# Broken-Calculator Division

**Objective** To guide children as they explore computational strategies for division and interpret remainders.

## Key Concepts and Skills
- Interpret calculator displays for remainders in equal-sharing and equal-grouping problems.  
  [Operations and Computation Goal 6]
- Use equal sharing to solve division number stories.  
  [Operations and Computation Goal 6]

## Key Activities
Children divide numbers using the division keys on a calculator and interpret the calculator display. They devise ways of dividing numbers using a calculator without using the division key and solve division number stories with remainders.

### Ongoing Assessment: Informing Instruction
See pages 756 and 757.

## Materials
- Math Journal 2, pp. 222 and 224
- Home Link 9-7
calculator  slate  half-sheet of paper  play money (optional)  counters (optional)

## Teaching the Lesson

### 1 Teaching the Lesson

#### Key Concepts and Skills

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## Ongoing Learning & Practice

### Playing Roll to 100
Math Masters, p. 456  
Student Reference Book, pp. 307 and 308  
per group: 2 six-sided dice  
Children practice mental computation.

### Math Boxes 9-8
Math Journal 2, p. 225  
Children practice and maintain skills through Math Box problems.

### Ongoing Assessment: Recognizing Student Achievement
Use Math Boxes, Problem 2.  
[Patterns, Functions, and Algebra Goal 3]

### Home Link 9-8
Math Masters, p. 290  
Children practice and maintain skills through Home Link activities.

## Differentiation Options

### Readiness

#### Picturing Division
Math Masters, p. 291  
Children use a visual model to explore equal-sharing and equal-grouping problems.

#### Enrichment

#### Solving Division Number Stories
Math Masters, p. 292  
Children solve division number stories and express the remainders as fractions.

### Ell Support

#### Using Calculators to Solve Division Problems
Children discuss calculator keys they press to solve division problems.

## Advance Preparation

**Teacher’s Reference Manual, Grades 1–3** pp. 23–29
Getting Started

Mental Math and Reflexes
Children record answers to fraction number stories on their slates. Encourage children to draw or use counters as needed. Suggestions:

- Troy read 8 books over the summer. \( \frac{7}{8} \) of the books were mysteries. How many mysteries did Troy read? 7 mysteries
- Perry saved 20 coins. \( \frac{2}{5} \) of them were dimes, \( \frac{1}{5} \) of them were quarters. \( \frac{3}{10} \) of the coins were nickels. The rest were pennies. How many of each coin did Perry save? 8 dimes, 5 quarters, 6 nickels and 1 penny
- The guests at Tory and Marissa’s birthday party ate 10 slices of pie. If each pie had six slices, what fraction of pies was eaten? 1 \( \frac{10}{6} \), or 1 \( \frac{4}{3} \) or \( \frac{2}{3} \) pies

Math Message
Solve Problems 3 through 6 on journal page 222 using your calculator. On a half-sheet of paper, write the answers the calculator displays. Compare with your answers on the journal page.

Home Link 9-7 Follow-Up
Briefly go over the answers. Have children share strategies for solving Problem 1.

1 Teaching the Lesson

Math Message Follow-Up
(Math Journal 2, p. 222)

In discussing calculator answers to Problems 3 through 6 on journal page 222, point out that the display must be interpreted to fit the situation. For example, the display for \( 75 \div 6 \) is 12.5 (a number with one decimal place), but the answer is \( \frac{75}{6} \) is \$12.50 (a number with two decimal places).

Adjusting the Activity

When using calculators, it is important to discuss the meaning of each calculator entry. Ask questions such as: What does [number] represent? Why are you dividing? What does the answer mean? What are the units?

ELL

Ask children to solve the following problem with their calculators:

- A farmer wants to pack 246 eggs into egg cartons that hold a dozen eggs each. How many full cartons will she have?

Remind children that they must divide 246 by 12 to find how many 12s there are in 246. When this is done on a calculator, the display shows 20.5. Ask: In this problem, what does 20.5 stand for? Cartons of eggs Is 20.5 cartons the answer to the problem? No. 20.5 is between 20 and 21, so there are 20 full cartons with some eggs left over. Some children assume that the 5 after the decimal point is the remainder or the number of eggs left over. Clarify that this is not the case.
Adjusting the Activity

Pose the following question: How many eggs are left over? 6 Possible strategies: 0.5 is another name for \( \frac{1}{2} \), and a half-full carton of eggs contains 6 eggs. 20 full cartons of eggs contain \( 20 \times 12 = 240 \) eggs. That leaves 6 unpacked eggs (246 – 240 = 6).

AUDITORY • KINESTHETIC • TACTILE • VISUAL

As time permits, pose and discuss additional problems in which children must interpret the calculator display. Suggestions:

- There are 263 pencils. A box holds 50 pencils. How many full boxes of pencils are there? 5 boxes
- A bus holds 36 people. 155 people are going on a field trip. How many buses are needed? 5 buses

Ongoing Assessment: Informing Instruction

For the bus problem, the calculator display will show 4.3055555. Watch for children who think this is a big number. Direct their attention to the decimal point and the whole number to the left of the decimal point.

Exploring Strategies for Finding Quotients

Ask children to pretend that the division key on each calculator is broken. How would they use their broken calculators to solve the following problem?

- A farmer packs 576 eggs into cartons that hold a dozen eggs each. How many full cartons does she pack?

Ask each group to write a brief report describing the strategies they used to solve the problem. Bring the class together to share strategies. Possible strategies:

- Clear the calculator and enter 576. Subtract 12 over and over until the display shows a number less than 12 (in this case, 0). Keep a tally of the number of times 12 is subtracted. This tally gives the number of full cartons. 48
- Clear the calculator and enter 576. Subtract 120 (the number of eggs in 10 full cartons) over and over until the display shows a number less than 120 (in this case, 96). Keep a tally of the number of times 120 is subtracted. This tally gives the number of tens of cartons. 4 tens = 40 Subtract 12 from the number in the display until the display shows a number less than 12. This gives the number of additional full cartons. 8. Add 40 + 8 to get 48 cartons.
Use repeated estimates for the number multiplied by 12 to get 576. The repeated-estimates strategy is often referred to as guess-and-check. For example:

- $25 \times 12 = 300$—too small
- $40 \times 12 = 480$—too small
- $50 \times 12 = 600$—too large, but close
- $48 \times 12 = 576$—right on target!

Pose additional broken-calculator problems as necessary for the groups to solve. Suggestions:

- A baker packs 315 hamburger buns into packages of 8. How many full packages does he have? 39
- How many leftover buns? 3
- The cafeteria manager plans to serve 78 cartons of yogurt for lunch. The cartons come in packages of 6. How many 6-carton packages must be purchased? 13

Solving Division Number Stories with Remainders

*(Math Journal 2, p. 224)*

Partners use their calculators to solve the division problems on journal page 224. Explain to children that they can use the division key on Problems 1 through 3, but they will pretend it is broken in Problems 4 and 5. When children finish, have volunteers explain how they interpreted the calculator display for each problem and how they solved Problems 4 and 5 without using the division key.

Adjusting the Activity

When you introduce the idea of the broken calculator to English language learners, it should be clear that you are pretending it is broken. Explain that children will be asked to solve some problems without using certain calculator keys.

**Auditory** • **Kinesthetic** • **Tactile** • **Visual**

Ongoing Assessment: Informing Instruction

Watch for children who need support in implementing a strategy for solving the division problems. Encourage them to draw pictures to illustrate the problems. (See margin.)

Links to the Future

The activities in this lesson are an early exposure to interpreting remainders. Some children will need more practice before they develop a full understanding of division concepts. Expressing the remainder as a whole number or fraction appropriate to the context of the problem is a Grade 5 Goal.
Differentiation Options

2 Ongoing Learning & Practice

Playing Roll to 100
(Math Masters, p. 456; Student Reference Book, pp. 307 and 308)

Children play Roll to 100 to practice mental addition. For directions, see Lesson 2-1 or Student Reference Book, pages 307 and 308.

Math Boxes 9-8
(Math Journal 2, p. 225)

Mixed Practice Math Boxes in this lesson are paired with Math Boxes in Lesson 9-6. The skill in Problem 6 previews Unit 10 content.

Ongoing Assessment:
Recognizing Student Achievement

Use Math Boxes, Problem 2 to assess children’s progress toward understanding that parentheses affect the order of operations. Children are making adequate progress if they successfully complete Problem 2. Some children may be able to write and solve their own number sentences with parentheses.

Home Link 9-8
(Math Masters, p. 290)

Home Connection Children solve number stories about dividing quantities into equal parts and interpreting remainders.

3 Differentiation Options

Picturing Division
(Math Masters, p. 291)

To explore equal-sharing and equal-grouping problems using a visual model, children illustrate the solution to division problems. Children record their work on Math Masters, page 291.
Solving Division Number Stories
(Math Masters, p. 292)

To apply children’s understanding of remainders, have them solve division problems and express the remainders as fractions on Math Masters, page 292. Have children share solution strategies. For Problem 2, children might draw 4 pizzas and divide each into 8 equal slices. They would shade 3 of the pizzas (for 24 slices) and one of the slices in the fourth pizza (for a total of 25 shaded slices). Point out that to serve everyone, the class will need to order 4 pizzas.

4 pizzas are needed to serve 25 people.

Using Calculators to Solve Division Problems

To provide support for solving division problems with a calculator, discuss the keys that are pressed and the resulting displays. For example, pose the following problem: A bus holds 36 people. 162 people are going on a field trip. How many buses are needed?

After the children have solved the problem, ask the following questions:

- What keys did you press on the calculator to solve the problem? 162 ÷ 36 =
- What number did you see in the display? 4.5
- What does the 4 represent? The number of buses carrying 36 people
- How many people will the 4 buses hold? 36 × 4 = 144
- How many more people will need a seat? 162 − 144 = 18
- Where will these 18 sit? On the fifth bus