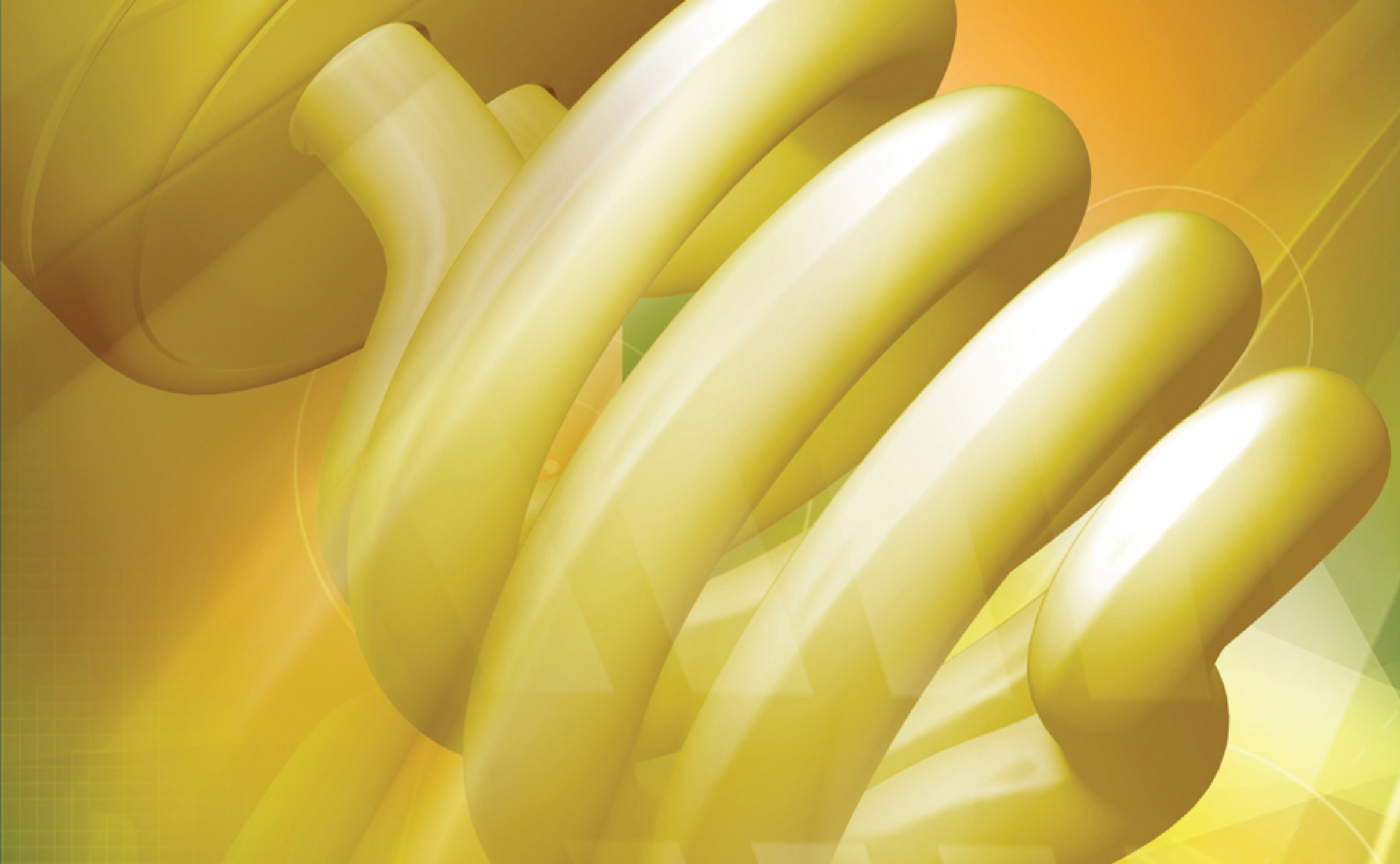
PPM

PRACTICAL PROBLEMS IN MATHEMATICS

ELECTRICIANS



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Practical Problems in Mathematics for Electricians, Ninth Edition
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1 2 3 4 5 6 7 14 13 12 11 10

SECTION 1

Whole Numbers

UNIT 1

Addition of Whole Numbers

Basic Principles of Addition of Whole Numbers

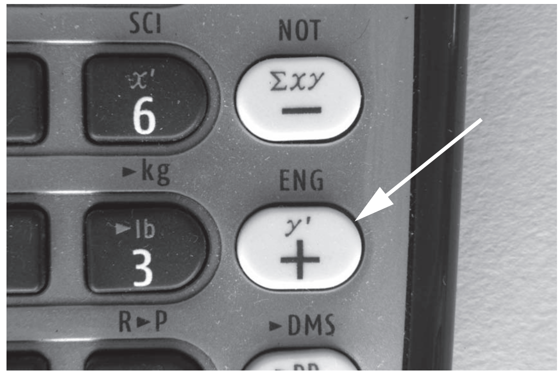
Whole numbers are numerical units with no fractional parts. Addition is the process of finding the *sum* of two or more numbers. Whole numbers are added by placing them in a column with the numbers aligned on the right side of the column. The right column of numbers is added first. The last digit of the sum is written in the answer. The remaining digit is carried to the next column and added. This procedure is followed until all columns have been added.

EXAMPLE: Find this sum. 25 + 7 + 126 + 54 + 367

$$
\begin{array}{r}
\scriptstyle 2 \\
25 \\
7 \\
126 \\
54 \\
+\ 367 \\
\hline
9
\end{array}
\qquad\qquad
\begin{array}{r}
\scriptstyle 12 \\
25 \\
7 \\
126 \\
54 \\
+\ 367 \\
\hline
79
\end{array}
\qquad\qquad
\begin{array}{r}
\scriptstyle 12 \\
25 \\
7 \\
126 \\
54 \\
+\ 367 \\
\hline
579
\end{array}
$$

Using the Calculator

The calculator can make adding numbers in succession a very simple task. The plus key can be used repeatedly when finding the sum of several different numbers.



EXAMPLE: To add the number in the above example, enter the following:

(25)(+)(7)(+)(126)(+)(54)(+)(367)(=)

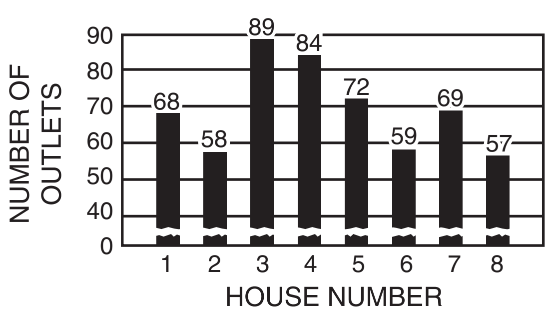
NOTE: Parentheses will be used to indicate different keystrokes on the calculator. Although entering 25 actually requires two different keystrokes, numbers will be shown as one entry.

Practical Problems

1. When taking inventory, you find that the numbers of BX connectors in five different bins are 176, 264, 375, 234, and 116. What is the total number of connectors in all bins? ________

2. Eight different boxes contain a number of ¾-inch, #8 flat-head, bright wood screws. The numbers of screws are 124, 72, 36, 92, 38, 64, 74, and 67. What is the total number of screws? ________

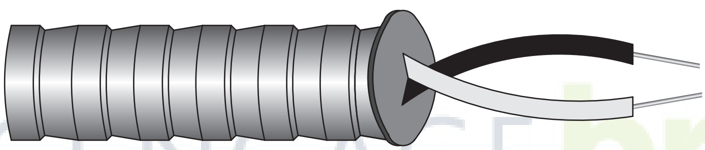
3. In wiring eight houses, you are to install outlets. The graph below shows the number of outlets to be installed in each house. Find the total number of outlets that must be roughed-in. ________



4. An electrician uses switch outlet boxes on eight different jobs. The number of boxes used on each job is 56, 9, 86, 36, 93, 105, 42, and 56. Find the total number of outlet boxes used. ____________

5. The materials charged to a wiring job are as follows: 100-ampere distribution panel, $118; meter switch, $38; conduit, $64; number 2 wire, $88; BX cable, $73; conduit fittings, $26; outlet boxes, $153; switches, $112; fixtures, $215; and $64 for wire nuts, grounding clips, staples, and pipe clamps. What is the total amount charged for these materials? ____________

6. At different times during a week, an electrician takes the following amounts of metallic cable from stock: 500 feet, 1,200 feet, 250 feet, 90 feet, 38 feet, 65 feet, 84 feet, 225 feet, and 125 feet. What is the total number of feet of metallic cable taken from stock? ____________

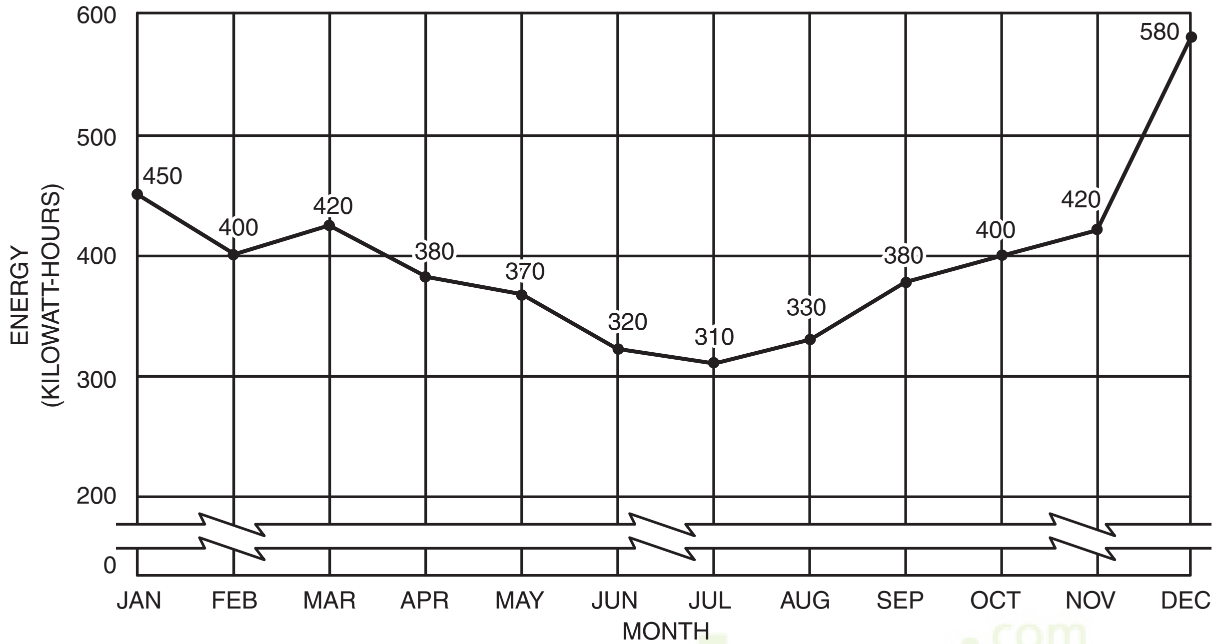


7. The following amounts of nonmetallic cable are used on an apartment house job: 625 feet, 785 feet, 75 feet, 140 feet, 310 feet, 325 feet, and 120 feet. What is the total number of feet of nonmetallic cable used on the job? ____________

8. A factory department has motors of 75 horsepower, 30 horsepower, 200 horsepower, 40 horsepower, 25 horsepower, 15 horsepower, 5 horsepower, 125 horsepower, 150 horsepower, and 175 horsepower. What is the combined horsepower of the 10 motors? ____________

9. An electrical supply house purchases solder in separate lots of 35 pounds, 40 pounds, 125 pounds, 200 pounds, 75 pounds, 90 pounds, 20 pounds, and 30 pounds. Find the total number of pounds of solder purchased. ____________

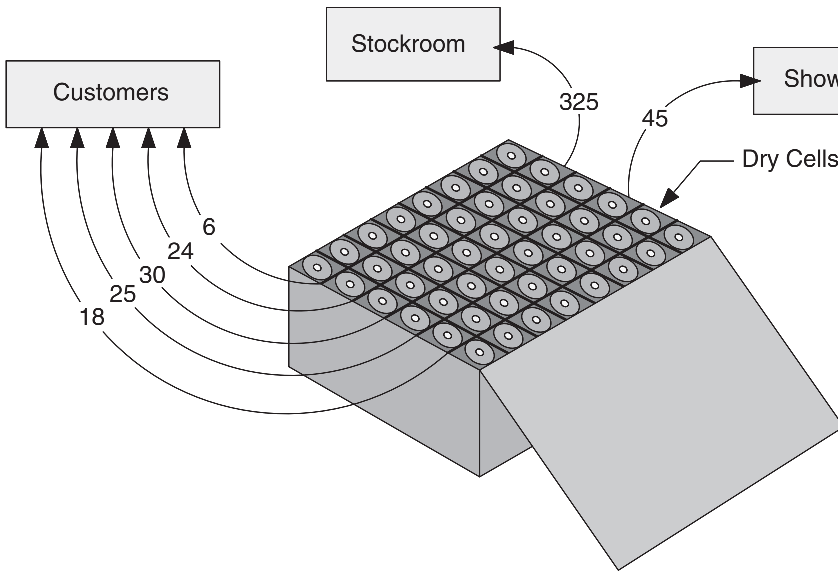
10. The line graph on the next page shows the monthly consumption of energy in kilowatt-hours for a house during a 1-year period. Find the total amount of energy consumed during the year. ____________



11. A school has twelve lighting circuits that use the following wattages: 545 watts, 650 watts, 750 watts, 1,820 watts, 2,462 watts, 2,571 watts, 1,360 watts, 1,540 watts, 793 watts, 1,225 watts, 330 watts, and 793 watts. What is the total number of watts consumed when all these circuits are being used? ________________

12. The cost of magnet wire for a motor repair shop during a 1-week period is as follows: 14 pounds of number 17, \$58; 12 pounds of number 16, \$55; 10 pounds of number 24, \$51; 6 pounds of number 21, \$19; 5 pounds of number 25, \$24. Find the total cost of magnet wire during this period. ________________

13. From a full container of dry cells, 325 dry cells are placed in the stockroom, 45 dry cells are placed on the shelf in the showroom, and 18, 25, 30, 24, and 6 dry cells are sold to customers. How many dry cells are taken from the full container? ________________



14. Three rooms of a house contain lamps that have the following wattage: living room, 150 watts; dining room, 125 watts; bathroom, 75 watts. What is the total load when all lamps are operating? __________

15. The following number of BX cable staples are used during a given period: 250, 125, 65, 36, 48, 96, 92, 28, 42, 106, 140, and 24. Find the total number of BX cable staples used during this period. __________

16. An electrical contractor receives the following quantities of Braidx cable during the first quarter of the year: January, 7,500 feet; February, 10,750 feet; March, 4,500 feet. Find the total number of feet of Braidx cable received. __________

17. During 1 week of work, an electrician uses the following amounts of 3-conductor wire with ground NM cable: 1,200 feet, 1,150 feet, 1,076 feet, 180 feet, and 100 feet. Find the total amount of cable used. __________

UNIT 2

Subtraction of Whole Numbers

Basic Principles of Subtraction of Whole Numbers

Subtraction is the process of finding the *difference* between two numbers. The smaller of the two numbers is placed below the larger, keeping the right column of numbers aligned.

EXAMPLE: Subtract 432 from 768.

$$\begin{array}{r} 768 \\ -\ 432 \\ \hline 336 \end{array}$$

Borrowing

In subtracting whole numbers, it is sometimes necessary to borrow from the number in the adjacent column. When you do this, the amount borrowed must be in increments of value of the column borrowed from. For example, starting from the right, the first column represents units, or 1s, the second column represents 10s, the third column represents 100s, the fourth column represents 1,000s, and so on.

EXAMPLE: The number 9,876 could actually be rewritten as 1,000 nine times, 100 eight times, 10 seven times, and 1 six times.

1,000	100	10	1
1,000	100	10	1
1,000	100	10	1
1,000	100	10	1
1,000	100	10	1
1,000	100	10	1
1,000	100	10	
1,000	100		
1,000			
9,000	800	70	6

EXAMPLE: Now assume that the number 7,787 is to be subtracted from 9,876.

Write the smaller number below the larger.

$$\begin{array}{r} 9{,}876 \\ -\ 7{,}787 \\ \hline \end{array}$$

In this example, 7 cannot be subtracted from 6. Therefore, the 6 must borrow from the 7 in the column adjacent to it. Because the 7 is in the 10s column, 10 is borrowed, leaving 60 in that column. The borrowed 10 is added to the original 6, making 16 (10 + 6 = 16). Now 7 can be subtracted from 16, leaving a difference of 9.

$$\begin{array}{r} 986\ \mathbf{(16)} \\ -\ 778\ \mathbf{(\ 7)} \\ \hline 9 \end{array}$$

In the next column, 80 must be subtracted from 60. Because this is not possible, 100 will be borrowed from the 800 in the adjacent column and added to the existing 60, making 160. (This now leaves 7 in the 100s column.) The difference will be 80.

$$\begin{array}{r} 97\ \mathbf{(160)}\ 6 \\ -\ 77\ \mathbf{(\ 80)}\ 7 \\ \hline 8\ \ 9 \end{array}$$

In the third column, 700 is subtracted from 700, leaving a difference of 0.

$$\begin{array}{r} 9{,}876 \\ -\ 7{,}787 \\ \hline 089 \end{array}$$

In the fourth column, 7,000 is subtracted from 9,000, leaving a difference of 2,000.

$$\begin{array}{r} 9{,}876 \\ -\ 7{,}787 \\ \hline 2{,}089 \end{array}$$

The "Borrow 1" Method

"Borrow 1" is another borrowing method used in the subtraction of whole numbers. The term is actually a misnomer because 1 can be borrowed only from the units column, but many people use this method and find it simpler to understand.

EXAMPLE: Assume the number 58 is to be subtracted from the number 843. Place 58 below 843.

$$\begin{array}{r} 843 \\ -\ 58 \\ \hline \end{array}$$

Because 8 cannot be subtracted from 3, 1 is borrowed from the adjacent 4. The 3 now becomes 13, and the 4 becomes 3.

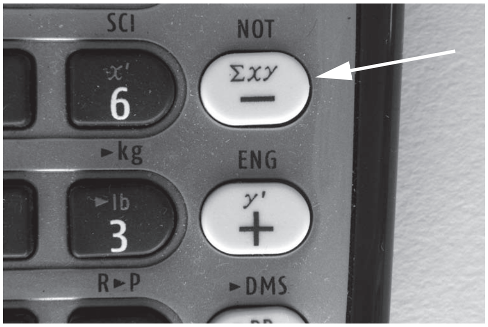
$$\begin{array}{rr} \mathbf{83} & \mathbf{(13)} \\ -\ 5 & 8 \\ \hline & 5 \end{array}$$

The 5 must now be subtracted from the 3 in the second column. Because 5 cannot be subtracted from 3, 1 is borrowed from the adjacent 8, and the 3 becomes 13. The 8 now becomes a 7.

$$\begin{array}{rrr} \mathbf{7} & \mathbf{(13)} & 3 \\ - & 5 & 8 \\ \hline 7 & 8 & 5 \end{array}$$

Using the Calculator

When subtracting numbers with the calculator, the minus key is used.



EXAMPLE: To subtract the number 4389 from 6521, enter the following:

(6521)(−)(4389)(=)

The answer is 2138.

The calculator can also work with negative numbers. Negative numbers have a value less than zero.

EXAMPLE: Subtract 854 from 238. Enter the following:

(238)(−)(854)(=)

The answer is −616.

The minus sign in front of the answer indicates that the answer is a negative number and has a value less than zero. The plus/minus key can be used to enter a negative number in the calculator. The plus/minus key is generally called the *change sign* key. It is used to change the sign of any number. It will change a positive number into a negative number, or a negative number into a positive number.

EXAMPLE: To subtract the number 322 from −46, enter the following:

(46)(+/−)(−)(322)(=)

The answer is −368.

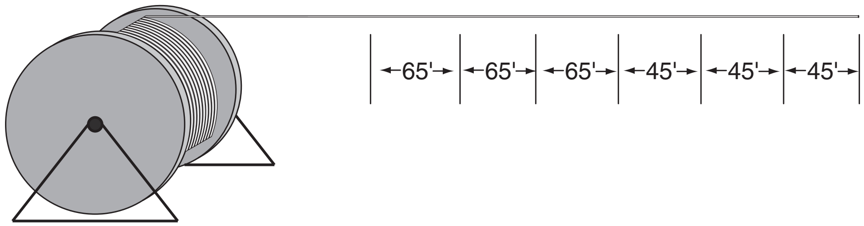
Practical Problems

1. An electrician removes from stock 500 feet of BX cable on Monday, 250 feet on Tuesday, and 750 feet on Wednesday. On Friday, 339 feet of BX cable are returned. How many feet of BX cable are used? __________

2. An electrical contractor charges $598 for a job. The materials cost is $263, the cost of labor is $173, and the cost of transportation is $10. Find the profit. __________

3. An inventory sheet shows 565 outlet boxes on January 1. On the 10th of January, 145 boxes are taken out of stock. On the 14th of January, 35 boxes are returned to stock. How many outlet boxes are in stock after January 14? __________

4. For a residential job, a reel containing 1,050 feet of cable is delivered. Three 45-foot lengths and three 65-foot lengths are used. How many feet are left? __________



5. A coil of Type S cord, 250 feet long, is taken on a job. The lengths cut off for drop and extension cords are 30 feet, 15 feet, 8 feet, 25 feet, 15 feet, and 20 feet. How many feet of cord remain in the coil? __________

6. A 1,000-foot reel of large stranded cable weighs 1,106 pounds. Of this, 365 pounds are used on a certain job from the switch to the first pull box, and 422 pounds are used from the first box to the last box. How many pounds of wire are left on the reel? __________

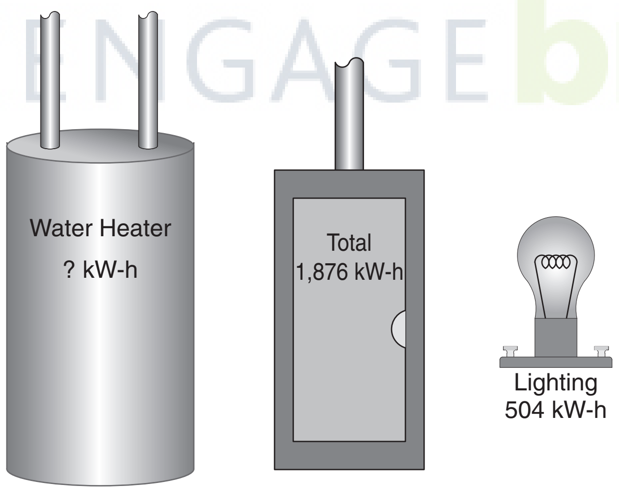
7. A purchase of 2,500 feet of number 14 wire is made for a job. On November 1, 1,365 feet of this wire are used. On November 3, an additional 830 feet are used. How many feet of wire are left after November 3? __________

8. On a certain job, a sum of $438 is spent for materials. Of this amount, $76 is spent for 1-inch conduit, and $105 is spent for cable. How much money is spent for other materials? ________

9. During the month of December, 400 outlet boxes are purchased at a cost of $385. The numbers of outlet boxes used are as follows: 59 boxes on December 1, 69 boxes on December 5, and 72 boxes on December 12. How many outlet boxes are left? ________

10. At inventory time, 435 pounds of magnet wire for winding motors are checked as being available. In ten successive days, 15 pounds, 6 pounds, 24 pounds, 12 pounds, 3 pounds, 8 pounds, 17 pounds, 32 pounds, 16 pounds, and 13 pounds of wire are taken out of stock. How many pounds are left? ________

11. A customer receives an electricity bill. The bill states that 1,876 kilowatt-hours of energy are used. Of this total, 504 kilowatt-hours are used for lighting and the rest are used for hot water. How many kilowatt-hours does the customer use for hot water? ________

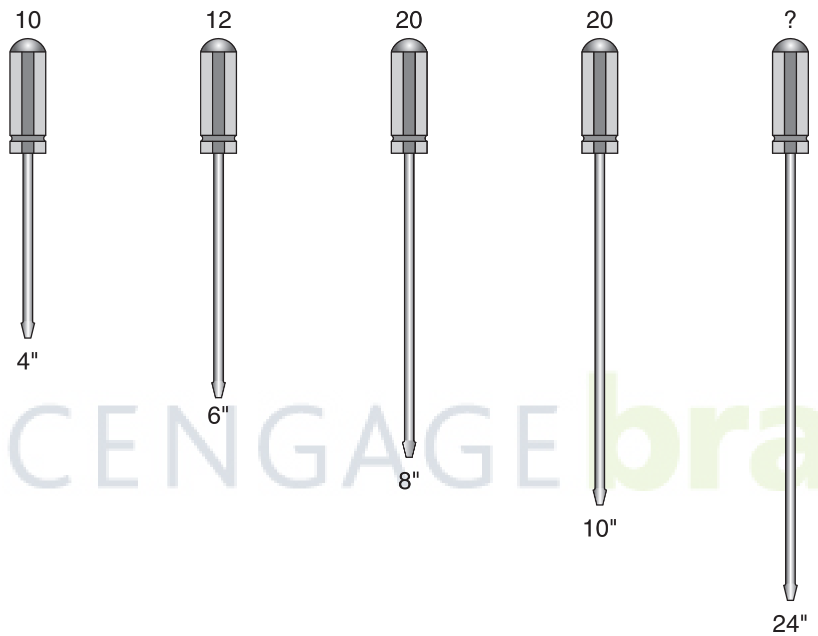


12. A supply house has 804 solenoids for 5-horsepower motor controls. The clerk must reorder this item when the supply reaches 60. Fourteen are sold on January 1, and 75 are sold on January 16. How many more can be sold before reordering? ________

13. A bin contains a total of 173 octagon boxes. For two jobs, 47 boxes and 65 boxes are taken from the bin. One job uses 4 boxes less than

originally estimated, and these 4 are returned to the bin. How many boxes are in the bin at the end of the two jobs? ______

14. A buyer can purchase 70 screwdrivers. Ten 4-inch lengths, twelve 6-inch lengths, twenty 8-inch lengths, and twenty 10-inch lengths are needed. How many heavy 24-inch length screwdrivers can be bought to obtain the total of 70 screwdrivers? ______



15. An electrician is given a 250-foot coil of BX cable. On one run, 29 feet are used. How much BX cable is returned to stock? ______

16. A 2-wire transmission line requires 134 miles of conductor for each wire. By straightening the proposed right-of-way, the distance is reduced by 7 miles. What will be the length of each new wire? ______

17. A total resistance of 60 megohms is needed. On hand are three resistors with the following values: 14 megohms, 25 megohms, and 11 megohms. What is the value of the additional resistor required? ______

18. A tapered pin has a small-end diameter of 101 centimeters and a large-end diameter of 189 centimeters. What is the difference between the two diameters? ______

UNIT 3

Multiplication of Whole Numbers

Basic Principles of Multiplication of Whole Numbers

Multiplication is actually a method of addition used when like numbers are added.

EXAMPLE: If four 5s are added, the answer will be 20. If the number 5 is multiplied by 4, the answer (known as the *product*) is equal to 20. Therefore, 5×4 is the same as adding four 5s.

$$\begin{array}{r} 5\\ 5\\ 5\\ +\ 5\\ \hline 20 \end{array} \qquad \begin{array}{r} 5\\ \times\ 4\\ \hline 20 \end{array}$$

To multiply larger numbers, first write the number to be multiplied; then write underneath it the number of times it is to be multiplied. In the following example, the number 247 is to be multiplied by 32. Write the numbers keeping the units column aligned.

EXAMPLE: 247×32

$$\begin{array}{r} \\ \scriptstyle 1\\ 247\\ \times\ \ 32\\ \hline 4 \end{array} \qquad \begin{array}{r} \\ \scriptstyle 1\\ 247\\ \times\ \ 32\\ \hline 94 \end{array} \qquad \begin{array}{r} \\ \scriptstyle 1\\ 247\\ \times\ \ 32\\ \hline 494 \end{array} \qquad \begin{array}{r} \scriptstyle 2\\ \scriptstyle 1\\ 247\\ \times\ \ 32\\ \hline 494\\ 1 \end{array} \qquad \begin{array}{r} \scriptstyle 12\\ \scriptstyle 1\\ 247\\ \times\ \ 32\\ \hline 494\\ 41 \end{array} \qquad \begin{array}{r} \scriptstyle 12\\ \scriptstyle 1\\ 247\\ \times\ \ 32\\ \hline 494\\ 7\,41\\ \hline 7{,}904 \end{array}$$

Multiply the unit, or 1s, column (2 × 7 = 14). Place the 4 below the 2 and carry the 1 to the next column. *Note that the 1 carried over is actually 10 carried to the next column, which is the 10s column.* Then multiply (2 × 4 = 8) and add the 1 (8 + 1 = 9). *Because the 8 is in the 10s column, the answer is actually (80 + 10 = 90).* Place the 9 beside the 4. Multiply (2 × 2 = 4). *The 2 is located in the 100s column. This is actually (2 × 200 = 400).* Place the 4 beside the 9. Next, multiply each digit of 247 by 3 in 32. The answer will be brought down in the same manner except that one space will be skipped. *The reason for skipping the space is because the 3 in 32 is actually 30, not 3.* Multiple (3 × 7 = 21). *The 21 is actually 210 (30 × 7 = 210). Some people place a 0 under the number in the 1s column, in this case 4, just as a place holder.* Place the 1 below the 9 and carry the 2 to the next column. Multiply (3 × 4 = 12). *This is actually (30 × 40 = 1,200).* Add the 2 from the first column (12 + 2 = 14). *This is actually (1,200 + 200 = 1,400).* Place the 4 beside the 1 and carry the 1 to the next column. *The 1 carried to the next column is actually 1,000 carried to the next column.* Multiply (3 × 2 = 6). *This is actually (30 × 200 = 6,000).* Add the 1 (6 + 1 = 7). *(6,000 + 1,000 = 7,000)* Place the 7 beside the 4. The final step is to add the two sets of products together to obtain the total. The final answer is seven thousand, nine hundred and four.

Using the Calculator

The times or multiplication key is used to perform multiplication on a calculator.

EXAMPLE: Assume that the numbers 234 and 21 are to be multiplied together. To make this calculation with a calculator enter the following:

(234)(×)(21)(=)

The answer is 4,914.

Like the plus key, the multiplication key can be used to multiply numbers in a string.

EXAMPLE: Assume that the numbers, 12, 3, 6, 18, and 5 are to be multiplied together. To perform this calculation enter the following:

(12)(×)(3)(×)(6)(×)(18)(×)(5)(=)

The answer is 19,440.

Practical Problems

1. A panel board requires sixteen ½-inch holes, twenty-one ¼-inch holes, and eleven 5⁄16-inch holes. Each hole requires a bolt with three washers and two nuts.

   a. Find the total number of washers needed for the ½-inch holes. a. ________

   b. Find the total number of washers needed for the ¼-inch holes. b. ________

   c. Find the total number of washers needed for the 5⁄16-inch holes. c. ________

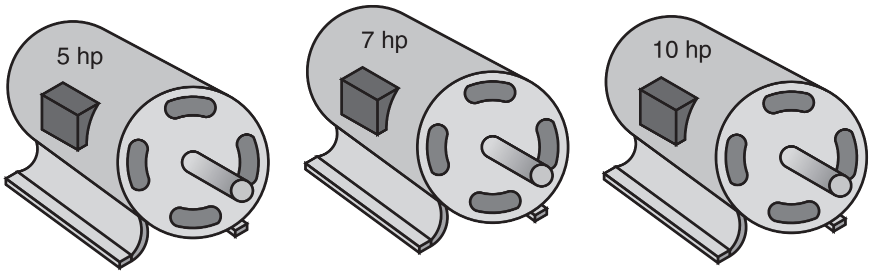
   d. Find the total number of nuts needed for the ½-inch holes. d. ________

   e. Find the total number of nuts needed for the ¼-inch holes. e. ________

   f. Find the total number of nuts needed for the 5⁄16-inch holes. f. ________

2. A bearing on a large machine is tested over a period of 8 hours at a speed of 40,500 revolutions per hour. How many revolutions does the shaft turn in the bearing during the test period? ________

3. Find the total amount of power in watts for the three motors shown. (One horsepower equals 746 watts.) ________

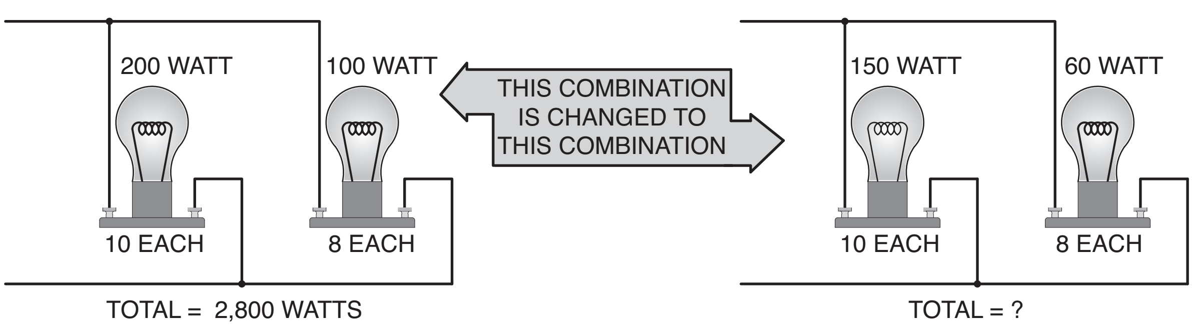


4. A very small magnet is wound with 97 layers with 215 turns per layer. How many turns of wire are on the coil? ________

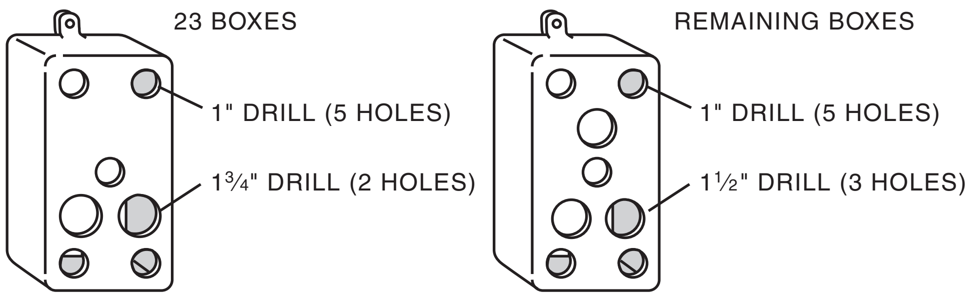
5. A coil requires 2,900 turns of number 14 wire. If each of 20 layers is wound with 143 turns, will the requirements for the coil be satisfied? ________

6. A building uses the following size lamps: sixteen 50-watt, nine 15-watt, twelve 25-watt, six 75-watt, and four 100-watt. How many watts are consumed when all the lights in the building are burning? ________

7. It is found that a certain electrical circuit having a total load of 2,800 watts in lamps must be reduced. Ten 200-watt lamps are replaced with ten 150-watt lamps; eight 100-watt lamps are replaced with eight 60-watt lamps. What is the total number of watts in connected lamps after the change is made? ________

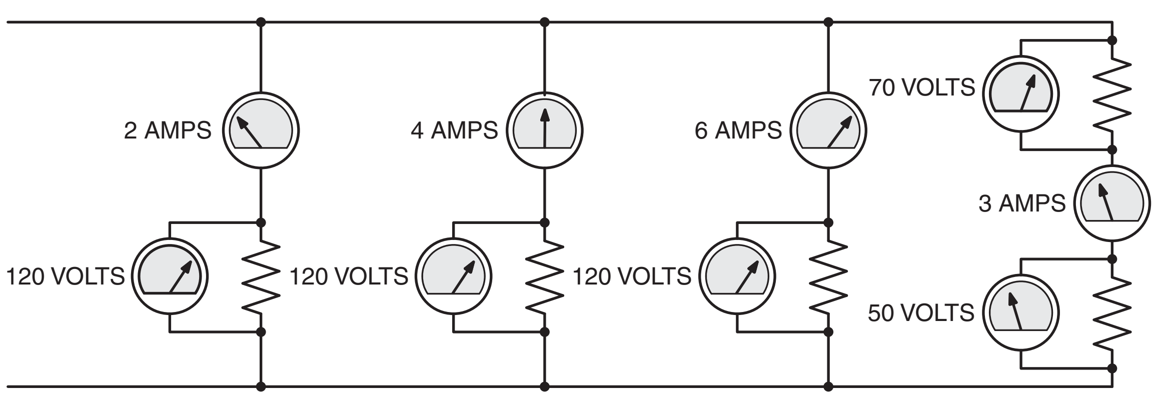


8. Thirty-four steel boxes are used for a certain wiring job. In each box, five 1-inch holes are drilled. In twenty-three of the boxes, two 1¾-inch holes are drilled, and the remaining boxes have three 1½-inch holes drilled in them. How many holes are drilled in all the boxes? ________________



9. An electrical company has a payroll of 27 people. Seven people earn \$18 per hour, eleven people earn \$20 per hour, and nine people earn \$16 per hour. If all employees work 40 hours during the week, what is the total payroll for 1 week? ________________

10. The product of current (amperes) and voltage (volts) equals power (watts). The total power of an electrical circuit is equal to the sum of the individual powers. Find the total power for the circuit shown. ________________



11. A large room contains 40 fluorescent lamps. Twenty-three of them are 40-watt lamps, and the remainder are 60-watt lamps. What is the total number of watts used by the lamps? ________________

12. A certain lighting job requires four incandescent fixtures, twelve direct fluorescent luminaires and nine semidirect fluorescent luminaires. The incandescent fixtures cost $19 each, the direct luminaires cost $26 each, and the semidirect luminaires cost $31 each. Find the total cost of all the fixtures and luminaires. ________________

13. A nine-floor apartment building has an average of four electrical circuits for each apartment. There are six apartments on each floor and one additional apartment on the roof. Find the total number of electrical circuits in the apartment building. ________________

14. An electrician uses 763 feet of conduit on each floor of a five-story building. What is the total length of conduit used? ________________

UNIT 4

Division of Whole Numbers

Basic Principles of Division of Whole Numbers

In Unit 3 it was shown that multiplication is actually the process of adding a number to itself a certain number of times. Division is just the opposite, or inverse. Division is actually the process of subtracting a smaller number from a larger number a certain number of times. The larger number, the number to be divided, is referred to as the *dividend.* The number used to indicate the number of times the dividend is to be divided is called the *divisor.* The answer is known as the *quotient.* To begin the process of division, the dividend is placed inside the division bracket and the divisor is placed to the left of the dividend. The quotient is placed above the dividend.

$$\text{Divisor}\,\overline{\smash{)}\text{Dividend}}^{\;\text{Quotient}}$$

EXAMPLE: Divide 1,140 by 17.

$$
\begin{array}{r}
6 \\
17\,\overline{)\,1,140} \\
\underline{-1\,02} \\
12
\end{array}
\qquad
\begin{array}{r}
6 \\
17\,\overline{)\,1,140} \\
\underline{-1\,02} \\
120
\end{array}
\qquad
\begin{array}{r}
67 \\
17\,\overline{)\,1,140} \\
\underline{-1\,02} \\
120 \\
\underline{-119}
\end{array}
\qquad
\begin{array}{r}
67\text{ R1} \\
17\,\overline{)\,1,140} \\
\underline{-1\,02} \\
120 \\
\underline{119} \\
1
\end{array}
$$

Place the number 1,140 under the division bracket and the number 17 to the left of it. The number 17 cannot be divided into a number that is smaller than itself. Therefore, 17 is divided into the number 114 first. Find what number multiplied by 17 will come the closest to 114 without going over 114. Six is that number ($6 \times 17 = 102$). Place 6 in the quotient directly over 4 in the dividend. The number 102 is placed below 114 and subtracted from it. This leaves 12. Because 17 cannot be divided into 12, the next number of the dividend is brought down to the right of 12. When the zero is placed beside 12, 17 is then divided into 120. The nearest number that 17 can be multiplied by and not go over 120 is 7 ($7 \times 17 = 119$). Place 7 in the quotient directly over 0 in the dividend, then place 119 below 120 and subtract from it. This leaves a remainder of 1. Because there are no more numbers in the dividend, the 1 is taken to the quotient and shown as R1, which means a *remainder of* 1.

Another way of understanding the process of division is to think of separating some number of objects into piles of fewer objects. Assume that an electrician finds 31 half-inch conduit clamps in a box. Now assume that each length of conduit will require 2 clamps. If he separates the 31 clamps into piles of 2 clamps each, how many piles of 2 clamps will he have? The answer is fifteen piles that contain 2 clamps and one pile that contains only 1 clamp; 31 divided by 2 is 15, with a remainder of 1.

Using the Calculator

The division key is used to perform the function of divide.

EXAMPLE: In the previous example, the number 1,140 is divided by 17. To perform this calculation, enter the following:

(1,140)(÷)(17)(=)

The calculator displays the answer 67.05882353.

Note that the calculator displays a whole number and a decimal fraction. It does not display a whole number remainder. The decimal number is the fractional part of the divisor.

EXAMPLE: To determine the remainder as a whole number, multiply the fractional part of the answer by the divisor.

(17)(×)(.05882353)(=)

The answer is 1. The answer to the problem is 67 r1.

A Shortcut

To prevent having to re-enter the entire decimal number, if the original answer is still on the display, it is an easy matter to first subtract the whole number. This would leave the decimal fraction on the display. You can then simply multiply by the divisor.

EXAMPLE: Assume that the original number, 67.05882353, is still on the calculator display. Enter the following:

(−)(67)(=)(×)(17)(=)

The answer is 1.

Practical Problems

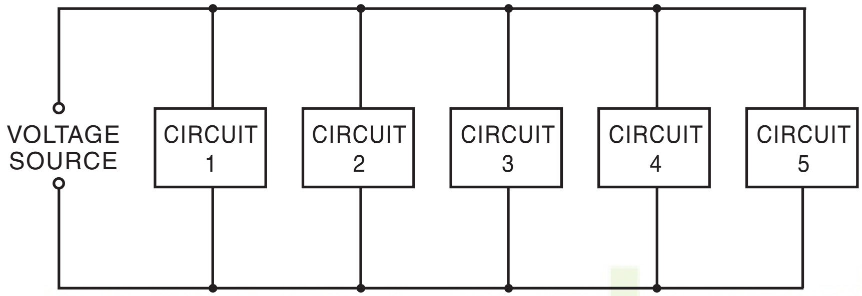
1. In a 184-foot run of BX cable, the staples are placed 4 feet apart. How many staples are used if one staple is placed at the beginning and one at the end of the run? ________________

2. An electrical contractor purchases 15 fittings of one type for $45 and 6 of another type for $36. ______

   a. Find the cost per fitting for those costing $45. a. ______

   b. Find the cost per fitting for those costing $36. b. ______

3. A total load of 25,620 watts is distributed equally over the 5 branch circuits shown. What is the average load per circuit in watts? ______



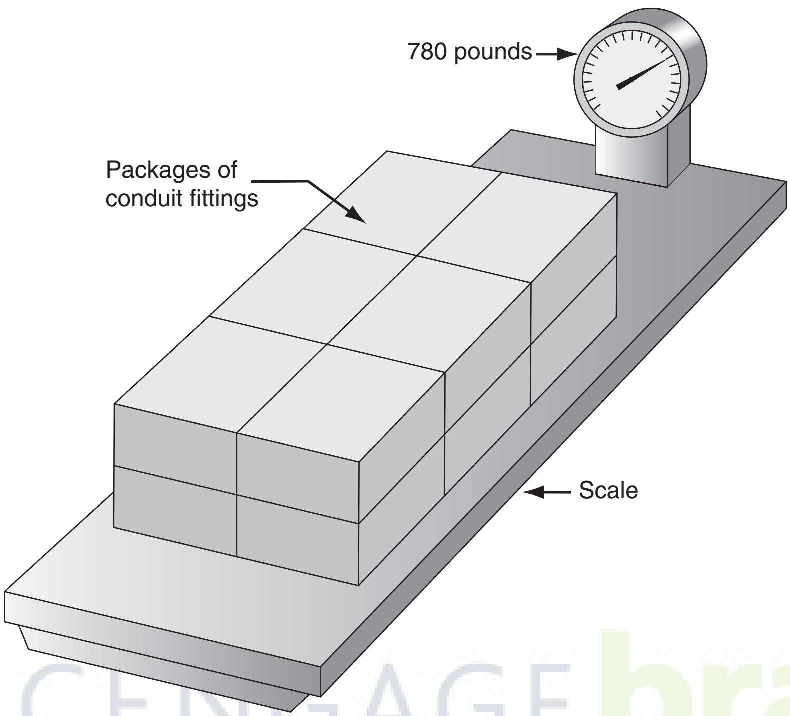
4. How many 250-foot rolls of BX cable are needed if a job requires a total of 5,250 feet? ______

5. A hotel with 22 rooms on each of its seven floors has a total of 770 outlets. If each room has the same number of outlets, how many are there in each room? ______

6. A certain wiring job has 28 outlets equally spaced over 351 feet. If one outlet is placed at the beginning and one at the end, what is the center-to-center distance between outlets? ______

7. In a house where 35 outlets are installed, 735 feet of cable are used. What is the average number of feet of cable used per outlet? ______

8. Twelve standard packages of conduit fittings are purchased. Their combined weight is 780 pounds. What is the weight per package? ______



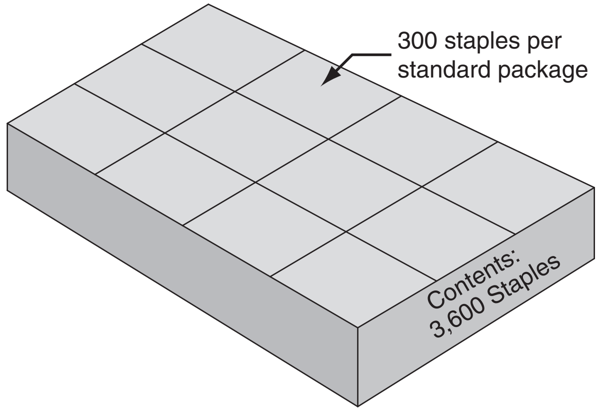
9. Two electricians work a total of 640 hours on a job. Each works 8 hours per day, 5 days per week. How many weeks does each electrician work? ________________

10. Two thousand five hundred feet of BX cable are ordered. The cable is shipped in 250-foot coils. How many coils are shipped? ________________

11. A certain machine room uses 2,160 watts to supply 60-watt lamps for bench lighting. How many lamps are connected? ________________

12. A wiring job uses 1,232 feet of cable for 56 outlets. What is the average number of feet per outlet? ________________

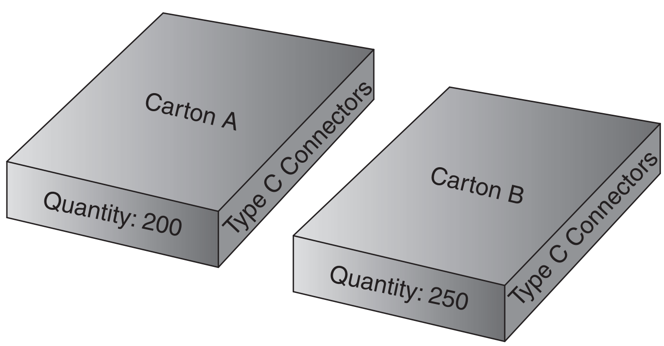
13. The cost for the carton of staples shown is $36. What is the cost per standard package if the carton contains 12 standard packages? ________________



14. On a 124-foot length of Romex cable, 32 staples are used. The staples are equally spaced. If one staple is placed at the beginning and one at the end of the cable, how far apart are the staples placed? ____________

15. A total load of 15,840 watts is distributed equally over 12 circuits. What is the load per circuit in watts? ____________

16. Box A and box B each contain type C connectors. Box A contains 200 connectors and costs $30. Find the cost of box B, which contains 250 connectors. The unit price is the same for both boxes. ____________



17. A school study hall is 90 feet by 90 feet. Two rows of lighting are placed in the ceiling. What is the center-to-center distance between the rows of lights if the rows are spaced with equal distances from the side walls and between the rows? ____________

UNIT 5

Combined Operations with Whole Numbers

Basic Principles of Combined Operations with Whole Numbers

This unit provides problems involving combined operations with addition, subtraction, multiplication, and division of whole numbers. There is a standard order that should be followed when dealing with combined operations.

1. Do all operations inside parentheses.
2. Solve any expressions that contain exponents or roots.
3. Multiply or divide from left to right.
4. Add or subtract from left to right.

EXAMPLE: $(8 + 7) \times 4$ $(15) \times 4$ $15 \times 4 = 60$

EXAMPLE: $(10 \times 2) \div 5$ $(20) \div 5$ $20 \div 5 = 4$

EXAMPLE: $(18 + 10) - (6 + 12)$ $(28) - (18)$ $28 - 18 = 10$

Practical Problems

1. In wiring eight houses, the electricians install 68, 87, 57, 74, 49, 101, 99, and 56 outlets. Find the total number of outlets that must be roughed-in. ________________

2. An electrician removes from stock, at different times, the following amounts of BX cable: 120 feet, 327 feet, 637 feet, 302 feet, 500 feet, 250 feet, 140 feet, 75 feet, and 789 feet. Find the total number of feet of BX cable taken from stock. _______________

3. An electrical supply house purchases solder in separate lots of 30 pounds, 120 pounds, 37 pounds, 125 pounds, 103 pounds, 33 pounds, 210 pounds, and 40 pounds. What is the total number of pounds of solder purchased? _______________

4. A school has twelve electrical circuits that carry 2,569 watts, 1,260 watts, 1,639 watts, 563 watts, 790 watts, 800 watts, 1,137 watts, 250 watts, 500 watts, 750 watts, 1,830 watts, and 2,462 watts. What is the total number of watts consumed when all these circuits are being used under their total loads? _______________

5. BX cable in the following amounts is used on an apartment house job: 250 feet, 71 feet, 39 feet, 110 feet, 75 feet, 87 feet, and 560 feet. What is the total amount of cable used on the job? _______________

6. The following number of BX staples are used during a given period: 28, 250, 38, 108, 92, 130, 25, 36, 97, 91, 65, and 40. Find the total number of BX staples used. _______________

7. An electrician takes out of stock 498 feet of BX cable on Monday, 103 feet on Tuesday, and 78 feet on Wednesday. On Friday, 27 feet of BX cable are returned to stock. How much BX cable is used? _______________

8. An inventory sheet shows a balance of 500 outlet boxes on January 1. On January 10, 127 outlet boxes are taken out of stock. On January 14, 61 outlet boxes are returned to stock. How many outlet boxes are left in stock after January 14? _______________

9. An electrical contractor charges \$875 for a job. The materials cost \$262. The cost of labor is \$348, and the cost of transportation is \$27. Find the profit. _______________

10. A purchase of 2,500 feet of number 14 double-braided, rubber-covered wire is made for a job. On November 1, 978 feet of this wire are used, and on November 3, 1,023 feet are used. How many feet of wire are left? _______________

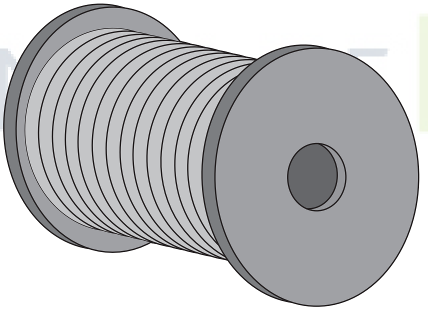
11. A building contains seventy 100-watt lamps, thirty-eight 75-watt lamps, ten 60-watt lamps, and twenty 40-watt lamps. If all lamps are on at the same time, how many watts are used? ________

12. An electrical contractor employs 16 people. Five people earn $15 per hour, four people earn $17 per hour, and the remaining people earn $16 per hour. What is the total hourly wage earned by all 16 people? ________

13. A 7-floor apartment building has an average of 7 electrical circuits per apartment, and there are 8 apartments per floor. How many electrical circuits are there in the building? ________

14. A wiring job requires 5,127 feet of cable. If the cable comes in 250-foot coils, how many coils of cable are required? ________

15. A coil of wire is wound in 7 layers with 13 turns per layer. How many turns of wire are on the coil? ________



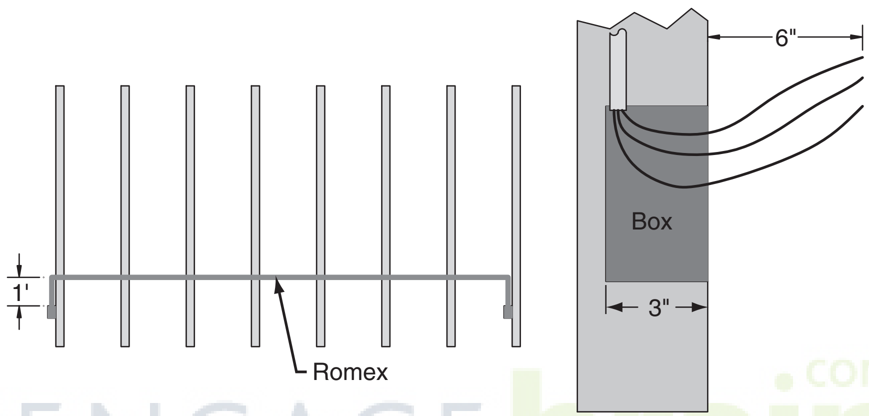
16. A wiring job requires 29 outlets to be spaced equally over 336 feet. One outlet is placed at the beginning of the 336 feet and one at the end. Find the center-to-center distance between the outlets. ________

17. An order is placed for 16 coils of cable. The cable comes in 250-foot coils. How many feet of cable are received? ________

18. Twenty standard cartons of octal boxes weigh a total of 1,100 pounds. Find the weight per carton. ________

19. A box contains 315 half-inch conduit couplings and weighs 119 pounds. An identical box also contains half-inch conduit couplings and weighs 47 pounds. How many couplings are in the second box? ________

20. Receptacle boxes are placed 12 feet apart. Holes are drilled in the wall studs 1 foot above the boxes to permit Romex wire to be run between them. Each receptacle box is 3 inches deep, and 6 inches of wire extends beyond the edge of a box. How many receptacle boxes can be wired with one box of Romex wire? (**Note:** A box of Romex wire contains 250 feet.) __________



21. An electrician takes a job wiring 25 identical apartments. Each apartment contains 16 outlets that fit in a single-gang box and 6 single-pole switches that fit in a single-gang box. In addition to the single-gang switches, there are three 2-gang switch boxes. Two of the 2-gang switch boxes contain a single-pole switch and 3-way switch. The third 2-gang box contains two single-pole switches. __________

   a. How many single-gang boxes are required to wire the 25 apartments? __________

   b. How many 2-gang boxes are required to wire the 25 apartments? __________

   c. How many outlets are required to wire these apartments? __________

   d. How many single-pole switches are required to wire these 25 apartments? __________

   e. How many 3-way switches are required to wire these 25 apartments? __________

ANSWERS
TO ODD-NUMBERED PROBLEMS

Section 1
Whole Numbers

Unit 1
Addition of Whole Numbers

1. 1,165
3. 556
5. 951
7. 2,380 ft
9. 615 lb
11. 14,839 W
13. 473
15. 1,052
17. 3,706 ft

Unit 2
Subtraction of Whole Numbers

1. 1,161 ft
3. 455
5. 137 ft
7. 305 ft
9. 200
11. 1,372 kW•h
13. 65
15. 221 ft
17. 10 MΩ

Unit 3
Multiplication of Whole Numbers

1. a. 48
   b. 63
   c. 33
   d. 32
   e. 42
   f. 22
3. 16,412 W
5. No
7. 1,980 W
9. $19,600
11. 1,940 W
13. 220 circuits

Unit 4
Division of Whole Numbers

1. 47 staples
3. 5,124 W
5. 5 outlets
7. 21 ft
9. 8 weeks
11. 36 lamps
13. $3
15. 1,320 W
17. 30 ft

Unit 5
Combined Operations with Whole Numbers

1. 591
3. 698 lb
5. 1,192 ft
7. 652 ft
9. $238
11. 11,250 W
13. 392
15. 91
17. 4,000 ft
19. 124
21. a. 550
    b. 75
    c. 400
    d. 250
    e. 50