What was the difference between the most and least amounts in the account?'*

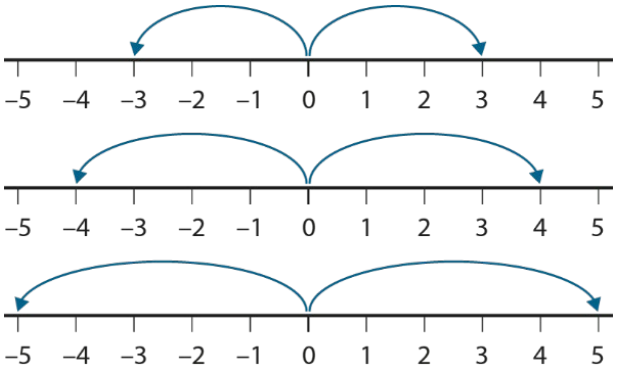
'How much money was paid into the account between July and August?'

'How much money was paid out of the account between August and September?'

Calculating with negative numbers

In this section, the focus is on children understanding how to calculate with **negative numbers**. The position of negative numbers has been explored within a previous question.

Prior to children calculating with negative numbers, they need to have experience of positioning negative numbers on a number line, understanding that a positive number and a negative number can be the same distance away from zero. For example, –3 and (+) 3 are both the same distance from zero.

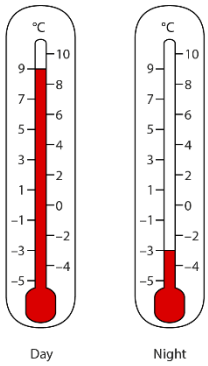


Through this exploration, children should work towards the generalisation that for both positive and negative numbers, **the larger the value of the number, the further away it is from zero**.

This understanding will also support children when they are comparing numbers. Providing a context, such as temperature, will deepen this understanding. Children will develop the knowledge that for negative temperatures, the further the number is from zero, the colder it is and for positive temperatures, the further the number is from zero, the warmer it is.

When children have understood the relative positions of positive and negative numbers, they will then be able to calculate across zero, initially supported by number lines.

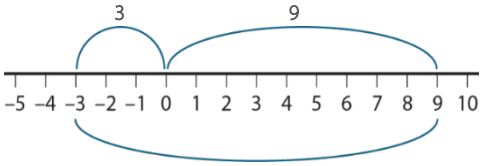
The temperature was 9 ˚C in the day, then it dropped to –3 ˚C at night. What was the change in temperature?



Two thermometers can be used to display temperatures, to help with this question.

By modelling how to find the difference on a number line, attention can be drawn to the structure of the calculation and the 'step' through zero.

The length of the jumps is added together (9 ˚C + 3 ˚C) to reach the final correct answer. Children must then refer back to the context to say the temperature dropped by 12 ˚C.



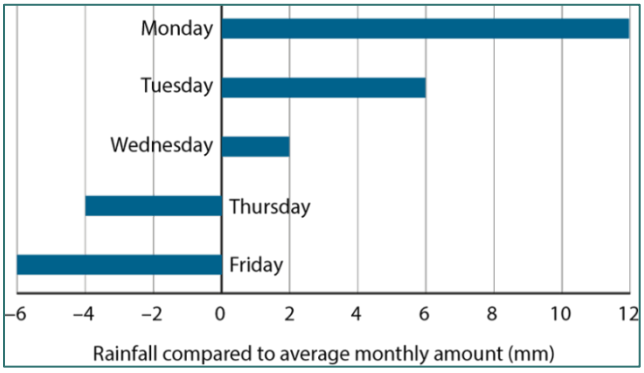
Build on previous work of addition as augmentation and subtraction as reduction and finding the difference, to ask further questions that include calculating intervals across zero.

- **Addition** (augmentation): *'At night, the temperature was –3 ˚C. It rose by 8 degrees during the day. What is the temperature now?'*
- **Subtraction** (reduction): *'Charlie had £3 in his bank account. He borrowed £25 to pay a bill. How much money does Charlie now have in his bank account?'*
- **Subtraction** (finding the difference): *'A diver is at –15m. His friend is at –7m. How far apart are they?'*

Children should also be comfortable calculating within negative numbers, practising in a variety of contexts and with a range of question structures, including calculations across zero.

Negative numbers are often seen within a graphing context. This bar chart shows the amount of rain that fell in the nature garden on different days of the week. The amounts are measured compared to the average monthly rainfall for that time of year.

If the average monthly rainfall is 8 mm, how much rain fell on each day?



Children will have the opportunity to apply their understanding of calculating with negative numbers.

Common errors in this area may include:

- children not taking the negative sign into account when calculating
- children thinking that decimals and fractions are negative numbers
- children not moving along the number line in the correct direction for the operation or the amount given.

What to look for

Can a child:

- show that positive and negative numbers can be the same distance from zero?
- use augmentation and reduction strategies to find the difference?
- calculate the difference between a positive and negative number, going through zero?

Links to supporting materials:
NCETM Primary Professional Development materials, Spine 1: Number, Addition and Subtraction • Topic 1.27: Negative numbers: counting, comparing and calculating

Notes:
Key learning from support material and self-study:
What I will focus on developing in my classroom practice: