CAMOSUN COLLEGE

School of Access

Academic and Career Foundations Department

MATH 037/038/052/053/057

Unit R

Arithmetic Review

adapted from:

ABE Intermediate Level Mathematics

Module 1: Arithmetic and Estimation

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Contents

Learning outcomes and instructions

Being able to work with whole numbers, decimals and fractions, without the use of a calculator, is important in everyday life and in your future math courses.

Estimating an answer to a problem is also important, because it helps put the problem in context, and confirms that the answer is reasonable.

When you have completed this unit, you should be able to:

- round numbers and estimate answers to problems
- calculate and solve problems involving adding, subtracting, multiplying and dividing whole numbers, decimals, fractions and exponents, without a calculator
- understand and use order of operations when performing multiple operation calculations
- check that answers are reasonable in the context of the given problem

Requirements

You will be required to complete a written Final Test for this unit, without using a calculator. However, you may use a calculator to check your calculations throughout this unit.

Procedure for independent study

1. Work through each section of this unit in order, by studying the explanations and examples, and then completing all of the exercises and checking your answers with the answer key at the back of the book. If you need assistance or additional practice problems, contact your instructor.

2. Use the Glossary to explain the meaning of these mathematical terms.

3. If recommended by your instructor, complete additional problem sets.

4. Complete the Practice Test and check your answers.

5. Complete the Final Test for this unit.

R.1 Place value

Place value

Words are formed with letters. Numbers are formed with digits. The ten digits of our number system are:

0, 1, 2, 3, 4, 5, 6, 7, 8 and 9

By stringing these digits together we can form numbers. The position that a digit occupies in a number tells us how many ones, tens, hundreds, thousands (and so on) that the number contains. If the number has a decimal point, then the position of the digits after the decimal point indicates how many tenths, hundredths, thousandths (and so on) the number contains. The place values or position values in a number are shown in Figure 1.

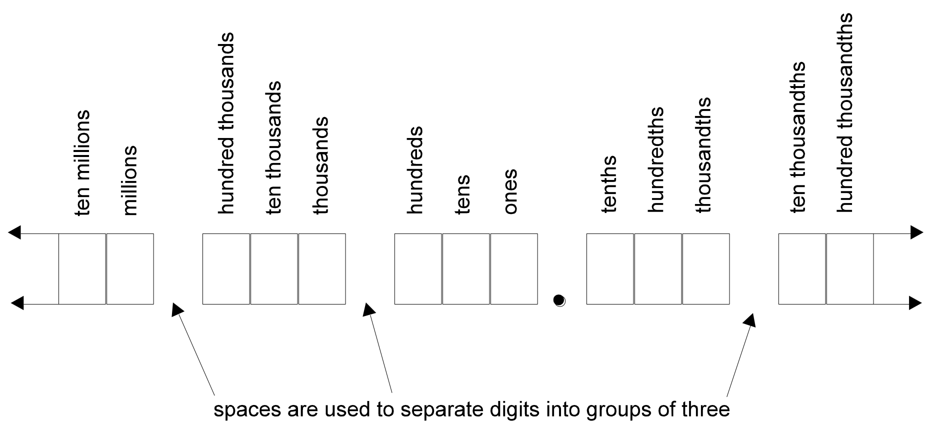


Figure 1 Place values

If a number contains a decimal point it is called a decimal (also known as a decimal fraction or decimal notation). If the number has no decimal point, it is called a whole number. For example, 25.8 is a decimal while 63 is a whole number.

Example 1

Write the place value for each underlined digit.

a. 43 2$\underline{0}$9 b. 6.05$\underline{3}$ 21 c. $\underline{6}$35 096.58

Solution

a. tens b. thousandths c. hundred thousands

Example 2

Write 23 805.90 in expanded form.

Solution

To write a number in expanded form means to write it as the sum of the values of each digit.

$$23\ 805.90 = 20\ 000 + 3\ 000 + 800 + 5 + \frac{9}{10} + \frac{0}{100}$$

Example 3

Write three million in standard notation.

Solution

To write a number in standard notation means to write it using only digits.

Three million in standard notation is 3 000 000.

Now complete Exercise R.1 and check your answers.

Exercise R.1

1. Write the place value for each underlined digit.

   a. $85\underline{2}$
   b. $43.92\underline{1}$
   c. $0.0\underline{5}6$
   d. $1\underline{6}3\ 940$
   e. $0.000\ 5\underline{0}2$
   f. $4\underline{2}\ 806\ 900$
   g. $8.\underline{4}2$
   h. $9\underline{4}.06$
   i. $3\ 698.5\underline{1}$
   j. $7\underline{3}\ 480$

2. Underline the digit for the place value named.

a. tens	842.56
b. tenths	842.56
c. hundredths	68 923.05
d. millions	843 907 000
e. ten thousandths	63 521.009 842

3. Write in expanded form.

   a. 823
   b. 8.23
   c. 9 605
   d. 0.087
   e. 3 842.65

4. Luna had 6 one hundred dollar bills, 3 tens and 8 loonies. How much money did she have?

5. Bill had 5 ten dollar bills, 3 dimes and 2 pennies. How much money did Bill have?

6. Ida found 4 pennies and 1 loonie. Together with her ten dollar bill, how much money does Ida have?

7. Dan wants $203.41. How many hundred dollar bills, ten dollar bills, loonies, dimes and pennies should he receive?

8. A certain company lost 18.3 million dollars last year. Write this number in standard notation.

R.2 Comparing numbers

When comparing numbers, one number is either equal to (=) another number, greater than (>) another number, or less than (<) another number.

When comparing decimals, it is often a good idea to write both numbers with the same number of digits after the decimal point. This is possible because placing zeros after the last decimal digit will not change the value of the number. For example:

63.5 = 63.50
63.5 = 63.500
63.5 = 63.5000
and so on.

We can do the same with whole numbers, but only after placing a decimal point at the end of the whole number. For example:

804 = 804
804 = 804.0
804 = 804.00
804 = 804.000
and so on.

Example 1

Use >, < or = to compare each pair of numbers.

a. 0.002______0.01 b. 69 ______69.00 c. 305 ______30.5

Solution

a. Since 0.002 has three decimal digits, write 0.01 with three decimal digits, by putting another 0 after the 1. Comparing 2 thousandths to 10 thousandths:

0.002 < 0.010

b. 69 can be written as 69.00, so they are equivalent:

69 = 69.00

c. 305 can be written as 305.0, and comparing the whole numbers:

305 > 30.5

> Notice how greater than (>) or less than (<) signs always point to the smaller number, such as 13 > 5 or 5 < 13.

Example 2

Find the smallest of the three numbers below:

5.0 5.01 4.999

Solution

The equivalent numbers with three decimal digits are:

5.000 5.010 4.999

The smallest number is 4.999.

Now complete Exercise R.2 and check your answers.

Exercise R.2

1. Use >, < or = to compare the numbers.

   a. 9 919______9 991

   b. 0.5 ______0.50

   c. 6.2 ______6.02

   d. 84.009______84.1

   e. 31 280_____31 280.0

   f. 6 924_____6.924

   g. 0.050 9______0.49

   h. 0.000 65_____0.001

   i. 3.0 ______3.000 000

   j. 1.01______0.999

2. Find the smallest number in each set of numbers.

   a. 16 1.6 16.0 160

   b. 0.040 20 0.040 18 0.041

   c. 8.70 8.700 000 8.07 8.7

   d. 13 562 13 625 13 265 16 235

   e. 199.0 99.999 0.999 999 999

3. Use an “is equal to” (=) or an “is not equal to” (≠) symbol to compare the numbers.

   a. 0.02______0.20

   b. 6.3 ______63

   c. 9.00______9

   d. 842 ______8420.0

   e. 107 ______1.07

   f. 98 761_______98.761

4. Jill bought gas for 117.9 cents per litre. Jack said he bought gas for $1.19 per litre. Who paid the most for gas?

R.3 Rounding numbers

No one would ever report their age as being 30.859 years old. Knowing that the person is approximately 30 years old is usually sufficient. Most values like age can never be known exactly. To make things simple, we often round numbers to a convenient place value.

Example 1

The population of Canada in 2000 was 28 463 900 people. Round to the nearest million. In other words, was the population closer to 28 million or 29 million?

Solution

Step 1: Underline the millions digit

$2\underline{8}\ 463\ 900$

Step 2: If the next digit after the underlined digit is a 0, 1, 2, 3, or 4, then do not change the underlined digit. If the next digit is a 5, 6, 7, 8, or 9, then add 1 to the underlined digit. Since the next digit is a 4, the number is still $2\underline{8}\ 463\ 900$.

Step 3: Change all the digits after the underlined digit to zeros. Then remove the underline. The population of Canada was approximately 28 000 000.

The steps required to round any decimal fraction are as follows:

Step 1: Underline the digit to which the number is being rounded.

Step 2: If the next digit after the underlined digit is a 0, 1, 2, 3, or 4, then do not change the underlined digit. If the next digit is a 5, 6, 7, 8, or 9, then add 1 to the underlined digit.

Step 3: Change all the digits after the underlined digit to zeros. If any of the digits after the underlined digit follow a decimal point, then drop them from the number.

Step 4: Remove the underline from your answer.

> We use the sign ≈ which means “is approximately equal to” to compare a rounded number.
>
> For example: 38 942 ≈ 39 000.

Example 2

Round the following to the nearest tenth.

a. 13.57
b. 0.034
c. 18.962 487

Solution

a. Step 1: the digit in the tenths place is a 5. Underline it.

$13.\underline{5}7$

Step 2: the digit after the 5 is a 7. Add 1 to the 5.

$13.\underline{6}7$

Step 3: change the 7 to a zero. Since this zero comes after the decimal point, drop it.

$13.\underline{6}0 = 13.\underline{6}$

Step 4: $13.57 \approx 13.6$

b. Step 1: the digit in the tenths place is a 0. Underline it.

$0.\underline{0}34$

Step 2: the digit after the 0 is a 3. The 0 remains unchanged.

$0.\underline{0}34$

Step 3: replace the 3 and 4 with zeros and drop them.

$0.\underline{0}00 = 0.\underline{0}$

Step 4: $0.034 \approx 0.0$

c. Step 1: the digit in the tenths place is a 9. Underline it.

$18.\underline{9}62\ 487$

Step 2: the digit after the 9 is a 6. Adding 1 to 9 = 10, which is carried to the ones place.

$19.\underline{0}62\ 487$

Step 3: replace all the numbers after the underlined number with zeros.

$19.\underline{0}00\ 000$

Step 4: $18.962\ 487 \approx 19.0$

Now complete Exercise R.3 and check your answers

Exercise R.3

1. Round to the nearest hundred.

   a. 8 355
   b. 203
   c. 85
   d. 47
   e. 1 342 969
   f. 433.789

2. Round to the nearest one (also called rounding to the nearest whole number).

   a. 6.3
   b. 18.7
   c. 49.6
   d. 55.55
   e. 0.807
   f. 3.141 59
   g. 499.503
   h. 2.499 999
   i. 109.5
   j. 0.389 642

3. Round as indicated.

   a. 43 826 984 to the nearest ten thousand
   b. 0.0352 to the nearest tenth
   c. 0.499 to the nearest hundredth
   d. 0.438 206 to the nearest ten thousandth
   e. 0.83 to the nearest whole number
   f. 645.96 to the nearest ten

4. Round to the nearest hundredth.

   a. 0.909
   b. 16.583
   c. 0.123 456
   d. 968.155
   e. 0.000 016
   f. 10.698
   g. 45.0249
   h. 5.3062
   i. 0.096 12
   j. 11.682

5. Mike had $19.50, Mary had $84.05 and Sandra had $43.88. Round their amounts to the nearest dollar.

R.4 Adding and subtracting whole numbers and decimals

When numbers are added, the answer is called a sum. The sum of 8 and 5 is 13. When numbers are subtracted, the answer is called a difference. The difference of 10 and 4 is 6.

When adding or subtracting whole numbers and decimals it is important that we add only ones digits to ones digits, tens digits to tens digits, hundreds digits to hundreds digits, tenths digits to tenths digits and so on. To accomplish this, make sure that the decimal points are aligned in a column and each decimal has the same number of digits after the decimal point.

Example 1

Add the following: 1.56 + 35.9 + 0.009 + 0.78

Solution

$$\begin{array}{r} {}^{2\ 1} \\ 1.560 \\ 35.900 \\ 0.009 \\ \underline{0.780} \\ 38.249 \end{array}$$

Align the decimal points, writing all numbers with 3 decimal digits.

Add the columns from right to left, writing the sum below the line.

When the sum of a column has 2 digits, we add or "carry" the tens digit to the sum of the column on the left.

Example 2

Subtract the following: (a) 275 – 48 (b) 68.03 – 4.87 (c) 26 – 9.89

Solutions

Align the columns, then from right to left, subtract the bottom digit from the top digit.

(a)

$$\begin{array}{r} {}^{6\ 15} \\ 2\cancel{7}\cancel{5} \\ \underline{-48} \\ 227 \end{array}$$

We can't subtract 8 from 5, so we "borrow" 1 from the 7, which adds 10 to the 5. (the 7 has 10 times the value of the 5)

(b)

$$\begin{array}{r} {}^{9\ 13} \\ {}^{7\ \cancel{10}} \\ 6\cancel{8}.\cancel{0}\cancel{3} \\ \underline{-4.87} \\ 63.16 \end{array}$$

We can't subtract 7 from 3, and we can't borrow from 0, so we borrow 1 from the 8, which adds 10 to the 0.

Then we borrow 1 from the 10, which turns the 3 into 13.

(c)

$$\begin{array}{r} {}^{1\ 15} \\ {}^{9\ 10} \\ {}^{\cancel{5}\ \cancel{10}} \\ \cancel{2}\cancel{6}.\cancel{0}\cancel{0} \\ \underline{-9.89} \\ 16.11 \end{array}$$

We can't subtract 9 from 0 or borrow from the other 0, so we borrow 1 from the 6, which turns the 0 next to it into 10.

Then we borrow 1 from the 10, which turns the other 0 into 10.

Finally, since we can't subtract 9 from 5, we borrow 1 from the 2, which turns the 5 into 15.

	Now complete Exercise R.4 and check your answers.

Exercise R.4

1. Find the sum.

a. $\begin{array}{r} 846 \\ +95 \\ \hline \end{array}$ b. $\begin{array}{r} 13 \\ 74 \\ 812 \\ +195 \\ \hline \end{array}$ c. $\begin{array}{r} 692 \\ 5 \\ 84 \\ 1387 \\ +42966 \\ \hline \end{array}$

2. Find the sum.

a. 64 + 31 + 942 + 7

b. 88 943 + 369 + 1 003

c. 109 864 + 9 980 + 49 877 + 4 698

3. Find the sum.

a. $\begin{array}{r} 84.26 \\ +12.09 \\ \hline \end{array}$ b. $\begin{array}{r} 16.5 \\ 0.03 \\ 47.2 \\ +92.06 \\ \hline \end{array}$ c. $\begin{array}{r} 1249.0 \\ 70.16 \\ +8.297 \\ \hline \end{array}$

4. Find the sum.

a. 84 + 1.2 + 0.96 + 107

b. 29.093 + 14.08 + 9 635

c. 0.005 + 0.94 + 0.012 58 + 0.000 92

5. Find the difference.

a. $\begin{array}{r} 182 \\ -39 \\ \hline \end{array}$ b. $\begin{array}{r} 4\,602 \\ -4\,583 \\ \hline \end{array}$ c. $\begin{array}{r} 116\,058 \\ -37\,069 \\ \hline \end{array}$

d. $\begin{array}{r} 27.03 \\ -5.84 \\ \hline \end{array}$ e. $\begin{array}{r} 0.029 \\ -0.008\,43 \\ \hline \end{array}$ f. $\begin{array}{r} 96 \\ -0.74 \\ \hline \end{array}$

g. $\begin{array}{r} 11.023 \\ -7.2 \\ \hline \end{array}$ h. $\begin{array}{r} 69\,003 \\ -8\,527.81 \\ \hline \end{array}$ i. $\begin{array}{r} 0.006\,837 \\ -0.000\,938 \\ \hline \end{array}$

6. Find the difference.

a. 83 - 0.83 b. 29 - 6.52

c. 0.5 - 0.003 d. 74.3 - 8.930 2

7. Mom found three dimes, three quarters, one nickel, seven pennies and two loonies in Billy's pocket. How much money did Billy have?

8. Nadine had $50 before she bought a calculator for $19.95 and a geometry set for $2.98. How much did she have after these purchases?

9. Calculate the balance values.

Date	Item	Withdrawal	Deposit	Balance
June 1				480.51
June 4	cash withdrawal	200.00		a
June 8	salary deposit		891.45	b
June 12	BC Tel	33.69		c
June 20	car repair cheque	146.35		d
June 30	rent cheque	450.00		e

10. Round each of the numbers to the nearest ten and estimate the sum or difference.

a.
$$\begin{array}{r} 462 \\ 95.6 \\ 0.25 \\ \underline{+79.1} \end{array}$$

b.
$$\begin{array}{r} 8\,299 \\ \underline{-315} \end{array}$$

R.5 Multiplying whole numbers and decimals

When numbers are multiplied, they are called factors, and the answer is called a product. For example, when $2 \times 3 = 6$, we say that 2 and 3 are factors while 6 is the product.

Example 1

Find the product of 537 and 274.

Solution

Multiply 537 from right to left first by 4, then by 7, and then by 2 as shown. Add these products.

```
      1
     2 4
     1 2
     537
    ×274
    ----
    2148
   37590
  107400
  ------
  147138
```

When multiplying by 4 ones, we start writing the product in the ones column. When a product has 2 digits (4×7=28), we add the tens digit (2) to the next product (4×3=12+2=14).

When multiplying by 7 tens, we write 0 ones and start the product in the tens column below the first product.

And when multiplying by 2 hundreds, we write 0 ones and 0 tens, and start the product in the hundreds place.

Example 2

Multiply 1.35 by 0.409.

Solution

When multiplying decimals, the number of decimal places in the product is the sum of the number of decimal places in both factors.

```
     1.35    2 decimal places
   ×0.409    3 decimal places
   ------
     1215
     0000
    54000
  -------
  0.55215    5 decimal places
```

We don't need to align the decimal points or have the same number of decimal places in both factors.

Since the factors have a total of five decimal places, the product must also have five decimal places.

Now complete Exercise R.5 and check your answers.

Exercise R.5

1. Complete the times table chart.

×	0	1	2	3	4	5	6	7	8	9
0										
1										
2										
3										
4										
5										
6										
7										
8										
9										

2. Use the times table chart to help answer the following.

   a. the product of 0 and any number is always ____________ .

   b. the product of 1 and any number is always ____________ .

   c. The product of 5 and any number always ends in a _____ or a ________ .

   d. Look at the products in the 9's row or column. Except for the 0 product, the sum of the digits in each product is always _________ .

3. Multiply

   a. $\begin{array}{r} 41 \\ \underline{\times 5} \end{array}$ b. $\begin{array}{r} 96 \\ \underline{\times 13} \end{array}$ c. $\begin{array}{r} 944 \\ \underline{\times 87} \end{array}$ d. $\begin{array}{r} 5062 \\ \underline{\times 804} \end{array}$

   e. $\begin{array}{r} 83 \\ \underline{\times 1.1} \end{array}$ f. $\begin{array}{r} 152 \\ \underline{\times 0.07} \end{array}$ g. $\begin{array}{r} 602 \\ \underline{\times 0.504} \end{array}$ h. $\begin{array}{r} 9065 \\ \underline{\times 1.83} \end{array}$

i. $\begin{array}{r} 16.3 \\ \underline{\times 0.07} \end{array}$ j. $\begin{array}{r} 19.84 \\ \underline{\times 62} \end{array}$ k. $\begin{array}{r} 0.15 \\ \underline{\times 3.7} \end{array}$ l. $\begin{array}{r} 0.004 \\ \underline{\times 0.0205} \end{array}$

4. Find the products.

   a. 17.7×0.6

   b. 3.004×0.008

   c. 0.006×0.02

   d. $0.079 \times 0.000\ 1$

   e. 0.008×0.008

5. Tim earns $1408.45 bi-weekly. There are 26 bi-weekly pay days in one year. How much will he earn in a year?

6. Holly drives an average speed of 84 km/hr in her car. How far will she travel in 4.5 hours?

R.6 Powers - repeated multiplication

As you may recall, multiplying is a way of indicating that we should add the same number so many times. For example,

$$5 \times 3 = 5 + 5 + 5$$

The power operation is a way of indicating that we should multiply the same number so many times. For example,

$$5^3 = 5 \times 5 \times 5$$

The power operation is indicated by placing a small number, called an exponent, to the top right of some number, or base, that we then multiply so many times together.

5^3 is called a power.
5 is called the base.
^{3} is called the exponent.

The power, 5^3, is read "five to the third" or "five to the power of three" or more commonly, "five cubed". Powers with exponents of 2 are said to be "squared", while those with exponents of 3 are said to be "cubed". Below are some examples of how we read powers.

7^2 is read "seven squared"
7^3 is read "seven cubed"
9^4 is read "nine to the fourth" or "nine to the power of four"
12^8 is read "twelve to the eighth" or "twelve to the power of eight"

Notice that the exponent is not really a number - it is really an instruction: it says "multiply the number below me by itself this many times". So $9^4 = 6561$, not 36.

We can use exponents to find powers of integers, decimals and fractions:

$$(3)^5 = (3)(3)(3)(3)(3) = 243$$

$$(1.25)^3 = (1.25)(1.25)(1.25) = 1.953125$$

$$\left(\frac{2}{3}\right)^8 = \left(\frac{2}{3}\right)\left(\frac{2}{3}\right)\left(\frac{2}{3}\right)\left(\frac{2}{3}\right)\left(\frac{2}{3}\right)\left(\frac{2}{3}\right)\left(\frac{2}{3}\right)\left(\frac{2}{3}\right) = \frac{256}{6561}$$

You probably realize now why exponents are used - they save a lot of time writing down repeated multiplication.

Scientific calculators have an exponent key, usually labelled y^x (sometimes x^y or a^x is used). To use this function, press the y^x key in between the base number and the exponent, then press = .

Example 1

To find $3^5 = ?$ press: 3 $\boxed{y^x}$ 5 $\boxed{=}$

Did you get 243?

Example 2

To find $(1.25)^3 = ?$ press: 1.25 $\boxed{y^x}$ 3 $\boxed{=}$

Did you get 1.953125?

Example 3

To find $(2.57)^{10} = ?$ press: 2.57 $\boxed{y^x}$ 10 $\boxed{=}$

Did you get 12569.88294?

Here is a shortcut you can use on your calculator: The most common exponent used in algebra is 2. Your calculator will have a key labelled x^2. You can use this key instead of the y^x key, and save yourself some time:

13 $\boxed{x^2}$ or 13 $\boxed{x^2}$ $\boxed{=}$

Did you get 169?

Fractions can also be squared as follows:

$$\left(\frac{2}{3}\right)^2 = \frac{2^2}{3^2}$$

To square the 2 and 3 separately:

2 $\boxed{x^2}$ is 4 and 3 $\boxed{x^2}$ is 9 and rewrite as

$$\left(\frac{2}{3}\right)^2 = \frac{4}{9}$$

Now complete Exercise R.6 and check your answers.

Exercise R.6

1. How would you read the following?

   a. 3^2 b. 10^3 c. x^3 d. $\left(\frac{1}{2}\right)^4$ e. 6^6

2. Write the following as powers.

   a. $2 \times 2 \times 2$ b. $8 \times 8 \times 8 \times 8 \times 8$

   c. $\left(\frac{1}{4}\right)\left(\frac{1}{4}\right)$ d. $(9.7)(9.7)(9.7)(9.7)$

   e. xxxxxxxxxx f. 26

3. Evaluate the following:

   a. 13^2 b. 14^2 c. 15^2 d. 20^2 e. 25^2

   f. $\left(\frac{1}{2}\right)^2$ g. $\left(\frac{1}{2}\right)^3$ h. $\left(\frac{1}{2}\right)^4$ i. $(0.5)^3$ j. $\left(\frac{2}{3}\right)^3$

   k. $(5.3)^1$ l. 9^4 m. $\left(\frac{5}{8}\right)^2$ n. $(1.2)^2$ o. $(0.1)^5$

4. The following are called "powers of ten". Evaluate them.

   a. 10^0 b. 10^1 c. 10^2 d. 10^3 e. 10^4

   f. 10^5 g. 10^6 h. 10^7

R.7 Dividing whole numbers and decimals

When numbers are divided, the answer is called a quotient. The number being divided is called a dividend, while the dividing number is called a divisor.

There are three ways of writing division:

$$\text{divisor}\overset{\displaystyle\text{quotient}}{\overline{\smash{)}\text{dividend}}} \quad \text{or} \quad \text{dividend} \div \text{divisor} = \text{quotient} \quad \text{or} \quad \frac{\text{dividend}}{\text{divisor}} = \text{quotient}$$

For example, the problem of dividing 10 by 2 can be written as:

$$2\overset{\displaystyle 5}{\overline{\smash{)}10}} \quad \text{or} \quad 10 \div 2 = 5 \quad \text{or} \quad \frac{10}{2} = 5$$

We read $2\overline{\smash{)}10}$ as "2 into 10", $10 \div 2$ as "10 divided by 2" and $\frac{10}{2}$ as "10 over 2".

Caution: It is impossible to divide by zero, or to divide zero into any number. For example, $5 \div 0$ is impossible ("0 into 5" makes no sense). We say that division by zero is "undefined".

Example 1

Find $860 \div 12$ by long division.

Solution

$$\begin{array}{r} 71 \\ 12\overline{\smash{)}860} \\ \underline{84} \\ 20 \\ \underline{12} \\ 8 \end{array}$$

Write the problem as 12 into 860. 12 does not go into 8, but 12 into 86 goes 7 times, so place 7 above the 6.

Multiply $7 \times 12 = 84$, place 84 below 86, subtract, and bring down 0.

12 goes into 20 once, so place 1 above the 0 and multiply $1 \times 12 = 12$.

Place 12 below 20 and subtract, leaving a remainder of 8.

We write the quotient as 71 R8 ($860 \div 12 = 71$ R8).

When dividing whole numbers we often get a remainder, which we indicate by the letter R.

But when dividing decimals, we use decimal digits to indicate the remainder, so we must take special care in dealing with the decimal points. We make the task simpler by rearranging the problem so that we are dividing by a whole number.

Example 2

Find 9.407 ÷ 0.23 by long division.

Solution

$$0.23\overline{)9.407}$$

Write as 0.23 into 9.407. To rearrange this problem in order to divide by a whole number, multiply both the divisor and the dividend by 100, and rewrite as 23 into 940.7.

$$\begin{array}{r} 40.9 \\ 23\overline{)940.7} \\ \underline{92} \\ 20 \\ \underline{0} \\ 207 \\ \underline{207} \\ 0 \end{array}$$

Place the decimal point in the quotient directly above the decimal point in the dividend.

Divide as in Example 1.
Notice that 23 goes into 20 zero times.

We write the quotient as 40.9 (9.407 ÷ 0.23 = 40.9)

Example 3

Find 13 ÷ 0.7 by long division. Round the answer to the nearest hundredth.

Solution

$$0.7\overline{)13}$$

Write as 0.7 into 13. multiply both the divisor and the dividend by 100, and rewrite as 7 into 130. Since we must round the quotient to two places after the decimal point, write three zeros after the 130.

$$\begin{array}{r} 18.571 \\ 7\overline{)130.000} \\ \underline{7} \\ 60 \\ \underline{56} \\ 40 \\ \underline{35} \\ 50 \\ \underline{49} \\ 10 \\ \underline{7} \\ 3 \end{array}$$

Place the decimal point in the quotient directly above the decimal point in the dividend.

Divide as before.

Rounding the quotient, 13 ÷ 0.7 = 18.57.

Now complete Exercise R.7 and check your answers.

Exercise R.7

1. Divide.

a. $56 \div 7$ b. $\frac{54}{9}$ c. $72 \div 8$

d. $83 \div 1$ e. $\frac{0}{6}$ f. $6 \div 0$

g. $\frac{63}{9}$ h. $43 \div 43$ i. $850 \div 10$

j. $6.3 \div 10$ k. $94.7 \div 100$ l. $0.3 \div 0.03$

2. Divide. Round answers to the nearest hundredth.

a. $5\overline{)124}$ b. $7\overline{)7650}$ c. $12\overline{)6012}$

d. $9\overline{)111.06}$ e. $41\overline{)125.46}$ f. $.08\overline{)112}$

g. $0.06\overline{)96}$ h. $1.5\overline{)47.55}$ i. $0.22\overline{)0.6666}$

j. $0.048\overline{)2.4}$ k. $1.02\overline{)91.8}$ l. $3.4\overline{)346.902}$

3. Divide. Round the answers to the nearest hundredths.

a. $3\overline{)61}$ b. $7\overline{)20}$ c. $0.6\overline{)11}$

d. $11\overline{)6}$ e. $1.3\overline{)5.4}$ f. $0.17\overline{)9.2}$

g. $0.41\overline{)18.63}$ h. $23\overline{)842.96}$

4. Three children decide to share the cost of their mother's $40 gift. How much should each pay? Round the answer to the nearest cent.

5. Kim drove 310 km on 28.5 litres of gas. How far does she travel on one litre of gas? Round the answer to the nearest tenth.

6. Tracy bought 9 apples for $1.71. How much did each apple cost?

R.8 Order of operations

Consider the following calculation:

$2 + 3 \times 4$

Do we add first or multiply first? In other words, is it $5 \times 4 = 20$ or $2 + 12 = 14$? Mathematicians have decided upon the following order of operations:

1. First, perform all operations **within brackets**, such as ( ), { } or [ ].
2. Second, perform all operations involving **exponents** (or powers).
3. Third, perform all **multiplying and dividing** operations, from left to right.
4. Fourth and last, perform all **adding and subtracting** operations, from left to right.

The acronym **BEDMAS** will help you to remember the order of operations. The letters stand for:

Brackets

Exponents

$\left.\begin{array}{l}\textbf{D}\text{ivision}\\ \textbf{M}\text{ultiplication}\end{array}\right\}$ left to right

$\left.\begin{array}{l}\textbf{A}\text{ddition}\\ \textbf{S}\text{ubtraction}\end{array}\right\}$ left to right

This is an international system for dealing with multiple operations.

We can now answer the above question:

$2 + 3 \times 4 = 2 + 12 = 14$

Example 1

Find $50 - 2(3^2 + 8)$

Solution

First, calculate the exponent inside the brakets:

$3^2 = 3 \text{ x } 3 = 9$

$50 - 2(3^2 + 8) \quad = \quad 50 – 2(9 + 8)$

Next, add 9 + 8 inside the brackets.

$$50 - 2\,(9 + 8) = 50 - 2(17)$$

Next, multiply 2(17). This expression means 2×17. Multiplication is always indicated by placing a number in front of brackets, or by using the multiplication dot, as in $2 \cdot 17$.

$$50 - 2(17) = 50 - 34$$

Last, subtract 50 - 34.

$$50 - 34 = 16$$

When working towards a solution, it is safest to perform just one operation at a time.

Example 2

Calculate $7 + 3 \div 0.5 \times 10$

Solution

First perform the division, then the multiplication, and finally the addition operations.

$$\begin{aligned} &7 + 3 \div 0.5 \times 10 \\ &= 7 + 6 \times 10 \\ &= 7 + 60 \\ &= 67 \end{aligned}$$

Example 3

Calculate $2[1.4 \div 0.7 \times 0.5 \div (0.05 + 0.2)]$

Solution

When a bracket contains another bracket, we first calculate the inner bracket, then the outer one. Use the order of operations (BEDMAS) within each bracket. Finally, multiply by 2.

$$\begin{aligned} &\;\;2[1.4 \div 0.7 \times 0.5 \div (0.05 + 0.2)] \\ &= 2[1.4 \div 0.7 \times 0.5 \div (0.25)] \\ &= 2[2 \times 0.5 \div (0.25)] \\ &= 2[1.0 \div (0.25)] \\ &= 2[4] \\ &= 8 \end{aligned}$$

Now complete Exercise R.8 and check your answers.

Exercise R.8

1. Calculate

   a. $12 + 6 \div 3$ b. $36 \div 9 \times 2$ c. $36 \times 2 \div 9$

   d. $10^2 \div 5 + 5$ e. $2(8.1 - 0.6)$ f. $99 \div (10 - 0.1)$

   g. $99 + 10 \div 0.1^2$ h. $6.5 - 3.2 \div 0.8$ i. $16 + 4(1.0 - 0.5)$

2. Calculate

   a. $16 - (2 + 3^3 - 1) \div 2$ b. $18 \div 3 + 3 \times 5 - 2$

   c. $3[0.3 + 3(3 + 0.3)]$ d. $14 - 7 \div (0.3 + 0.4) \times 0.2$

   e. $(9 - 7)(9 + 7)$ f. $0.5(1.0 - 0.1)(1.0 + 0.1)$

   g. $4 + 6(8.1 - 1.1) - 25$ h. $20 - 12 \div 2 \times 6(0.8 - 0.3)$

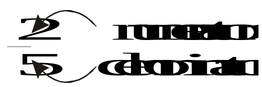
3. Donna has saved \$180. She plans to save \$55 every week for the next 8 weeks. How much will she have saved altogether after 8 weeks?

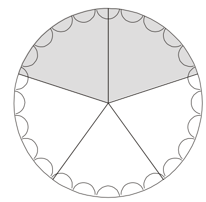
4. Four people went to dinner. Three people had the \$12.95 dinner special while the fourth person had a \$14.95 dinner. The wine totaled \$22.50. If they split the bill four ways, how much should each pay?

R.9 Operations with fractions

Fractions are numbers that express parts of a whole. For example, if we cut a pie into 5 equal pieces and we eat 2 of them, then we ate 2 out of 5 pieces, or $\frac{2}{5}$ (two fifths) of the pie.

Fractions are written as one number over another. The top number is the **numerator** (the number of parts selected) and the bottom number is the **denominator** (total number of equal parts in the whole).





When working with fractions it is important to remember that the whole is the same as the number one. So if we ate 5 out of 5 pieces, or $\frac{5}{5}$ of the pie, then we ate one whole pie.

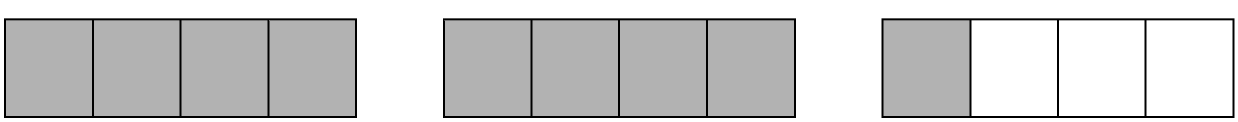
Fractions can be used to represent numbers less than one, more than one, or equal to one.

Proper fractions are less than one, because the numerator is less than the denominator. For example, $\frac{1}{2} < 1$, $\frac{3}{4} < 1$, $\frac{9}{10} < 1$ and $\frac{1}{40} < 1$.

Improper fractions are greater than or equal to one, because the numerator is greater than or equal to the denominator. For example, $\frac{4}{3} > 1$, $\frac{10}{10} = 1$, $\frac{9}{4} > 1$ and $\frac{13}{12} > 1$.

Mixed numbers are composed of a whole number and a proper fraction. Mixed numbers are always greater than one. For example, $1\frac{1}{4} > 1$, $5\frac{3}{8} > 1$, $10\frac{1}{2} > 1$ and $2\frac{4}{7} > 1$.

The rectangles shown below have been divided into four equal parts. The shaded part can be described by the improper fraction as $\frac{9}{4}$ or by the mixed number $2\frac{1}{4}$.



Example 1

Write $\frac{13}{5}$ as a mixed number.

Solution

Since $\frac{5}{5} = 1$, we can write $\quad \frac{13}{5} = \frac{5}{5} + \frac{5}{5} + \frac{3}{5} = 1 + 1 + \frac{3}{5} = 2\frac{3}{5}$

But since fractions also indicate division, $\frac{13}{5}$ means 13 ÷ 5, so a better way to write an improper fraction as a mixed number is to divide the numerator by the denominator.

$$\frac{13}{5} \Rightarrow \begin{array}{r} 2 \\ 5\overline{)13} \\ \underline{10} \\ 3 \end{array} \Rightarrow 2\frac{3}{5}$$

Example 2

Write $4\frac{3}{8}$ as an improper fraction.

Solution

To find the number of eighths in $4\frac{3}{8}$, we can write

$$4\frac{3}{8} = 1 + 1 + 1 + 1 + \frac{3}{8} = \frac{8}{8} + \frac{8}{8} + \frac{8}{8} + \frac{8}{8} + \frac{3}{8} = \frac{35}{8}$$

A more efficient way to change a mixed number to an improper fraction is to multiply the whole number by the denominator, and then add this product to the numerator.

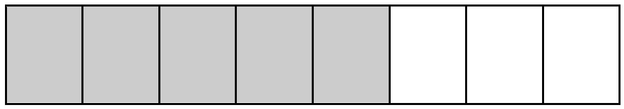
$$4\frac{3}{8} = \frac{4 \times 8 + 3}{8} = \frac{32 + 3}{8} = \frac{35}{8}$$

Now complete Exercise R.9 and check your answers.

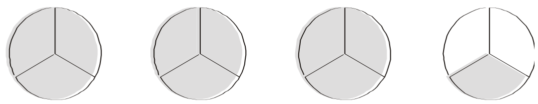
Exercise R.9

1. Write the fraction that describes the shaded regions.

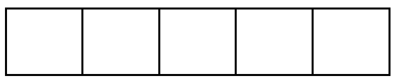
a.



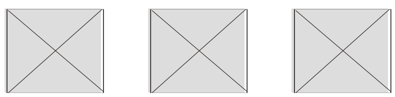
b.



c.



d.



2. Write as mixed numbers.

a. $\frac{7}{5}$ b. $\frac{19}{2}$ c. $\frac{41}{9}$ d. $\frac{12}{4}$

e. $\frac{8}{8}$ f. $\frac{64}{11}$ g. $\frac{43}{22}$ h. $\frac{10}{9}$

i. $\frac{84}{7}$

3. Write as improper fractions.

a. $2\frac{1}{2}$ b. $10\frac{3}{4}$ c. $4\frac{3}{5}$ d. 8

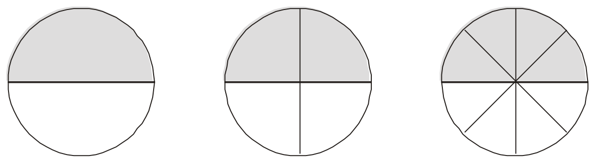
e. $33\frac{1}{3}$ f. $9\frac{5}{8}$ g. $14\frac{9}{10}$ h. $1\frac{73}{100}$

i. $15\frac{7}{12}$

4. Bill has 31 quarters. How much money, in dollars and quarters is this?

R.10 Equivalent fractions

In each of the following, one half of the pie is shaded.



$\frac{1}{2}$ $\frac{2}{4}$ $\frac{4}{8}$

The fractions $\frac{1}{2}$, $\frac{2}{4}$, and $\frac{4}{8}$ are called **equivalent fractions** because they represent the same value, so $\frac{1}{2} = \frac{2}{4} = \frac{4}{8}$.

There are infinitely many ways of expressing the value $\frac{1}{2}$ as equivalent fractions, such as:

$$\frac{1}{2} = \frac{2}{4} = \frac{3}{6} = \frac{4}{8} = \frac{5}{10} = \frac{6}{12} = \frac{7}{14} = \ldots$$

For ease of understanding, a fraction can be **simplified** by expressing it in "lowest terms".

A fraction is in lowest terms when both the numerator and the denominator cannot be divided by the same number, that is, they have no common factor other than 1.

For example, $\frac{10}{15}$ is not in lowest terms because both 10 and 15 are divisible by 5, as follows:

$$\frac{10}{15} = \frac{10 \div 5}{15 \div 5} = \frac{2}{3}$$ This creates an equivalent fraction $\frac{2}{3}$, which is in lowest terms.

Example 1

Simplify by reducing to lowest terms: a) $\frac{78}{54}$ b) $\frac{125}{400}$

Solutions

(using 1 or 2 or more steps, depending on the common factor we divide by)

2 steps a) $\frac{78}{54} = \frac{78 \div 2}{54 \div 2} = \frac{39 \div 3}{27 \div 3} = \frac{13}{9}$ b) $\frac{125}{400} = \frac{125 \div 5}{400 \div 5} = \frac{25 \div 5}{80 \div 5} = \frac{5}{16}$

1 step a) $\frac{78}{54} = \frac{78 \div 6}{54 \div 6} = \frac{13}{9}$ b) $\frac{125}{400} = \frac{125 \div 25}{400 \div 25} = \frac{5}{16}$

When it is difficult to find a common factor to divide by, another way to simplify fractions is to factor both the numerator and the denominator into “prime” factors.

Prime numbers are divisible only by one or by themselves. The first 10 prime numbers are:

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, ...

Example 2

Write 140 as a product of prime factors (this process is called “prime factoring”).

Solution The process is to factor the number until all factors are prime numbers. Note that we can start the process with any two factors of 140, using the “tree” method as shown:

```
 140                          140
 /   \                        /   \
2 × 70                      10 × 14
    /  \         OR         /  \   /  \
   2 × 35                 2 × 5  2 × 7
       /  \
      5 × 7
```

We write 140 as a product of prime factors as 2 × 2 × 5 × 7 (“prime factorization” of 140).

Using the prime factoring method to reduce a fraction to lowest terms, the prime numbers that occur in both the numerator and denominator can be cancelled, as shown below:

(because $\frac{5}{5}=1$) $\frac{15}{20}=\frac{3\times5}{2\times2\times5}=\frac{3\times\cancel{5}}{2\times2\times\cancel{5}}=\frac{3}{2\times2}=\frac{3}{4}$

Example 3

Simplify by reducing to lowest terms: a. $\frac{30}{63}$ b. $\frac{66}{24}$

Solutions (using either division by common factors, or the prime factoring method)

a. $\frac{30\div3}{63\div3}=\frac{10}{21}$ **OR** $\frac{30}{63}=\frac{2\times3\times5}{3\times3\times7}=\frac{2\times\cancel{3}^{1}\times5}{\cancel{3}_{1}\times3\times7}=\frac{10}{21}$

b. $\frac{66\div2}{24\div2}=\frac{33\div3}{12\div3}=\frac{11}{4}$ **OR** $\frac{66}{24}=\frac{2\times3\times11}{2\times2\times2\times3}=\frac{\cancel{2}^{1}\times\cancel{3}^{1}\times11}{\cancel{2}_{1}\times2\times2\times\cancel{3}_{1}}=\frac{11}{4}$

	Now complete Exercise R.10 and check your answers.

Exercise R.10

1. Prime factor (write as a product of primes):

   a. 80 b. 18 c. 35 d. 49

   e. 77 f. 100 g. 144 h. 20

   i. 200 j. 150

2. List the prime numbers that are greater than 20 but less than 40.

3. Simplify by reducing to lowest terms:
   (using either division by common factors, or the prime factoring method):

   a. $\frac{9}{24}$ b. $\frac{3}{6}$ c. $\frac{8}{12}$ d. $\frac{10}{15}$

   e. $\frac{21}{21}$ f. $\frac{25}{20}$ g. $6\frac{10}{35}$ h. $\frac{32}{64}$

   i. $\frac{60}{70}$ j. $\frac{26}{20}$ k. $\frac{32}{24}$ l. $12\frac{18}{40}$

   m. $\frac{8}{80}$ n. $\frac{51}{17}$ o. $\frac{26}{78}$ p. $9\frac{88}{110}$

4. Is 2001 a prime number?

R.11 Adding and subtracting fractions

To add or subtract fractions, they must have the same denominator (a common denominator), as in the examples below. We simply add or subtract the numerators, write the sum or difference over the common denominator, and simplify if possible.

a. $\frac{2}{8}+\frac{3}{8}=\frac{5}{8}$

b. $\frac{15}{16}-\frac{3}{16}=\frac{15-3}{16}=\frac{12}{16}\Rightarrow\frac{12\div 4}{16\div 4}=\frac{3}{4}$

To add or subtract fractions with different denominators, like $\frac{2}{3}+\frac{1}{4}$, we first need to

- Find the "least common denominator" (LCD).
- Rewrite each fraction as an equivalent fraction having the LCD.

To find the LCD, look at the first few multiples of the larger denominator (4, 8, $\boxed{12}$…), then select the smallest multiple (12) which is also divisible by the other denominator.

To rewrite each fraction as an equivalent fraction having a denominator of 12, multiply the original denominator (as well as the numerator) by the factor required, as shown below.

$$\frac{2}{3}+\frac{1}{4}=\frac{2\times 4}{3\times 4}+\frac{1\times 3}{4\times 3}=\frac{8}{12}+\frac{3}{12}=\frac{11}{12}$$

Note

- This process of multiplying the numerator and denominator by the same factor is the reverse of dividing by the same factor, when reducing fractions to lowest terms.
- When the LCD is difficult to find, we can always multiply the denominators to find a common denominator, although it may not be the smallest one.

Example 1

a. Add $\frac{7}{10}+\frac{3}{8}$

b. Subtract $\frac{11}{16}-\frac{1}{4}$

Solutions

LCD is 10, 20, 30, $\boxed{40}$…

a. $\frac{7}{10}+\frac{3}{8}=\frac{7\times 4}{10\times 4}+\frac{3\times 5}{8\times 5}=\frac{28}{40}+\frac{15}{40}=\frac{43}{40}=1\frac{3}{40}$

LCD is $\boxed{16}$…

b. $\frac{11}{16}-\frac{1}{4}=\frac{11}{16}-\frac{1\times 4}{4\times 4}=\frac{11}{16}-\frac{4}{16}=\frac{7}{16}$

Example 2

Subtract $9\frac{4}{5} - 6\frac{3}{10}$

Solution

The LCD is 10. With mixed numbers we can align the whole numbers and the fractions, and add or subtract them separately, then simplify the answer if possible.

$$\begin{array}{r}
9\frac{4}{5} = 9\frac{4\times 2}{5\times 2} = 9\frac{8}{10} \\
-6\frac{3}{10} = 6\frac{3}{10} = 6\frac{3}{10} \\
\hline
3\frac{5}{10} = 3\frac{1}{2}
\end{array}$$

Example 3

Subtract $4\frac{1}{3} - 1\frac{1}{2}$

Solution

The LCD is 6. Rewriting the problem as $4\frac{2}{6} - 1\frac{3}{6}$, note that we cannot subtract $\frac{3}{6}$ from $\frac{2}{6}$, so we borrow $\frac{6}{6}$ (= 1) from the 4. Then we add the $\frac{6}{6}$ to $\frac{2}{6}$, so we can subtract $\frac{3}{6}$ from $\frac{8}{6}$.

$$\begin{array}{rr}
4\frac{1}{3} = 4\frac{1\times 2}{3\times 2} = 4\frac{2}{6} & = 3 + \frac{6}{6} + \frac{2}{6} = 3\frac{8}{6} \\
-1\frac{1}{2} = 1\frac{1\times 3}{2\times 3} = 1\frac{3}{6} & -1\frac{3}{6} \\
\hline
 & 2\frac{5}{6}
\end{array}$$

	Now complete Exercise R.11 and check your answers.

Exercise R.11

1. Add or subtract, and write the answers in lowest terms.

   a. $\frac{3}{4}-\frac{1}{4}$ b. $\frac{5}{8}+\frac{3}{8}$ c. $\frac{1}{5}+\frac{3}{5}+\frac{4}{5}$

   d. $4\frac{5}{6}-3\frac{1}{6}$ e. $2\frac{13}{16}+5\frac{5}{16}+7\frac{9}{16}$ f. $13\frac{1}{3}-6\frac{2}{3}$

   g. $4\frac{1}{2}-2$ h. $9-6\frac{3}{10}$ i. $4\frac{7}{12}+16+3\frac{5}{12}$

2. Add and write the answers in lowest terms.

   a. $\frac{1}{4}+\frac{1}{2}$ b. $\frac{2}{3}+\frac{1}{4}$ c. $\frac{7}{8}+\frac{3}{4}$

   d. $\frac{2}{15}+\frac{7}{10}$ e. $16\frac{3}{4}+24\frac{5}{6}$ f. $2\frac{2}{3}+\frac{11}{12}$

   g. $\frac{1}{2}+\frac{1}{3}+\frac{1}{4}$ h. $4\frac{2}{5}+17\frac{1}{3}+6\frac{5}{6}$

3. Subtract and write the answers in lowest terms.

   a. $\frac{5}{6}-\frac{1}{3}$ b. $\frac{59}{100}-\frac{3}{10}$ c. $7\frac{5}{8}-2\frac{1}{4}$

   d. $13-4\frac{3}{4}$ e. $19\frac{1}{2}-11\frac{2}{3}$ f. $5\frac{3}{8}-\frac{3}{4}$

   g. $10\frac{3}{16}-5\frac{2}{3}$ h. $22\frac{7}{10}-21\frac{3}{4}$

4. If Jack ate half a pie and Jill ate a third of the same pie, how much was left over?

5. Roy worked $3\frac{1}{4}$ hours on Monday, $5\frac{1}{2}$ hours on Wednesday and $4\frac{1}{3}$ hours on Friday. How many hours altogether did he work?

6. Joan cut $7\frac{3}{4}$ inches off a 12 inch board. How much of the board was left?

R.12 Multiplying fractions

To multiply fractions,

1. **rewrite whole numbers and mixed numbers as improper fractions**
2. **multiply the numerators**
3. **multiply the denominators**
4. **reduce the product to lowest terms**

Example 1

Multiply $\frac{2}{3} \times \frac{4}{5}$

Solution

$$\frac{2}{3} \times \frac{4}{5} = \frac{2 \times 4}{3 \times 5} = \frac{8}{15}$$

Example 2

Multiply $2\frac{3}{4} \times 5$. Write the answer as a mixed number.

Solution

$$2\frac{3}{4} \times 5 = \frac{11}{4} \times \frac{5}{1} = \frac{11 \times 5}{4 \times 1} = \frac{55}{4} = 13\frac{3}{4}$$

Example 3

Multiply $\frac{4}{21} \times 3\frac{1}{2}$

Solutions

1. $\frac{4}{21} \times 3\frac{1}{2} = \frac{4}{21} \times \frac{7}{2} = \frac{4 \times 7}{21 \times 2} = \frac{28}{42} \quad \Rightarrow \quad \frac{28 \div 2}{42 \div 2} = \frac{14 \div 7}{21 \div 7} = \frac{2}{3}$

2. $\frac{4}{21} \times 3\frac{1}{2} = \frac{\overset{2}{\cancel{4}}}{\underset{3}{\cancel{21}}} \times \frac{\overset{1}{\cancel{7}}}{\underset{1}{\cancel{2}}} = \frac{2 \times 1}{3 \times 1} = \frac{2}{3}$

Hint Before we multiply in solution 2, we divide the 7 and 21 by the common factor of 7, and the 4 and 2 by the common factor of 2. This process of "cancelling" common factors reduces the numbers that are multiplied, and makes reducing to lowest terms easier.

Now complete Exercise R.12 and check your answers.

Exercise R.12

1. Multiply and write the products in lowest terms.

a. $\frac{2}{3} \times \frac{7}{11}$　　b. $\frac{5}{12} \times \frac{3}{5}$　　c. $\frac{5}{8} \times \frac{8}{5}$　　d. $\frac{7}{8} \times 1\frac{1}{2}$

e. $3\frac{1}{4} \times 5$　　f. $2\frac{7}{10} \times 5\frac{1}{3}$　　g. $12 \times \frac{3}{4}$　　h. $1\frac{1}{2} \times 1\frac{3}{5}$

i. $2\frac{7}{8} \times 3\frac{1}{5}$　　j. $\frac{3}{4} \times 7\frac{2}{9}$

2. Shelly exercised $\frac{3}{4}$ of an hour every day.
How many hours in a week did she exercise?

3. Bill did $\frac{2}{3}$ of the 69 math questions. How many questions did he **not** do?

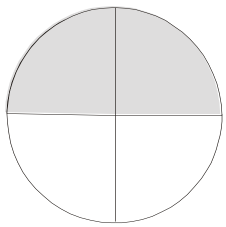
Note A fraction "of" another number means multiplication.
So $\frac{2}{3}$ of 69 means $\frac{2}{3} \times 69$.

4. Carol spent three quarters of the $1\frac{1}{2}$ hour long English class staring out the window.
How much time did she spend doing this?

R.13 Dividing fractions

What is one half divided by one quarter? That is, how many quarters are there in one half? The drawing shows there are two quarters in the shaded half of the pie, or that $\frac{1}{2} \div \frac{1}{4} = 2$.

$\frac{1}{2}$



Notice also that $\frac{1}{2} \times \frac{4}{1} = 2$, which shows that $\frac{1}{2} \div \frac{1}{4}$ has the same value as $\frac{1}{2} \times \frac{4}{1}$.

The number $\frac{4}{1}$ is the "reciprocal" of $\frac{1}{4}$, (numerator and denominator are interchanged).

So the way to divide by a fraction is to multiply by the reciprocal.

To divide fractions,

1. **rewrite whole numbers and mixed numbers as improper fractions**
2. **rewrite the division problem as multiplication by the reciprocal**
3. **multiply and reduce the answer to lowest terms**

Example 1 Divide $\frac{1}{2} \div \frac{2}{3}$

Solution

To divide by $\frac{2}{3}$, rewrite the problem as multiplication by the reciprocal $\frac{3}{2}$.

$$\frac{1}{2} \div \frac{2}{3} = \frac{1}{2} \times \frac{3}{2} = \frac{1 \times 3}{2 \times 2} = \frac{3}{4}$$

Example 2 Divide $6\frac{3}{8} \div 5$

Solution

Rewrite both numbers as improper fractions, then multiply by the reciprocal.

$$6\frac{3}{8} \div 5 = \frac{51}{8} \div \frac{5}{1} = \frac{51}{8} \times \frac{1}{5} = \frac{51 \times 1}{8 \times 5} = \frac{51}{40} = 1\frac{11}{40}$$

Now complete Exercise R.13 and check your answers.

Exercise R.13

1. Divide

a. $\frac{1}{2} \div \frac{3}{5}$ b. $\frac{1}{2} \div \frac{1}{2}$ c. $\frac{3}{4} \div 2$ d. $\frac{7}{12} \div \frac{4}{5}$

e. $1\frac{1}{2} \div \frac{3}{4}$ f. $\frac{1}{8} \div 2\frac{1}{4}$ g. $12 \div 2\frac{2}{5}$ h. $3\frac{2}{3} \div 5\frac{1}{4}$

i. $3 \div \frac{1}{2}$ j. $4\frac{1}{2} \div 3\frac{7}{8}$

2. Kim made nine plates in $2\frac{1}{4}$ hours.
How long did it take her to make one plate?

3. Greg cut two thirds of the cake into five equal pieces and then ate one piece.
What fraction of the whole cake did Greg eat?

R.14 Converting fractions and decimals

Converting fractions to decimals

To write a fraction as an equivalent decimal,
1. **divide the numerator by the denominator**
2. **add as many zeros after the decimal point as needed to achieve the desired accuracy**

$$\frac{3}{4} = 3 \div 4 = 4\overset{0.75}{\overline{)3.00}}$$

Example 1

Write $\frac{5}{8}$ as a decimal.

Solution

$$\frac{5}{8} = 5 \div 8 = 8\overset{0.625}{\overline{)5.000}}$$

Example 2

Write $\frac{2}{7}$ as a decimal. Round to the nearest thousandth.

Solution

To round to the nearest thousandth, 4 decimal places are required.

$$\frac{2}{7} = 2 \div 7 = 7\overset{0.2857}{\overline{)2.0000}}$$ To the nearest thousandth, $\frac{2}{7} = 0.286$

Example 3

Write $5\frac{1}{3}$ as a decimal.

Solution

The whole number 5 remains the same. Only the fraction $\frac{1}{3}$ needs to be converted.

$$\frac{1}{3} = 1 \div 3 = 3\overset{0.333}{\overline{)1.000}}$$ This is a repeating decimal, so $5\frac{1}{3} = 5.\bar{3}$

Converting decimals to fractions

To write a decimal as an equivalent fraction, write the fraction as you would read the decimal, as shown in the examples below:

0.7 = seven tenths = $\frac{7}{10}$

4.83 = four and eighty-three hundredths = $4\frac{83}{100}$

0.029 = twenty-nine thousandths = $\frac{29}{1000}$

0.2011 = two thousand eleven ten thousandths = $\frac{2011}{10000}$

5.00891 = five and eight hundred ninety-one hundred thousandths = $5\frac{891}{100000}$

To write a decimal as an equivalent fraction,

1. **write the decimal digits in the numerator**
2. **write the power of 10 with the same number of zeros as there are decimal digits in the denominator**
3. **reduce to lowest terms**

Example 1

Write 8.0306 as a mixed number.

Solution

Since there are four decimal digits, the denominator is 10 000.

$$8.0306 = 8\frac{306}{10000} = 8\frac{153}{5000}$$

Now complete Exercise R.14 and check your answers.

Exercise R.14

1. Write as decimals, and then try to memorize these common conversions.

   a. $\frac{1}{2}$ b. $\frac{1}{3}$ c. $\frac{2}{3}$ d. $\frac{1}{4}$ e. $\frac{2}{4}$

   f. $\frac{3}{4}$ g. $\frac{1}{5}$ h. $\frac{2}{5}$ i. $\frac{3}{5}$ j. $\frac{4}{5}$

2. Write as decimals.

   a. $\frac{1}{6}$ b. $\frac{5}{6}$ c. $\frac{1}{8}$ d. $\frac{5}{8}$ e. $2\frac{1}{4}$

   f. $\frac{1}{12}$ g. $\frac{3}{10}$ h. $\frac{3}{100}$ i. $1\frac{5}{12}$ j. $6\frac{7}{8}$

3. Write as fractions and reduce to lowest terms.

   a. 0.9 b. 0.61 c. 0.907 d. 1.1 e. 6.02

   f. 0.70 g. 0.001 h. 27.95 i. 0.0105 j. 1.502

4. Write as fractions and reduce to lowest terms.

   a. 0.5 b. 0.25 c. 0.125 d. 0.2

   e. 0.04f. 0.75 g. 0.6 h. 0.4

5. Write as decimals.

   a. $\frac{7}{9}$ b. $\frac{14}{99}$ c. $\frac{2}{9}$ d. $\frac{82}{99}$

R.15 Estimation

Estimation is a very useful math skill, when we calculate the approximate cost of something.

Example

You and a friend are having dinner at a restaurant. As you look at the menu, you try to estimate the cost of your meal.

Main Course

Roast Beef	**$13.95**
Chicken	**$11.50**
Spaghetti	**$ 9.75**
Vegetarian Lasagne	**$10.99**

Desserts

Cheesecake	**$ 4.25**
Apple Pie	**$ 3.90**
Ice Cream	**$ 2.75**

Beverages

Milk	**$ 1.50**
Coffee	**$ 0.99**
Tea	**$ 0.99**
Soft Drinks	**$ 1.55**

You choose chicken, apple pie and coffee. Your friend chooses lasagne, ice cream and a soft drink.

To estimate the cost of each person's meal, you can round each price up or down. In this example, if your round up, your estimate will be higher than the actual cost.

	Your meal		**Your friend**	
	Chicken	**$12**	**Lasagne**	**$11**
	Apple pie	**$ 4**	**Ice cream**	**$ 3**
	Coffee	**$ 1**	**Soft drink**	**$ 2**
Total estimated cost		**$17**		**$16**

Note that estimates are not exact answers and may vary depending on whether you round up or down.

Estimation can also be used to confirm that our calculations are reasonable, because whether we use paper and pencil or an electronic calculator, we can easily make a calculation error, such as misplacing a decimal point, entering an extra zero, or copying a number incorrectly.

To estimate we round the numbers to the nearest 1, 10, 100, 1000, etc, which often allows us to calculate mentally, and gives us an approximate or "ballpark" answer.

There is more than one way to estimate, and it takes practice to be able to choose numbers that make estimating easier and more accurate. Here are some estimating strategies:

1. Round numbers to the largest place value possible, which makes them easier to compute mentally.

   For example, to estimate the answer to 189 × 325 (exact answer = 61 425), round to the nearest 100, then multiply 200 × 300 = 60 000 (mentally, 2 × 3 plus 4 zeros).

2. To increase the accuracy of the estimate, when it is reasonable and convenient,
   - all numbers do not need to be rounded
   - round one number up and the other number down when adding or multiplying
   - round both numbers in the same direction when subtracting or dividing

problem	**estimate**	**exact answer**
31 × 4	30 × 4 = 120	124
48 × 5	50 × 5 = 250	240
75 × 47	70 × 50 = 3500	3525
789 ÷ 35	800 ÷ 40 = 20	22.5

3. Use numbers that are compatible and easy to work with.
   For example, to estimate 2775 ÷ 6 (exact answer 462.5), a couple of options are
   - 3000 ÷ 6 = 500
   - 2800 ÷ 7 = 400

4. Round fractions and decimals to easy-to-calculate whole numbers. For example:

problem	**estimate**	**exact answer**
19.32 − 7.69	19 − 8 = 11	11.63
3.7 × 8.2	4 × 8 = 32	30.34
$16\frac{2}{3}+12\frac{1}{8}$	17 + 12 = 29	$28\frac{19}{24}$
$21\frac{3}{4}\div 3\frac{4}{5}$	20 ÷ 4 = 6	$5\frac{55}{76}$

5. Group numbers to make estimation easier.
   For example, a good estimate of 48 + 27 + 55 + 75 + 98 is approximately 300.
   This is because 48 + 55 is about 100, 27 + 75 is about 100, and 98 is about 100.

Now complete Exercise R.15 and check your answers.

Exercise R.15

1. Round the numbers as required, then mentally estimate the answers:

a. $\$4.99 + \$3.29 + \$6.89$

b. 7.4×9.8

c. $2\frac{2}{3} + 4\frac{1}{8} + 3\frac{1}{4}$

d. $4397 - 1970$

e. $125 + 98 + 73 + 142 + 59$

f. $174\frac{3}{4} - 49\frac{3}{5}$

g. $17.4 + 9.1 + 2.8 + 10.7$

h. $795 \div 4$

i. $9\frac{2}{3} \times 4\frac{7}{8}$

j. $8125 \div 52$

k. $\$7.69 + \$5.49 + \$7.99$

l. 18.5×42.9

m. $5\frac{13}{16} + 9\frac{1}{4} + 6\frac{7}{8}$

n. $2621 - 1685$

o. $38 + 21 + 105 + 82 + 157$

p. $128\frac{7}{8} - 62\frac{15}{16}$

q. $3.2 + 22.1 + 16.5 + 8.9$

r. $688 \div 7$

s. $8\frac{3}{10} \times 6\frac{3}{4}$

t. $2895 \div 48$

Now complete the Practice Test and check your answers.

Practice Test

1. Write the place value for the underlined digit.

   a. $8\underline{4}\ 926$ b. $6.0\underline{2}04$

2. Underline the tenths digit in 43.09.

3. Use >, < or = to compare the numbers below.

   a. 93.0______90.38 b. 84________84.00

   c. 0.002_____0.02 d. 99.9______10.000

4. Round as indicated.

   a. 3 452 to the nearest hundred

   b. 16.97 to the nearest tenth

   c. 804.99 to the nearest ten

5. Add 30.7 + 12 + 960.9 + 84.63

6. Subtract 689.49 from 1 207.3

7. Multiply.

   a. 24.06×0.58 b. 768×0.097

8. Divide.

   a. $8\overline{)3205}$ b. $1.3\overline{)0.052}$

9. Divide 7 by 0.11 and round the answer to the nearest hundredth.

10. Calculate.

    a. $28 - 12 \div 3 + 2^3$ b. $0.4[10 - 0.2(4.8 - 0.8)]$

11. Donna won \$5 000 and decided to share half of it among her three children. How much should each child receive?

12. Write as mixed numbers.

a. $\frac{25}{3}$ b. $\frac{39}{6}$

13. Write as improper fractions.

a. $4\frac{3}{5}$ b. $16\frac{2}{3}$

14. Reduce to lowest terms.

a. $\frac{25}{30}$ b. $8\frac{12}{90}$

15. Add or subtract and reduce answers to lowest terms.

a. $\frac{2}{5}+\frac{1}{3}$ b. $\frac{7}{8}-\frac{1}{2}$ c. $6\frac{4}{5}+18\frac{5}{12}+\frac{2}{3}$

d. $12-3\frac{7}{10}$ e. $4\frac{3}{16}-\left(\frac{3}{4}\right)^2$

16. Multiply or divide and reduce answers to lowest terms.

a. $6\times\frac{3}{4}$ b. $4\frac{1}{3}\div\frac{1}{2}$

c. $\frac{9}{10}\times\frac{5}{12}$ d. $3\frac{3}{8}\div 2\frac{2}{5}$

17. Write as decimals.

a. $\frac{5}{8}$ b. $3\frac{4}{11}$

18. Write as fractions.

a. 0.501 b. $12.\overline{3}$

19. Audrey has read two-thirds of a 396 page report. How many pages did she read?

20. Bill did $\frac{1}{4}$ of his assignment the first night, then $\frac{1}{3}$ the second night. How much would he have left to do on the third night?

21. The recipe calls for $\frac{3}{4}$ cup of sugar if you want to serve 6 people. How much sugar should you use to serve 2 people?

22. Estimate.

a. $14.7 + 12.36 + 18.25$ b. $5\frac{3}{4} \times 3\frac{1}{8} \times 9\frac{5}{6}$

23. In driving a distance of 489 km, Paul's car consumes 51.2 litres of gasoline. Estimate how many kilometres he can travel on one litre of gasoline.

Answers

Exercise R.1

1. a. ones b. thousandths c. hundredths
   d. ten thousand e. hundred thousandths f. millions
   g. tenths h. ones i. hundredths
   j. thousands
2. a. $8\underline{4}2.56$ b. $842.\underline{5}6$ c. $68\ 923.0\underline{5}$ d. $84\underline{3}\ 907\ 000$
   e. $63\ 521.009\ \underline{8}42$
3. a. $823 = 800 + 20 + 3$ b. $8.23 = 8 + \frac{2}{10} + \frac{3}{100}$
   c. $9\ 605 = 9\ 000 + 600 + 5$ d. $0.087 = \frac{0}{10} + \frac{8}{100} + \frac{7}{1000}$
   e. $3\ 842.65 = 3\ 000 + 800 + 40 + 2 + \frac{6}{10} + \frac{5}{100}$
4. $638
5. $50.32
6. $11.04
7. 2 hundred dollar bills, 0 ten dollar bills, 3 loonies, 4 dimes and 1 penny
8. 18 300 000 dollars

Exercise R.2

1. a. $<$ b. $=$ c. $>$ d. $<$ e. $=$ f. $>$
   g. $<$ h. $<$ i. $=$ j. $>$
2. a. 1.6 b. 0.040 18 c. 8.07 d. 13 265 e. 0.999 999 999
3. a. $\neq$ b. $\neq$ c. $=$ d. $\neq$ e. $\neq$ f. $\neq$
4. Jack

Exercise R.3

1. a. 8400 b. 200 c. 100 d. 0 e. 1 343 000
   f. 400
2. a. 6 b. 19 c. 50 d. 56 e. 1 f. 3
   g. 500 h. 2 i. 110 j. 0
3. a. 43 830 000 b. 0.0 c. 0.50 d. 0.4382 e. 1 f. 650
4. a. 0.91 b. 16.58 c. 0.12 d. 968.16 e. 0.00 f. 10.70
   g. 45.02 h. 5.31 i. 0.10 j. 11.68
5. Mike $20, Mary $84 and Sandra $44

Exercise R.4

1. a. 941 b. 1 094 c. 45 134
2. a. 1044 b. 90 315 c. 174 419
3. a. 96.35 b. 155.79 c. 1 327.457

4. a. 193.16 b. 9 678.173 c. 0.958 5
5. a. 143 b. 19 c. 78 989 d. 21.19 e. 0.020 57
   f. 95.26 g. 3.823 h. 60 475.19 i. 0.005 899
6. a. 82.17 b. 22.48 c. 0.497 d. 65.369 8
7. $3.17
8. $27.07
9. a. $280.51 b. $1 171.96 c. $1 138.27 d. $991.92 e. $541.92
10. a. 460 + 100 + 0 + 80 = 640 b. 8300 – 320 = 7980

Exercise R.5

1.

×	0	1	2	3	4	5	6	7	8	9
0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9
2	0	2	4	6	8	10	12	14	16	18
3	0	3	6	9	12	15	18	21	24	27
4	0	4	8	12	16	20	24	28	32	36
5	0	5	10	15	20	25	30	35	40	45
6	0	6	12	18	24	30	36	42	48	54
7	0	7	14	21	28	35	42	49	56	63
8	0	8	16	24	32	40	48	56	64	72
9	0	9	18	27	36	45	54	63	72	81

2. a. 0 b. that number c. 0 or 5 d. 9
3. a. 205 b. 1248 c. 82 128 d. 4 069 848
   e. 91.3 f. 10.64 g. 303.408 h. 16 588.95
   i. 1.141 j. 1 230.08 k. 0.555 l. 0.000 082
4. a. 10.62 b. 0.024 032 c. 0.000 12 d. 0.000 007 9
   e. 0.000 064
5. $36 619.70
6. 378 km

Exercise R.6

1. a. three squared b. ten cubed c. x cubed
   d. one half to the fourth OR one half to the power of four
   e. six to the sixth OR six to the power of six
2. a. 2^3 b. 8^5 c. $\left(\frac{1}{4}\right)^2$ d. 9.7^4 e. x^{10} f. 26^1
3. a. 169 b. 196 c. 225 d. 400 e. 625 f. $\frac{1}{4}$
   g. $\frac{1}{8}$ h. $\frac{1}{16}$ i. 0.125 j. $\frac{8}{27}$ k. 5.3 l. 6561

m. $\frac{25}{64}$ n. 1.44 o. 0.00001

4. a. 1 b. 10 c. 100 d. 1000 e. 10000 f. 100000
g. 1000000 h. 10000000

Exercise R.7

1. a. 8 b. 6 c. 9 d. 83 e. 0
   f. Undefined. It is impossible to divide any number by 0.
   g. 7 h. 1 i. 85 j. 0.63 k. 0.947 l. 10
2. a. 24 R4 b. 1 092 R6 c. 501 d. 12.34 e. 3.06 f. 1400
   g. 1 600 h. 31.7 i. 3.03 j. 50 k. 90 l. 102.03
3. a. 20.33 b. 2.86 c. 18.33 d. 0.55 e. 4.15 f. 54.12
   g. 45.44 h. 36.65
4. $13.33
5. 10.9 km
6. $0.19

Exercise R.8

1. a. 14 b. 8 c. 8 d. 25 e. 15 f. 10
   g. 1099 h. 2.5 i. 18
2. a. 2 b. 19 c. 30.6 d. 12 e. 32 f. 0.495
   g. 21 h. 2
3. $180 + 8($55) = $620
4. [12.95(3) + 14.95 + 22.50] ÷ 4 = $19.08

Exercise R.9

1. a. $\frac{5}{8}$ b. $\frac{10}{3}$ or $3\frac{1}{3}$ c. $\frac{0}{5}$ or 0 d. $\frac{12}{4}$ or 3
2. a. $1\frac{2}{5}$ b. $9\frac{1}{2}$ c. $4\frac{5}{9}$ d. 3 e. 1 f. $5\frac{9}{11}$
   g. $1\frac{21}{22}$ h. $1\frac{1}{9}$ i. 12
3. a. $\frac{5}{2}$ b. $\frac{43}{4}$ c. $\frac{23}{5}$ d. $\frac{8}{1}$ e. $\frac{100}{3}$ f. $\frac{77}{8}$
   g. $\frac{149}{10}$ h. $\frac{173}{100}$ i. $\frac{187}{12}$
4. $\frac{31}{4} = 7\frac{3}{4}$ or 7 dollars and 3 quarters

Exercise R.10

1. a. $80 = 2 \times 2 \times 2 \times 2 \times 5$
   b. $18 = 2 \times 3 \times 3$
   c. $35 = 5 \times 7$
   d. $49 = 7 \times 7$
   e. $77 = 7 \times 11$
   f. $100 = 2 \times 2 \times 5 \times 5$
   g. $144 = 2 \times 2 \times 2 \times 2 \times 3 \times 3$
   h. $20 = 2 \times 2 \times 5$
   i. $200 = 2 \times 2 \times 2 \times 5 \times 5$
   j. $150 = 2 \times 3 \times 5 \times 5$
2. 23, 29, 31, 37
3. a. $\frac{3}{8}$ b. $\frac{1}{2}$ c. $\frac{2}{3}$ d. $\frac{2}{3}$ e. 1 f. $\frac{5}{4}$
   g. $6\frac{2}{7}$ h. $\frac{1}{2}$ i. $\frac{6}{7}$ j. $\frac{13}{10}$ k. $\frac{4}{3}$ l. $12\frac{9}{20}$
   m. $\frac{1}{10}$ n. 3 o. $\frac{1}{3}$ p. $9\frac{4}{5}$
4. No ($2001 = 3 \times 23 \times 29$)

Exercise R.11

1. a. $\frac{1}{2}$ b. 1 c. $1\frac{3}{5}$ d. $1\frac{2}{3}$ e. $15\frac{11}{16}$
   f. $6\frac{2}{3}$ g. $2\frac{1}{2}$ h. $2\frac{7}{10}$ i. 24
2. a. $\frac{3}{4}$ b. $\frac{11}{12}$ c. $1\frac{5}{8}$ d. $\frac{5}{6}$ e. $41\frac{7}{12}$
   f. $3\frac{7}{12}$ g. $1\frac{1}{12}$ h. $28\frac{17}{30}$
3. a. $\frac{1}{2}$ b. $\frac{29}{100}$ c. $5\frac{3}{8}$ d. $8\frac{1}{4}$ e. $7\frac{5}{6}$
   f. $4\frac{5}{8}$ g. $4\frac{25}{48}$ h. $\frac{19}{20}$
4. $\frac{1}{6}$ of the pie was left over
5. $13\frac{1}{12}$ hours
6. $4\frac{1}{4}$ inches

Exercise R.12

1. a. $\frac{14}{33}$ b. $\frac{1}{4}$ c. 1 d. $1\frac{5}{16}$ e. $16\frac{1}{4}$
   f. $14\frac{2}{5}$ g. 9 h. $2\frac{2}{5}$ i. $9\frac{1}{5}$ j. $5\frac{5}{12}$
2. $5\frac{1}{4}$ hours in a week
3. 23 questions
4. $1\frac{1}{8}$ hours

Exercise R.13

1. a. $\frac{5}{6}$ b. 1 c. $\frac{3}{8}$ d. $\frac{35}{48}$ e. 2 f. $\frac{1}{18}$
   g. 5 h. $\frac{44}{63}$ i. 6 j. $1\frac{5}{31}$
2. $\frac{1}{4}$ hour per plate
3. $\frac{2}{15}$ of the cake

Exercise R.14

1. a. $\frac{1}{2} = 0.5$ b. $\frac{1}{3} = 0.\overline{3}$ c. $\frac{2}{3} = 0.\overline{6}$ d. $\frac{1}{4} = 0.25$ e. $\frac{2}{4} = 0.5$
   f. $\frac{3}{4} = 0.75$ g. $\frac{1}{5} = 0.2$ h. $\frac{2}{5} = 0.4$ i. $\frac{3}{5} = 0.6$ j. $\frac{4}{5} = 0.8$
2. a. $0.1\overline{6}$ b. $0.8\overline{3}$ c. 0.125 d. 0.625 e. 2.25
   f. $0.08\overline{3}$ g. 0.3 h. 0.03 i. $1.41\overline{6}$ j. 6.875
3. a. $\frac{9}{10}$ b. $\frac{61}{100}$ c. $\frac{907}{1000}$ d. $1\frac{1}{10}$ e. $6\frac{1}{50}$ f. $\frac{7}{10}$
   g. $\frac{1}{1000}$ h. $27\frac{19}{20}$ i. $\frac{21}{2000}$ j. $1\frac{251}{500}$
4. a. $\frac{1}{2}$ b. $\frac{1}{4}$ c. $\frac{1}{8}$ d. $\frac{1}{5}$ e. $\frac{1}{25}$ f. $\frac{3}{4}$
   g. $\frac{3}{5}$ h. $\frac{2}{5}$
5. a. $0.\overline{7}$ b. $0.\overline{14}$ c. $0.\overline{2}$ d. $0.\overline{82}$

Exercise R.15

1. (answers may vary)

a. $15	b. 70	c. 10	d. 2400	e. 500	f. 125
g. 40	h. 200	i. 50	j. 160	k. $21	l. 800
m. 22	n. 900	o. 400	p. 70	q. 50	r. 100
s. 56	t. 60				

Practice Test

1. a. thousands b. hundredths
2. $43.\underline{0}9$
3. a. $>$ b. $=$ c. $<$ d. $>$
4. a. 3500 b. 17.0 c. 800
5. 1 088.23
6. 517.81
7. a. 13.9548 b. 74.496
8. a. 400 R5 b. 0.04
9. 63.64
10. a. 32 b. 3.68
11. $833.33
12. a. $8\frac{1}{3}$ b. $6\frac{1}{2}$
13. a. $\frac{23}{5}$ b. $\frac{50}{3}$
14. a. $\frac{5}{6}$ b. $8\frac{2}{15}$
15. a. $\frac{11}{15}$ b. $\frac{3}{8}$ c. $25\frac{53}{60}$ d. $8\frac{3}{10}$ e. $3\frac{5}{8}$
16. a. $4\frac{1}{2}$ b. $8\frac{2}{3}$ c. $\frac{3}{8}$ d. $1\frac{13}{32}$
17. a. 0.625 b. $3.\overline{36}$
18. a. $\frac{501}{1000}$ b. $12\frac{1}{3}$
19. 264 pages
20. $\frac{5}{12}$ of the assignment
21. $\frac{1}{4}$ cup
22. (answers may vary)
    a. 45 b. 180
23. 10 kilometres

Glossary

Difference

The answer to a subtraction problem.

Equivalent

Equivalent quantities are equal.

Exponent

A quantity representing the power to which a given number or expression is to be raised, usually expressed as a raised symbol beside the number or expression.
For example:“3” in $2^3 = 2 \times 2 \times 2$

Factor

A number that divides evenly into another number (2 and 3 are factors of 6).

Improper fraction

An improper fraction has a numerator larger than the denominator.

Mixed number

A mixed number is a combination of a whole number and a proper fraction.

Prime number

A prime number is divisible only by itself and one. The number one is not a prime number. The first few prime numbers are 2, 3, 5, 7, 11, ...

Product

The answer to a multiplication problem.

Proper fraction

A proper fraction has a numerator smaller than the denominator.

Quotient

The answer to a division problem.

Sum

The answer to an addition problem.