

INTRODUCTION

Trades workers in the construction industry perform basic math skills on the job every day. Adding, subtracting, multiplying and dividing whole numbers are used in measuring, averaging, estimating and blueprint reading. As a trade worker you need to be able to add, subtract, multiply and divide both in your head and using a calculator.

Being able to do basic calculations with whole numbers quickly and easily makes it easier to work with fractions, decimals and other math skills. When you have completed this section you will be able to:

- Add, subtract, multiply and divide whole numbers.
- Use the order of operations to calculate an equation that has more than one operation.
- Use addition, subtraction, multiplication and division to calculate a missing dimension.

PLACE VALUE

Did you know?

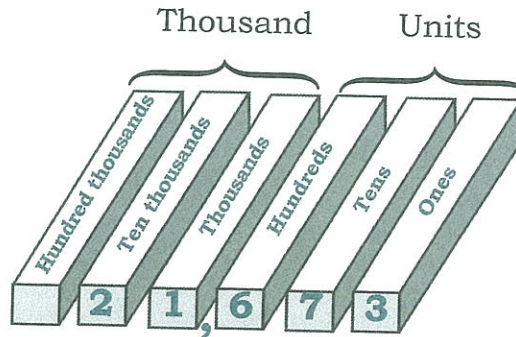
The Latin word decem means ten.

Understanding Place Value

The number system we use is called the decimal number system because its base is ten. Each digit in a written number has a “place value”. You know what its value is by its place or location in the written number.

The value of each place is 10 times as large as the value of the place to its immediate right. The value of each place is 10 times as small as the value of the place to its immediate left.

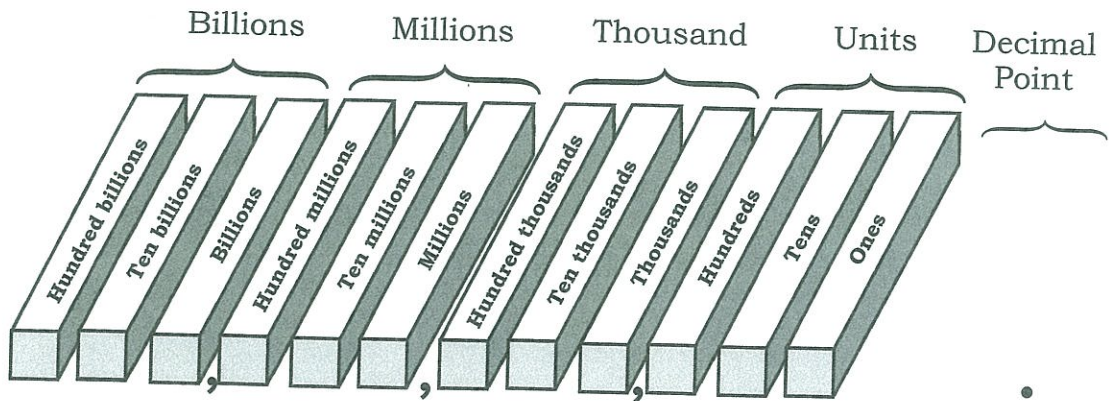
The number 21,673 can be placed in the diagram like this



and read “twenty one thousand, six hundred seventy-three”.

Also Look!

For more on place value look in the section on Decimals.



Write the place value of each underlined number.

1. 43116 3 _____ 6 _____
2. 900 356 0 _____ 3 _____
3. 7965 7 _____ 6 _____
4. 211,355 2 _____ 5 _____

Zeros and Place Value

Zeros are placeholders. When you are adding, subtracting, dividing and multiplying whole numbers, you need to remember to use zeros as placeholders or you will get the wrong answer.

- 350 \implies The zero holds the ones or units place.
- 3,500 \implies The zeros hold the ones and tens places.
- 7,050 \implies The zeros hold the hundreds and ones places.

Reading and Writing Large Numbers

- Step 1: Start at the right side of the number. 5467891
- Step 2: Separate the numbers into groups of three.
5 467 891 or 5,467,891
- Step 3: Read each group of three numbers followed by the value of that group.
5 million, 467 thousand, 891

Rounding Whole Numbers

To round a whole number, follow these steps:

- Step 1: Underline the number in the place you are rounding to.
- Step 2: If the digit to the right of the underlined digit is greater than or equal to five, round up. Add 1 to the underlined digit. Change all the digits to the right of the underlined number to zeros.
539 \implies 540
- Step 3: If the number to the right of the underlined digit is less than 5, leave the number as it is. Change all the digits to the right of the underlined number to zeros.
2.328 \implies 2,300

Also Look!

For more on zeros and place value look in the section on Decimals.

Did you know?

Groups of numbers can be separated using spaces or commas: 200.312 or 200 312

Estimation means finding a reasonable answer. An estimate is not exact, but it is close. Rounding the numbers in a problem is a good way to estimate an answer. Estimating on the job is an important skill. Errors mean a loss of time and money.

Carrying More Than Once

Sometimes you must continue "carrying" as you add the columns from right to left.

Example 2:

$$\begin{array}{r} \overset{1}{2}89 \\ + 436 \\ \hline 5 \end{array}$$

Step 1: $9 + 6 = 15$.
Write down the 5.
Carry the 1.

$$\begin{array}{r} \overset{1}{1}\overset{1}{2}89 \\ + 436 \\ \hline 25 \end{array}$$

Step 2: Add the "carried" $1 + 8 + 3 = 12$.
Write down the 2.
Carry the 1.

$$\begin{array}{r} \overset{1}{1}\overset{1}{1}\overset{1}{2}89 \\ + 436 \\ \hline 725 \end{array}$$

Step 3: Add the "carried" $1 + 2 + 4 = 7$.
Write down the 7.

Add the following.

1) $\begin{array}{r} 89 \\ +17 \\ \hline \end{array}$

2) $\begin{array}{r} 136 \\ +48 \\ \hline \end{array}$

3) $\begin{array}{r} 47 \\ +94 \\ \hline \end{array}$

4) $\begin{array}{r} 82 \\ +19 \\ \hline \end{array}$

5) $\begin{array}{r} 902 \\ +18 \\ \hline \end{array}$

6) $\begin{array}{r} 456 \\ +544 \\ \hline \end{array}$

7) $\begin{array}{r} 28 \\ +82 \\ \hline \end{array}$

8) $\begin{array}{r} 77 \\ +54 \\ \hline \end{array}$

9) $\begin{array}{r} 8 \\ 5 \\ +4 \\ \hline \end{array}$

10) $\begin{array}{r} 9 \\ 9 \\ +3 \\ \hline \end{array}$

11) $\begin{array}{r} 13 \\ 72 \\ +89 \\ \hline \end{array}$

12) $\begin{array}{r} 91 \\ 13 \\ +17 \\ \hline \end{array}$

SUBTRACTION

Subtraction is the opposite of addition. You can check your answer in subtraction using addition.

Example 1:	12 - 3 = 9
	9 + 3 = 12
Example 2:	37 - 24 = 13
	13 + 24 = 37

BORROWING

Example 1:

Ones	6	-	7	=	9
Tens	3	-	1	=	2
	2		1		6
	3		7		13
	2		1		6
	3		7		13
	1		9		9

Step 1: Borrow 1 from the tens column. Change the 3 to a 2.

Step 2: Place the 1 borrowed from the tens column in front of the 6 in the ones column.

Step 3: Subtract.

Borrowing:

You can write a small number:

- at the top of the next column
- carry the number mentally to the next column

Hint:

Most errors are caused from not lining up the numbers correctly: ones, tens, hundreds and so on.

Borrowing More Than Once

Example 2:

Ones	3	-	4	=	9
Tens	6	-	8	=	7
Hundreds	4	-	1	=	3
	5		1		3
	4		8		4
	3		1		3
	4		8		4
	3		15		9
	4		8		4
	2		7		9

Step 1: Borrow 1 from the tens column. Change the 6 to 5.

Step 2: Place the 1 borrowed from the tens column in front of the 3 in the ones column.
13 - 4 = 9

Step 3: Borrow 1 from the hundreds column. Change the 4 to 3.

Step 4: Place the 1 borrowed from the tens column in front of the 5 in the tens column.
15 - 8 = 7

Step 5: Subtract the hundreds column.
3 - 1 = 2

Borrowing With Zeros

You cannot borrow from zero. When you are borrowing and you come to a zero, you move to the next column to the left.

Example 3:

$$\begin{array}{r} \overset{1}{2}04 \\ - 89 \\ \hline \end{array}$$

Step 1: You cannot subtract 9 from 4.
You cannot borrow 1 from the zero in the tens column.
Borrow 1 from the hundreds column.
Change the 2 to a 1.
Place the 1 borrowed from the hundreds column in front of the 0 in the tens column.

$$\begin{array}{r} \overset{1}{1}\overset{9}{0}4 \\ - 89 \\ \hline \end{array}$$

Step 2: Borrow 1 from the tens column.
Change the 10 to 9.
Place the 1 from the tens column in front of the 4.

$$\begin{array}{r} \overset{1}{1}\overset{9}{1}4 \\ - 89 \\ \hline 115 \end{array}$$

Step 3: Subtract the ones.
Subtract the tens.
Subtract the hundreds.

Subtract the following numbers.

1) $\begin{array}{r} 50 \\ - 6 \\ \hline \end{array}$

2) $\begin{array}{r} 60 \\ - 8 \\ \hline \end{array}$

3) $\begin{array}{r} 98 \\ - 9 \\ \hline \end{array}$

4) $\begin{array}{r} 34 \\ - 17 \\ \hline \end{array}$

5) $\begin{array}{r} 117 \\ - 28 \\ \hline \end{array}$

6) $\begin{array}{r} 313 \\ - 168 \\ \hline \end{array}$

7) $\begin{array}{r} 574 \\ - 486 \\ \hline \end{array}$

8) $\begin{array}{r} 924 \\ - 446 \\ \hline \end{array}$

9) $\begin{array}{r} 201 \\ - 99 \\ \hline \end{array}$

10) $\begin{array}{r} 506 \\ - 87 \\ \hline \end{array}$

11) $\begin{array}{r} 100 \\ - 31 \\ \hline \end{array}$

12) $\begin{array}{r} 400 \\ - 42 \\ \hline \end{array}$

MULTIPLICATION

Multiplication is a fast way to add repeated numbers. Following the rules of multiplication, you can perform multiple addition in one operation.

Remember:

- $0 \times \text{any number} = 0$
 $0 \times 42 = 0$
- $1 \times \text{any number} =$
the same number
 $1 \times 14 = 14$
- It doesn't matter
which order you
multiply numbers.
 $4 \times 8 = 32$
 $8 \times 4 = 32$

Example:

A carpenter worked for 23 hours at \$24 an hour.
How much pay did he earn in all?

To solve this problem you could add:
 $\$24 + \$24 + \$24 + \$24 + \$24 \dots 23$ times.

You can perform this multiple addition in one operation by multiplying
 $\$24 \times 23$.

$$\begin{array}{r} \$24 \\ \times 23 \\ \hline \$552 \end{array}$$

THE MULTIPLICATION TABLE

Having these facts in your head will allow you to carry out many math calculations more quickly.

More complex math calculations will be easier because you know your multiplication tables.

Reading the Multiplication Table

You need to know basic multiplication facts quickly and accurately. Take the time now to memorize them.

Example:

$$7 \times 9 = 63$$

	1	2	3	4	5	6	7	8	9	10	11	12
1	1	2	3	4	5	6	7	8	9	10	11	12
2	2	4	6	8	10	12	14	16	18	20	22	24
3	3	6	9	12	15	18	21	24	27	30	33	36
4	4	8	12	16	20	24	28	32	36	40	44	48
5	5	10	15	20	25	30	35	40	45	50	55	60
6	6	12	18	24	30	36	42	48	54	60	66	72
7	7	14	21	28	35	42	49	56	63	70	77	84
8	8	16	24	32	40	48	56	64	72	80	88	96
9	9	18	27	36	45	54	63	72	81	90	99	108
10	10	20	30	40	50	60	70	80	90	100	110	120
11	11	22	33	44	55	66	77	88	99	110	121	132
12	12	24	36	48	60	72	84	96	108	120	132	144

CARRYING IN MULTIPLICATION

Example 1:

$$\begin{array}{r} \overset{1}{2}6 \\ \times 3 \\ \hline 8 \end{array}$$

Step 1: Multiply $3 \times 6 = 18$.
Write down the 8, carry the 1.

$$\begin{array}{r} \overset{1}{2}6 \\ \times 3 \\ \hline 78 \end{array}$$

Step 2: Multiply $3 \times 2 = 6$.
Add the carried 1.
Write down the 7.

Example 2:

$$\begin{array}{r} \overset{2}{2}7\overset{2}{6} \\ \times 4 \\ \hline 4 \end{array}$$

Step 1: Multiply $4 \times 6 = 24$
Write down the 4.
Carry the 2.

$$\begin{array}{r} \overset{2}{2}7\overset{2}{6} \\ \times 4 \\ \hline 04 \end{array}$$

Step 2: Multiply $4 \times 7 = 28$
Add the carried 2.
 $28 + 2 = 30$
Write down the 0.
Carry the 3.

$$\begin{array}{r} \overset{2}{2}7\overset{2}{6} \\ \times 4 \\ \hline 1104 \end{array}$$

Step 3: Multiply $4 \times 2 = 8$
Add the carried 3.
 $8 + 3 = 11$
Write down the 11.

Example 3:

Ones	4
Tens	3
Hundreds	2
Thousands	1
Ten	0
Thousands	0

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

Step 1: Multiply $164 \times 3 = 492$
Write down 492 (partial answer).
Write the 2 directly under the 3.

Step 2: Multiply $164 \times 5 = 820$
Write down 820 (partial answer).
Write the 0 directly under the 5.

Step 3: Multiply $164 \times 2 = 328$
Write down 328 (partial answer).
Write the 8 directly under the 2.

Step 4: Add the columns.
Make sure you keep your columns lined up.

Multiply the following.

1) $\begin{array}{r} 42 \\ \times 21 \\ \hline \end{array}$

2) $\begin{array}{r} 13 \\ \times 13 \\ \hline \end{array}$

3) $\begin{array}{r} 71 \\ \times 71 \\ \hline \end{array}$

4) $\begin{array}{r} 912 \\ \times 37 \\ \hline \end{array}$

5) $\begin{array}{r} 782 \\ \times 104 \\ \hline \end{array}$

6) $\begin{array}{r} 612 \\ \times 108 \\ \hline \end{array}$

7) $\begin{array}{r} 521 \\ \times 805 \\ \hline \end{array}$

8) $\begin{array}{r} 711 \\ \times 100 \\ \hline \end{array}$

DIVISION

Division is the opposite of multiplication. Division separates a given quantity into equal parts. For example, how many two foot pieces can be made from a 12 foot 2×4 ?

Division can be shown several ways:

$$257 \div 9 =$$

$$\frac{257}{9}$$

$$9 \overline{)257}$$

LONG DIVISION

Keep your numbers lined up and do one step at a time.

Example 1:

$$6 \overline{)342}$$

Step 1: 6 does not divide into 3.

$$\begin{array}{r} 5 \\ 6 \overline{)342} \\ \underline{30} \\ 42 \end{array}$$

Step 2: Divide 6 into 34.
 $34 \div 6 = 5$
 Write 5 in the answer space.
 $6 \times 5 = 30$
 Write 30 under 34.
 $34 - 30 = 4$
 Write 4. Bring down the 2.

$$\begin{array}{r} 57 \\ 6 \overline{)342} \\ \underline{30} \\ 42 \\ \underline{42} \\ 0 \end{array}$$

Step 3: Divide 6 into 42.
 $42 \div 6 = 7$
 Write 7 beside the 5.
 $6 \times 7 = 42$
 Write 42 under 42.
 $42 - 42 = 0$

Step 4: Check your answer.
 $57 \times 6 = 342$

Example 2:

Sometimes there are zeros. Remember:
Zeros hold places.

$$\begin{array}{r} 7 \overline{)3507} \end{array}$$

Step 1: 7 does not divide into 3.

$$\begin{array}{r} 5 \\ 7 \overline{)3507} \\ \underline{35} \\ 0 \end{array}$$

Step 2: Divide 7 into 35.
 $35 \div 7 = 5$
Write 5 in the answer space.
 $7 \times 5 = 35$
Write 35 under 35.
 $35 - 35 = 0$

$$\begin{array}{r} 50 \\ 7 \overline{)3507} \\ \underline{35} \\ 00 \end{array}$$

Step 3: Bring down the 0.
7 does not divide into 0.
Write 0 in the answer space beside the 5.

$$\begin{array}{r} 50 \\ 7 \overline{)3507} \\ \underline{35} \\ 00 \end{array}$$

Step 4: Bring down the 7.
Divide 7 into 7.
 $7 \div 7 = 1$
Write 1 in the answer space beside the 0.
 $7 \times 1 = 7$
 $7 - 7 = 0$

$$\begin{array}{r} 501 \\ 7 \overline{)3507} \\ \underline{35} \\ 007 \\ \underline{\quad 7} \\ 0 \end{array}$$

Step 5: Check your answer.
 $501 \times 7 = 3507$

REMAINDERS

Answers do not always come out evenly when you are dividing. When there is an amount left over, it is called the remainder.

Example:

$$\begin{array}{r} 121 \\ 8 \overline{)971} \\ \underline{8} \\ 17 \\ \underline{16} \\ 11 \\ \underline{8} \\ R3 \end{array}$$

Step 1: Write the answer as 121 R3

Step 2: Check your answer the same way as for other long division.

$$121 \times 8 = 968$$

Add the remainder.

$$968 + 3 = 971$$

Divide the following.

1) $2 \overline{)248}$

2) $8 \overline{)168}$

3) $5 \overline{)215}$

4) $7 \overline{)224}$

5) $12 \overline{)264}$

6) $28 \overline{)868}$

7) $31 \overline{)868}$

8) $57 \overline{)1\ 824}$

9) $5 \overline{)5\ 025}$

10) $4 \overline{)436}$

11) $30 \overline{)6\ 030}$

12) $21 \overline{)2\ 205}$

13) $16 \overline{)283}$

14) $21 \overline{)487}$

15) $26 \overline{)973}$

16) $39 \overline{)1\ 637}$

ORDER OF OPERATIONS

When an equation combines more than one operation, you must follow the order of operations. An operation is a mathematical process such as addition, subtraction, multiplication or division.

Example:

$$(15 + 6) \div 3 + 4 \times 2 - 3^2$$

The acronym **BEDMAS** is an easy way to remember the order of operations. BEDMAS tells you the order to do calculations.

	Symbol	Example
B rackets	()	$(15 + 6) \div 3 + 4 \times 2 - 3^2$
E xponents	3^2	$21 \div 3 + 4 \times 2 - 3^2$
D ivision	\div	$21 \div 3 + 4 \times 2 - 9$
M ultiplication	\times	$7 + 4 \times 2 - 9$
A ddition	$+$	$7 + 8 - 9$
S ubtraction	$-$	$15 - 9 = 6$

Hint:

The exponent tells you how many times to multiply the base.

base $\rightarrow 3^2 \leftarrow$ exponent

$$3^2 = 3 \times 3 = 9$$

$$3^3 = 3 \times 3 \times 3 = 27$$

Example 1:

$$5 + 8 \times 7 =$$

There are no brackets, exponents or division so the first calculation is multiplication. The last calculation is addition.

$$5 + 8 \times 7 =$$

$$5 + 56 = 61$$

Example 2:

$$8 \times 16 \div 4 =$$

There are no brackets or exponents so the first calculation is division. The last calculation is multiplication.

$$8 \times 16 \div 4 =$$

$$8 \times 4 = 32$$

Calculate the following.

1) $9 + 8 \times 3 =$

2) $6 \times 8 + 6 =$

3) $13 \times 2 - 2 =$

4) $20 \times 10 \div 5 =$

5) $36 \div (8 - 2) =$

6) $(20 - 11) \div (6 \div 2) =$

7) $20 \div (2 \times 5) =$

8) $(35 \div 7) - (8 \div 4) =$

9) $5^2 - 6 \div 2 =$

10) $9 \times 5 + (7 - 2) - 4^2 =$

PRACTICE

- 1) The following deliveries of 2" × 6" were made to a job site:

1 728 board feet
 1 634 board feet
 892 board feet

How many board feet of 2" × 6" were delivered?

- 2) An apprentice works 152 hours in January, 138 hours in February, 149 hours in March and 155 hours in April. How many hours did he work during those 4 months?

- 3) The cost of materials for a job were as follows:

Lumber -----	\$2 812	Hardware -----	\$97
Concrete -----	\$254	Gravel -----	\$48
Pipe -----	\$115	Other -----	\$26

How much did the materials cost?

- 4) A contractor used the following figures to estimate the amount of hardwood flooring needed.

Bedroom #1 ---	144 sq. feet	Living Room --	206 sq. feet
Bedroom #2 --	168 sq. feet	Dining Room -	184 sq. feet
Bedroom #3 --	128 sq. feet	Kitchen -----	133 sq. feet

What total should he use to calculate his estimate?

- 5) \$83 was deducted from a worker's wages of \$596. How much money did the worker take home?

- 6) A roof is 1 174 square feet. Fifteen sheets of plywood have been used to cover 480 square feet. How much area is there left to cover?
- 7) A wall was 251 mm shorter than the footing at each end. The footing was 3 447 mm. How long was the wall?
- 8) A shed costs \$5 718 to build. How much does it cost to build 17 of them?
- 9) Cove moulding is bought in 8 foot sections. How many feet are there in 37 pieces?
- 10) One sheet of plywood is 1 220 mm wide. What width would 13 sheets cover?
- 11) Seventeen board feet of hardwood are required to make a coffee table. How much wood is required for 14 tables?
- 12) Twelve snap ties are used in each sheet of plywood on an outside concrete form. How many snap ties are needed if 97 sheets of plywood are used?
- 13) A carpenter uses 518 nails to install 7 sheets of floor plywood. How many nails does he use in each sheet?

Hint:

' = foot

" = inches

- 14) An apprentice cuts 3' pieces out of a 16' long 2×4 .
- a) How many pieces can he cut out of one 2×4 ?
 - b) How long would the left over piece be?
- 15) A trades worker cuts 9" pieces from an 96" piece of plywood.
- a) How many pieces can he cut?
 - b) What is the length of the remaining piece?
- 16) A trades worker uses 7 nails to assemble a door header. A box of nails contains exactly 1 000 nails.
- a) How many headers could he assemble using 1 box of nails?
 - b) How many nails would he have left over?
- 17) A house is built on 16 footings. Each footing requires 7 cubic feet of concrete and 23 feet of reinforcing bars.
- a) How many cubic feet of concrete are required in total?
 - b) How many feet of reinforcing bars are required in total?
- 18) An apprentice can nail a sheet of plywood in 6 minutes. How long will it take to nail 24 sheets?
- 19) How many lineal feet of cove moulding is required for a dining room that measures $12' \times 16'$?
- 20) On three consecutive days, a crew of four labourers worked eight hours. Calculate the total number of hours worked by the crew.

ANSWER KEY

WHOLE NUMBERS

Page 2, **Place Value**

- 1) 3 thousands, 6 ones
- 2) 0 ten thousands, 3 hundreds
- 3) 7 thousands, 6 tens
- 4) 2 hundred thousands, 5 tens

Page 4, **Rounding Whole Numbers**

- | | | | |
|----------|-----------|------------|------------|
| 1) 10 | 2) 160 | 3) 290 | 4) 2 840 |
| 5) 100 | 6) 600 | 7) 8 300 | 8) 10 600 |
| 9) 1 000 | 10) 4 000 | 11) 28 000 | 12) 52 000 |

Page 5, **Adding Whole Numbers**

- | | | | |
|--------|----------|---------|---------|
| 1) 106 | 2) 184 | 3) 141 | 4) 101 |
| 5) 920 | 6) 1 000 | 7) 110 | 8) 131 |
| 9) 17 | 10) 21 | 11) 174 | 12) 121 |

Page 7, **Subtracting Whole Numbers**

- | | | | |
|--------|---------|--------|---------|
| 1) 44 | 2) 52 | 3) 89 | 4) 17 |
| 5) 89 | 6) 145 | 7) 88 | 8) 478 |
| 9) 102 | 10) 419 | 11) 69 | 12) 358 |

Page 10, **Multiplying Whole Numbers**

- | | | | |
|-----------|-----------|------------|-----------|
| 1) 882 | 2) 169 | 3) 5 041 | 4) 33 744 |
| 5) 81 328 | 6) 66 096 | 7) 419 405 | 8) 71 100 |

ANSWER KEYS

Page 13, **Dividing Whole Numbers**

- | | | | |
|------------|-----------|------------|------------|
| 1) 124 | 2) 21 | 3) 43 | 4) 32 |
| 5) 22 | 6) 31 | 7) 28 | 8) 32 |
| 9) 1 005 | 10) 109 | 11) 201 | 12) 105 |
| 13) 17 R11 | 14) 23 R4 | 15) 37 R11 | 16) 41 R38 |

Page 15, **Order of Operations**

- | | |
|--|---|
| 1) $9 + 8 \times 3 = 9 + 24 = 33$ | 2) $6 \times 8 + 6 = 48 + 6 = 54$ |
| 3) $13 \times 2 - 2 = 26 - 2 = 24$ | 4) $20 \times 10 \div 5 = 20 \times 2 = 40$ |
| 5) $36 \div (8 - 2) = 36 \div 6 = 6$ | 6) $(20 - 11) \div (6 \div 2) = 9 \div 3 = 3$ |
| 7) $20 \div (2 \times 5) = 20 \div 10 = 2$ | 8) $(35 \div 7) - (8 \div 4) = 5 - 2 = 3$ |
| 9) $5^2 - 6 \div 2 = 25 - 6 \div 2 = 25 - 3 = 22$ | |
| 10) $9 \times 5 + (7 - 2) - 4^2 = 9 \times 5 + 5 - 4^2 = 9 \times 5 + 5 - 16 = 45 + 5 - 16 = 50 - 16 = 34$ | |

Page 16, **Practice**

- | | | |
|-----------------------|----------------------|---------------------|
| 1) 4 254 board feet | 2) 594 hours | 3) \$3 352 |
| 4) 963 sq. feet | 5) \$513 | 6) 694 square feet |
| 7) 2 945 mm | 8) \$97 206 | 9) 296 feet |
| 10) 15 860 mm | 11) 238 board feet | 12) 1 164 snap ties |
| 13) 74 nails | | |
| 14) a) 5 pieces | b) 1 foot | |
| 15) a) 10 pieces | b) 6 inches | |
| 16) a) 142 headers | b) 6 nails left over | |
| 17) a) 112 cubic feet | b) 368 feet | |
| 18) 144 minutes | 19) 56 lineal feet | 20) 96 hours |