Grade 7 Solving percent problems

7.N.3	
Solve problems involving percents from 1% to 100%.	1. Express a percent as a decimal or fraction. 2. Solve a problem that involves finding a percent. 3. Determine the answer to a percent problem where the answer requires rounding, and explain why an approximate answer is needed (e.g., total cost including taxes).

Clarification of the outcome:

- The outcome concerns solving percent problems where the percent is a "whole number" from 1% to 100%.
- The outcome is a continuation of the grade 6 outcome. Refer to **Meaning of percent**

Required close-to-at-hand prior knowledge:

- Understand percent means out of 100.
- Proficiency in simple decimal multiplication (e.g. .2 x 40)
- Proficiency in changing percent to fraction and decimal form (e.g. 3% is 3/100 or .03).
- Understand the container model of ratio. Refer to **Meaning of percent**

SET SCENE stage

The problem task to present to students:

Organize students into groups. Provide them with clippings from newspapers and advertising flyers that describe situations such as a 10% off sale, population increase expected to be 5%, 20% of Canadians live under the poverty line, and so on.

Ask each group to select one situation that involves calculating a percent of a number (a percentage). Have each group invent a method for calculating a percent of a number (for example, a 5% increase in population) and determine an answer using their invented method.

Comments:

The main purpose of the task is to get students thinking about "real world" uses of percent and to stimulate their understanding of it.

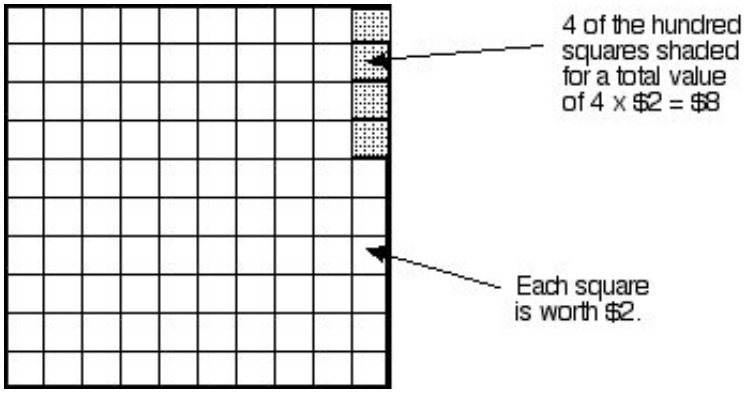
DEVELOP stage

Activity 1: Revisits SET SCENE and addresses indicator 2.

- Have each group present their idea on how to calculate a percent of a number (methods will range from "don't know", container model of ratio, equivalent fraction strategy, to "use a calculator"). [DO NOT CORRECT THEIR INVENTED METHOD.] Discuss whether the answer makes sense. [For example, should 5% of 3 000 be much smaller than, bigger than etc. than 3 000?]
- If a group presents a method something like "multiply percent times the number" ask that group to explain why they think the method works. In any case, suggest that it might be important to figure out an efficient method for calculating a percent of a number and to understand why the method works.

Activity 2: Addresses achievement indicators 1 and 2.

- Pose a simple problem involving the calculation of a percentage (e.g. "*What is 4% of $200*?"). Ask students to use a hundreds grid to represent $200 and to solve the problem. Discuss their approaches.
- Encourage way #2 thinking. Ensure that students realize that 4 of the 100 squares would need to be shaded. [See diagram.] Discuss why this shows that 4% of $200 is $8 (4 squares with each worth 2 becomes a total value of 8 shaded).



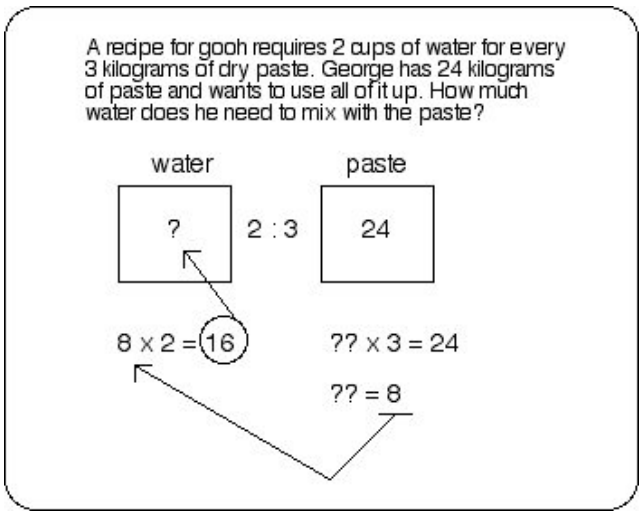
- Present one simple problem (the number is a multiple of 100) and have students use a hundreds grid to determine the percentage (the solution to the problem). Discuss their solution.
- Discuss why the hundreds grid method might not always be appropriate (for example: "*What is 4% of $231*?"). Suggest that ratio might be useful for figuring out a shortcut for easily calculating a percent of any number.

Note

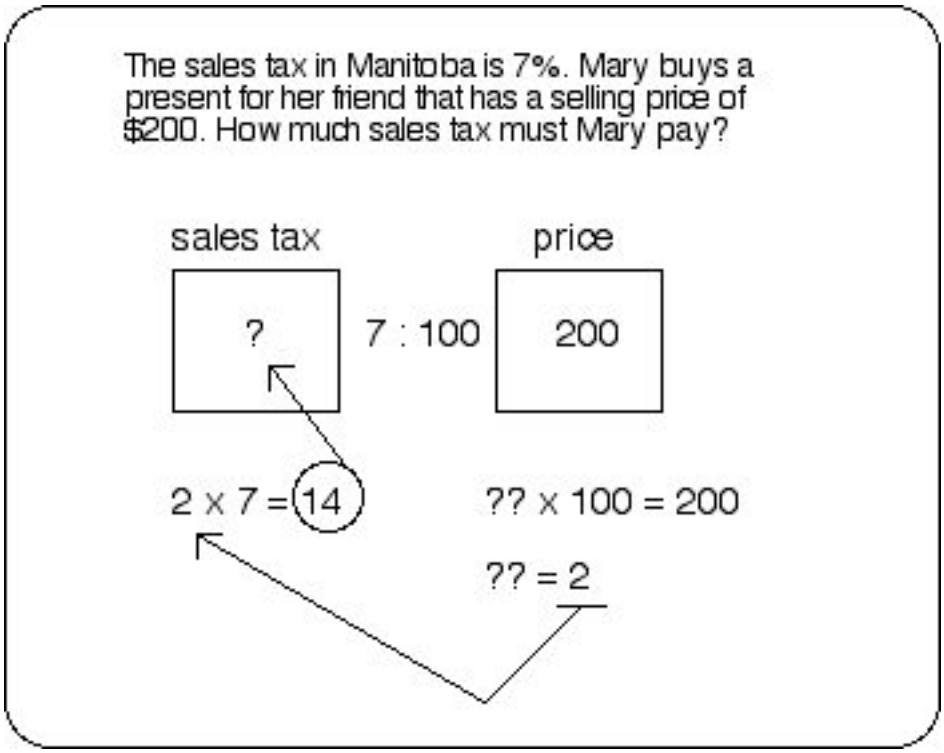
There are 2 basic ways to proceed with a hundreds grid: (1) Use two hundreds grids and shade 4 small squares in each one, making a total of 8 squares shaded or (2) Use one hundreds grid, where each small square is worth $2, and shade 4 squares, for a total value of 4 x $2 = $8. Way #2 is preferable because it encourages multiplicative thinking, and thus helps set the stage for developing an efficient method for calculating a percent.

Activity 3: Addresses achievement indicators 1 and 2, and revisits ratio approach.

- Revisit the **container model of ratio** by having students use it to do a simple ratio problem (see example here).

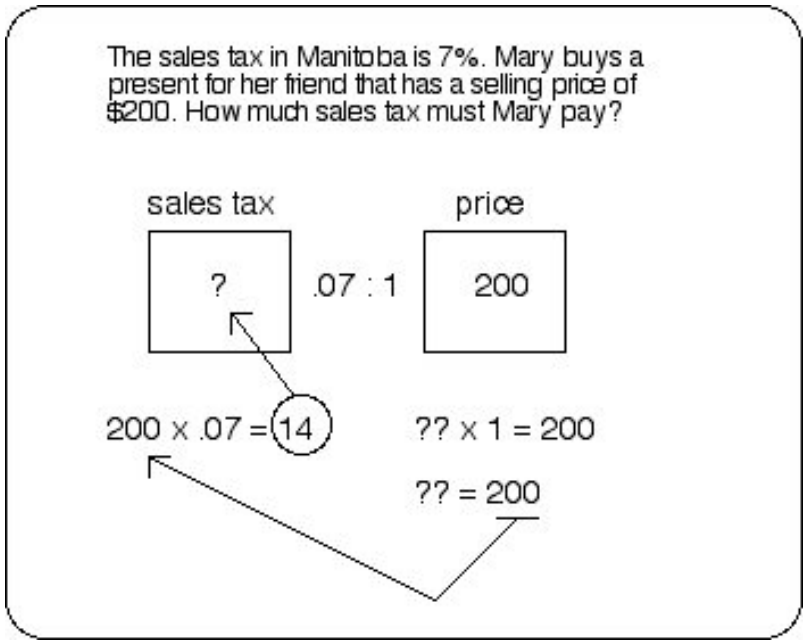


- Have students use the container model of ratio to solve about three percent problems that involve numbers are multiples of 100. [See example below.] Ensure that students understand why, for example, 7% can be interpreted as a ratio of 7 : 100.



Activity 4: Addresses achievement indicators 1 and 2.

- Revisit changing a percent to a decimal form (e.g. 7% is .07). Ask students what the ratio rule would be if we used a decimal form for a percent. Ensure that they understand that the ratio rule would become, for example, **.07 : 1**. [7% is **7** : **100** and **7** divided by 100 is .07 and **100** divided by 100 is 1.]
- Have students resolve the percent problems from the previous activity by using the new version of the ratio rule (e.g. .07 : 1). [See example.] Have them compare answers. [Naturally, the answers should be the same.]



- Have students think about a shortcut for calculating a percent of a number. The ratio method that involves using a ratio rule of, for example, **.07 : 1**, should help them realize that the shortcut is 'multiply the number by the percent in decimal form'. The short cut method is visible when using the ratio approach. For example, in the above problem solution, the short cut is visible as: **200 x .07 = 14**. Use the commutative property for multiplication (switching the order of multiplying does not change the answer) to arrive at the conventional form for the shortcut method (e.g. .07 x 200 = 14). Generalize the short cut to the form: '**percent in decimal form x the number**'.
- Have students use the short cut method to redo the three percent problems. Discuss the advantage of the short cut method over other methods.

Activity 5: Revisits SET SCENE and addresses achievement indicators 1 and 2.

- Revisit the SET SCENE task. Organize students into groups and have each group calculate the answers for a few of the situations, using a calculator. Expect them to use the shortcut method, 'percent in decimal form x the number'). Discuss solutions.

Activity 6: Addresses achievement indicators 1, 2, and 3, and practice.

- Pose the following problem: "*The bank gives 4% interest each year on deposits. Joe has $167.73 in his bank account. He earned the money raking leaves. How much interest will Joe earn at the end of the year?*" Have students solve the problem, using a calculator. Discuss the answer of 6.7092 shown on the calculator display. Ask students what the bank is likely to do with a part of a penny interest (Expect: Round off to $6.71). Discuss why.
- Pose the following problem: "*The bank gives 4% interest each year on deposits. Joe has $101.31 in his bank account. How much interest will Joe earn at the end of the year?*" Have students solve it, using a calculator. Discuss the answer of 4.0524 shown on the calculator display. Ask students what the bank is likely to do with a part of a penny interest this time (Expect: Drop the part of a penny and only give $4.05 interest). Discuss why.
- Pose the following problem: "*The rabbit population increased by 7% in 2007. In 2006, the population was 15 238 rabbits. What was the increase?*" Have students solve it, using a calculator. Discuss the answer of 1066.66 shown on the calculator display. Ask students what to do with the .66 of a rabbit. They will likely want to round off to 1067 rabbits. Discuss why this is inappropriate. This time it makes sense to drop the .66 (called truncation). The answer should be 1066 rabbits.
- Provide students with a mixture of percent problems, some involving rounding off, others involving truncation. Have students solve the problems. Discuss their solutions.

Activity 7: Assessment of teaching.

- Present students with three percent problems (e.g. *The population of rabbits in Winnipeg is estimated to be 250 000. The city thinks that there will be an increase in population this year of about 8%. About how many more rabbits will there be at the end of the year?*). Ensure that one of the problems involves a round off or truncation situation. Ask them to solve the problems, using a calculator to do the arithmetic.

If all is well with the assessment of teaching, engage students in PRACTICE (the conclusion to the lesson plan).

An example of a partially well-designed worksheet follows.

The worksheet contains a sampling of question types. More questions of each type are needed.

The MAINTAIN stage follows the sample worksheets.

Question 1.

Calculate each percent using the hundreds grid method.

a) 3% of 400

b) 11% of 300

Question 2.

Calculate each percent using the ratio method.

a) 6% of 200

b) 23% of 300

Question 3.

Calculate each percent using the short cut method.

a) 7% of 610

b) 20% of 350

c) 50% of 1080

Question 4.

Solve each problem, using the short cut method. The answer must make sense. You may have to round off or truncate to have the answer make sense.

a) The sale tax is 8%. What is the tax on a purchase of 235.76? What is the final cost of the purchase.

b) The pigeon population of Winnipeg increased by 17% in 2o12. In 2011, the population was 23 025 pigeons. What is the population in 2013?

c) The student population of a middle years school was 231 in 2011. The population decreased by 3% in 2013. What was the student population in 2013?

MAINTAIN stage

Mini-task example

Every so often:

- Present a "nice" percent calculation (e.g. 5% of 200) and a "not nice" percent calculation (e.g. 6% of 456). Ask students to do both questions by whatever method they want.

Rich-task example

Have students find a circle graph in a newspaper, website or other source that shows percent information about some matter (e.g. percent of people in Canada of various ethnic origins). ENSURE the percents are whole numbers only (if not round off/truncate as appropriate). Have students make a circle graph that shows the information as actual numbers (e.g. 250 000 Canadians are of Serbian origin). To do this, they will have to calculate percentages.

Comments

This is a rich-task because it is a complex problem that integrates percent with a circle graph.