Fractions, Decimals, and Percents

Ice Skates $50.00

Skis $200.00

Running Shoes $40.00

Stores offer goods on sale to encourage you to spend money.
Look at these advertisements.
What is the sale price of each item in the picture using each advertisement?
How did you calculate the sale price?
Explain your strategy.

What You'll Learn

- Convert between fractions and terminating or repeating decimals.
- Compare and order fractions, decimals, and mixed numbers.
- Add, subtract, multiply, and divide decimals.
- Solve problems involving fractions, decimals, and percents.

Why It's Important

- You use fractions and decimals when you shop, measure, and work with a percent; and in sports, recipes, and business.
- You use percents when you shop, to find sale prices and to calculate taxes.

Hockey
Sweater
$80.00

EVERYTHING
25% OFF

All
items
$\frac{1}{2}$ off

Numbers can be written in both fraction and decimal form.

For example, 3 can be written as $\frac{3}{1}$ and 3.0.

A fraction illustrates division;

that is, $\frac{1}{10}$ means $1 \div 10$.

Recall that $\frac{1}{10}$ is 0.1 in decimal form.

$\frac{3}{100}$ is 0.03 in decimal form.

$\frac{45}{1000}$ is 0.045 in decimal form.

Here are some more fractions and decimals you learned in earlier grades.

Fraction	$\frac{7}{10}$	$\frac{1}{100}$	$\frac{19}{100}$	$\frac{1}{1000}$	$\frac{23}{1000}$	$\frac{471}{1000}$
Decimal	0.7	0.01	0.19	0.001	0.023	0.471

Explore

You will need a calculator.

➤ Use a calculator.
Write each fraction as a decimal: $\frac{1}{11}, \frac{2}{11}, \frac{3}{11}, \frac{4}{11}$
What patterns do you see?
Use your patterns to predict the decimal forms of these fractions:
$\frac{5}{11}, \frac{6}{11}, \frac{7}{11}, \frac{8}{11}, \frac{9}{11}, \frac{10}{11}$
Use a calculator to check your predictions.

➤ Use a calculator.
Write each fraction as a decimal: $\frac{1}{9}, \frac{2}{9}, \frac{3}{9}$
What patterns do you see?
Use your patterns to predict the fraction form of these decimals:
0.777 777 777…   0.888 888 888…
Check your predictions.
What do you notice about the last digit in the calculator display?

Reflect & Share

Compare your patterns, decimals, and fractions with those of another pair of classmates. How did you use patterns to make predictions?

Connect

➤ Decimals, such as 0.1 and 0.25, are **terminating decimals**.
Each decimal has a definite number of decimal places.

➤ Decimals, such as 0.333 333 333…; 0.454 545 454…; 0.811 111 111…
are **repeating decimals**.
Some digits in each repeating decimal repeat forever.
We draw a bar over the digits that repeat.
For example, $\frac{4}{33} = 4 \div 33 = 0.121\ 212\ 121…$, which is written as $0.\overline{12}$
$\frac{73}{90} = 73 \div 90 = 0.811\ 111\ 111…$, which is written as $0.8\overline{1}$

➤ Patterns sometimes occur when we write fractions in decimal form.
For example,
$$\frac{1}{99} = 0.\overline{01} \qquad \frac{2}{99} = 0.\overline{02} \qquad \frac{15}{99} = 0.\overline{15} \qquad \frac{43}{99} = 0.\overline{43}$$
For fractions with denominator 99, the digits in the numerator
of the fraction are the repeating digits in the decimal.
We can use this pattern to make predictions.
To write $0.\overline{67}$ as a fraction, write the repeating digits, 67,
as the numerator of a fraction with denominator 99.
$0.\overline{67} = \frac{67}{99}$
Similarly, $0.\overline{7} = 0.\overline{77} = \frac{77}{99} = \frac{7}{9}$

Example

a) Write each fraction as a decimal.
b) Sort the fractions as representing repeating or terminating decimals:
$\frac{13}{200}, \frac{1}{5}, \frac{11}{20}, \frac{3}{7}$

A Solution

a) Try to write each fraction with denominator 10, 100, or 1000.

$$\frac{13}{200} \overset{\times 5}{\underset{\times 5}{=}} \frac{65}{1000}, \text{ or } 0.065$$

$$\frac{1}{5} \overset{\times 2}{\underset{\times 2}{=}} \frac{2}{10}, \text{ or } 0.2$$

$$\overset{\times 5}{\overbrace{}}$$

$\frac{11}{20} = \frac{55}{100}$, or 0.55

$$\underset{\times 5}{\underbrace{}}$$

$\frac{3}{7}$ cannot be written as a fraction with denominator 10, 100, or 1000.

Use a calculator.

$\frac{3}{7} = 3 \div 7 = 0.428\ 571\ 429$

This appears to be a terminating decimal.

We use long division to check.

Since we are dividing by 7, the remainders must be less than 7.

Since we get a remainder that occurred before, the division repeats.

So, $\frac{3}{7} = 0.\overline{428\ 571}$

```
        0.4285714
    7) 3.00000000
       28
      → 20
        14
        60
        56
        40
        35
        50
        49
        10
         7
        30
        28
      → 20
```

The calculator rounds the decimal to fit the display:

$\frac{3}{7} = 0.428\ 571\ 428\ 571\ldots$

This is the last digit in the display.

Since this digit is 5, the calculator adds 1 to the preceding digit.

So, the calculator displays an approximate decimal value:

$\frac{3}{7} \doteq 0.428\ 571\ 429$

b) Since 0.065, 0.2, and 0.55 terminate, $\frac{13}{200}$, $\frac{1}{5}$, and $\frac{11}{20}$ represent terminating decimals.
Since $0.\overline{428\ 571}$ repeats, $\frac{3}{7}$ represents a repeating decimal.

Practice

Use a calculator when you need to.

1. a) Write each fraction as a decimal.

    i) $\frac{2}{3}$ **ii)** $\frac{3}{4}$ **iii)** $\frac{4}{5}$ **iv)** $\frac{5}{6}$ **v)** $\frac{6}{7}$

  b) Identify each decimal as terminating or repeating.

2. Write each decimal as a fraction.

  a) 0.9   **b)** 0.26   **c)** 0.45   **d)** 0.01   **e)** 0.125

3. a) Write each fraction as a decimal.

   i) $\frac{1}{27}$ **ii)** $\frac{2}{27}$ **iii)** $\frac{3}{27}$

   b) Describe the pattern in your answers to part a.

   c) Use your pattern to predict the decimal form of each fraction.

   i) $\frac{4}{27}$ **ii)** $\frac{5}{27}$ **iii)** $\frac{8}{27}$

4. For each fraction, write an equivalent fraction
   with denominator 10, 100, or 1000.
   Then, write the fraction as a decimal.

   a) $\frac{2}{5}$ **b)** $\frac{1}{4}$ **c)** $\frac{13}{25}$ **d)** $\frac{19}{50}$ **e)** $\frac{37}{500}$

5. Write each decimal as a fraction in simplest form.

   a) $0.\overline{6}$ **b)** $0.\overline{5}$ **c)** $0.\overline{41}$ **d)** $0.1\overline{6}$

6. Write each fraction as a decimal.

   a) $\frac{4}{7}$ **b)** $\frac{4}{9}$ **c)** $\frac{6}{11}$ **d)** $\frac{7}{13}$

7. Write $\frac{5}{17}$ as a decimal.
   The calculator display is not long enough to show the repeating digits.
   How could you find the repeating digits?

8. Write $\frac{1}{5}$ as a decimal.
   Use this decimal to write each number below as a decimal.

   a) $\frac{4}{5}$ **b)** $\frac{7}{5}$ **c)** $\frac{9}{5}$ **d)** $\frac{11}{5}$

9. a) Write each fraction as a decimal.

   i) $\frac{1}{999}$ **ii)** $\frac{2}{999}$ **iii)** $\frac{54}{999}$ **iv)** $\frac{113}{999}$

   b) Describe the pattern in your answers to part a.

   c) Use your pattern to predict the fraction form of each decimal.

   i) $0.\overline{004}$ **ii)** $0.\overline{089}$ **iii)** $0.\overline{201}$ **iv)** $0.\overline{326}$

10. Match each set of decimals and fractions.
   Explain how you know.

   a) $\frac{1}{3}, \frac{2}{3}, \frac{3}{3}, \frac{4}{3}, \frac{5}{3}$ **i)** 0.125, 0.25, 0.375, 0.5, 0.625

   b) $\frac{1}{8}, \frac{2}{8}, \frac{3}{8}, \frac{4}{8}, \frac{5}{8}$ **ii)** $0.1\overline{6}$, $0.\overline{3}, 0.5, 0.\overline{6}, 0.8\overline{3}$

   c) $\frac{1}{5}, \frac{2}{5}, \frac{3}{5}, \frac{4}{5}, \frac{5}{5}$ **iii)** $0.\overline{3}, 0.\overline{6}, 1.0, 1.\overline{3}, 1.\overline{6}$

   d) $\frac{1}{6}, \frac{2}{6}, \frac{3}{6}, \frac{4}{6}, \frac{5}{6}$ **iv)** 0.2, 0.4, 0.6, 0.8, 1.0

11. **Assessment Focus** Here is the Fibonacci sequence:

1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, …

We can write consecutive terms as fractions:

$\frac{1}{1}, \frac{2}{1}, \frac{3}{2}, \frac{5}{3}, \frac{8}{5}, \frac{13}{8}$, and so on

a) Write each fraction above as a decimal.
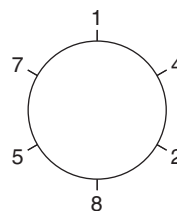What do you notice about the trend in the decimals?

b) Continue to write consecutive terms as decimals.
Write about what you find out.

12. **a)** Write $\frac{1}{7}$ as a repeating decimal.
How many digits repeat?
These repeating digits are shown around the circle
at the right.

b) Write the fractions $\frac{2}{7}, \frac{3}{7}, \frac{4}{7}, \frac{5}{7}$, and $\frac{6}{7}$ in decimal form.
What patterns do you see?
Explain how the circle of digits can help you write
these fractions as decimals.

13. **Take It Further**

a) Write each fraction as a decimal.
Identify the decimals as repeating or terminating.

i) $\frac{7}{8}$ **ii)** $\frac{5}{18}$ **iii)** $\frac{3}{10}$ **iv)** $\frac{8}{27}$ **v)** $\frac{4}{25}$

b) Write the denominator of each fraction in part a
as a product of prime factors.

c) What do you notice about the prime factors
of the denominators of the terminating decimals?
The repeating decimals?

> A prime number has
> exactly two factors,
> itself and 1. We can
> write 12 as a product
> of prime factors:
> $2 \times 2 \times 3$

d) Use your answers to part c.
Predict which of these fractions can be written
as terminating decimals.

i) $\frac{7}{15}$ **ii)** $\frac{13}{40}$ **iii)** $\frac{5}{81}$ **iv)** $\frac{9}{16}$

Reflect

Sometimes it is hard to figure out if a fraction can be written
as a terminating decimal or a repeating decimal.
What can you do if you are stuck?

Comparing and Ordering Fractions and Decimals

Focus Use benchmarks, place value, and equivalent fractions to compare and order fractions and decimals.

Recall how to use the benchmarks $0, \frac{1}{2}$, and 1 to compare fractions.

For example, $\frac{3}{20}$ is close to 0 because the numerator is much less than the denominator.

$\frac{11}{20}$ is close to $\frac{1}{2}$ because the numerator is about $\frac{1}{2}$ the denominator.

$\frac{19}{20}$ is close to 1 because the numerator and denominator are close in value.

Explore

Use any materials to help.

Dusan, Sasha, and Kimberley sold chocolate bars as a fund-raiser for their choir.

The bars were packaged in cartons, but sold individually.

Dusan sold $2\frac{2}{3}$ cartons. Sasha sold $\frac{5}{2}$ cartons. Kimberley sold 2.25 cartons.

Who sold the most chocolate bars?

Reflect & Share

Share your solution with another pair of classmates.
How did you decide which number was greatest?
Did you use any materials to help? How did they help?
Try to find a way to compare the numbers without using materials.

Connect

Any fraction greater than 1 can be written as a mixed number.

The benchmarks $0, \frac{1}{2}$, and 1 can be used to compare the fraction parts of mixed numbers.

We can use benchmarks on a number line to order these numbers: $\frac{2}{11}, 2\frac{3}{8}, 1\frac{1}{16}, \frac{14}{9}, \frac{14}{15}$

$\frac{2}{11}$ is close to 0.

Since $\frac{3}{8}$ is close to $\frac{1}{2}$, but less than $\frac{1}{2}$,

$2\frac{3}{8}$ is close to $2\frac{1}{2}$, but less than $2\frac{1}{2}$.
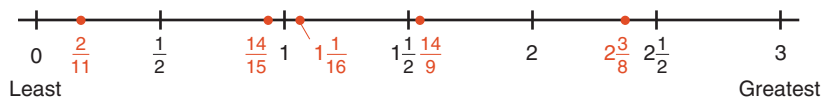
$1\frac{1}{16}$ is close to 1, but greater than 1.

$\frac{14}{9} = \frac{9}{9} + \frac{5}{9} = 1\frac{5}{9}$

$1\frac{5}{9}$ is close to $1\frac{1}{2}$, but greater than $1\frac{1}{2}$.

$\frac{14}{15}$ is close to 1, but less than 1.

Place the fractions on a number line.

The numbers in order from greatest to least are: $2\frac{3}{8}, \frac{14}{9}, 1\frac{1}{16}, \frac{14}{15}, \frac{2}{11}$

We can also use equivalent fractions to order fractions.

Example

a) Write these numbers in order from least to greatest: $\frac{7}{8}, \frac{9}{8}, 1\frac{1}{4}, 0.75$

b) Write a fraction between $\frac{9}{8}$ and $1\frac{1}{4}$.

A Solution

a) Write equivalent fractions with like denominators, then compare the numerators.

First write the decimal as a fraction: $0.75 = \frac{75}{100} = \frac{3}{4}$

Compare: $\frac{7}{8}, \frac{9}{8}, 1\frac{1}{4}, \frac{3}{4}$

Since 8 is a multiple of 4, use 8 as a common denominator.

$1\frac{1}{4} = \frac{4}{4} + \frac{1}{4}$
$\quad = \frac{5}{4}$

$$\frac{3}{4} \xrightarrow{\times 2} = \frac{6}{8} \xleftarrow{\times 2}$$

$$\frac{5}{4} \xrightarrow{\times 2} = \frac{10}{8} \xleftarrow{\times 2}$$
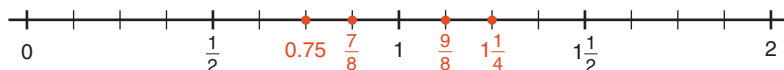
Each fraction now has denominator 8: $\frac{7}{8}, \frac{9}{8}, \frac{10}{8}, \frac{6}{8}$

Compare the numerators: $6 < 7 < 9 < 10$

So, $\frac{6}{8} < \frac{7}{8} < \frac{9}{8} < \frac{10}{8}$

So, $0.75 < \frac{7}{8} < \frac{9}{8} < 1\frac{1}{4}$

We can verify this order by placing the numbers on a number line.

b) Use the equivalent fraction for $1\frac{1}{4}$ with denominator 8 from part a: $\frac{10}{8}$

Find a fraction between $\frac{9}{8}$ and $\frac{10}{8}$.

The numerators are consecutive whole numbers. There are no whole numbers
between 9 and 10. Multiply the numerator and denominator of
both fractions by the same number to get equivalent fractions.

Choose 2:

$$\frac{9}{8} \overset{\times 2}{\underset{\times 2}{=}} \frac{18}{16} \qquad \frac{10}{8} \overset{\times 2}{\underset{\times 2}{=}} \frac{20}{16}$$

> **We can verify this using a number line.**

Look at the numerators.

19 is between 18 and 20,

so $\frac{19}{16}$ is between $\frac{18}{16}$ and $\frac{20}{16}$.

So, $\frac{19}{16}$, or $1\frac{3}{16}$, is between $\frac{9}{8}$ and $1\frac{1}{4}$.
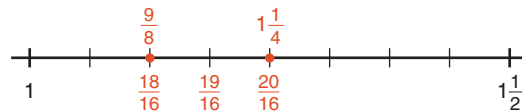
Another Solution

We can also use place value to order decimals.

a) Write each number as a decimal.

$$\frac{7}{8} = 0.875 \qquad \frac{9}{8} = 1.125 \qquad 1\frac{1}{4} = 1.25 \qquad 0.75$$

Write each decimal in a
place-value chart.
Compare the ones.
Two numbers have
1 one and two numbers
have 0 ones.

Ones • Tenths	Hundredths	Thousandths
0 • 8	7	5
1 • 1	2	5
1 • 2	5	0
0 • 7	5	0

Look at the decimals with 0 ones: 0.**8**75, 0.**7**50
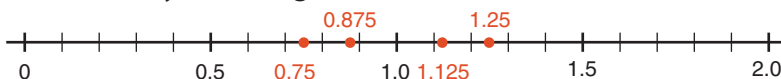Compare the tenths: 7 tenths is less than 8 tenths, so 0.750 < 0.875

Look at the decimals with 1 one: 1.**1**25 and 1.**2**50
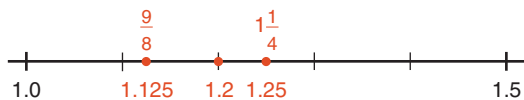Compare the tenths: 1 tenth is less than 2 tenths, so 1.125 < 1.250

The numbers in order from least to greatest are: 0.750, 0.875, 1.125, 1.250
So, $0.75 < \frac{7}{8} < \frac{9}{8} < 1\frac{1}{4}$

We can verify this using a number line.

b) $\frac{9}{8} = 1.125$ $\qquad$ $1\frac{1}{4} = 1.25$

Use the number line above.

1.2 lies between 1.125 and 1.25.

Write 1.2 as a fraction.

1.2 is $1\frac{2}{10}$, or $1\frac{1}{5}$.

So, $1\frac{1}{5}$, or $\frac{6}{5}$, lies between $\frac{9}{8}$ and $1\frac{1}{4}$.

> There are many other possible fractions between $\frac{9}{8}$ and $1\frac{1}{4}$.

Practice

1. Write 5 different fractions with like denominators.
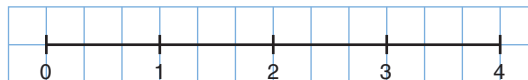Draw a number line, then order the fractions on the line.
Explain your strategy.

2. Use 1-cm grid paper.
Draw a 12-cm number line like the one shown.
Use the number line to order these
numbers from greatest to least.
$2\frac{1}{2}, \frac{11}{3}, 2\frac{5}{6}$

3. Use benchmarks and a number line to order each set of numbers
from least to greatest.
a) $\frac{7}{6}, \frac{15}{12}, 1\frac{2}{9}, 1$
b) $1\frac{3}{4}, \frac{7}{3}, \frac{7}{6}, 2$
c) $\frac{7}{4}, \frac{15}{10}, \frac{11}{5}, 2$
d) $\frac{10}{4}, 2\frac{1}{3}, \frac{9}{2}, 3$

4. Use equivalent fractions.
Order each set of numbers from greatest to least.
Verify by writing each fraction as a decimal.
a) $3\frac{1}{2}, \frac{13}{4}, 3\frac{1}{8}$
b) $\frac{5}{6}, \frac{2}{3}, 1\frac{1}{12}, \frac{9}{12}$
c) $1\frac{2}{5}, \frac{4}{3}, \frac{3}{2}$

5. Use place value.
Order each set of numbers from least to greatest.
Verify by using a number line.
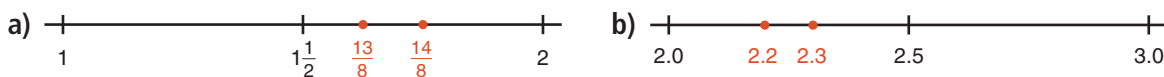a) $\frac{7}{4}, 1.6, 1\frac{4}{5}, 1.25, 1$
b) $2\frac{5}{8}, 1.875, 2\frac{3}{4}, \frac{5}{2}, 2$

6. a) Use any method. Order these numbers from greatest to least. Explain the method you used.

$\frac{17}{5}, 3.2, 2.8, 3\frac{1}{4}, \frac{21}{7}, 2$

b) Use a different method. Verify your answer in part a.

7. Find a number between the two numbers represented by each pair of dots.

a)

b)

8. Find a number between each pair of numbers.

a) $\frac{5}{7}, \frac{6}{7}$ **b)** $1\frac{2}{5}, \frac{8}{5}$ **c)** $1.3, 1\frac{2}{5}$ **d)** $0.5, 0.6$

9. Identify the number that has been placed incorrectly. Explain how you know.
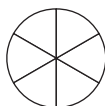
a)

b)

10. In each set, identify the number that is not in the correct order. Show where it should go. Explain your work.

a) $\frac{29}{5}, 6\frac{2}{10}, 6.25, 6\frac{2}{20}$ **b)** $1\frac{7}{16}, 1\frac{3}{8}, \frac{3}{2}, 1.2, \frac{3}{4}$

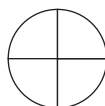**11.** **Assessment Focus** Amrita, Paul, and Corey baked pizzas for the fund-raising sale. The students cut their pizzas into different sized slices.

Amrita   Paul   Corey

Amrita sold $\frac{11}{6}$ pizzas. Paul sold 1.875 pizzas. Corey sold $\frac{9}{4}$ pizzas.

a) Use a number line to order the numbers of pizzas sold from least to greatest.

b) Who sold the most pizzas? The fewest pizzas?

c) Use a different method. Verify your answers in part b.

d) Alison sold $2\frac{1}{5}$ pizzas. Where does this fraction fit in part a?

Reflect

Describe 3 ways to compare and order fractions and decimals. Give an example of when you would use each method. Which way do you prefer? Why?

3.3 Adding and Subtracting Decimals

When you go to the theatre to see a movie, your attendance and how much you paid to see the movie are entered in a database.
Data are collected from theatres all across Canada and the United States.
Movie studios use these data to help predict how much money the movie will earn.

Explore

Shrek 2 was one of the highest-earning movies of 2004.
The table shows how much money *Shrek 2* earned in Canada and the United States for the first week it played in theatres.
Studios record the earnings in millions of US dollars.

Date	Earnings (US$ Millions)
Wednesday, May 19	11.786
Thursday, May 20	9.159
Friday, May 21	28.340
Saturday, May 22	44.797
Sunday, May 23	34.901
Monday, May 24	11.512
Tuesday, May 25	8.023

➤ Estimate first.
  Then find the combined earnings on:
  • the first 2 days
  • Saturday and Sunday
  • all 7 days

➤ Estimate first.
  Then find the difference in earnings on:
  • Thursday and Friday
  • Saturday and Sunday
  • Sunday and Monday
  • the days with the greatest and the least earnings

Reflect & Share

Share your results with another pair of classmates.
Discuss the strategies you used to estimate and to find the sums and differences.
Why do you think the earnings on 3 of the days are so much higher? Explain.

Connect

When we add or subtract decimals, we estimate if we do not need an exact answer.
We also estimate to check the answer is reasonable.

Example

Ephram is a long-distance runner. His practice distances
for 5 days last week are shown in the table.
a) How far did Ephram run in 5 days last week?
b) How much farther did Ephram run on Tuesday than
   on Thursday?

Day	Distance (km)
Monday	8.85
Tuesday	12.25
Wednesday	10.9
Thursday	9.65
Friday	14.4

A Solution

a) $8.85 + 12.25 + 10.9 + 9.65 + 14.4$

Use front-end estimation.
Add the whole-number part of each decimal.
Think: $8 + 12 + 10 + 9 + 14 = 53$
Ephram ran about 53 km.

Add. Write each number with the same number of decimal places.
Use zeros as placeholders: 8.85, 12.25, 10.90, 9.65, 14.40
Record the numbers without the decimal points.
Add as you would whole numbers.

$$
\begin{array}{r}
{\scriptstyle 2\,3\,1} \\
885 \\
1225 \\
1090 \\
965 \\
+\ 1440 \\
\hline
5605
\end{array}
$$

Since the estimate is 53 km, place the decimal point after
the first 2 digits; that is, between the 6 and the 0.
Ephram ran 56.05 km.

b) Ephram ran 12.25 km on Tuesday and 9.65 km on Thursday.
   Estimate.
   $12.25 - 9.65$
   Think: $12 - 9 = 3$
   Ephram ran about 3 km farther on Tuesday.

Subtract. Align the numbers.
Subtract as you would whole numbers.

$$\begin{array}{r} \overset{11\ 12}{\cancel{12}\cancel{.2}5} \\ -\ \ 9.65 \\ \hline 2.60 \end{array}$$

2.6 is close to the estimate 3, so the answer is reasonable.
Ephram ran 2.6 km farther on Tuesday than on Thursday.

Practice

1. Use front-end estimation to estimate each sum or difference.
   a) $2.876 - 0.975$ b) $71.382 + 6.357$
   c) $125.12 + 37.84$ d) $9.7 - 1.36$

2. The tallest building in the world is the Taipei 101 in Taiwan.
   Its height is 0.509 km. The tallest building in North America
   is the Sears Tower in Chicago, USA. Its height is 0.442 km.
   What is the difference in the heights of the buildings?

3. Four classes of students from Mackenzie School are planning
   a field trip. The total cost of the trip is $1067.50.
   To date, the classes have raised: $192.18, $212.05, $231.24, $183.77
   a) How much money have the classes raised so far?
   b) How much more money do the classes need to raise in total?
   Show your work.

4. **Assessment Focus** A baker wants to make 3 different kinds of
   chocolate chip cookies. The recipes call for 2.75 kg, 4.4 kg, and 5.55 kg
   of chocolate chips. The baker has 10.5 kg of chocolate chips.
   a) How many kilograms of chocolate chips does the baker need?
      Estimate to check your answer is reasonable.
   b) Does the baker have enough chocolate chips to make the cookies?
      How do you know?
   c) The baker wants to follow the recipes exactly.
      If your answer to part b is no, how many more kilograms of chocolate
      chips are needed? If your answer to part b is yes, how many
      kilograms of chocolate chips will the baker have left over?

5. Estimate, then calculate, the sum below.
Explain how you estimated.
$46.71 + 3.9 + 0.875$

6. The Robb family and the Chan family have similar homes.
The Robb family sets its thermostat to 20°C during the winter months.
Its monthly heating bills were: $171.23, $134.35, and $123.21
The Chan family used a programmable thermostat to lower the
temperature at night, and during the day when the family was out.
The Chan family's monthly heating bills were: $134.25, $103.27,
and $98.66

a) How much money did each family pay to heat its home
during the winter months?

b) How much more money did the Robb family pay?
Estimate to check your answer is reasonable.

c) What other things could a family do to reduce its heating costs?

7. Find two numbers with a difference of 151.297.

8. Use each of the digits from 0 to 7 once to make this addition true.
Find as many different answers as you can.

$$\begin{array}{r} \square.\square\square\square \\ + \ \square.\square\square\square \\ \hline 5.788 \end{array}$$

9. A student subtracted 0.373 from 4.81 and got the difference 0.108.

a) What mistake did the student make?

b) What is the correct answer?

10. Two 4-digit numbers were added. Their sum was 3.3.
What could the numbers have been?
Find as many different answers as you can. Show your work.

11. Take It Further Find each pattern rule. Explain how you found it.

a) 2.09, 2.13, 2.17, 2.21, …

b) 5.635, 5.385, 5.135, 4.885, …

Reflect

How did your knowledge of estimation help you in this lesson?
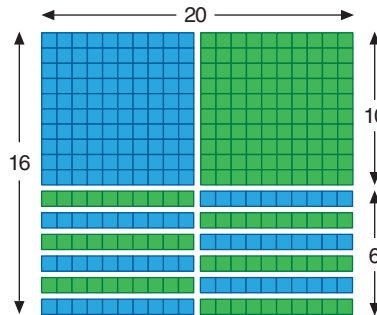
3.4 Multiplying Decimals

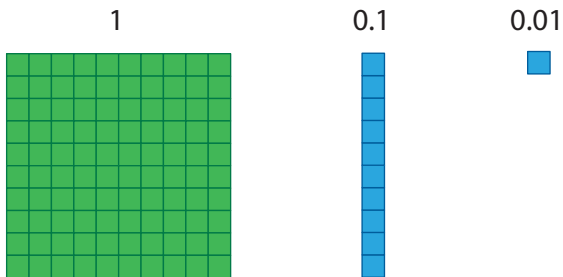Recall how to multiply 2 whole numbers using Base Ten Blocks.
This picture shows the product:

$$20 \times 16 = 100 + 100 + 60 + 60$$
$$= 320$$

We can also use Base Ten Blocks to multiply 2 decimals.

Let the flat represent 1, the rod represent 0.1, and the small cube represent 0.01.

1	0.1	0.01

Explore

You will need Base Ten Blocks and grid paper.
Use Base Ten Blocks to model a rectangular patio with area greater than 4 m² and less than 6 m².
Let the side length of the flat represent 1 m.
How many different patios can you model?
Record your designs on grid paper.

Reflect & Share

Compare your designs with those of another pair of classmates.
Did you have any designs the same? Explain.
Explain how your designs show the area of the patio.

A rectangular park measures 1.7 km by 2.5 km.
Here are 2 ways to find the area of the park.

➤ Use Base Ten Blocks.
Build a rectangle with length 2.5 and width 1.7.
Count the blocks in the rectangle.
There are 2 flats: $2 \times 1 = 2$
There are 19 rods: $19 \times 0.1 = 1.9$
There are 35 small cubes: $35 \times 0.01 = 0.35$
The total area is: $2 + 1.9 + 0.35 = 4.25$
The total area of the park is 4.25 km².
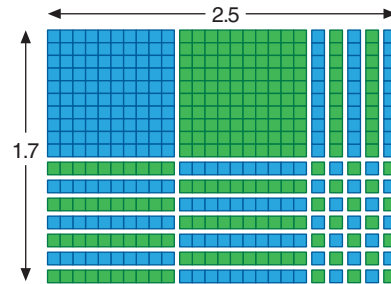
➤ Use the method for multiplying 2 whole numbers.
The area, in square kilometres, is 1.7×2.5.
Multiply: 17×25

$$\begin{array}{r} 17 \\ \times\ 25 \\ \hline 85 \\ 340 \\ \hline 425 \end{array}$$

1.7 × 2.5
Think: 1 × 2 = 2
So, 1.7 × 2.5 is about 2.
Place the decimal point
between the 4 and the 2.

Using front-end estimation to place the decimal point, $1.7 \times 2.5 = 4.25$.
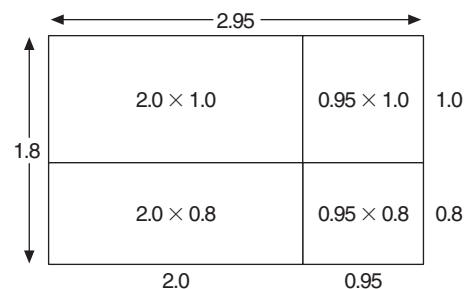The area of the park is 4.25 km².

Example

At the Farmers' Market, 1 kg of grapes costs $2.95.
How much would 1.8 kg of grapes cost?

A Solution

1 kg of grapes costs $2.95.
So, 1.8 kg would cost: 2.95×1.8
Use a rectangle model.

2.95		
2.0×1.0	0.95×1.0	1.0
2.0×0.8	0.95×0.8	0.8
2.0	0.95	

1.8

$$\begin{aligned} 2.95 \times 1.8 &= (2.0 \times 1.0) + (0.95 \times 1.0) + (2.0 \times 0.8) + (0.95 \times 0.8) \\ &= (2 \times 1) + (0.95 \times 1) + (2 \times 0.8) + (0.95 \times 0.8) \\ &= 2 + 0.95 + 1.6 + 0.76 \\ &= 5.31 \end{aligned}$$

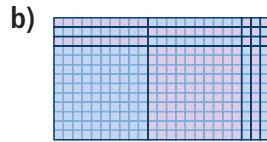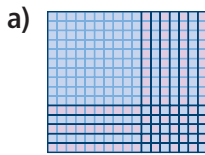**Another Strategy**
We could use a calculator
to multiply.

1.8 kg of grapes would cost $5.31.

Use a calculator when the multiplier has more than 2 digits.

Practice

1. Write the product that each picture represents.
Each small square represents 0.01.

a)

b)

2. Use Base Ten Blocks to find each product.
Record your work on grid paper.

a) 2.6×1.5 **b)** 2.3×0.4 **c)** 0.8×0.7

3. Choose one part from question 2.
Explain how the Base Ten Blocks show the product.

4. Multiply. Use a rectangle model.

a) 4.2×3.7 **b)** 8.9×0.3 **c)** 0.6×0.9

5. A rectangular plot of land measures 30.5 m by 5.3 m.
What is the area of the plot?
Estimate to check your answer is reasonable.

6. Multiply. Describe any patterns you see.

a) 8.36×10 **b)** 8.36×0.1
  8.36×100 8.36×0.01
  8.36×1000 8.36×0.001
  $8.36 \times 10\ 000$ 8.36×0.0001

7. **Assessment Focus** An area rug is rectangular.
Its dimensions are 3.4 m by 2.7 m.
Show different strategies you can use
to find the area of the rug.
Which strategy is best? Justify your answer.

8. Multiply.

a) 2.7×4.786
b) 12.52×13.923
c) 0.986×1.352
Explain how you can check your answers.

9. The fuel consumption estimates of Josie's car are:

City: 21.2 km/L   Highway: 23.3 km/L

The car's gas tank holds 40.2 L of fuel.

a) How far could Josie drive on a full tank of gas on the highway before she runs out of fuel?

b) How far could she drive on a full tank of gas in the city?

What assumptions did you make?

10. Find the cost of each item at the Farmers' Market. Which strategy will you use? Justify your choice.

a) 2.56 kg of apples at $0.95/kg

b) 10.5 kg of potatoes at $1.19/kg

c) 0.25 kg of herbs at $2.48/kg

11. The product of 2 decimals is 0.36. What might the decimals be? Find as many answers as you can.

12. a) Multiply 18 × 12.

b) Use only the result from part a and estimation. Find each product.

i) 1.8 × 12   **ii)** 18 × 0.12   **iii)** 0.18 × 12   **iv)** 0.18 × 0.12

Explain your strategies.

13. Take It Further

a) Multiply.

i) 6.3 × 1.8   **ii)** 0.37 × 0.26   **iii)** 3.52 × 2.4   **iv)** 1.234 × 0.9

b) Look at the questions and products in part a. What patterns do you see in the numbers of decimal places in the question and the product? How could you use this pattern to place the decimal point in a product without estimating?

c) Multiply: 2.6 × 3.5 Does the pattern from part b hold true? If your answer is no, explain why not.

Reflect

When you multiply 2 decimals, how do you know where to place the decimal point in the product? Use examples to explain.
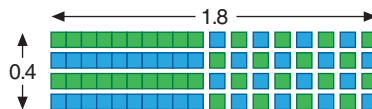
Dividing Decimals

Recall how you used Base Ten Blocks to multiply:

Since multiplication and division are related, we can also use Base Ten Blocks to divide.

Which division sentences could you write for this diagram?

$1.8 \times 0.4 = 0.72$

Explore

You will need Base Ten Blocks and grid paper.
Marius bought 1.44 m of ribbon for his craft project.
He needs to cut the ribbon into 0.6-m lengths.
How many 0.6-m lengths can he cut?
Use Base Ten Blocks to find out.
Record your work on grid paper.

Reflect & Share

Compare your solution with that of another pair of classmates.
What was your strategy?
How could you use division of whole numbers to check your answer?
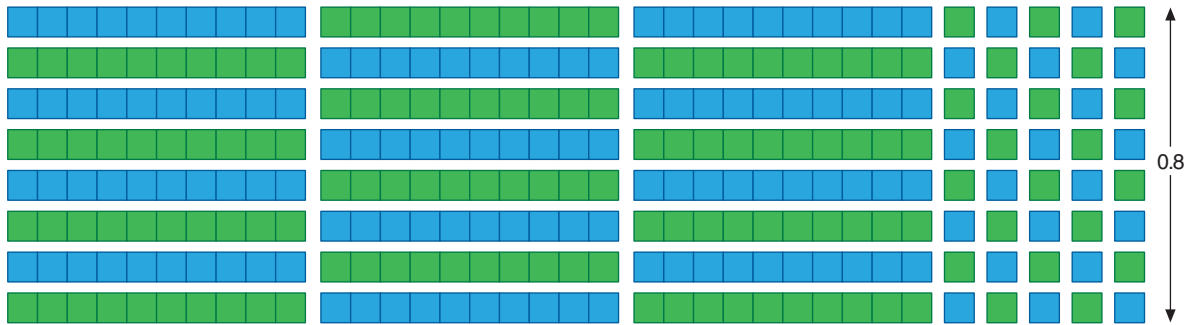
Connect

Jan bought 2.8 m of framing to make picture frames.
Each picture needs 0.8 m of frame.
How many frames can Jan make?
How much framing material is left over?

Use Base Ten Blocks to divide: $2.8 \div 0.8$

Make a rectangle with area 2.8 and width 0.8.

The length of the rectangle is 3.5.
So, Jan can make 3 frames.
3 frames use: 3×0.8 m $= 2.4$ m
So, the framing material left is: 2.8 m $-$ 2.4 m $= 0.4$ m

Sometimes when we divide 2 decimals, the quotient is not a terminating decimal.
Then we can use paper and pencil.

Example

Divide: $52.1 \div 0.9$

A Solution

Estimate first: $52.1 \div 0.9$
Write each decimal to the nearest whole number, then divide.
$52 \div 1 = 52$

> 52.1 is closer to 52.
> 0.9 is closer to 1.

So, $52.1 \div 0.9$ is about 52.

Divide as you would whole numbers.
$521 \div 9$

$$
\begin{array}{r}
5788 \\
9\overline{)52100} \\
45 \\
\overline{71} \\
63 \\
\overline{80} \\
72 \\
\overline{80} \\
72 \\
\overline{8}
\end{array}
$$

divisor ⟶ 9)52100 ⟵ dividend
5788 ⟵ quotient

> Divide until the quotient has 2 more digits than the estimate. Then we can write the quotient to the nearest tenth.

If the quotient is not exact, write zeros in the dividend, then continue to divide.

Since the estimate has 2 digits, divide until there are 4 digits in the quotient.

Since the estimate was 52, place the decimal point
so the quotient is close to 52: $52.1 \div 0.9 \doteq 57.88$
In the question, the dividend and divisor were given to the nearest tenth.
So, we write the quotient to the nearest tenth.
$52.1 \div 0.9 \doteq 57.90$, or 57.9

57.88 is closer to 57.90 than to 57.80.

We can use a calculator when the divisor has more than 1 digit.

Practice

1. Use Base Ten Blocks to divide. Record your work on grid paper.
   a) $0.8 \div 0.1$ **b)** $1.2 \div 0.3$ **c)** $2.7 \div 0.6$ **d)** $2.2 \div 0.4$

2. Divide. Describe any patterns you see.
   a) $124.5 \div 10$ **b)** $124.5 \div 0.1$
   $124.5 \div 100$ $124.5 \div 0.01$
   $124.5 \div 1000$ $124.5 \div 0.001$
   $124.5 \div 10\ 000$ $124.5 \div 0.0001$

3. Why do all these division statements have 6 as the answer?
   a) $30 \div 5$ **b)** $3.0 \div 0.5$ **c)** $0.3 \div 0.05$ **d)** $300 \div 50$
   Which one is easiest to calculate? Explain.

4. Estimate to choose the correct quotient for each division question.

Question	Possible Quotients		
a) $59.5 \div 5$	119	11.9	1.19
b) $195.3 \div 0.2$	9765	976.5	97.65
c) $31.32 \div 0.8$	3915	391.5	39.15

5. Use paper and pencil to divide.
   a) $1.5 \div 0.6$ **b)** $2.24 \div 0.7$ **c)** $1.28 \div 0.8$ **d)** $2.16 \div 0.9$

6. Divide. Write each quotient to the nearest tenth.
   Use front-end estimation to check your answer is reasonable.
   a) $8.36 \div 2.4$ **b)** $1.98 \div 1.3$ **c)** $27.82 \div 3.9$ **d)** $130.4 \div 5.4$

7. A toonie is approximately 0.2 cm thick.
   How many toonies are in a stack of toonies 17.4 cm high?

8. The area of a large rectangular flowerbed is 22.32 m².
   The width is 0.8 m. What is the length?

9. A 0.4-kg bag of oranges costs $1.34.
   a) Estimate. About how much does 1 kg of oranges cost?
   b) What is the actual cost of 1 kg of oranges?
       How do you know your answer is reasonable?
   c) Suppose you spent $10 on oranges.
       What mass of oranges did you buy?

10. **Assessment Focus** Alex finds a remnant
   of landscaping fabric at a garden store.
   The fabric is the standard width, with length 9.88 m.
   Alex needs fourteen 0.8-m pieces for a garden patio.
   a) How many 0.8-m pieces can Alex cut from the remnant?
       What assumptions did you make?
   b) Will Alex have all the fabric he needs? Why or why not?
   c) If your answer to part b is no, how much more fabric does Alex need?
   d) Alex redesigns his patio so that he needs fourteen 0.7-m pieces of fabric.
       Will the remnant be enough fabric? Explain.

11. The quotient of two decimals is 0.12. What might the decimals be?
   Write as many different possible decimal pairs as you can.

12. Last week, Alicia worked 37.5 h. She earned $346.88.
   How much money did Alicia earn per hour?
   Why is the answer different from the number in the calculator display?

13. The question 237 ÷ 7 does not have an exact quotient.
   The first five digits of the quotient are 33857.
   The decimal point has been omitted. Use only this information and estimation.
   Write an approximate quotient for each question.
   Justify each answer.
   a) 237 ÷ 0.7   **b)** 2.37 ÷ 0.07   **c)** 23.7 ÷ 7   **d)** 2370 ÷ 70

Reflect

Talk to a partner. Tell how you can find 1.372 ÷ 0.7 by dividing by 7.
Why does this work?

Order of Operations with Decimals

Focus Use the order of operations to evaluate expressions.

Explore

How many different ways can you find the answer for this expression?

$6 \times 15.9 + 36.4 \div 4$

Show your work for each answer.

Reflect & Share

Compare your answers with those of another pair of classmates.
Which solution do you think is correct? Explain your reasoning.

Connect

To make sure everyone gets the same answer for a given expression,
we add, subtract, multiply, and divide in this order:

- Do the operations in brackets first.
- Then divide and multiply, in order, from left to right.
- Then add and subtract, in order, from left to right.

When we find the answer to an expression, we *evaluate*.

> We use the same order of operations for decimals as for whole numbers.

Example

Evaluate: $12.376 \div (4.75 + 1.2) + 2.45 \times 0.2 - 1.84$

> Use a calculator when you need to.

A Solution

$12.376 \div (4.75 + 1.2) + 2.45 \times 0.2 - 1.84$ 　　　**Calculate in brackets.**

$= 12.376 \div 5.95 + 2.45 \times 0.2 - 1.84$ 　　　**Multiply and divide from left to right.**

$= 2.08 + 0.49 - 1.84$ 　　　**Add and subtract from left to right.**

$= 2.57 - 1.84$

$= 0.73$

Many calculators follow the order of operations.
To see whether your calculator does, enter: $12.4 \times 2.2 - 15.2 \div 4$
If your answer is 23.48, your calculator follows the order of operations.

Practice

1. Evaluate.
   a) $4.6 + 5.1 - 3.2$ b) $8 - 3.6 \div 2$ c) $46.4 - 10.8 \times 3$ d) $85.6 \div 0.4 \times 7$

2. Evaluate.
   a) $(46.78 - 23.58) \times 2.5$ b) $(98.5 + 7) \div 0.5$ c) $7.2 \div (2.4 - 1.8)$

3. Evaluate.
   a) $9.8 - 3.2 \div 0.4 + 2.6$ b) $(9.8 - 3.2) \div (0.4 + 2.6)$
   Explain why the answers are different.

4. Evaluate.
   a) $1.35 + (5 \times 4.9 \div 0.07) - 2.7 \times 2.1$ b) $9.035 \times 5.2 - 4.32 \times 6.7$
   c) $2.368 \div 0.016 + 16.575 \div 1.105$ d) $0.38 + 16.2 \times (2.1 + 4.7) + 21 \div 3.5$

5. **Assessment Focus** Ioana, Aida, and Norman got different answers
   for this problem: $12 \times (4.8 \div 0.3) - 3.64 \times 3.5$
   Ioana's answer was 39.12, Aida's answer was 179.26,
   and Norman's answer was 659.26.
   a) Which student had the correct answer?
      How do you know?
   b) Show and explain how the other
      two students got their answers.
      Where did they go wrong?

6. Evaluate. Show all steps:
   $0.38 + 16.2 \times (2.1 - 1.2) + 21 \div 0.8$

7. **Take It Further** Use at least 4 of the numbers 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8 and 0.9,
   and any operations or brackets to make each whole number from 1 to 5.

Reflect

Why do we need to agree on an order of operations?

Mid-Unit Review

Use a calculator when you need to.

3.1 **1. a)** Write each fraction as a decimal.

  i) $\frac{1}{33}$ **ii)** $\frac{2}{33}$ **iii)** $\frac{3}{33}$

  b) Describe the pattern in your answers to part a.

  c) Use your pattern to predict the fraction form of each decimal.

  i) $0.\overline{15}$ **ii)** $0.\overline{36}$

2. Write each fraction as a decimal. Identify the decimals as repeating or terminating.

  a) $\frac{1}{8}$ **b)** $\frac{3}{5}$

  c) $\frac{2}{3}$ **d)** $\frac{7}{13}$

3. Write each decimal as a fraction.

  a) 0.2   **b)** $0.\overline{8}$

  c) 0.005   **d)** $0.\overline{23}$

3.2 **4.** Order each set of numbers from least to greatest. Use a different method for each part.

  a) $2\frac{1}{4}, \frac{11}{6}, \frac{8}{3}, 2$ **b)** $3.5, \frac{23}{8}, 1\frac{3}{4}$

  c) $1.75, \frac{13}{10}, \frac{9}{5}, 1\frac{3}{5}, 1$

5. Find a number between each pair of numbers. Which strategy did you use each time?

  a) $\frac{4}{3}, \frac{5}{3}$ **b)** $2\frac{3}{8}, \frac{5}{2}$ **c)** $1.4, \frac{8}{5}$

3.3 **6.** Use front-end estimation to place the decimal point in each answer.

  a) $32.47 - 6.75 = 2\,5\,7\,2$

  b) $118.234 + 19.287 = 1\,3\,7\,5\,2\,1$

  c) $17.9 - 0.8 = 1\,7\,1$

7. Winsome is being trained as a guide dog for a blind person.
At birth, she had a mass of 0.475 kg.
At 6 weeks, her mass was 4.06 kg.
From 6 weeks to 12 weeks, she gained 5.19 kg.

  a) By how much did Winsome's mass change from birth to 6 weeks?

  b) What was her mass at 12 weeks?

3.4 **8.** Estimate to place the decimal point in each product.
Show your estimation strategy.

  a) $9.3 \times 0.8 = 7\,4\,4$

  b) $3.62 \times 1.3 = 4\,7\,0\,6$

  c) $11.25 \times 5.24 = 5\,8\,9\,5$

9. A rectangular park has dimensions 2.84 km by 3.5 km.
What is the area of the park?

3.5 **10.** When you divide 15.4 by 2, the quotient is 7.7.
When you divide 1.54 by 0.2, the quotient is 7.7.
Explain why the quotients are the same.

3.6 **11.** Evaluate.

  a) $5.9 + 3.7 \times 2.8$

  b) $12.625 \times (1.873 + 2.127)$
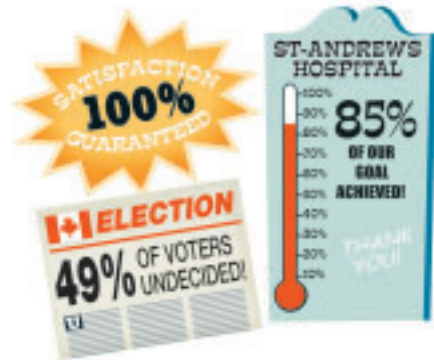
  c) $2.1 \div 0.75 + 6.38 \times 2.45$

Focus	Relate percent to fractions and decimals.

We see uses of percent everywhere.

What do you know from looking at each picture?
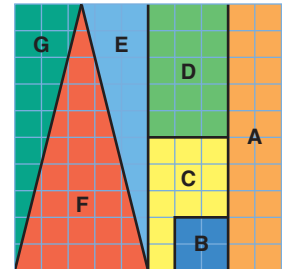Recall that percent means per hundred.
49% is $\frac{49}{100} = 0.49$

Explore

Your teacher will give you a large copy of this puzzle.
Describe each puzzle piece as a percent, then as a fraction
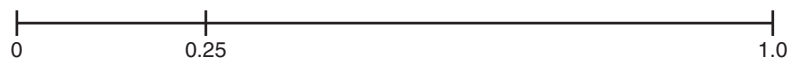and a decimal of the whole puzzle.

Reflect & Share

Compare your answers with those of another pair of classmates.
If the answers are different, how do you know which are correct?

Connect

➤ We can use number lines
to show how percents
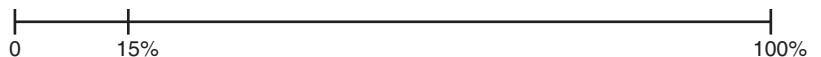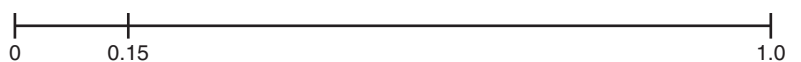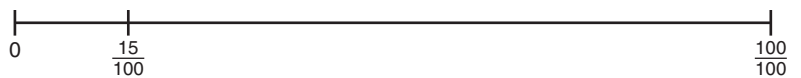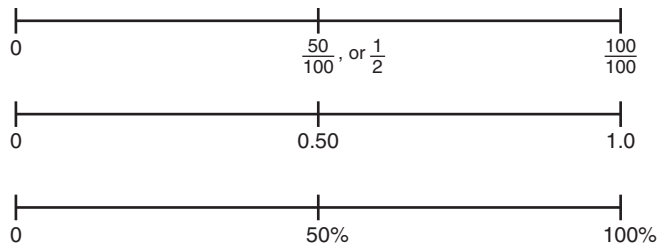relate to fractions
and decimals.
For example:
$25\% = \frac{25}{100} = 0.25$

➤ Conversely, a decimal
can be written as a percent:
$0.15 = \frac{15}{100} = 15\%$

➤ To write a fraction as a percent, write the equivalent fraction with denominator 100.
For example:

$$\frac{1}{2} = \frac{50}{100} = 50\%$$

with $\times 50$ above and $\times 50$ below.

(Number lines showing 0, $\frac{50}{100}$, or $\frac{1}{2}$, $\frac{100}{100}$; 0, 0.50, 1.0; 0, 50%, 100%)

Example

a) Write each percent as a fraction and as a decimal.
   i) 75%   ii) 9%
b) Write each fraction as a percent and as a decimal.
   i) $\frac{2}{5}$ ii) $\frac{7}{20}$
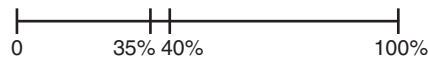
Draw number lines to show how the numbers are related.

A Solution

a) i) $75\% = \frac{75}{100} = 0.75$

(Number lines: 0, 0.09, 0.75, 1.0; 0, $\frac{9}{100}$, $\frac{75}{100}$, $\frac{100}{100}$)

   ii) $9\% = \frac{9}{100} = 0.09$

(Number line: 0, 9%, 75%, 100%)

b) i) $\frac{2}{5} = \frac{40}{100} = 40\% = 0.40$ (with $\times 20$ above and below)

(Number lines: 0, 0.35, 0.40, 1.0; 0, $\frac{35}{100}$, $\frac{40}{100}$, $\frac{100}{100}$)

   ii) $\frac{7}{20} = \frac{35}{100} = 35\% = 0.35$ (with $\times 5$ above and below)

(Number line: 0, 35%, 40%, 100%)
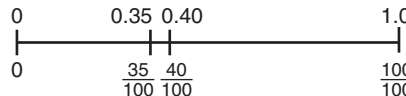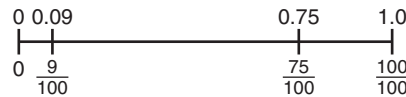
Practice

1. What percent of each hundred chart is shaded?
Write each percent as a fraction and as a decimal.

a)   b)   c)
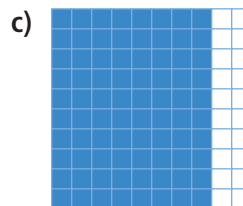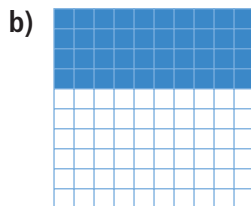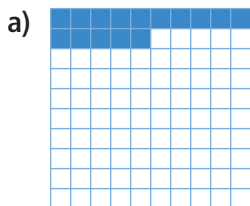
2. Write each percent as a fraction and a decimal.
Sketch number lines to show how the numbers are related.
a) 2%   **b)** 9%   **c)** 28%   **d)** 95%

3. Write each fraction as a decimal and a percent.
a) $\frac{2}{10}$ **b)** $\frac{3}{50}$ **c)** $\frac{4}{25}$ **d)** $\frac{13}{20}$ **e)** $\frac{4}{5}$

4. Fred had 8 out of 10 on a test. Janet had 82% on the test.
Who did better? How do you know?

5. **Assessment Focus** You will need a sheet of paper
and coloured pencils.
Divide the paper into these 4 sections.
• 1 blue section that is $\frac{1}{2}$ of the page
• 1 red section that is 10% of the page
• 1 yellow section that is 25% of the page
• 1 green section to fill the remaining space.
Explain how you did this.
What percent of the page is the green section?
How do you know?

6. **Take It Further** Suppose each pattern is continued on a hundred chart.
The numbers in each pattern are coloured red.
For each pattern, what percent of the numbers on the chart are red?
Explain your strategy for each pattern.
a) 4, 8, 12, 16, 20, …   **b)** 1, 3, 5, 7, …   **c)** 2, 4, 8, 16, …   **d)** 1, 3, 7, 13, …

Reflect

Suppose you know your mark out of 20 on an English test.
Tell how you could write the mark as a decimal and a percent.

Solving Percent Problems

Focus Solve problems involving percents to 100%.

When shopping, it is often useful to be able to calculate a percent, to find the sale price, the final price, or to decide which of two offers is the better deal.

Explore

A jacket originally cost $48.00.
It is on sale for 25% off.
What is the sale price of the jacket?
How much is saved by buying the jacket on sale?
Find several ways to solve this problem.

GRAND SALE EVERYTHING 25% OFF

Reflect & Share

Compare strategies with those of another pair of classmates.
Which strategy would you use if the sale was 45% off? Explain your choice.

Connect

A paperback novel originally cost $7.99.
It is on sale for 15% off.
To find how much you save, calculate 15% of $7.99.
$15\% = \frac{15}{100} = 0.15$
So, 15% of $7.99 $= \frac{15}{100}$ of 7.99
$= 0.15 \times 7.99$
Use a calculator.
$0.15 \times 7.99 = 1.1985$
So, $0.15 \times \$7.99 = \$1.1985$
$1.1985 to the nearest cent is $1.20.
You save $1.20 by buying the book on sale.
We can show this on a number line.

```
        $1.20                                    $7.99
  |-------|----------------------------------------|
  0      15%                                      100%
```

Estimate to check if the answer is reasonable.

15% is about 20%, which is $\frac{1}{5}$.

$7.99 is about $10.00.

So, 0.15×7.99 is about $\frac{1}{5}$ of 10, which is 2.

This is close to the calculated amount, so the answer is reasonable.

Example

Sandi works at Fancies Flowers on Saturdays.
The owner pays Sandi 3% of all money she takes in on a day.
Last Saturday, Sandi took in $1200.00.
How much money did Sandi earn last Saturday?
Illustrate the answer on a number line.

A Solution

Sandi took in $1200.00.

We want to find 3% of $1200.00.

3% is $\frac{3}{100} = 0.03$

So, 3% of $1200 = 0.03 \times 1200$

Ignore the decimal point and multiply as whole numbers.

Another Strategy
We could find 1% of $1200.00,
then multiply by 3.

$$\begin{array}{r} 1200 \\ \times\ \ 3 \\ \hline 3600 \end{array}$$

Estimate to place the decimal point.
$1200 is about $1000.
1% of $1000 is $10.
So, 3% of $1000 is: $10 \times 3 = $30

So, $0.03 \times $1200 = 36.00

Sandi earned $36.00 last Saturday.

Show this on a number line.

0 $36 ——————————————— $1200
0 3%   100%

Practice

1. Calculate.
   a) 10% of 30   **b)** 20% of 50   **c)** 18% of 36   **d)** 67% of 112

2. The regular price of a radio is $60.00.
   Find the sale price before taxes when the radio is on sale for:
   a) 25% off   **b)** 30% off   **c)** 40% off

3. Find the sale price before taxes of each item.

    a) coat: 55% off $90   **b)** shoes: 45% off $40   **c)** sweater: 30% off $50

4. Find the tip left by each customer at a restaurant.

    a) Denis: 15% of $24.20   **b)** Molly: 20% of $56.50   **c)** Tudor: 10% of $32.70

5. The Goods and Services tax (GST) is currently 6%.
    For each item below:
    i) Find the GST.
    ii) Find the cost of the item including GST.

        a) bicycle: $129.00   **b)** DVD: $24.99   **c)** skateboard: $42.97

6. There are 641 First Nations bands in Canada.
    About 30% of these bands are in British Columbia.
    About how many bands are in British Columbia?
    Sketch a number line to show your answer.

7. **Assessment Focus** A clothing store
    runs this advertisement in a local paper.
    "Our entire stock up to 60% off"
    a) What does "up to 60% off" mean?
    b) Which items in the advertisement
        have been reduced by 60%?
    c) Suppose all items are reduced by 60%.
        Explain the changes you would make
        to the sale prices.

Item	Regular Price	Sale Price
Sweaters	$49.99	$34.99
Ski Jackets	$149.99	$112.49
Scarves	$29.99	$12.00
Leather Gloves	$69.99	$38.49
Hats	$24.99	$10.00

8. **Take It Further** Marissa and Jarod plan to purchase
    DVD players with a regular price of $199.99.
    The DVD players are on sale for 25% off.
    Marissa starts by calculating 25% of $199.99.
    Jarod calculates 75% of $199.99.
    a) Show how Marissa uses her calculation to find the sale price.
    b) How does Jarod find the sale price? Show his work.
    c) Do both methods result in the same sale price? Explain.

Reflect

How does a good understanding of percents help you outside
the classroom? Give an example.

Sports Trainer

Sports trainers use scientific research and scientific techniques to maximize an athlete's performance. An athlete may be measured for percent body fat, or percent of either fast- or slow-twitch muscle fibre.

A trainer may recommend the athlete eat pre-event meals that contain a certain percent of carbohydrate, or choose a "sports drink" that contains a high percent of certain minerals. The trainer creates and monitors exercise routines. These enable the athlete to attain a certain percent of maximum heart rate, speed, or power.

Most sports drinks contain minerals. Research shows that the most effective sports drink has a magnesium to calcium ratio of 1:2. The body absorbs about 87% of magnesium in a drink, and about 44% of calcium in a drink. One serving of a particular sports drink contains about 96 mg of calcium and 48 mg of magnesium. About how many milligrams of each mineral will the body absorb?
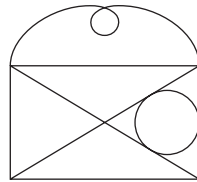
Writing Instructions

Life is full of instructions.
If you have ever filled out a form,
assembled a desk, or followed
directions to someone's house,
you know the importance of
good instructions.

Rhonda describes
this shape to Rashad.
She asks Rashad
to sketch it.

Ok, draw a box, then make an "x"
in the centre of the box. Draw a small circle
on the right. There is a curly line on top, so
draw a line from one corner to the other
that loops once in the middle.
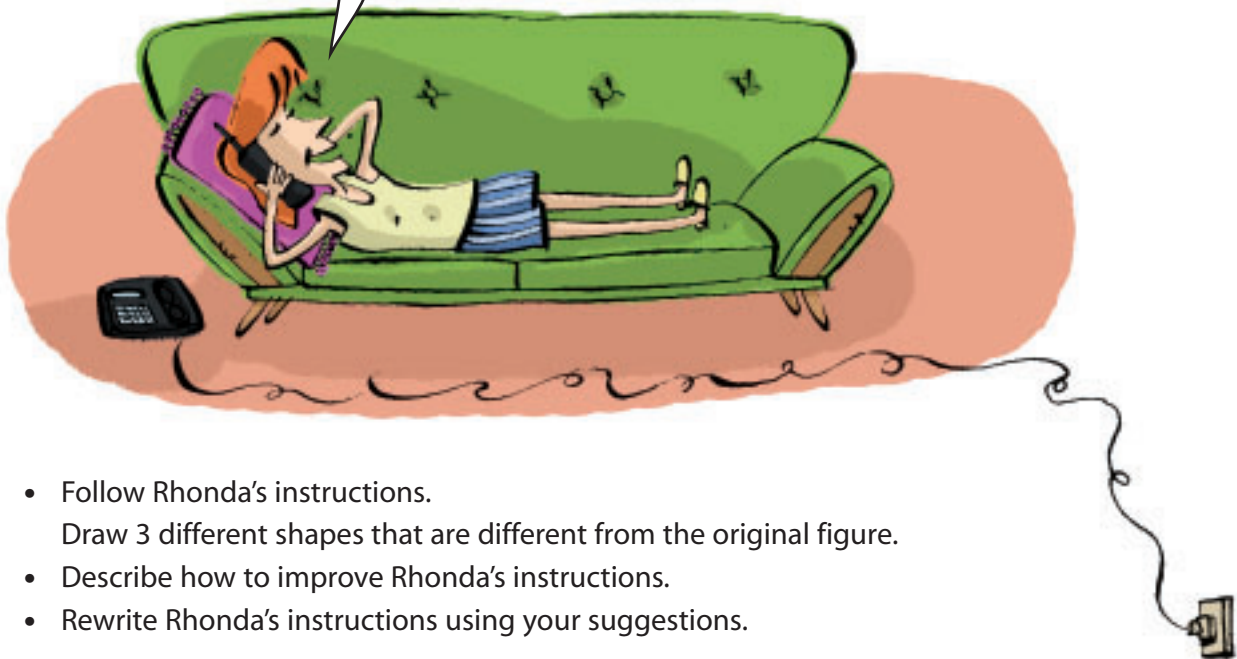
- Follow Rhonda's instructions.
  Draw 3 different shapes that are different from the original figure.
- Describe how to improve Rhonda's instructions.
- Rewrite Rhonda's instructions using your suggestions.

Instructions for Drawing

- Draw a shape.
  Write instructions that someone else could follow to draw it.
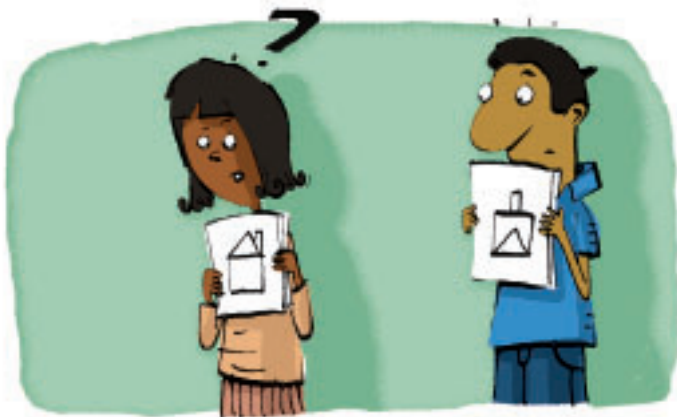- Trade instructions with a classmate.
  Follow your classmate's instructions to draw the shape.
- Compare your shape with the original shape.
  Are the shapes the same?
  If not, suggest ways to improve your classmate's instructions.

Instructions for Calculations

- Your friend has forgotten his calculator at school.
  Write instructions that your friend could follow
  to find 87×0.17 without a calculator.
- Trade instructions with a classmate.
  Follow your classmate's instructions
  to find the product.
- Use a calculator to find the product.
  Are the products the same?
  If not, suggest ways to improve
  your classmate's instructions.

Unit Review

What Do I Need to Know?

✔ Here are some fractions and decimals you should know.

$\frac{1}{2} = 0.5$ $\qquad$ $\frac{1}{3} = 0.\overline{3}$ $\qquad$ $\frac{1}{4} = 0.25$

$\frac{1}{5} = 0.2$ $\qquad$ $\frac{1}{8} = 0.125$ $\qquad$ $\frac{1}{10} = 0.1$

$\frac{1}{20} = 0.05$ $\qquad$ $\frac{1}{100} = 0.01$ $\qquad$ $\frac{1}{1000} = 0.001$

✔ Percent is the number of parts per hundred.
A percent can be written as a fraction and as a decimal.

✔ Here are some fractions, decimals, and percents that you should also know.

$\frac{1}{4} = 0.25 = 25\%$ $\qquad$ $\frac{1}{2} = 0.5 = 50\%$ $\qquad$ $\frac{3}{4} = 0.75 = 75\%$

$\frac{1}{20} = 0.05 = 5\%$ $\qquad$ $\frac{1}{10} = 0.1 = 10\%$ $\qquad$ $\frac{1}{5} = 0.2 = 20\%$

✔ The order of operations with whole numbers applies to decimals.
- Do the operations in brackets first.
- Then divide and multiply, in order, from left to right.
- Then add and subtract, in order, from left to right.

Math Link

Your World
When you buy a Canada Savings
Bond (CSB), you are lending
the Canadian government money.
The government pays you
for borrowing your money.
It pays a percent of what you invested.
In 2006, if you invested money for 1 year,
the government paid you 2%
of the amount you invested.
Suppose you bought a $2000 CSB in 2006.
How much will the government pay you for 1 year?
What if you bought a $2500 CSB?

What Should I Be Able to Do?

3.1

1. Write each fraction as a decimal. Identify each decimal as terminating or repeating.
a) $\frac{3}{5}$ b) $\frac{5}{6}$ c) $\frac{3}{8}$ d) $\frac{3}{20}$

2. Write each decimal as a fraction or a mixed number in simplest form.
a) 0.55   b) $1.\overline{3}$
c) 0.8   d) $0.\overline{07}$

3.2

3. a) Use any method. Order these numbers from least to greatest. Explain the method you used.
$\frac{5}{4}, 1\frac{1}{16}, \frac{3}{6}, 1.1, \frac{5}{8}$
b) Use a different method to order the numbers, to verify your answer in part a.

4. In each ordered set, identify the number that has been placed incorrectly. Explain how you know.
a) $2\frac{1}{3}, 2.25, \frac{17}{6}, 2\frac{11}{12}$
b) $\frac{3}{5}, \frac{9}{10}, \frac{21}{20}, 1\frac{3}{15}, 1.1$

3.3

5. Two decimals have a sum of 3.41. What might the decimals be? Find as many answers as you can.

6. Asafa Powell of Jamaica holds the men's world record for the 100-m sprint, with a time of 9.77 s. Florence Griffith Joyner of the United States holds the women's world record, with a time of 10.49 s. What is the difference in their times?

3.4

7. Kiah works at the library after school. She earns $7.65/h. She usually works 15.5 h a week.
a) What does Kiah earn in a week? Use estimation to check your answer.
b) One week Kiah only works one-half the hours she usually works. What are her earnings that week?

8. Lok needs 1.2 m of fabric to make a tote bag. He finds two fabrics he likes. One fabric costs $7.59/m and the other fabric costs $6.29/m. How much money will Lok save if he buys the less expensive fabric?

3.5

9. Estimate.
Which quotients are:
 i) greater than 100?
ii) less than 50?
Calculate the quotients that are less than 50.
a) 259.8 ÷ 1.65
b) 35.2 ÷ 0.2
c) 175.08 ÷ 0.8
d) 93.8 ÷ 22.4
e) 162.24 ÷ 31.2
f) 883.3 ÷ 36.5

10. The area of a rectangle is 3.75 m². Its length is 0.6 m. What is the width of the rectangle?

3.6 **11.** Evaluate. Use the order of operations.
a) $8.11 + 6.75 \times 5.6 - 2.12$
b) $3.78 \times 2.25 - 4.028 \div 1.52$

12. a) Simplify.
i) $1.2 + 2.8 \times 2.1 + 3.6$
ii) $1.2 \times 2.8 + 2.1 \times 3.6$
iii) $1.2 \times (2.8 + 2.1) + 3.6$
iv) $1.2 + 2.8 + 2.1 \times 3.6$
b) All the expressions in part a have the same numbers and operations. Why are the answers different?

3.7 **13.** Write each percent as a fraction and as a decimal. Sketch number lines to illustrate.
a) 80%   b) 12%
c) 2%   d) 63%

14. Write each fraction as a decimal and as a percent. Sketch number lines to illustrate.
a) $\frac{14}{25}$ b) $\frac{19}{20}$
c) $\frac{7}{50}$ d) $\frac{1}{5}$

3.8 **15.** There are 35 students in a Grade 7 class. On one day, 20% of the students were at a sports meet. How many students were in class?

16. Find the sale price before taxes of each item.
a) video game: 15% off $39
b) lacrosse stick: 25% off $29
c) fishing rod: 30% off $45

17. A souvenir Olympic hat sells for $29.99.
a) Russell lives in Newfoundland where there is a sales tax of 14%. Calculate the final cost of the hat in Newfoundland.
b) Jenna lives in Alberta where the GST tax is 6%. Calculate the final cost of the hat in Alberta.
c) What is the difference between the final costs of the hat in Newfoundland and Alberta?

18. Madeleine received good service in a restaurant. She left the waitress a tip of 20%. Madeleine's bill was $32.75. How much tip did the waitress receive? Show your work. Draw a number line to illustrate your answer.

Practice Test

1. Write each decimal as a fraction in simplest form
   and each fraction as a decimal.
   a) 0.004   b) 0.64   c) $0.\overline{3}$ d) $\frac{51}{200}$ e) $\frac{3}{4}$

2. Ryan earns $18.00 a day walking dogs.
   He walked dogs 5 days last week.
   a) How much money did Ryan earn last week?
   Ryan is saving to buy inline skating equipment.
   The skates cost $59.95.
   A helmet costs $22.90.
   A set of elbow, knee, and wrist guards costs $24.95.
   b) Does Ryan have enough money to buy the equipment?
      Show your work.
   c) If your answer to part b is no, how much more money does Ryan need?
      What assumptions did you make?

3. Maria stated that $1\frac{5}{6}$ is between 1.8 and $\frac{13}{7}$.
   Do you agree?
   Give reasons for your answer.

4. Evaluate.
   a) $3.8 + 5.1 \times 6.4 - 1.7$
   b) $3.54 \div 0.3 + (2.58 \times 1.5)$

5. Last spring, 40 cats were adopted from the local animal shelter.
   This spring, the number of cats adopted dropped by 35%.
   How many cats were adopted this spring?
   Draw a number line to show your answer.

6. The regular price of a pair of shoes is $78.00.
   The shoes are on sale for 25% off.
   a) What is the sale price of the shoes?
   b) How much money is saved by buying the shoes on sale?
   c) The GST is 6%. How much GST would be added to the sale price?
   d) What is the final price of the shoes?

Part 1

Tanya and Marcus used the store's coupon below while shopping at *Savings for U*. They purchased:

$29.95 $39.99 $39.99 $9.00 $9.00 $9.00

Savings for U
Present this coupon and save
$10.00 off
your total purchase

a) Find the total cost of the items before sales tax.
b) Find the total cost of the items after they used the coupon.
c) Find the total cost of the items including GST of 6%.

Part 2

Winnie used the Scratch'n'Save coupon to buy:

Savings for U
Scratch'n'Save
Scratch the circle below
to reveal your discount.

$75.99 $42.95

The clerk scratched the coupon to reveal 20%.
a) Find the total cost of the items before sales tax.
b) Find the total cost of the items after the scratch coupon was used.
c) Find the total cost of the items including GST of 6%.

Part 3

Marty wants to purchase the following items.

i) **$59.99**   ii) **$85.99**   iii) **$19.95**   iv) **$37.95**

Use each discount coupon on page 124. The scratch coupon shows 20%.
Calculate the cost of each item, with each coupon.
Which coupon offers the better deal on each item?

Check List

Your work should show:

✔ all calculations in detail

✔ that you can use percents to solve real-life problems

✔ clear explanations and conclusions, and how you reached your conclusions

Reflect on Your Learning

Look back at the goals under *What You'll Learn*.
Which goals were easiest for you to achieve? Why do you think so?
Which were more challenging? What strategies did you use to meet these goals?
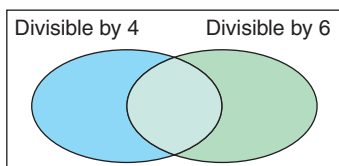
UNIT

1

1. Copy this Venn diagram.
Sort these numbers.

| 320 | 264 | 762 | 4926 |
| 2660 | 1293 | 488 | 504 |

How did you know where to put
each number?

Divisible by 4   Divisible by 6

2. Suppose you have 40 strawberries.
You must share the strawberries
equally with everyone at the picnic
table. How many strawberries will
each person get, in each case?
a) There are 8 people at the table.
b) There are 5 people at the table.
c) There is no one at the table.
Explain your answer.

3. Write an algebraic expression for
each phrase.
a) a number divided by twelve
b) eleven added to a number
c) eight less than a number

4. a) Describe the patterns in this table.
b) Use the patterns to extend the
table 3 more rows.
c) Use algebra.
Write a relation
that describes
how the output
is related to
the input.

Input x	Output
1	4
2	6
3	8
4	10

5. Identify the numerical coefficient,
the variable, and the constant term
in each algebraic expression.
a) $3s + 2$ **b)** $7p$
c) $c + 8$ **d)** $11w + 9$

6. The cost to park a car is $5 for
the first hour, plus $3 for each
additional half hour.
a) Write a relation to show how
the total cost is related to the
number of additional half hours.
b) Copy and complete this table.

Number of Additional Half Hours	Cost ($)
0	
1	
2	
3	
4	

c) Draw a graph to show the
relation. Describe the graph.
d) Use the graph to answer
these questions.
   i) Tanya parked for 6 additional
   half hours.
   What was her total cost?
   ii) Uton paid $29 to park his car.
   How long was he parked?

7. Draw pictures to represent the steps
you took to solve each equation.
a) $3x = 15$
b) $x + 9 = 11$

2

8. a) Suppose you have 8 yellow tiles, and use all of them. How many red tiles would you need to model -3? How do you know?

b) Suppose you have 5 red tiles and 5 yellow tiles. How many ways can you find to model -3 with tiles?

9. Use coloured tiles to represent each sum. Find each sum. Sketch the tiles you used.

a) $(-7) + (+7)$ **b)** $(-7) + (+5)$

c) $(-7) + (-5)$ **d)** $(+7) + (-5)$

10. Use a number line. For each sentence below:

a) Write each number as an integer.

b) Write an addition equation. Explain your answer in words.

i) You deposit $10, then withdraw $5.

ii) A balloon rises 25 m, then falls 10 m.

iii) You ride the elevator down 9 floors, then up 12 floors.

11. What is the difference in altitudes? How can you subtract to find out?

a) An altitude of 80 m above sea level and an altitude of 35 m below sea level

b) An altitude of 65 m below sea level and an altitude of 10 m above sea level

12. Add or subtract.

a) $(+5) + (-9)$ **b)** $(-1) + (-5)$

c) $(+2) - (-8)$ **d)** $(-9) - (-3)$

3

13. a) Write each fraction as a decimal.

i) $\frac{1}{33}$ **ii)** $\frac{2}{33}$ **iii)** $\frac{3}{33}$

b) Describe the pattern in your answers to part a.

c) Use your pattern to predict the fraction form of each decimal.

i) $0.\overline{15}$ **ii)** $0.\overline{24}$ **iii)** $0.\overline{30}$

14. a) Use any method. Order these numbers from greatest to least. $\frac{21}{4}, 4.9, 5\frac{1}{3}, \frac{24}{5}, 5.3$

b) Use a different method. Verify your answer in part a.

15. The tallest woman on record was 2.483 m tall. The shortest woman on record was 0.61 m tall. What is the difference in their heights?

16. Multiply. Draw a diagram to show each product.

a) 2.3×3.4 **b)** 1.8×2.2

c) 4.1×3.7 **d)** 1.7×2.9

17. Nuri has 10.875 L of water. He pours 0.5 L into each of several plastic bottles.

a) How many bottles can Nuri fill?

b) How much water is left over?

18. The Goods and Services Tax (GST) is currently 6%. For each item below:

i) Find the GST.

ii) Find the cost of the item including GST.

a) snowshoes that cost $129.99

b) a CD that costs $17.98