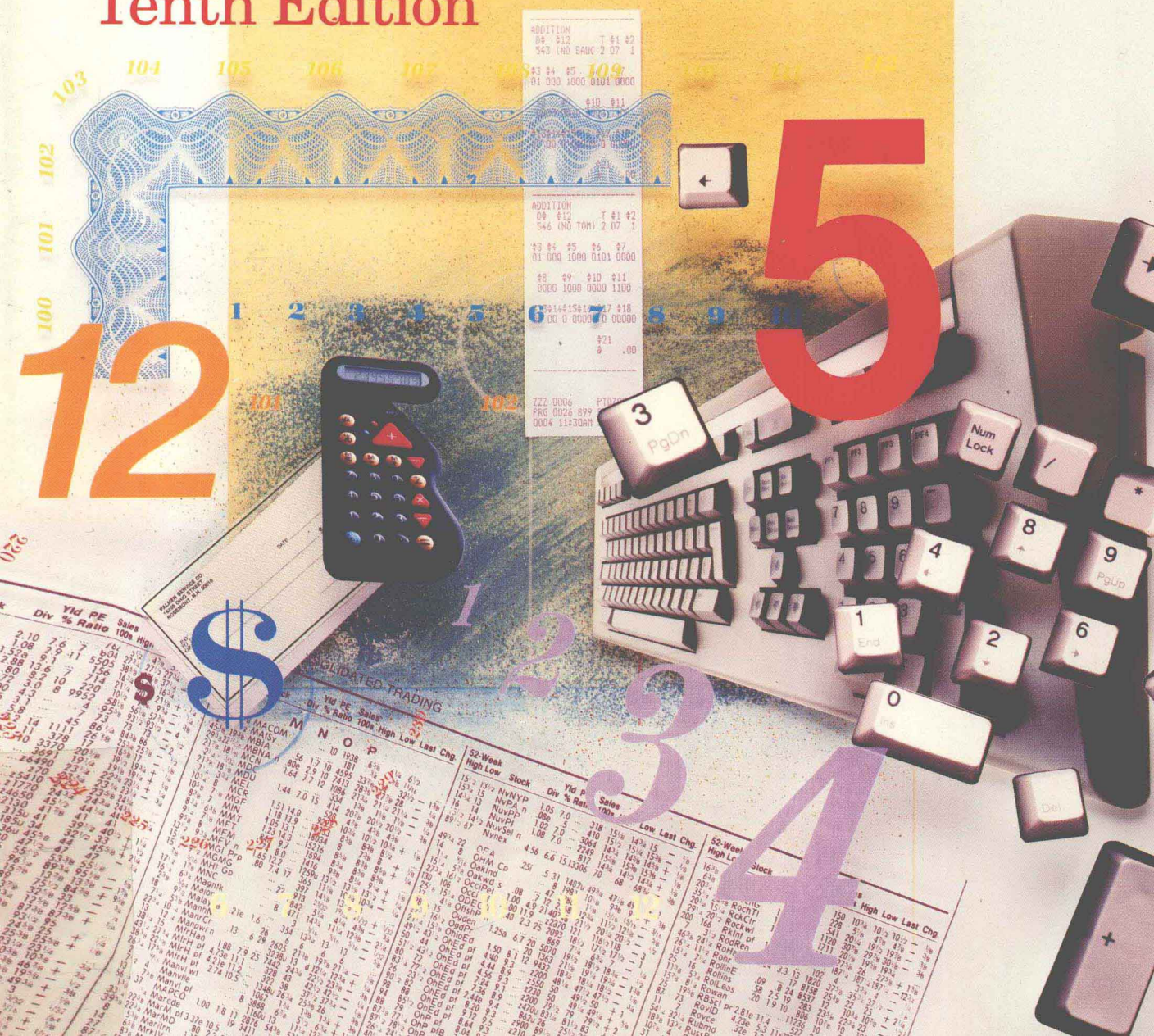# Business Mathematics for Colleges

Deitz & Southam

Tenth Edition

Business Mathematics for Colleges

Tenth Edition

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To the Student

In modern business, everyone needs knowledge of and skill in business mathematics. The Tenth Edition of BUSINESS MATHEMATICS FOR COLLEGES will assist you in developing your knowledge and skill by presenting the necessary fundamental principles and applying these principles in a series of practical business problems.

The following suggestions will aid you in using this book:

1. For each section, read the text, and study the steps and the examples carefully before beginning an assignment.

2. Read carefully the instructions for each group of assignment problems before attempting to solve them. Master the technique for solving word problems as presented on pages 33-34.

3. Do your own work. You learn by doing the calculations yourself. Ask your instructor for help if you have any difficulty in understanding what you are to do or how to do it.

4. Before working each problem try to approximate your answer. The text presents methods for doing this.

5. Try to use shortcuts in your calculations. You will find shortcuts presented in several chapters.

6. Improve your writing of figures through regular practice so that you will not make errors as a result of mistaking one number for another.

7. Align figures in columns to avoid errors in addition and subtraction.

8. Practice problems have been provided in all chapters. These problems do not require the use of a calculator. Master the fundamental processes before you depend on a calculator. Be able to work employment test problems without any mechanical device, since many potential employers may not allow its use.

9. Space is allowed on the assignment sheets for you to calculate most problems. *Show each step* in your solution so that if you make an error, your instructor can help you locate the cause of your difficulty.

10. If you need additional practice, ask your instructor about the microcomputer study guide.

11. Write your name and the date at the top of the first page of each assignment before you submit it to the instructor.

12. Record your score or grade for each assignment on the Progress Record at the end of your book.

Many students have used the earlier editions of this text in preparing themselves for business. The authors hope that this new edition will provide even greater assistance to the thousands of students who will become the business people of the future.

James E. Deitz
James L. Southam

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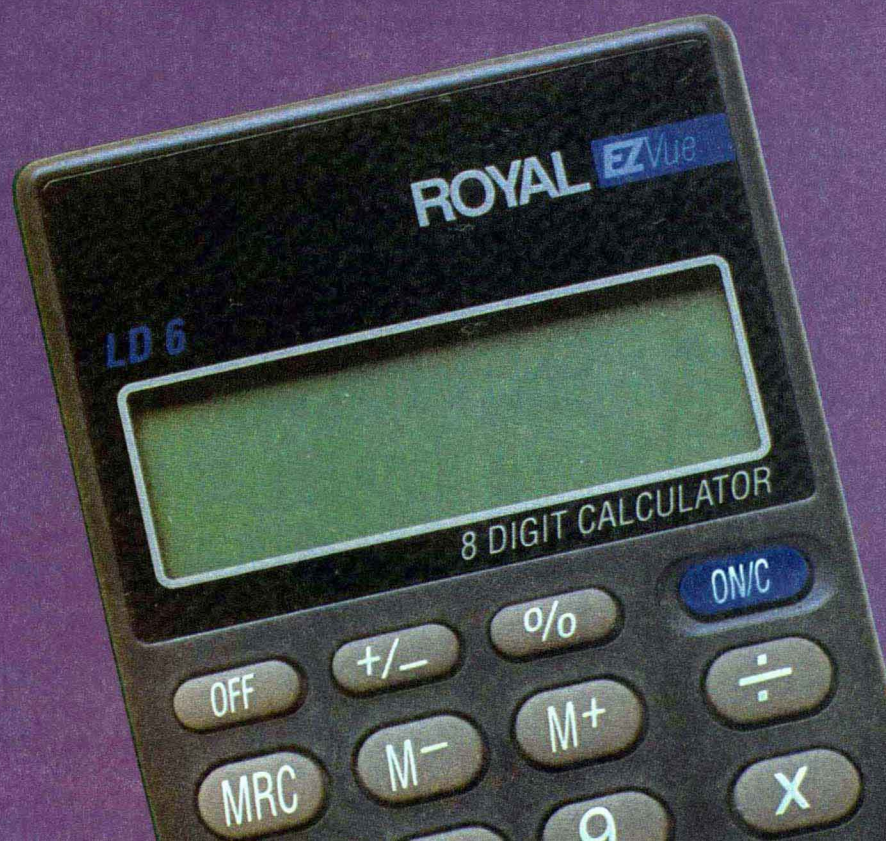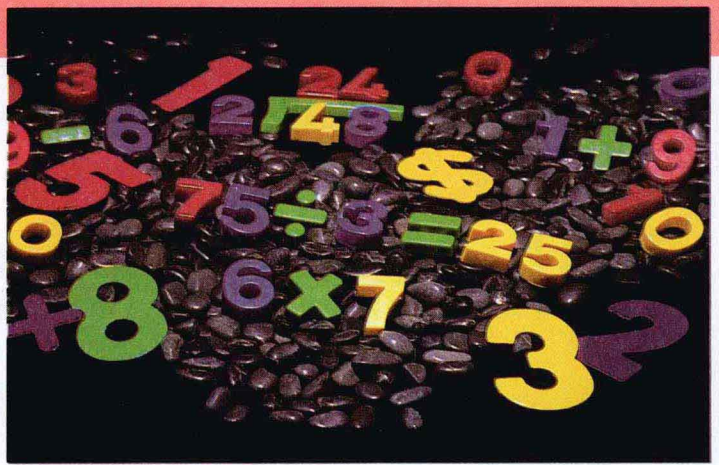
Chapter 1
Fundamental Processes

OBJECTIVES
After completing this chapter, you should be able to:

- **Add, subtract, multiply, and divide with greater ease**
- **Estimate multiplication and division solutions**

Numbers are used in practically every aspect of business—to represent prices, to measure weights and quantities, to check the time worked by employees, and to indicate profit and general value.

It is important that students who plan to enter business gain competence in handling numbers. The purpose of this chapter is to review the fundamental mathematical processes and to provide practice in the use of certain short-cuts using numbers.

ADDITION

About half of the calculations used in business involve addition. The more skilled you become in recognizing the sum of any two digits, the more rapidly and accurately you will be able to add.

Number Combinations

Certain aids can help you in adding more accurately and rapidly. One of the most helpful of these is combining any two numbers that total 10. The combinations that total 10 are illustrated below. Practice the combinations until you can identify them instantly.

1	2	3	4	5
9	8	7	6	5

In the reverse order:

9	8	7	6	5
1	2	3	4	5

When these combinations are found in any column of numbers, they should be added as 10.

In example a., you might add the numbers in the right-hand column by saying, as you count down the column, "9 plus 4 is 13, plus 6 is 19, plus 3 is 22, plus 7 is 29, plus 8 is 37" (or simply "13, 19, 22, 29, 37"). By using the combinations of 10, however, you can simply add down the column by saying "9 plus 10 is 19, plus 10 is 29, plus 8 is 37" (or "9, 19, 29, 37").

The number 3, which is to be carried over to the top of the next column, is written in a small figure above the number 7 in the center column. The combinations of 10 are used in adding the center column by simply saying "10, 20, 30."

In adding the left-hand column, you can simply say "8, 18, 28, 32."

It also is helpful to instantly recognize combinations of three numbers that total 10. These basic combinations are:

1	1	1	1	2	2	2	3
1	2	3	4	2	3	4	3
8	7	6	5	6	5	4	4

These numbers in each combination may appear in a different sequence. For example, the numbers 2, 3, and 5 may appear in any one of six arrangements:

2	3	2	3	5	5
3	2	5	5	2	3
5	5	3	2	3	2

When these numbers totaling 10 are in sequence in a column, they should be combined and added as 10. In example b., you might add the numbers in the right-hand column by saying, as you add down the column, "10, 18, 28, 38, 41." The number 4, which is carried over, is written as a small figure above the 5 in the first column. The combinations of 10's are used in adding the left-hand column by saying "9, 19, 29, 39, 47."

Addition of Repeated Digits
When adding a column in which most of the digits are the same, it is often quicker to count the number of repeated digits, and then multiply the digit by that number. (See "Steps for Multiplying Two Numbers" later in this chapter.) In example c., the ones column totals 33 (10 + 10 + 13). The tens column shows five 4's equaling 20: 5 × 4 = 20. The carry over of 3 and the 5 are then added to the 20 for a total of 28 in the tens column. The total in the problem is 283.

Checking Addition
It is always desirable to check the accuracy of your addition. This is done by adding the columns again in the opposite direction—that is, if you added down, add up for the check.

Horizontal Addition
It is often necessary in business papers and records to add numbers horizontally, or across the line, to save the time of recopying the numbers vertically. Several horizontal additions may be checked by adding the columns vertically and by then adding these totals horizontally. This is called *cross-checking*. The sums obtained by adding the totals horizontally and vertically should be the same.

a.
```
      3  ③
   5 ⑦ 9
   4 ② 4
   6 ⑧ 6
   9 ⓪ 3
   1 ⑤ 7
+  4 ⑤ 8
3 , 2 0 7
```

b.
```
        4
   9    57
        62
  19    41    10
        28    18
        25
  29    65    28
        54
        24
  39    32    38
  47    83    41
       471
```

c.
```
           3
        4 ①
        4 ⑨    10
  5 × 4 4 ⑧
        4 ②    10
        4 ⑦
        5 ⑥    13
       28 3    33
```

d.

282 +	346 +	723 +	409 +	716 =	2,476
113 +	806 +	629 +	916 +	620 =	3,084
240 +	318 +	718 +	312 +	309 =	1,897
716 +	501 +	423 +	716 +	114 =	2,470
872 +	417 +	909 +	704 +	472 =	3,374
2,223 +	2,388 +	3,402 +	3,057 +	2,231 =	13,301 (same total)

SUBTRACTION

Subtraction is the process of finding the difference between two numbers. When the *subtrahend* (number being subtracted) is taken from the *minuend* (number from which subtraction is being made), the result is the *difference*, as shown. When the subtrahend is less than the minuend, the result is a positive difference. When the subtrahend is greater than the minuend, the result is a negative difference. In business, a negative difference may be called a *credit balance*. A credit balance is frequently shown in parentheses.

e.

Positive Differences			Negative Difference (Credit Balances)	
$32.22	18.88	Minuend	12.00	$32.22
− 22.22	− 3.63	Subtrahend	− 13.50	− 42.22
$10.00	15.25	Difference	(1.50)	($10.00)

Checking Subtraction

Subtraction is checked with addition since subtraction is the opposite of addition. If 209 is subtracted from 317, the difference is 108. This can be checked by adding 108 to 209. The sum is 317. The same procedure can be used to check subtraction with a negative difference (credit balance).

f.

Subtract	Check	Subtract	Check
317	108	$21.10	($ 3.40)
− 209	+ 209	− 24.50	+ 24.50
108	317	($ 3.40)	$21.10

Horizontal Subtraction

Certain business forms and records are constructed so that it is necessary to subtract numbers horizontally unless time is taken to copy the numbers vertically. A number of horizontal subtractions are checked by adding the columns vertically and then subtracting these totals horizontally. This answer should equal the total of the differences in the column at the right.

g.

Minuend		Subtrahend	Difference
$ 367.65	−	$ 194.50	= $173.15
829.30	−	516.28	= 313.02
601.40	−	479.12	= 122.28
296.74	−	82.65	= 214.09
$2,095.09	−	$1,272.55	= $822.54 (same total)

MULTIPLICATION

Multiplication, stated simply, is "repeated addition." When two numbers (called *factors*) are multiplied, one number is repeated as many times as there are units in the other. The factor that is multiplied is called the *multiplicand*. The factor that indicates how many times to multiply is the *multiplier*. The result is the *product*. Note that in multiplication it does not matter which number is called the multiplier. Thus, $3 \times 5 = 5 \times 3$; $87 \times 100 = 100 \times 87$, etc. Also note that when multiplying numbers, the digit order will be from right to left.

Steps for Multiplying Two Numbers

1. a. Make the smaller factor the multiplier.
   b. Write the smaller factor under the larger one so that their right-hand digits are in the same column.
2. a. Multiply the multiplicand by the right-hand digit of the multiplier.
   b. Write the product directly below the line.
   c. Be sure the product's right-hand digit is lined up with the right-hand digit of the multiplier.
3. a. Multiply the multiplicand by the *second* digit of the multiplier.
   b. Write the product below and one place to the left of the Step 2 product. (Thus, this product's right-hand digit goes directly under the *second* digit of the multiplier.)
4. a. Multiply the multiplicand by the *third* digit of the multiplier.
   b. Write the product below and one place to the left of the Step 3 product. (Thus, this product's right-hand digit goes directly under the *third* digit of the multiplier.)
5. Continue following the pattern of Steps 3 and 4 as needed, each time choosing the multiplier digit that is just to the left of the one used in the prior step (for example, the fourth digit, the fifth digit, etc.) until all digits in the multiplier have been used.
6. Add the three products to get the final answer.

h.

	456	(multiplicand)
	$\times$ 237	(multiplier)
Step 1		
Step 2	3 192	
Step 3	13 68	
Step 4	91 2	
Step 6	108,072	(product)

In other words:

$7 \times 456 = 3{,}192$
$30 \times 456 = 13{,}680$
$200 \times 456 = 91{,}200$
$237 \times 456 = 108{,}072$

Checking Multiplication

The best method to check multiplication is to divide the product by the multiplier to obtain the multiplicand. Example i. shows the relationship between multiplication and division. (For the division process, see the next section.)

i.

multiplicand	22 $\longleftrightarrow$	22
multiplier	$\times$ 6 $\longrightarrow$	$6\overline{)132}$
product	132 $\longleftarrow$	

Multiplying Numbers Ending in 0

To multiply a number by 10, simply add a zero onto the end of the number. To multiply a number by 100, add two zeros onto the end: $10 \times 46 = 460$; $7{,}689 \times 100 = 768{,}900$.

1. Use as the multiplier the factor with the smaller number of digits after ignoring all zeros on the right-hand side of the number.
2. Ignore the right-hand zeros and multiply the remaining numbers.
3. Add to the right-hand side of the product the total number of zeros ignored in Step 2.

j. Step 1 370×200:   200   Step 1 $1,200 \times 160,800$:   1,200

$$
\begin{array}{rl}
 & \text{ignored} \\
37 & \text{(1 zero)} \\
\times\ 2 & \text{(2 zeros)} \\
\hline
74 & \text{(3 zeros)}
\end{array}
\qquad
\begin{array}{rl}
 & \text{ignored} \\
1608 & \text{(2 zeros)} \\
\times\ 12 & \text{(2 zeros)} \\
\hline
3216 & \\
1608\ \ & \\
\hline
\end{array}
$$

Step 2   74   (3 zeros)

Step 2   19296   (4 zeros)

Step 3 $74 \ \& \ 000 = 74,000$

Step 3 $19296 \ \& \ 0000 = 192,960,000$

k.
$$
\begin{array}{r}
42,674 \\
\times\ 401 \\
\hline
42\ 674 \\
17\ 069\ 6 \\
\hline
17,112,274 \\
\text{(2 places)}
\end{array}
$$

Multiplying When the Multiplier Contains 0

Often the 0 is found in the center of the multiplier rather than at the end. To multiply 42,674 by 401 in example k., first multiply the multiplicand by 1, and write down the product. Then multiply by 4 (which is really 400), and write the results two places, instead of one, to the left. In other words, one extra place is left for each 0 in the multiplier. (Refer to the example displayed in the margin.)

Whenever more than one zero is found within the multiplier, the multiplication process is similar. To multiply 33,222 by 2,004 as in example l., first multiply 33,222 by 4. Then, multiply 33,222 by 2, writing the answer three places to the left. Remember, space must be left for the two zeros (1 + 2 extra places = 3 places).

l.
$$
\begin{array}{r}
33,222 \\
\times\ 2,004 \\
\hline
132\ 888 \\
66\ 444 \\
\hline
66,576,888 \\
\text{(3 places)}
\end{array}
$$

Rule: Zero times any number is zero, and any number times zero is zero. Thus, $4 \times 0 = 0$, and $0 \times 567 = 0$.

Multiplying the Product of Two Factors

Sometimes in business you will need to multiply two factors, then multiply the product of those factors by a third factor. As shown in example m., you first multiply the first two factors and then multiply that product by the third factor.

m.

$21 \times 30 \times 12 = 7,560$

$$
\begin{array}{r}
21 \\
\times\ 30 \\
\hline
630
\end{array}
\qquad
\begin{array}{r}
630 \\
\times\ 12 \\
\hline
1,260 \\
6\ 30\ \ \\
\hline
7,560
\end{array}
$$

Multiplying by 25

A shortcut for multiplying by 25 is to multiply by 100 (add two zeros), and divide by 4. (For the division process, see the next section.)

n. 321×25 $\qquad$ 828×25 $\qquad$ $6,640 \times 25$

$32,100 \div 4 = 8,025$ $\quad$ $82,800 \div 4 = 20,700$ $\quad$ $664,000 \div 4 = 166,000$

Multiplying by 50

A shortcut for multiplying by 50 is to multiply by 100 (add two zeros), and divide by 2. (For the division process, see the next section.)

o. 732 × 50   1,245 × 50 $28.20 × 50

73,200 ÷ 2 = 36,600   124,500 ÷ 2 = 62,250 $2,820.00 ÷ 2 = $1,410.00

Estimating

Mentally estimating an approximate answer is a good method for checking whether or not your product is a reasonable answer.

Steps to Estimate a Multiplication Answer

1. Round the *multiplicand* and *multiplier* to the nearest *10* for 2-digit numbers, the nearest *100* for 3-digit numbers, the nearest *1,000* for 4-digit numbers, etc.
2. Drop the zeros to the right of the non-zero numbers.
3. Mentally multiply the non-zero numbers to determine the base product.
4. Add back *all* zeros dropped in Step 2.

---

p.

Problem	Round To	Drop Zeros	Base Product	Add Back Zeros (Approximate Answer)	Real Answer
68 × 21	70 × 20	7 × 2	14	1,400	1,428
473 × 1,957	500 × 2,000	5 × 2	10	1,000,000 −	925,661
7,869 × 43,242	8,000 × 40,000	8 × 4	32	320,000,000	340,271,298
147,203 × 13	100,000 × 10	1 × 1	1	1,000,000 +	1,913,639
9 × 511,739	9 × 500,000	9 × 5	45	4,500,000	4,605,651
882 × 39 × 134	900 × 40 × 100	9 × 4 × 1	36	3,600,000	4,609.332

− Since both the multiplicand and multiplier were rounded to *larger* numbers, the real answer will be *lower* than the approximate answer.

+ Since both the multiplicand and multiplier were rounded to *smaller* numbers, the real answer will be *higher* than the approximate answer.

COMPLETE ASSIGNMENT 1-3

DIVISION

Division is the process of finding how many times one number (the *divisor*) is contained in another (the *dividend*). The result is called the *quotient*. If anything remains after division is completed, it is called the *remainder*. In example q., 47 ÷ 2 = 23 (with 1 left over), 47 is the dividend, 2 the divisor, 1 the remainder, and the answer of 23 with a remainder of (1) is the quotient.

q.

```
                23(1)    quotient
    divisor  2)47        dividend
               4
               7
               6
               1         remainder
```

1. a. Write the divisor.
    b. Draw the division bracket ( )̄).
    c. Write in the dividend.
2. Take as the first partial dividend the least number of digits at the left of the dividend that will contain the divisor.
3. a. Write the number of times the divisor will go into the partial dividend selected in Step 2.
    b. Multiply the divisor by this answer, write the product under the partial dividend, and subtract.
    c. To the internal remainder thus obtained, bring down the next digit of the dividend for the second partial dividend.
4. Divide as before, and continue until all the digits of the dividend have been used.

r.   Step 3a

                     174
            164)28,675   Step 2
                 16 4
                 12 27   Step 3b
                 11 48   Step 3c
                    795
                    656   Step 4
                    139
                 (remainder)

s.   20,108
        34)683,672
           68
            3 6
            3 4
             272
             272
               0

As illustrated in example s., when the partial dividend is smaller than the divisor, a zero must be placed in the quotient above that digit. This process is continued until the partial dividend is at least as large as the divisor. Then the long division steps are continued.

Checking Division

To check division, simply multiply the quotient by the divisor, and add any remainder to the product. The result will equal the original dividend. (Refer to examples r. and s.)

            174   20,108
         × 164   ×   34
            696   80 432
        10 44   603 24
        17 4   683,672
        28,536
        + 139   (remainder)
        28,675

NOTE: Division is the opposite of multiplication.

t.

Multiplication	Division
$4 \times 6 = 24$	$24 \div 4 = 6$
$36 \times 52 = 1,872$	$1,872 \div 36 = 52$

Dividing by 10

To divide by 10, drop the digit at the extreme right of the dividend; the dropped digit will be the remainder.

u. $790 \div 10 = 79$ (0 remainder) $3,562 \div 10 = 356$ (2 remainder)

Dividing by 100

To divide by 100, drop the two right-hand digits of the dividend, and use them as the remainder.

v. $81,400 \div 100 = 814$ (0 remainder) $257,948 \div 100 = 2,579$ (48 remainder)

Dividing When Divisor and Dividend End with Zeros

When a divisor and dividend both end with zeros, an easy shortcut is to delete the ending zeros common to both, and then divide.

w.

Problem with both divisor and dividend ending with zeros	Zeros common to divisor and dividend have been dropped	Answer	
$8,400 \div 200$	$84 \div 2$	42	
$46,000 \div 2,300$	$460 \div 23$	20	
$42,000 \div 100$	$420 \div 1$	420	
$20,000,000 \div 4,000$	$20,000 \div 4$	5,000	
$2,760 \div 270$	$276 \div 27$	10	(6 remainder or R6)
$3,200 \div 1,000$	$32 \div 10$	3	(2 remainder or R2)

Estimating

Before doing long division problems, it is best to estimate mentally an approximate whole-number answer. Later, when working with decimals, fractions, and electronic calculators, the process of mentally estimating whole-number answers helps to avoid major and embarrassing errors.

Steps to Estimate a Long Division Whole-Number Answer

1. Round the *divisor* and *dividend* to the nearest *10* for 2-digit numbers, the nearest *100* for 3-digit numbers, the nearest *1,000* for 4-digit numbers, etc.
2. Drop the number of zeros common to both.
3. Mentally divide the remaining divisor into the remaining dividend. (NOTE: for decimal information shown in the Real Answer column, see Chapters 7 and 8.)

x.

Problem	Round To	Drop Zeros	*Approximate Answer*	*Real Answer*
77 ÷ 39	80 ÷ 40	8 ÷ 4	2	1.97
196 ÷ 63	200 ÷ 60	20 ÷ 6	3+	3.11
2,891 ÷ 114	3,000 ÷ 100	30 ÷ 1	30	25.36
592 ÷ 29	600 ÷ 30	60 ÷ 3	20	20.41
18,476 ÷ 384	20,000 ÷ 400	200 ÷ 4	50	48.11
917 ÷ 186	900 ÷ 200	9 ÷ 2	4+	4.93
21,716,412 ÷ 40,796	20,000,000 ÷ 40,000	2,000 ÷ 4	500	532.32
99,624 ÷ 476	100,000 ÷ 500	1,000 ÷ 5	200	209.29
29,200 ÷ 316	30,000 ÷ 300	300 ÷ 3	100	92.41

+ Since 20 ÷ 6 and 9 ÷ 2 would result in a remainder, it is reasonable to assume the real answer will be *larger*.

COMPLETE ASSIGNMENT 1-4

Chapter terms for review

credit balance
cross-checking
difference
dividend
divisor
factors
minuend

multiplicand
multiplier
product
quotient
remainder
subtrahend

Assignment 1-1: Addition Review

A (10 points) — Add the following. Where possible, use combinations of tens (1 point for each correct answer).

1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**
14	41	19	34	97	50	72	82	38	94
56	29	51	33	44	54	99	43	39	71
25	17	14	43	33	54	99	47	22	56
85	13	96	33	36	52	21	15	71	29
53	36	81	37	76	47	89	93	45	55
52	44	28	36	32	59	47	58	47	84
35	15	11	34	72	54	63	34	25	31
32	55	43	32	34	55	40	22	13	98
48	62	51	38	76	55	62	46	29	76
32	66	76	32	27	35	68	73	79	62

Score for A (10)

B (20 points) — Add the following (1 point for each correct answer).

11.	**12.**	**13.**	**14.**	**15.**	**16.**	**17.**	**18.**
209	782	127	920	347	852	251	883
486	280	145	751	399	428	271	114
225	438	665	359	354	112	244	312
219	473	818	822	334	238	234	588
684	655	682	807	192	959	589	736

19.	**20.**	**21.**	**22.**	**23.**	**24.**	**25.**	**26.**
275	479	652	322	203	650	651	444
342	413	386	108	776	162	616	397
615	180	366	128	417	297	496	855
898	418	344	722	304	946	659	811
505	415	359	922	687	321	628	313

27.	**28.**	**29.**	**30.**
549	682	862	356
587	314	411	294
870	262	422	987
543	734	295	263
531	444	973	128

Score for B (20)

C (10 points) — Add the following (1 point for each correct answer).

31.	**32.**	**33.**	**34.**	**35.**
$ 78.25	$ 16.71	$ 34.42	$ 27.61	$128.02
49.41	243.80	127.81	71.96	43.92
38.12	72.73	84.25	389.91	104.64