N9 • Evaluating directed number statements

Mathematical goals

To enable learners to:

- make valid generalisations about the effect of operations on directed numbers.

Starting points

It is helpful if learners have already attempted to use directed quantities in contexts (e.g. money or temperature) before attempting this session. A suitable session to prepare for this is **N8 Using directed numbers in context**.

In this session, learners are provided with a collection of statements. They have to decide whether these statements are always, sometimes or never true and justify their choices with examples and counter-examples.

Materials required

For each learner you will need:

- mini-whiteboard.

For each small group of learners you will need:

- Card set A – *Statements*;
- large sheet of paper for making a poster;
- felt tip pens;
- glue stick.

and optionally:

- Sheet 1 – *Addition grid; subtraction grid; multiplication grid; division grid*;
- calculator.

Time needed

Approximately 1 hour.

Suggested approach

Beginning the session

Using mini-whiteboards, ask learners to show you simple addition, subtraction, multiplication and division questions that give the answers 12, 0, and –12.

> e.g. Give me an addition question where the answer is –12. Can you find a harder example?

Working in groups

Ask learners to work in pairs. Give each pair Card set A – *Statements*, a large sheet of paper, glue stick and felt tip pens.

If learners are likely to struggle, then just give the eight cards on addition and subtraction to start with.

Ask learners to divide the poster into three sections headed 'Always true', 'Sometimes true' or 'Never true'.

The object of the activity is for each pair of learners to produce a poster which shows each statement classified according to whether it is always, sometimes or never true and furthermore:

- if it is sometimes true, to write examples around the statement to show when it is true and when it is not true;
- if it is always true, to give a variety of examples demonstrating that it is true, using large numbers and decimals, if possible;
- if it is never true, to say how we can be sure that this is the case.

If learners have difficulties or make many mistakes, give them Sheet 1 – *Addition grid; subtraction grid; multiplication grid; division grid*. They can complete the grids quickly, using the patterns that rapidly become apparent. There are a few blank cells in each grid for learners to complete themselves. The results from these grids will provide learners with further examples they can use to check their posters.

Learners may also like to find ways of checking with a calculator. This requires careful use of the (+/–) key.

Reviewing and extending learning

Working with the whole group, write on the board a list of statements that learners think are always true and ask for examples

to justify this. There are some interesting additional discussions that might arise, such as the meaning of '0 ÷ 0'.

What learners might do next

Learners may be asked to create money or temperature problems that lead to the calculations on the cards.

Further ideas

This activity is about examining a mathematical statement and deciding on its truth or falsehood. This idea may be used in many other topics and levels. Examples in this pack include:

A4 **Evaluating algebraic expressions;**

SS4 **Evaluating statements about length and area;**

S2 **Evaluating probability statements.**

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N9 Card set A – *Statements*

A **(–5) + (–6)** **If you add two negative numbers you get a negative answer.**	**B** **(–5) + (+7)** **If you add a negative number and a positive number you get a positive answer.**
C **(–5) – (+4)** **If you subtract a positive number from a negative number you get a negative answer.**	**D** **(–5) – (–8)** **If you subtract a negative number from a negative number you get a positive answer.**
E **(+10) – (+5)** **If you subtract a positive number from a positive number you get a positive answer.**	**F** **(+8) – (–6)** **If you subtract a negative number from a positive number you get a positive answer.**
G **5 + (–8) = 5 – (+8)** **Adding a negative is like subtracting a positive.**	**H** **5 – (–8) = 5 + 8** **Subtracting a negative is like adding a positive.**

N9 Card set A – *Statements* (continued)

I **(–10) × (–5)** **If you multiply two negative numbers you get a negative answer.**	**J** **(–10) × (+6)** **If you multiply a negative number and a positive number you get a positive answer.**
K **(+12) ÷ (–4)** **If you divide a positive number by a negative number you get a negative answer.**	**L** **(–12) ÷ (+4)** **If you divide a negative number by a positive number you get a negative answer.**
M **(+12) ÷ (+4)** **If you divide a positive number by a positive number you get a negative answer.**	**N** **(–12) ÷ (–4)** **If you divide a negative number by a negative number you get a negative answer.**

N9 Sheet 1

Addition grid

3 + 3 =	3 + 2 =	3 + 1 =	3 + 0 =	3 + (–1) =	3 + (–2) =	3 + (–3) =
2 + 3 =	2 + 2 =	2 + 1 =	2 + 0 =	2 + (–1) =	2 + (–2) =	2 + (–3) =
1 + 3 =	1 + 2 =	1 + 1 =	1 + 0 =	1 + (–1) =	1 + (–2) =	1 + (–3) =
0 + 3 =	0 + 2 =	0 + 1 =	0 + 0 =	0 + (–1) =	0 + (–2) =	0 + (–3) =
–1 + 3 =	–1 + 2 =	–1 + 1 =	–1 + 0 =	–1 + (–1) =	–1 + (–2) =	–1 + (–3) =
–2 + 3 =	–2 + 2 =	–2 + 1 =	–2 + 0 =	–2 + (–1) =		
–3 + 3 =	–3 + 2 =	–3 + 1 =	–3 + 0 =	–3 + (–1) =		–3 + (–3) =

Subtraction grid

3 – 3 =	3 – 2 =	3 – 1 =	3 – 0 =	3 – (–1) =	3 – (–2) =	3 – (–3) =
2 – 3 =	2 – 2 =	2 – 1 =	2 – 0 =	2 – (–1) =	2 – (–2) =	2 – (–3) =
1 – 3 =	1 – 2 =	1 – 1 =	1 – 0 =	1 – (–1) =	1 – (–2) =	1 – (–3) =
0 – 3 =	0 – 2 =	0 – 1 =	0 – 0 =	0 – (–1) =	0 – (–2) =	0 – (–3) =
–1 – 3 =	–1 – 2 =	–1 – 1 =	–1 – 0 =	–1 – (–1) =	–1 – (–2) =	–1 – (–3) =
–2 – 3 =	–2 – 2 =	–2 – 1 =	–2 – 0 =	–2 – (–1) =		
–3 – 3 =	–3 – 2 =	–3 – 1 =	–3 – 0 =	–3 – (–1) =		–3 – (–3) =

N9 Sheet 1 (continued)

Multiplication grid

$3 \times 3 =$	$3 \times 2 =$	$3 \times 1 =$	$3 \times 0 =$	$3 \times (-1) =$	$3 \times (-2) =$	$3 \times (-3) =$
$2 \times 3 =$	$2 \times 2 =$	$2 \times 1 =$	$2 \times 0 =$	$2 \times (-1) =$	$2 \times (-2) =$	$2 \times (-3) =$
$1 \times 3 =$	$1 \times 2 =$	$1 \times 1 =$	$1 \times 0 =$	$1 \times (-1) =$	$1 \times (-2) =$	$1 \times (-3) =$
$0 \times 3 =$	$0 \times 2 =$	$0 \times 1 =$	$0 \times 0 =$	$0 \times (-1) =$	$0 \times (-2) =$	$0 \times (-3) =$
$-1 \times 3 =$	$-1 \times 2 =$	$-1 \times 1 =$	$-1 \times 0 =$	$-1 \times (-1) =$	$-1 \times (-2) =$	$-1 \times (-3) =$
$-2 \times 3 =$	$-2 \times 2 =$	$-2 \times 1 =$	$-2 \times 0 =$	$-2 \times (-1) =$		
$-3 \times 3 =$	$-3 \times 2 =$	$-3 \times 1 =$	$-3 \times 0 =$	$-3 \times (-1) =$		$-3 \times (-3) =$

Division grid

$9 \div 3 =$	$6 \div 3 =$	$3 \div 3 =$	$0 \div 3 =$	$-3 \div 3 =$	$-6 \div 3 =$	$-9 \div 3 =$
$6 \div 2 =$	$4 \div 2 =$	$2 \div 2 =$	$0 \div 2 =$	$-2 \div 2 =$	$-4 \div 2 =$	$-6 \div 2 =$
$3 \div 1 =$	$2 \div 1 =$	$1 \div 1 =$	$0 \div 1 =$	$-1 \div 1 =$	$-2 \div 1 =$	$-3 \div 1 =$
$0 \div 0 =$	$0 \div 0 =$	$0 \div 0 =$	$0 \div 0 =$	$0 \div 0 =$	$0 \div 0 =$	$0 \div 0 =$
$-3 \div (-1) =$	$-2 \div (-1) =$	$-1 \div (-1) =$	$0 \div (-1) =$	$1 \div (-1) =$	$2 \div (-1) =$	$3 \div (-1) =$
$-6 \div (-2) =$	$-4 \div (-2) =$	$-2 \div (-2) =$	$0 \div (-2) =$	$2 \div (-2) =$		
$-9 \div (-3) =$	$-6 \div (-3) =$	$-3 \div (-3) =$	$0 \div (-3) =$	$3 \div (-3) =$		$9 \div (-3) =$