EVALUATING
ACADEMIC READINESS
FOR APPRENTICESHIP TRAINING
Revised for
ACCESS TO APPRENTICESHIP

MATHEMATICS SKILLS
OPERATIONS WITH DECIMALS

AN ACADEMIC SKILLS MANUAL
for
The Precision Machining And Tooling Trades

This trade group includes the following trades:
General Machinist, Tool & Die Maker,
Mould Maker, Pattern Maker, and
Machine-Tool Builder Integrator

Workplace Support Services Branch
Ontario Ministry of Training, Colleges and Universities

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In preparing these Academic Skills Manuals we have used passages, diagrams and questions similar to those an apprentice might find in a text, guide or trade manual.

This trade related material is not intended to instruct you in your trade. It is used only to demonstrate how understanding an academic skill will help you find and use the information you need.

MATHEMATICS SKILLS
OPERATIONS WITH DECIMALS

An academic skill required for the study of the Precision Machining and Tooling Trades

INTRODUCTION

Throughout your course and on the job, you will use decimal numbers in numerous applications.

Examples:
You have to calculate bend allowances using the formula:
B/A = [(.01743 x R) + (.0078 x T)] x angle of bend.

The cost of an electric drill is listed at $499.75 plus tax.

All of the numerals above, include a dot. They are known as decimal numbers. Many of the numbers that you work with have a decimal part.

A decimal number is easily identified by the dot, called a decimal point, written in front of the decimal part of a number. A numeral, such as .5 is called a ***decimal number;*** *it expresses a quantity that is less than one whole.*

Example:
If you have part of a dollar or part of a meter, you can write that partial amount as a decimal.

- Often there is a unit attached to the decimal number so you know if it is part of a liter, part of a centimeter, or part of a dollar.

You use decimal numbers when dealing with money. To indicate amounts that are less than a whole dollar, a dollar is divided into100 smaller parts, called cents.

- The amount of money in cents is written using decimals.
  - The price of a welding manual is $18.95:
  - The price includes the number of whole dollars, 18, and a partial amount that is less than a whole dollar.
  - The partial amount of the dollar is written as a decimal number, .95, although we say the amount as a number of cents (95 cents).

You also work with decimals when you use a metric ruler. The smaller gradations on a metric ruler are expressed as decimals.

- A measurement that falls halfway between 3 and 4 centimeters is written as 3.5 centimeters.

Working with decimal numbers is similar to working with whole numbers with some special steps added. This skills manual looks at the following topics:

- Decimals as a special kind of fraction
- Addition and subtraction of decimals
- Multiplication of decimals
- Division of decimals
- Rounding off decimals
- Using a calculator
- Solving problems

DECIMALS AS A SPECIAL KIND OF FRACTION

Both decimals and fractions indicate partial amounts of something. Because a decimal is a special kind of fraction, we will briefly review fractions.

You know how to write a whole number. If there are 18 drill bits in a box, you write 18 to symbolize that amount. Sometimes, though, you need to indicate an amount that represents only part of a whole number or thing. To indicate this partial amount, you write a fraction or a decimal.

To write a fraction, you first must have an amount that represents one whole, such as 1 inch. On a measuring tape, each inch is divided into 16 smaller divisions. If you have a nail that measures 11 of those 16 smaller divisions, you have 11 out of the 16 parts that make a whole inch. This amount can be written as the fraction 11/16 inches.

In the fraction, 11/16, the bottom number, 16, represents the number of parts the whole inch was divided into. The top number, 11, represents the number of those parts your nail measures.

The parts of a fraction have their own names:

- The top part of a fraction is called the ***numerator***.
  - The numerator of the fraction 11/16 is 11.
- The bottom part is called the ***denominator***.
  - The denominator of the fraction 11/16 is 16.
- The dividing line is the ***fraction bar*** or ***fraction line***.

How Decimals Are Related to Fractions

A decimal number is an unusual kind of fraction. While a fraction can have any number as its denominator, the denominator of a decimal is always a power of ten (10, 100, 1000, 10 000 etc). But, in a decimal, the denominator is not shown. Only the numerator of the fraction is written. It is always written to the right of a period called the decimal point**.**

*The **decimal point** indicates that we have a fraction. However, only the numerator is shown; the denominator is not shown.*

Say a piece of aluminum is cut into 10 equal sized pieces. You use 3 of those pieces. You can write this amount as the fraction 3/10. You can also write this amount as a decimal.

- In the fraction 3/10, the denominator is 10.

You do not show the denominator when writing a decimal.

- Write a decimal point and then the numerator of the fraction after it.
- Since the numerator in this case is 3, write .3 as the decimal number that represents the fraction 3/10.

Using Place Value to Read and Write Decimals

In the decimal above, we knew that the denominator was 10. However, a decimal can have a denominator of 100, or 1000, or 10 000, or 1 000 000 etc. When you are given any decimal, you can tell how many zeros are in the denominator by counting the number of place values after the decimal point. *However many place values there are after the decimal point, there are that many zeros after the 1 in the denominator.* For example, in the decimal .453, there are three place values after the decimal point and so there are three zeros in the denominator, which is 1000. The decimal .453 is also the fraction 435/1000.

Reading decimals as fractions

We understand what the denominator is by the number of place values after the decimal point. Examine the place value table below to see what we mean.

1	.	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$	$\frac{1}{10\,00}$
7	.	5	6	9	8

The decimal of the example above goes to the ten-thousandths place. To read 7.5698 as a fraction we say seven **and** five thousand six hundred ninety-eight ten thousandths or $7\frac{5698}{10\,000}$
To read it as a decimal number we say seven **point** five six nine eight.

By the way, *just as there are names for the place values of whole numbers, there are also names for the place values of decimals. The place value names for decimals, starting just after or to the right of the decimal point are tenths, hundredths, thousandths, ten-thousandths, etc. Notice that the place values are similar to those of whole numbers except* ***th*** *is added to the end of the names and the decimal place values start with tenths.*

Writing Fractions as Decimals

If a fraction already has a power of ten as a denominator, like 3/10, you can change it to a decimal as shown above, just by removing the denominator and fraction line, then putting in a decimal point (3/10 = .3). However, if the fraction does not have a denominator that is a power of ten, such as the fraction 5/12, you use the following method to change the fraction to a decimal.

To change a fraction to a decimal:

1. Divide the numerator by the denominator.
2. The answer, with the decimal point, becomes the decimal number.

Example: Change 2/5 to a decimal.

The denominator 5 is divided into the numerator 2.

$$5\overline{)2.0}\quad .4$$

$$\underline{20}$$

$$0$$

Note: *This type of division with decimals will be explained in greater detail later in this skills manual.*

A whole number with a fraction part is called a mixed number. You can change a mixed number to a decimal number.

To change a mixed number to a decimal:

1. Change the fraction to a decimal by dividing the numerator by the denominator.
2. Then write the whole number with the decimal number following.

Example: Write 6 2/5 as a decimal.

Divide the denominator 5 into the numerator 2.

$2 \div 5 = .4$

Write the whole number 6 and then the decimal number .4.

$6\ 2/5 = 6.4$

Writing Decimals as Fractions

To reverse the process and write a decimal number as a fraction, you have to figure out what to use as the numerator and what to use as the denominator of the fraction.

Numerator: The number after the decimal point is the numerator.

Denominator: All decimals have an unwritten denominator that is a power of ten, such as 10 or 100, or 1000, or 10 000, or 1 000 000, etc.

When writing any decimal as a fraction, you can tell how many zeros to put in the denominator by counting the number of place values after, or to the right of, the decimal point. *However many place values there are after the decimal point, that is the number of zeros to put after the 1 in the denominator.*

To write any decimal as a fraction:

1. Write the number after the decimal point above the fraction line as the numerator.
2. Write 1 and the appropriate number of zeros as the denominator.
   - You can tell how many zeros to put in the denominator by counting the number of place values after, or to the right of, the decimal point.
   - *However many place values there are after the decimal point, that is the number of zeros to put after the 1 in the denominator*.
3. Reduce the fraction to its lowest terms.

Reducing the fraction: Fractions are usually written in *lowest terms*. To reduce a fraction to lowest terms, examine the numerator and denominator to find any number that will divide evenly into both of them (a common factor). If you find a common factor, do the division. Continue dividing by common factors until there are no more common factors. The fraction is then reduced to lowest terms.

The fraction answers in the two examples above are already in lowest terms. We will now look at an example where the fraction answer needs to be reduced.

Example: Write .45 as a fraction.

45 is the numerator.
There are two decimal places after the decimal point. The denominator is 100.
The fraction is 45/100.
Reduce 45/100 to lowest terms by dividing by the common factor 5.
The fraction in lowest terms is 9/20.

.45 = 45/100 = 9/20

Example: Write 8.075 as a mixed number.

75 is the numerator.

There are three places after the decimal point. The denominator is 1 followed by three 0's or 1000. The whole number 8 is not used in determining the number of place values in the denominator.

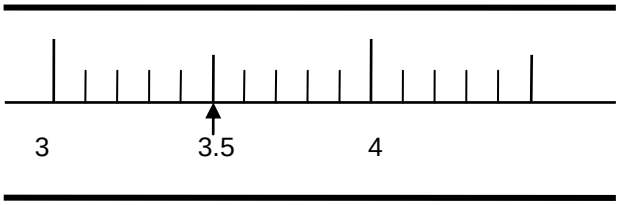
The mixed number is 8 75/1000.

Reduce 75/1000 to lowest terms by dividing by the common factor 25.

The fraction 75/1000 in lowest terms is 3/40.
8.075 = 8 75/1000 = 8 3/40

Decimals and Fractions on a Ruler
Rulers have scales consisting of whole units such as inches or centimeters. An amount that falls between two whole units is expressed as a fraction or a decimal. An imperial ruler is usually subdivided into fractions of an inch. Units on a metric ruler are subdivided into decimal amounts.

Metric rulers: Metric rulers usually have ten subdivisions between units. This means that a measurement which falls between two whole units, say between 3 cm and 4 cm, is read as a decimal. Look at the ruler below.



Part of a metric ruler

The arrow on the ruler shows a measurement made at the 5th subdivision after the whole unit, 3 cm. This partial amount after the 3 is shown as the decimal .5 (5/10 of a whole unit). The arrow points to the 3.5 cm mark.

Imperial rulers: Each inch on an imperial ruler is split into smaller subdivisions. Imperial rulers usually have sixteen divisions, each 1/16 of an inch, or thirty-two divisions, each 1/32 of an inch. A ruler divided into sixteenths also has two 1/2 inch divisions, four 1/4 inch divisions and eight 1/8 inch divisions.

If a measurement on a ruler divided into sixteenths falls between two whole inch divisions, count the number of sixteenths. That number is the numerator of the fraction with the denominator 16. A measurement which falls between 7 and 8 inches at the 11th subdivision, is 7 11/16 inches.

ADDING AND SUBTRACTING DECIMALS

Adding and subtracting decimal numbers is similar to adding and subtracting whole numbers. There is one extra step included:

- The decimal points are always lined up under each other. The decimal point in the answer is lined up beneath the other decimal points.

Adding Decimal Numbers

It is a good idea to write the decimal point in the answer line before you begin to add or subtract. In the examples, notice where the decimal point is placed. Practice each example on your own if you are not sure how to get the answer.

Example: 4.56 + 37 + .783 + 1.036 + 100.292

Write the question lining up the decimals. Put the decimal in the answer line. Add.

```
  4. 56
 37.
   . 783
  1. 036
100. 292
143. 671
```

Remember: The term *number* means the complete number that stands for some amount. A *digit* refers to one of the number symbols used to represent the place values of a number:

- 237 stands for a number, and
- the 3 is the tens digit in that number

The decimal point in a whole number: In most whole numbers, like 37, the decimal point isn't shown, *but the decimal point is always assumed to be after the last digit in a whole number.* A whole number can be written with a decimal point and zeros after the decimal point without changing its value. 37 can be written as 37.000.

Zeros after a decimal point: Zeros which follow the last digit *to the right of* a decimal point in a decimal number do not change the value of the number. Zeros placed elsewhere might change the value.

- If the number does not have a decimal point showing, it is assumed to be at the end of the number.
  - 37 = 37.
- You can write in zeros to the right of the decimal point in a whole number.
  - 37 = 37.000
- You can write in zeros after the last digit to the right of the decimal point.
  - 4.56 = 4.560

These zeros can also be removed later without changing the value of the number. But in a number like 67.088, the zero between the decimal point and the first 8 must remain where it is.

Zeros could have been written in the previous addition example, after the numbers 4.56 and 37 like this:

```
  4.560
 37.000
   .783
  1.036
100.292
143.671
```

Example: 3.11 + 21 + .006

```
  3.110
 21.000
   .006
 24.116
```

Subtracting Decimal Numbers

To subtract decimal numbers:

1. Line up the decimal points, then follow the rules for subtraction.
2. Write zeros in the empty spaces.
3. Subtract

Example: 397.54 − 28.0782

```
 397. 5400
-28. 0782
 369. 4618
```

Example: 98.078 − 14.5

```
 98. 078
-14. 500
 83. 578
```

Example: 27 − 13.117

```
 27.000
-13.117
 13.883
```

ADDITION AND SUBTRACTION OF DECIMAL NUMBERS

1. Place the numbers in columns with the decimal points lined up directly underneath each other; place the decimal point in the answer beneath the other decimals.
2. Add zeros as needed so the numbers line up evenly. Put zeros after the decimal point if the number is a whole number, or after the last digit to the right of the decimal point.
3. Add or subtract as with whole numbers.

Answer the following questions. **The answers are at the end of this skills manual.**

1. a) 78.25 + 452 + .38 + 7.96 b) .0067 + .2543 c) 34.712 +100.65

   d) 984.334 − 756.21 e) 544.037 − 34.9853 f) 26 − .03

   g) 324.7 + 567.85 + 97.6 + 123.45 + 684.52 h) $15.99 + $.75 + $33.97 + $200.00

   i) $721.99 − $54.03 j) $68.90 − $11.59 k) 674 − 32.07

2. If the outside diameter of a steel pipe is 25.75 cm and the wall of the pipe is 3.5 cm thick, what is the inside diameter of the pipe?

3. If the bill for machining job is $462.25 and the amount charged for materials is $289.95, how much is the charge for labour?

4. If you have 2.45 liters of oil and you add it to a partially filled oil can so that you end up with 3 liters, how much oil was already in the can?

MULTIPLYING DECIMALS

Multiplication of decimal numbers is the same as multiplying whole numbers except you have to know where to put the decimal point in the answer. You do not have to line up the decimals when writing down the question, but make sure you carefully show the decimal points.

To multiply decimal numbers:

1. Multiply as with whole numbers.
2. Count all the decimal places to the right of the decimal point in *both parts of the question*.
3. Put that number of decimal places in the answer.
   - Start at the right hand side and count over to the left that many places.
4. Insert the decimal point.

Example: 506**.**74 x 2**.**3

Multiply as for whole numbers.

506**.**74	2 decimal places
2**.**3	1 decimal place
152022	
1013480	
1165**.**502	3 decimal places

Count the decimal places in both parts of the question. There is a total of three. So, starting from the right side of the answer, count three places to the left in the answer and put the decimal point there.

When there are fewer digits than the required number of decimal places, put zeros to the left of, or in front of, the answer until you have enough decimal places. Then write in the decimal point.

Example: 4**.**4 x **.**006

Multiply to find the numerical answer.

4**.**4	1 decimal place
x **.** 006	3 decimal places
.0264	4 decimal places

Four decimal places in the question require four decimal places in your answer. Use a zero as a place holder so the answer has enough decimal places.

Example: 34.09 x 2.05

34**.**09	2 decimal places
x 2**.**05	2 decimal places
17045	
0000	
681800	
69**.**8845	4 decimal places

There are four decimal places in the problem; count four places from the end of the answer to the left. Put in the decimal.

Example: 22.6 x 3.03

22.6	
x 3.03	3 decimal places in the question
678	
0000	
67800	
68.478	3 decimal places in the answer

Example: 29.2 x .105

29.2	
x .105	4 decimal places in the question
1460	
0000	
29200	
3.0660	4 decimal places in the answer

If a decimal answer ends in one or more zeros to the right of the decimal point, those zeros can be discarded after you have counted them and placed the decimal correctly.

3.660 can be rewritten 3.066

In Brief: The steps used to multiply decimal numbers:

1. Multiply as with whole numbers.
2. Count all the decimal places to the right of the decimal point in *both parts of the question*. Count each digit including any zeros.
3. The number of decimal places in the numbers being multiplied is the number of decimal places in the answer.
4. Start at the right hand side and count over to the left that many places.
5. If there are fewer digits in the answer than decimal places in the question, put zeros to the left of the answer until you have enough decimal places.
6. Insert the decimal point.

MULTIPLICATION OF DECIMAL NUMBERS

1. Multiply as with whole numbers, clearly showing the decimals in the numbers being used.
2. Count the total number of decimal places in both numbers in the problem. Put that many decimal places in the answer, counting from the end of the number towards the left.

Answer the following questions. **Answers are at the end of this skills manual.**

5. a) 243 x 4.1 b) 45.9 x 35 c) 4.8 x 5.5

   d) 100 x 5.98 e) 36.52 x .27 f) 43.5 x .007

   g) $.79 x $.55 h) $109.73 x $2.08 i) .034 x .025

6. If each box of bolts costs $12.79 and you need to order 18, what will be the total cost of the order?

7. What is the area of a rectangle that measures 1.75 meters by .9 meters? The formula for finding area is A = l x w. The answer will be _____ square meters.

8. If a precision machining and tooling apprentice spends 15.5 hours on a job at a rate of $24.95 an hour, what is the cost of labour for the job?

9. A circle with a radius of .333 inches is cut from a sheet of metal with a length of 1.895 inches and a width of .965 inches. What is the area of the material that is left?
   Area of a circle = πr^2, $\pi = 3.14$

DIVIDING DECIMALS

Before doing any division, we need to define two terms. In the expression 48 ÷ 6, *the number you divide by*, 6, is called the **divisor**. *The number you divide into*, 48, is called the **dividend.**

Four situations can occur in division of decimals:

1. **The dividend is a decimal number,** but the divisor is a whole number.
2. **The dividend is a whole number,** but the divisor is a decimal number.
3. **Both the divisor and the dividend are decimals**.
4. **Both the divisor and the dividend are whole numbers,** but:
   a. the answer doesn't come out evenly, or
   b. the divisor is larger than the dividend.

Situation One: The dividend is a decimal number, but the divisor is a whole number.

1. Write the question as for whole number long division.
2. Put the decimal point in the answer line above the decimal point in the dividend, then divide.

Example: 73.24 ÷ 4

```
  18.31      decimal goes on the answer line above the decimal in the dividend
4) 73.24
   4
   33
   32
    12
    12
     04
      4
      0
```

Situation Two: The dividend is a whole number, but the divisor is a decimal number.

1. A decimal point in the divisor *is moved to the end of the divisor to make a whole number.*
2. *The decimal point of the dividend,* the number inside the division box, *must be moved to the right the same number of places.*
3. Divide, following the rules for dividing whole numbers.

Example: In the question 3285 ÷ .25, only the divisor is a decimal number.

1. Change the divisor .25 to a whole number:
   a. Move the decimal point two places to right (.25 → 25.)

2. Next move the decimal point two places to the right in the dividend 3285 (3285 → 328500.)
   a. You were left with two empty spaces.
   b. Fill the spaces with zeros before putting in the decimal point.

3. Finish the question following the rules for dividing whole numbers.

.25) 3285 the divisor has 2 decimal places

25) 328500. move the decimal point in the divisor and dividend two places to the left

```
  13140.
25 ) 328500
  25
   78
   75
    35
    25
    100
    100
      0
```

put the decimal point in the answer line and divide

Situation Three: Both the divisor and dividend are decimals. Combine the steps from Situation One and Two.

1. First, move the decimal point in the divisor over to the right to make the divisor a whole number.
   - Count the places you moved the decimal point in the divisor.
2. Move the decimal point in the dividend the same number of places.
   - Use zeros as needed.
3. Divide as for whole numbers.
4. Place the decimal point in the answer above the decimal point in the dividend.

Example: 3.655÷.05

Move the decimal point in the divisor two spaces to the right to make the it a whole number.

.05 → 5

The decimal point in the dividend is moved to the right the same number of spaces.

3.655 → 365.5

So .05)3.655

becomes

```
   .
5) 365.5
```

Put the decimal in the answer above the decimal in the dividend.

Divide.

```
  73.1
5)365.5
  35
   15
   15
    05
    5
    0
```

Sometimes a division problem doesn't come out evenly. In this case, *put as many zeros as needed on the right side of the dividend* to make the answer come out evenly or to finish the question to a certain number of decimal places.

Example: 5.838 ÷ .24

First change the divisor to a whole number by moving the decimal point two places to the right.

.24 → 24

Then move the decimal point the same number of places in the dividend.

5.838 → 583.8

Divide. Add zeros to the dividend as needed.

```
  24.325
24)583.800
  48
  103
   96
    78
    72
     60
     48
     120
     120
       0
```

Example: 74.7 ÷ .003

Move the decimal point three places to the right to change the divisor to a whole number:

.003 → 3

Then move the decimal point in the dividend the same number of places; use extra zeros as place holders.

74.7 → 74700.

Put the decimal point in the answer above the decimal point in the dividend. Divide.

```
  24900.
3) 74700.
   6
    14
    12
     27
     27
      0
```

Situation Four: Both the divisor and the dividend are whole numbers but,

a. the answer doesn't come out evenly, or
b. the divisor is larger than the dividend.

a. If the answer doesn't come out evenly:

1. Put a decimal at the end of the dividend and in the answer line.
2. Put zeros to the right of the decimal point as you continue dividing.

Example: 825 ÷ 50

```
   16.5
50 ) 825.0
     50
     325
     300
      250
      250
```

b. If the divisor is larger than the dividend:

1. Put a decimal at the end of the dividend and add zeros.
2. Continue dividing.
   - This is how to change a fraction to decimal. Divide the fraction's numerator by its denominator.

Example: Change 15/20 to a decimal.

```
   .75
20)15.00      divide the numerator by the denominator
  140
   100
   100
     0
15/20 = .75
```

Rounding off a Decimal Answer

Sometimes a division answer continues past the decimal point for several places without coming out evenly. Or the answer might be a repeating decimal, as in 1 ÷ 3 = .333... In these cases, you can round off the answer in order to finish the question. A question with money is usually rounded off to the hundredth place (to two decimal places).

To round off a division question to two places:

1. First solve the question to **three** decimal places.
2. Then look at the value of the digit in the third decimal place past the decimal point in the answer line.
3. If it is five or greater, change the value of the digit to its right (the second decimal place) to one digit higher and drop that last (third) digit.
4. If the last digit is less than five, keep the digit in the second decimal place the same and drop the digit in the third decimal place.

Example: Divide .7849 ÷ 2.5, making your answer correct to two decimal places.

Divide to three decimal places.

```
   .313
25)7.849
  75
   34
   25
    99
    75
    24
```

The last (third) digit in the answer, 3, is smaller than five. The second last digit remains the same and the last digit is dropped.

The answer rounded off to two places is .31

If the digit you are rounding off to is 9 and the digit one past it is five or greater, the situation is more complex.

1. Add 1 to the 9.
2. The 9 becomes a 10.
3. Write a 0 in the place where the 9 was.
4. Carry the 1 to the left and add it to that digit

Example: Divide 2.1459 ÷ 5.4. Make the answer correct to two decimal places.

To round off to two places, complete the division to three decimal places.

```
   .397
54) 21.459
   162
    525
    486
     399
     378
      21
```

The last digit, 7, is greater than five. You need to make the digit in the second last decimal place one greater than it already is.

The 9 becomes 10. Carry the one to add to the 3 on the left.

The 3 becomes 4.

The digit in the second last decimal place is now 0. Keep the 0 at the end of the answer because you need two decimal places in the answer.

.397 rounded off to two decimal places is .40

DIVISION OF DECIMAL NUMBERS

1. If there is a decimal point in the divisor, move it to the right to change the divisor to a whole number.
2. Move the decimal point in the dividend the same number of places.
3. Put the decimal point in the answer directly above the decimal point in the dividend.
4. Divide as with whole numbers.
5. If the answer doesn't come out evenly, use zeros at the end of the number to continue dividing. Divide to one place past where you want to round off and then round off your answer.

Answer the following questions. **Answers are at the end of this skills manual.**

10. a) 13.25 ÷ 25 b) 22.78 ÷ 3.4

    c) 52.08 ÷ .62 d) 749.43 ÷ 22

    e) $9.26 ÷ $.40 f) $30.52 ÷ $1.09

    g) Change 1/4 to a decimal. h) Change 20/36 to a decimal. Round your answer to two places.

11. A piece of metal that is 189.35 cm long is to be cut in 5 equal pieces. What will be the length of each of the cut pieces?

12. A machining apprentice earned $833.40 in one week. If the hourly wage was $13.89, how many hours did the apprentice work that week?

13. If the area of a room is 36.67 meters and the length is 10.5 meters, what is the width? The formula for area is A = l x w. To find the width, the formula becomes w = A ÷ l

USING A CALCULATOR

You can do calculations with decimal numbers using a calculator.

Addition and subtraction: Addition and subtraction with decimal numbers is *the same as with whole numbers except you have to key in the decimal point at the correct place.*

It is a good idea to repeat the calculation. If you get the same answer both times, you are probably correct. If not, do it again, watching carefully that you key in the numbers correctly, including the decimal point.

Multiplication: *As long as you key in the decimal places correctly in the question*, the answer will automatically show the decimal point in the right place.

Division: You must *enter the numbers of the dividend first, the division sign, and then the divisor, along with all their decimal points.*

Example: In the problem 576.25 ÷ 8.2, say to yourself: "576.25 ***divided by*** 8.2".

- This is the only order that will give you the right answer.
- Key in the decimal points exactly where they appear in the divisor and dividend.
- Don't move them over.

Fractions: If calculations involve measurements in fractions, such as adding 13 1/2 ft and 5 1/4 ft, *change any fractions in the measurements to decimals. Then enter them into the calculator.*

Examples:
Since 1/2 as a decimal is .5, you would enter 13 1/2 as 13.5.

Since 1/4 is .25 as a decimal, you would enter 5 1/4 as 5.25 into the calculator.

If you have to use a fraction and do not know its decimal equivalent, find it by dividing the numerator by the denominator.

Calculators need all partial numbers entered as decimals, unless there is a special fraction function. In this case, read the instructions that accompany the calculator to see how to enter fractions.

SOLVING PROBLEMS

Sometimes you have to figure out the answer to a problem, but you are not told what number operation to use. Instead, you have to decide for yourself what steps are required to solve the problem. You have to decide what operations to use and in what order. Although each problem will be different, the general steps below will help you find the right solution:

1. Read through the whole problem carefully.
2. List the facts and figures that are given in the question.

3. Draw a diagram if it is helpful.
4. Decide what needs to be found or calculated, rereading the question if necessary.
5. Decide what methods can be used to find the answer. Also note what order the steps should be done in.
6. Using the information given, solve the problem using the steps decided on. Be aware that sometimes information is given in the question that is not needed to solve the problem.
7. Write the answer including any needed units or dollar signs.
8. Check to see that the answer seems reasonable and that it provides the unknown quantity (the answer) the problem requires for its solution.

The following phrases might help you decide what operation to use:

- ***Use addition with*** words like "find the sum," and "what is the total".
- ***Use multiplication with*** words like "if each .... find all" "if one ... how much are all of them", "find the total" and "find all". Since the last two phrases can indicate either addition or multiplication, you will have to decide based on the facts in the problem.
- ***Use subtraction with*** words like "what is the difference", "how much more or larger or greater", and "how much less".
- ***Use division with*** words like "how much is each if ...", and "find the cost or rate per ...".

Example: If a machinist works 35 hours in one week and earns $32.50 an hour, how much does he make that week?

32.50 x 35 = $1137.50 Multiply the number of hours by the hourly rate to get the answer.

He makes $1137.50 that week.

If the problem deals with money, the answer should show two decimal places and the $ sign should be included.

Example: An order for a box of large bolts came to a total of $107.40. If each bolt costs $8.95, how many bolts were in the box?

Divide the total cost by the cost per bolt.

$107.40 ÷ $8.95 = 12

There were 12 bolts in the box.

Example: Kevin bought a truck for $18 000. He made a down payment of $4300 and will pay the rest in 49 monthly installments of $320.75 each. How much interest will he be paying?

You will probably need to think for a moment about what the question is asking. To find the amount of interest paid, you have to find the difference between the selling price of the truck and the total amount paid in down payments and installments.

Total amount paid by Kevin
= down payment + amount paid in installments

Amount paid in installments:
$320.75 x 49 = $15 716.75

Down payment = $4300

Total amount paid:
$15 716.75 + $4300 = $20 016.75

Amount of interest = difference between selling price and amount paid.

Selling price = $18 000

Interest paid:
$20 016.75 - $18 000 = $2016.75

The amount of interest paid is $2016.75.

Example: The formula for bend allowance or BA (the amount of material required to make a bend) is

BA = [(.01743 x R) + (.0078 x T)] x angle of bend,
where R is the inside bend radius
and T is the thickness of the material.

What is the bend allowance to three decimal places if the thickness is .189", the inside radius is .45" and the angle of bend is 90^{o}?

B/A = [(.01743 x R) + (.0078 x T)] x angle of bend
B/A = [(.01743 x .45) + (.0078 x .189)] x 90
= (.0078435 + .0014742) x 90
= (.0093177) x 90
= .838593
= .839

Problems Involving Units of Measurement

When problems involve quantities that have units of measurement (examples are meters, feet, centimeters and inches), the units must be included in the calculations. Any units not canceled out must be shown in the answer.

Remember: *If the problem involves numbers that measure the same general quantity, such as length, but the units are not the same, the units must be converted so they are all the same. You can't multiply meters and centimeters together. One unit must be converted to the other so they are either both meters or both centimeters.*

Example: A piece of metal 8 cm wide and 1.2 m long is cut from a larger sheet. What is the area of the cut piece?

You can't multiply centimeters and meters together. You must use all cm or all m. Meters is most likely in carpentry. Change the 8 cm to meters first and then multiply.

8 cm = .08 m
.08 m x 1.2 m = .096 m^2

Answer the following problems using decimals. You will need to choose the appropriate method to solve each one. **Answers are on the last page of the skills manual**.

14. An apprentice received $860.50 in wages in one week and $914.20 in the next. How much did he earn during the two weeks?

15. During a five week period, a precision machining and tooling business made earnings of $1287.89, $4351.76, $ 984.20, $3880.99 and $3215.65. If the material used during that period cost $4643.56 and salaries and overhead cost $5897.75, what was the profit for that five weeks?

16. If 2 mm steel costs $5.89 per meter and 28.5 meters are required, what is the total cost?

17. A circular piece of metal has a circumference of 34.75 square inches. What is the diameter of the piece? Round your answer to two places. (Circumference = π d, π = 3.14)

18. What is the bend allowance to three decimal places of a piece of metal if the radius is .5 ", the thickness is .126 " and the angle of bend is 90^o?
Formula: BA = [(.01743 x R) + (.0078 x T)] x angle of bend

ANSWER PAGE

ADDITION AND SUBTRACTION OF DECIMALS

1.

a) 78.25 + 452.00 + .38 + 7.96 = 538.59

b) .0067 + .2543 = .2610 or .261

c) 34.712 + 100.650 = 135.362

d) 984.334 − 756.210 = 228.124

e) 544.0370 − 34.9853 = 509.0517

f) 26.00 − .03 = 25.97

g) 324.70 + 567.85 + 97.60 + 123.45 + 684.52 = 1798.12

h) $15.99 + .75 + 33.97 + 200.00 = $250.71

i) $721.99 − 54.03 = $677.96

j) $68.90 − 11.59 = $57.31

k) 674.00 − 32.07 = 641.93

2. Add the thickness of the 2 walls of the pipe: 3.5cm + 3.5 cm = 7 cm.
   Subtract the thickness of the walls from the outside diameter of the pipe:
   25.75 - 7 = 18.75 cm.
   The inside diameter is 18.75 cm.

3. $462.25 − $289.95 = $172.30

4. 3 − 2.45m = .55 liters

MULTIPLICATION OF DECIMALS

5.

a) 243 × 4.1 = 243 + 9720 = 996.3

b) 45.9 × 35 = 2295 + 13770 = 1606.5

c) 4.8 × 5.5 = 240 + 2400 = 26.40 or 26.4

d) 100 × 5.98 = 800 + 50000 = 598.00 or 598

e) 36.52 × .27 = 25564 + 73040 = 9.8604

f) 43.5 × .007 = .3045

g) $.79 × $.55 = 395 + 3950 = $.4345 rounded off to $.43

h) $109.73 × $2.08 = 87784 + 000000 + 2194600 = $228.2384 rounded off to $228.24

i) .034 × .025 = 170 + 680 = .000850 or .00085

6. $12.79 x 18
   = $230.22

7. $A = l \times w$
   $= 1.75 \times .9$
   $= 1.575\ m^2$

8.
$$\begin{array}{r} \$24.95 \\ \times 15.5 \\ \hline 12475 \\ 124750 \\ 249500 \\ \hline \$386.725 \end{array}$$

9. Area of circle $= \pi r^2$
   $= 3.14 \times (.333)^2$
   $= .34819\ in^2$

   Area of the sheet metal $= l \times w$
   $= 1.895 \times .965$
   $= 1.828675\ in^2$

   Subtract the area of the circle from the area of the sheet metal
   $1.828675 - .34819 = 1.480485\ in^2$

   $1.48\ in^2$ of material are left

DIVISION OF DECIMALS

10.

a)
$$\begin{array}{r} .53 \\ 25\overline{)13.25} \\ 125 \\ \hline 75 \\ 75 \\ \hline 0 \end{array}$$

b)
$$\begin{array}{r} 6.7 \\ 34\overline{)227.8} \\ 204 \\ \hline 238 \\ 238 \\ \hline 0 \end{array}$$

c)
$$\begin{array}{r} 84 \\ 62\overline{)5208} \\ 496 \\ \hline 248 \\ 248 \\ \hline 0 \end{array}$$

d)
$$\begin{array}{r} 34.065 \\ 22\overline{)749.430} \\ 66 \\ \hline 89 \\ 88 \\ \hline 143 \\ 132 \\ \hline 110 \\ 110 \\ \hline 0 \end{array}$$

e) $\begin{array}{r} \$\ 23.15 \\ 4)92.6\ 0 \\ \underline{8} \\ 12 \\ \underline{12} \\ 06 \\ \underline{4} \\ 20 \\ \underline{20} \\ 0 \end{array}$

f) $\begin{array}{r} \$\ 28. \\ 109)3052 \\ \underline{218} \\ 872 \\ \underline{872} \\ 0 \end{array}$

g) $\begin{array}{r} .25 \\ 4)1.00 \\ \underline{8} \\ 20 \end{array}$

h) $\begin{array}{r} .5555... \\ 36\ )20.0000 \\ \underline{180} \\ 200 \\ \underline{180} \\ 200 \\ \underline{180} \\ 20 \end{array}$

.5555 round off to .56

11. 189.35 ÷ 5 = 37.87 cm

12. $833.40 ÷ $13.89 = 60 hours

13. 36.67 ÷ 10.5 = 3.5 m

PROBLEMS WITH DECIMAL NUMBERS

14. $\begin{array}{r} \$860.50 \\ +\ 914.20 \\ \$1774.70 \end{array}$

15.

sales:	costs:	profit = sales - costs
$1287.89	$4643.56	$15 720.49
4351.76	+ 5897.75	- 10 541.31
2984.20	$10541.31	$ 5 179.18
3880.99		
+3215.65		
$15720.49		

16. $\begin{array}{r} \$5.89 \\ \times\ 28.5 \\ 2945 \\ 47120 \\ 117800 \\ \$167.865 \end{array}$ Round off to $167.87

17. $C = \pi d$
$d = C/\pi$
$= 34.75 \div 3.14$
$= 11.066$ inches rounded off to 11.07 inches

18. B/A = [(.01743 x R) + (.0078 x T)] x angle of bend
= [(.01743 x .5) + (.0078 x .126)] x 90
= (.008715 + .0009828) x 90
= (.0096978) x 90
= .872802
= .873