4.4 Combining Percents

Focus on...

After this lesson, you will be able to...

- ❑ solve problems involving combined percents

Literacy Link

PST means provincial sales tax. PST varies by province.

GST means goods and services tax. GST is the same across Canada.

Jesse and Jenna have $55 to purchase prizes for a school fundraiser. The items cost $49.99 plus 5% GST and 7% PST. Do you think they will have enough money?

When they reach the cashier, they discover that the store has a one-day sale—they only have to pay 50% of the tax. How much tax do you think they will have to pay?

Explore the Math

How can you combine percents?

1. A store advertises 40% off. You purchase an item regularly priced at $100.

a) What is the discount for the item?

b) What is the sale price of the item?

c) What percent of the original price are you paying?

d) How are the percent discount and the percent of the original price related? Use a grid to explain your answer.

e) How could you estimate the price of something that has a 40% discount?

2. Suppose GST is 5% and PST is 7%. You purchase an item for $100.

a) Represent the GST and the PST on a hundred grid.

b) How much is the GST? the PST?

c) How much tax do you pay altogether?

d) What is your total tax as a percent of $100? How does this percent value compare to the sum of the percent values for GST and PST?

e) What decimal could you multiply $100 by to find the total cost including tax?

3. Suppose an item regularly priced at $200 is on sale for 10% off. PST is 7% and GST is 5%.

a) Write a multiplication expression to show how to determine the price of the item with the 10% discount applied.

b) Write a multiplication expression to show how to determine the total amount of tax on the item in part a).

c) What is the total cost of the item including tax?

4. Caroline purchased a sweatshirt originally priced at $50. It was on sale for 25% off. The PST where she lives is 5%. The GST is 5%.

a) What is the cost of the sweatshirt before tax?

b) Caroline used the single expression 10% of 75% of $50 to determine the total amount of tax. Explain why Caroline's expression is correct.

WWW Web Link

Not all provinces have the same PST. To learn more about PST rates, go to www.mathlinks8.ca and follow the links. What is the rate of PST where you live?

Did You Know?

In Saskatchewan, PST is 5%. In Alberta there is no PST. The city of Lloydminster, Saskatchewan, is half in Alberta!

A provincial law states that no PST is paid in the whole city. What might be a reason for the law?

Reflect on Your Findings

5. a) Describe two ways that you can calculate the total tax on an item.

b) Which method do you prefer to use? Explain why.

Example 1: Combined Percents

Suppose GST is 5% and PST is 7%. Calculate the total tax and total cost of a sound system that is priced at $250.

Solution

Method 1: Calculate the Taxes Separately

The GST is 5%.
5% is 0.05.
Multiply by the price to determine the amount of GST.
$0.05 \times 250 = 12.5$
The amount of GST is $12.50.

10% of 250 is 25.
5% of 250 is 12.5.
1% of 250 is 2.5.
7% of 250 is
12.5 + 2.5 + 2.5 = 17.5.

The PST is 7%.
7% is 0.07.
Multiply by the price to determine the amount of PST.
$0.07 \times 250 = 17.5$
The amount of PST is $17.50.

Add the two tax amounts.
$12.50 + 17.50 = 30.00$.
The total tax is $30.00.
Total Cost = Cost of Item + Total Tax
$= 250.00 + 30.00$
$= 280.00$
The total cost of the sound system is $280.00.

Literacy Link
You can combine percents by adding individual percent values together.

Method 2: Combine the Tax Percents First
The GST is 5%. The PST is 7%.
The combined tax is 5% + 7% or 12%.
Convert the percent to a decimal.
$12\% = 0.12$
Multiply by the price to determine the total amount of tax.
$0.12 \times 250 = 30$
The total tax is $30.00.

Total Cost = Cost of Item + Total Tax
$= 250.00 + 30.00$
$= 280.00$
The total cost of the sound system is $280.00.

Method 3: Combine the Cost and Tax Percents
You could use a percent greater than 100% to find the total cost.
The cost of the sound system is 100%.
The PST is 7%.
The GST is 5%.
The cost of the sound system expressed as a percent of the original cost is 100% + 7% + 5% or 112%.
Convert the percent to a decimal.
$112\% = 1.12$
Multiply by the price to determine the total cost.
$1.12 \times 250 = 280$
The total cost of the sound system is $280.00.

Show You Know

A backpack costs $35. Use the method of your choice to find the total cost of the backpack if GST is 5% and PST is 6%. Use another method to check your work.

Example 2: Percent of a Percent

Sports R Us offers a 10% off discount one day and then an additional 10% off the sale price the next day. Sports Galore offers a 20% discount on one day only. Keifer wants to buy a new goalie mask that has a regular price of $200 at both stores.

a) Which store gives the better buy? Explain your reasoning.

b) What single percent discount is equivalent to a discount of 10% one day followed by an additional discount of 10% off the sale price the second day?

Solution

a) *Sports R Us*

The discount on the first day is 10% of $200.

$10\% \text{ of } 200 = 0.10 \times 200$

$= 20$

Subtract to find the discount price.

$200 - 20 = 180$

The discount price on the first day is $180.

The discount on the sale price the second day is 10% of $180.

$10\% \text{ of } 180 = 0.10 \times 180$

$= 18$

Subtract to find the discount price.

$180 - 18 = 162$

The discount price after the second day is $162.

Sports Galore

The discount is 20% of $200.

$20\% \text{ of } 200 = 0.20 \times 200$

$= 40$

Subtract to find the discount price.

$200 - 40 = 160$

The discount price is $160.

Sports Galore gives a better buy than Sports R Us. The 10% discount followed by another 10% discount is not the same as a 20% discount because the discount on the second day is only 10% of $180 and not 10% of $200.

b) The original price is $200.

The selling price after two 10% discounts at Sports R Us is $162.

Subtract to find the total amount of the discount.

$200 - 162 = 38$

The total amount of the discount is $38.

Determine what percent the total discount is of the original price.

$\frac{38}{200} = 0.19$

The total discount is 19% of the original price.

A 19% discount is less than the single discount of 20% offered by Sports Galore.

Show You Know

What is the final sale price at each store? Which is a better buy? Explain your thinking.
Store A: 50% off one day only
Store B: 25% off one day followed by 25% off the reduced price the second day

Key Ideas

- Percents can be combined by adding to solve problems. $5\% + 7\% = 12\%$
- To calculate the increase in a number,
  - You can add the combined percent amount to the original number.
    12% of $100 = 0.12 \times 100 = 12$
    $100 + 12 = 112$
  - You can multiply the original number by a single percent greater than 100.
    112% of $100 = 1.12 \times 100$
    $= 112$
- Percents of percents can be used to determine amounts that result from consecutive percent increases or decreases.

Communicate the Ideas

1. Draw a diagram to show how you could represent the cost of a $100 item with and without tax.

2. Your friend shows you how to calculate the cost of an item including tax using several steps. You tell her that you can do the calculation in one step. Show how you would do this.

3. Kyle says that a population increase of 15% one year followed by an increase of 10% the next year is the same as a population increase of 25% over two years. Is Kyle correct? Explain your reasoning.

Check Your Understanding

Practise

For help with #4 and #5, refer to Example 1 on pages 145–146.

4. Chris purchased the following items:
- 2 binders at $4.99 each
- 1 math set for $3.99
- a backpack for $19.99

Find the total cost including 5% GST and 7% PST.

5. Ravi purchased 3 DVDs for $19.99 each. Find the total cost for the DVDs including 5% GST and 6% PST.

For help with #6 and #7, refer to Example 2 on page 147.

6. A store discounted items by 50% off the original price one week. The following week an additional 10% was taken off the already reduced price. The regular price of a CD player was $85.00. What is the reduced price in the second week?

7. A herd of 100 caribou was moved to a new location. The population increased by 10% the first year and then increased by 20% the second year.

a) Find the population after the second year.

b) Explain why there was not a 30% increase in population over the two years.

8. Copy and complete the following table. Use 5% GST and the percent of PST applicable to where you live.

Item Purchased	Price	Total Tax	Total Cost
a) Boots	$119.99		
b) Pants	$89.99		
c) Gloves	$39.99		
d) Helmet	$189.99		

Apply

9. Arjay was thinking of buying a car worth $23 000, but delayed purchasing the car for a year. During that year, the cost of the car increased by 3.2%.

a) What was the price of the car when Arjay purchased it?

b) What was the total cost of the car including 5% GST and 5% PST?

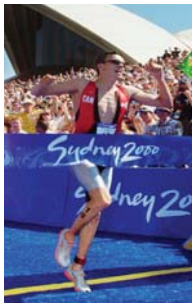
10. What is the total cost for four tires that sell for $85 each, plus 5% GST and a 1.5% environment tax?

11. A student is awarded a $1000 scholarship and places it in an account that pays 3% simple interest per year.

a) What is the total value of the scholarship amount at the end of the second year?

b) What is the single percent increase in value of the scholarship after two years?

12. Simon Whitfield of Victoria, British Columbia, won the men's triathlon at the Sydney Olympics. The race consisted of a 1.5-km swim in Sydney Harbour, a 40-km bike ride through Sydney and a 10-km run.



a) What percent of the race distance is each component? Express your answer to the nearest tenth of a percent.

b) What percent of the race distance is spent on land? Express your answer to the nearest tenth of a percent.

Extend

13. A ski jacket has been marked down on three occasions, first 20% off, then 25% off the new price, and finally 50% off the previous price. What is the overall percent saved?

14. The selling price of a DVD player is 35% more than its cost. It is sold at a discount of 20% off the selling price. How much does the store still gain?

MATH LINK

a) In one day, a dripping faucet wastes about 25 L of water. A regular toilet flush uses 6 L of water per flush. If you flush your toilet 30 times a day, what percent of the water used by your toilet is wasted by the dripping faucet?

b) $\frac{3}{10}$% of the world's fresh water is held in rivers and lakes. Approximately 9% of that water is used for industry and may be returned to the environment polluted. What percent of the world's fresh water is used by industry?