

# UNIT 10

## BASIC MATH

### 10.1 Introduction

Understanding math is the foundation to becoming a successful electrician. Many people have, unfortunately, been taught to fear math, but as you work through this material you will see that math enables you to do things faster and easier than you otherwise could have. In fact, you will begin to see math as a convenient short cut. In this unit you will learn:

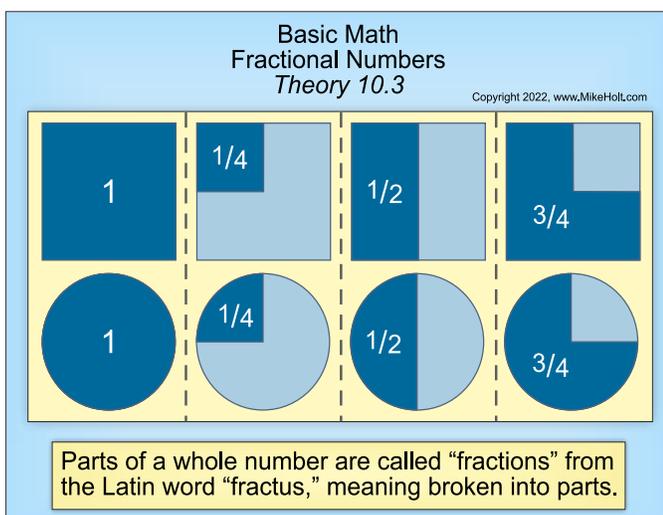
- ▶ The difference between whole numbers and fractional numbers
- ▶ How to convert a percentage into a decimal to use as a multiplier
- ▶ The differences between a reciprocal, a square root, and squaring a number

### 10.2 Whole Numbers

Whole numbers are exactly what the term implies; these numbers do not contain any fractions, decimals, or percentages.

### 10.3 Fractional Numbers

Parts of a whole number are called “fractions” from the Latin word “fractus,” meaning broken into parts. ▶Figure 10-1



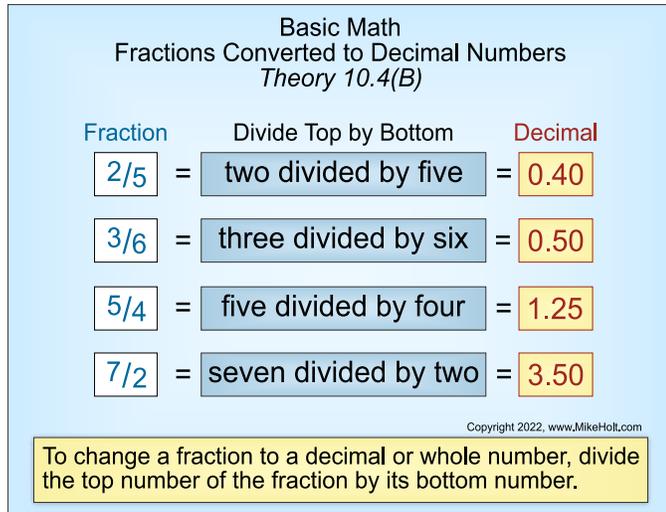
▶Figure 10-1

### 10.4 Decimal Numbers

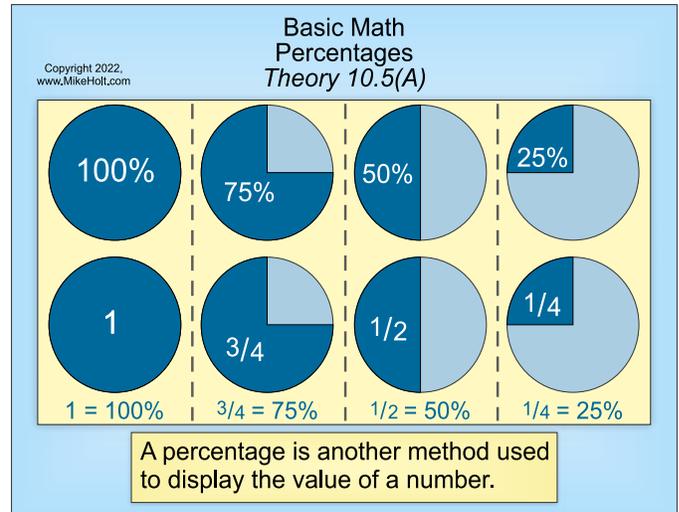
**(A) General.** A decimal number is a number that is a fractional part of a number separated by a decimal point.

**(B) Fractions Converted to Decimal Numbers.** A fraction represents part of a whole number. If you use a calculator for adding, dividing, subtracting, or multiplying fractions, you need to convert the fraction to a decimal or whole number. To change a fraction to a decimal or whole number, divide the top number of the fraction by its bottom number. ▶Figure 10-2

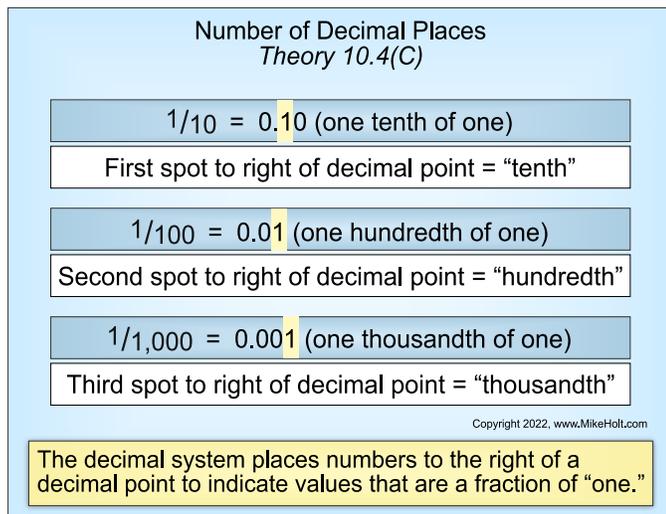
**(C) Number of Decimal Places.** The decimal system places numbers to the right of a decimal point to indicate values that are a fraction of “one.” For example, the first digit on the right of the decimal is one-tenth of a whole number, the second is one-hundredth of a whole number, and the third digit is one-thousandth of a whole number. ▶Figure 10-3



▶Figure 10-2



▶Figure 10-4



▶Figure 10-3

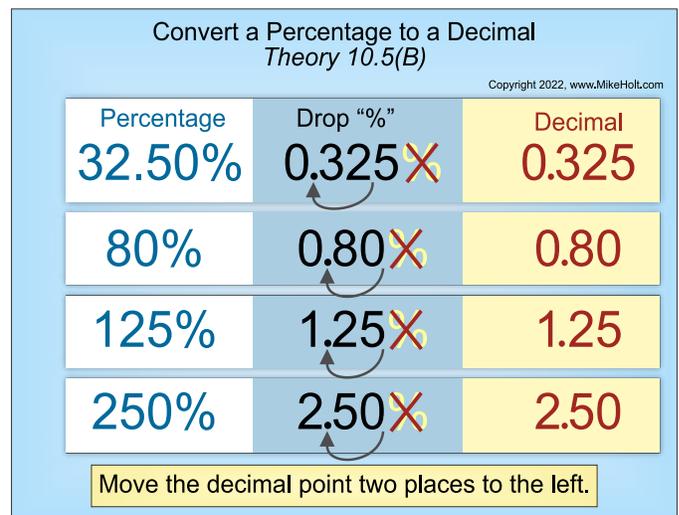
If the decimal number is greater than "one," the whole number will be to the left of the decimal point such as 1.25, 1.732, and 2.50.

## 10.5 Percentages

**(A) General.** A percentage is another method used to display the value of a number. One hundred percent means the entire value; 50 percent means one-half of a value, and 25 percent means one-fourth of a value. ▶Figure 10-4

**(B) Convert a Percentage to a Decimal.** For convenience in multiplying or dividing by a percentage, convert the percentage value to a whole number or whole number with a decimal, and then use that value for the calculation.

When changing a percent value to a decimal or whole number with a decimal, drop the percentage symbol and move the decimal point two places to the left. ▶Figure 10-5



▶Figure 10-5

## 10.6 Parentheses

In a math problem, parentheses are used to group steps of mathematical functions together. Whenever numbers are in parentheses, complete the mathematical function within the parentheses before proceeding with the remaining math functions.

### ► Parentheses Example

**Question:** What is the sum of 3 and 15 added to the product of 4 and 2?

**Note:** A “sum” is the result of adding numbers, and a “product” is the result of multiplying numbers.

- (a) 6                      (b) 12                      (c) 16                      (d) 26

**Solution:**

$$(3 + 15) + (4 \times 2)$$

$$18 + 8 = 26$$

**Answer:** (d) 26

## 10.7 Squaring a Number

Squaring (<sup>2</sup>) a number is the process of multiplying a number by itself.

### ► Squaring a Number Example 1

$$8^2 = 8 \times 8$$

$$8^2 = 64$$

### ► Squaring a Number Example 2

$$12^2 = 12 \times 12$$

$$12^2 = 144$$

## 10.8 Square Root

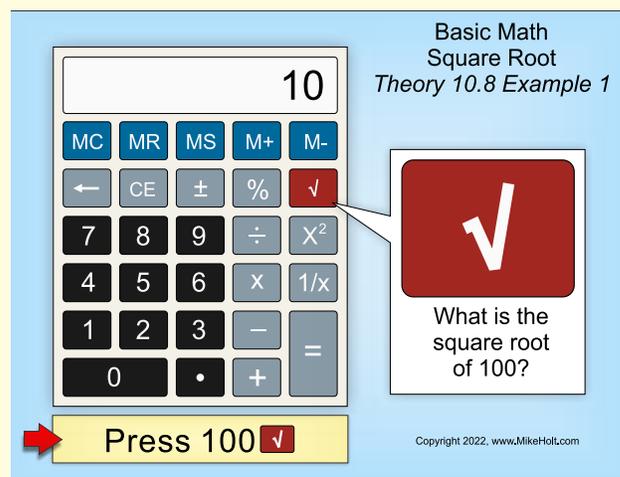
The square root ( $\sqrt{\quad}$ ) of a number is the number that, if squared (multiplied by itself), would equal the original number. You must use the square root key ( $\sqrt{\quad}$ ) on your calculator to perform this function.

### ► Square Root Example 1

**Question:** What is the square root of 100? ►Figure 10-6

- (a) 1                      (b) 10                      (c) 21.52                      (d) 31.62

**Answer:** (b) 10



►Figure 10-6

### ► Square Root Example 2

**Question:** What is the square root of 3?

- (a) 1.255                      (b) 1.55                      (c) 1.732                      (d) 1.935

**Answer:** (c) 1.732

## 10.9 Kilo

The letter “k” is the abbreviation for “kilo” which means “1,000.” To convert a number that includes the “k,” multiply the number by 1,000. To convert a number to a “k” value, divide the number by 1,000 and add “k” after the number.

### ► Kilo Conversion Example 1

**Question:** What is the value of 8k?

- (a) 8                      (b) 800                      (c) 4,000                      (d) 8,000

**Solution:**

$$8 \times 1,000 = 8,000$$

**Answer:** (d) 8,000

### ► Kilo Conversion Example 2

**Question:** What is the “k” value of 3,000?

- (a) 0.30k      (b) 3k      (c) 30k      (d) 300k

**Solution:**

$$k = 3,000/1,000$$

$$k = 3k$$

**Answer:** (b) 3k

## 10.10 Rounding

**(A) General.** There is no specific rule for rounding numbers, but; rounding to two or three “significant digits” should be sufficient for most electrical calculations. When rounding is desired, numbers below five are rounded down, while numbers five and above are rounded up.

►Figure 10-7

Basic Math  
Rounding Answers  
Theory 10.10(A)

Round 0.1245 to three decimal numbers =  
0.125 rounded up

Round 1.674 to two decimal numbers =  
1.67 rounded down

Round 21.99 to a whole number =  
22 rounded up

Round 367.20 to a whole number =  
367 rounded down

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►Figure 10-7

**(B) Rounding Answers for Multiple-Choice Questions.** When selecting an answer for a multiple-choice question, you need to round your answers in the same manner as the multiple-choice selections are given.

### ► Rounding Answers for Multiple-Choice Questions Example

**Question:** The sum of 12, 17, 28, and 40 is approximately equal to \_\_\_\_\_.

- (a) 70      (b) 80      (c) 90      (d) 100

**Solution:**

$$12 + 17 + 28 + 40 = 97$$

The multiple-choice selections in this case are rounded off to the nearest “tens,” so the answer is 100.

**Answer:** (d) 100

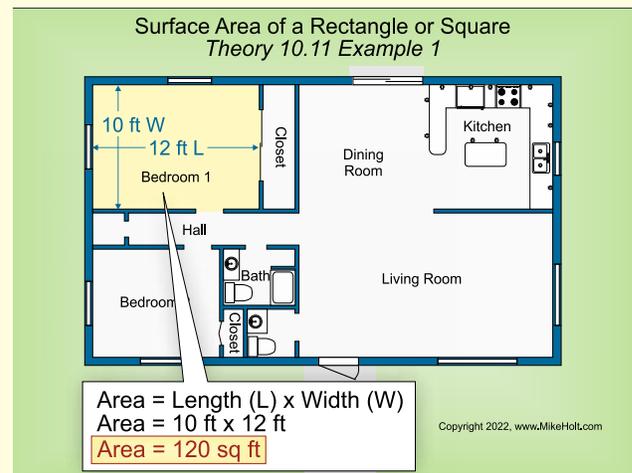
## 10.11 Surface Area of a Rectangle or Square

The surface area for a rectangle or square is calculated using the formula: **Area = Length (L) × Width (W)**

### ► Surface Area—Rectangle or Square Example 1

**Question:** What is the surface area of a bedroom that is 10 ft wide and 12 ft long? ►Figure 10-8

- (a) 10 sq ft      (b) 50 sq ft      (c) 80 sq ft      (d) 120 sq ft



►Figure 10-8

**Solution:**

$$\text{Area} = L \times W$$

$$\text{Area} = 12 \text{ ft} \times 10 \text{ ft}$$

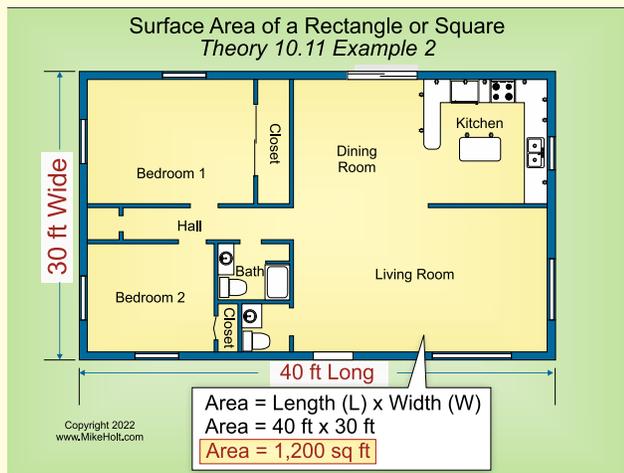
$$\text{Area} = 120 \text{ sq ft}$$

**Answer:** (d) 120 sq ft

### ► Surface Area—Rectangle or Square Example 2

**Question:** What is the surface area of a house that is 30 ft wide and 40 ft long? ►Figure 10-9

(a) 1,000 sq ft (b) 1,200 sq ft (c) 1,800 sq ft (d) 2,000 sq ft



►Figure 10-9

**Solution:**

$$\text{Area} = L \times W$$

$$\text{Area} = 40 \text{ ft} \times 30 \text{ ft}$$

$$\text{Area} = 1,200 \text{ sq ft}$$

**Answer:** (b) 1,200 sq ft

## 10.12 Surface Area of a Circle

The surface area of a circle is calculated using the formula: **Area of a Circle =  $\pi \times r^2$**

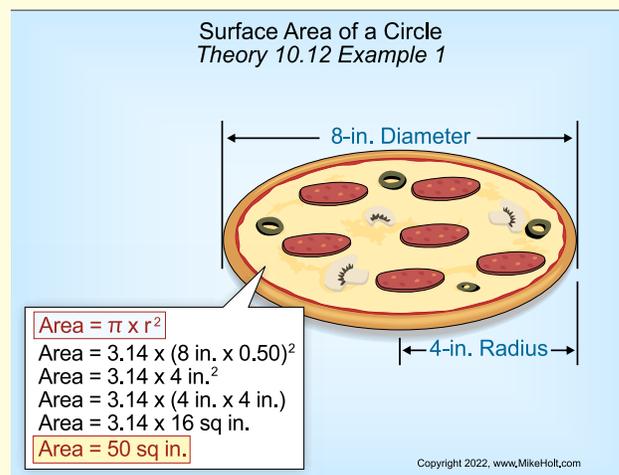
Use 3.14 for  $\pi$  (pi).

The radius ( $r^2$ ) is equal to one half the diameter of the circle.

### ► Surface Area—Circle Example 1

**Question:** What is the surface area of an 8-in. pizza? ►Figure 10-10

(a) 25 sq in. (b) 50 sq in. (c) 64 sq in. (d) 75 sq in.



►Figure 10-10

**Solution:**

$$\text{Area of a Circle} = \pi \times r^2$$

$$\pi = 3.14$$

$$\text{Radius} = \frac{1}{2} \text{ the diameter}$$

$$\text{Area} = 3.14 \times (8 \text{ in.} \times 0.50)^2$$

$$\text{Area} = 3.14 \times 4 \text{ in.}^2$$

$$\text{Area} = 3.14 \times (4 \text{ in.} \times 4 \text{ in.})$$

$$\text{Area} = 3.14 \times 16 \text{ sq in.}$$

$$\text{Area} = 50 \text{ sq in.}$$

**Answer:** (b) 50 sq in.

**Note:** If you prefer to use a calculator, then follow these steps:

**Step 1:** Find the radius ( $\frac{1}{2}$  the diameter) of the circle by multiplying 8 in. by 0.50:

$$8 \text{ in.} \times 0.50 = 4 \text{ in.}$$

**Step 2:** Press the square “ $\times^2$ ” key = 16 sq in.

**Step 3:** Multiply 16 sq in. (Step 2) by 3.14.

$$16 \text{ sq in.} \times 3.14 = 50.26 \text{ sq in.}$$

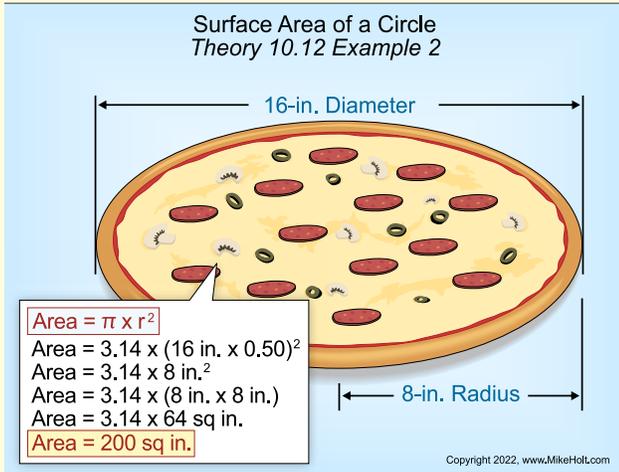
**Step 4:** Round to match the answer options: 50 sq in.

**Answer:** (b) 50 sq in.

► **Surface Area—Circle Example 2**

**Question:** What is the surface area of a 16-in. pizza? ► **Figure 10-11**

- (a) 100 sq in. (b) 150 sq in. (c) 200 sq in. (d) 256 sq in.



► **Figure 10-11**

**Solution:**

**Area of a Circle =  $\pi \times r^2$**

$\pi = 3.14$

Radius =  $\frac{1}{2}$  the diameter

Area =  $3.14 \times (16 \text{ in.} \times 0.50)^2$

Area =  $3.14 \times 8 \text{ in.}^2$

Area =  $3.14 \times (8 \text{ in.} \times 8 \text{ in.})$

Area =  $3.14 \times 64 \text{ sq in.}$

Area = 200 sq in.

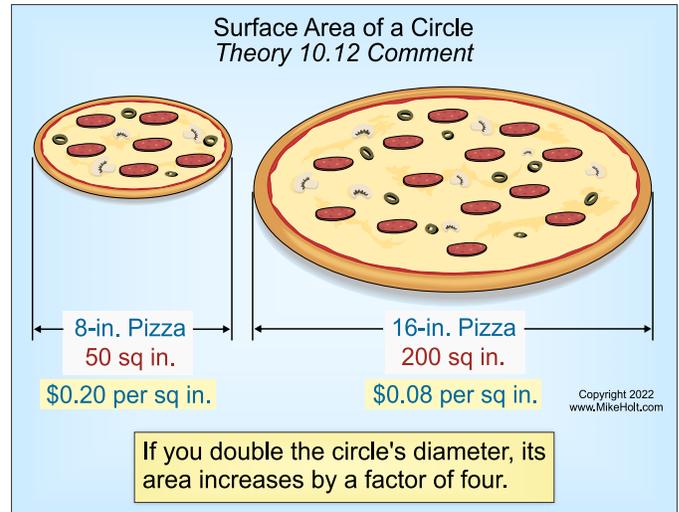
**Answer:** (c) 200 sq in.

**Author's Comment:**

- As you can see, if you double the circle's diameter (an 8-in. pizza versus a 16-in. pizza), its area is increased by a factor of four. By the way, a large (or extra-large) pizza is always cheaper per square inch than a small one! ► **Figure 10-12**

**10.13 Volume**

The volume of an enclosure is expressed in cubic inches (cu in. or in<sup>3</sup>), and is determined by multiplying the enclosure's length, width, and depth together: **Volume = Length (L) × Width (W) × Depth.**

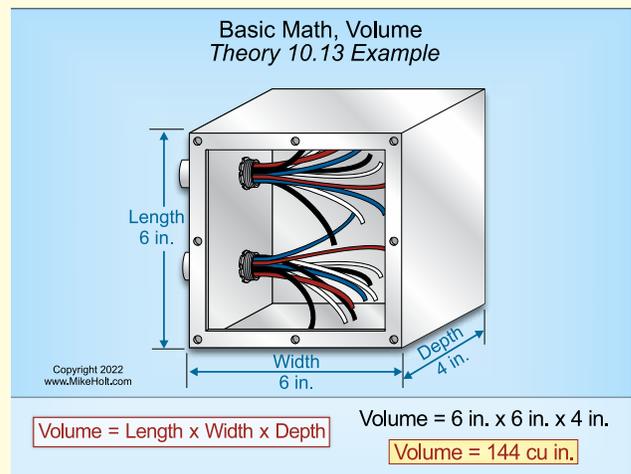


► **Figure 10-12**

► **Volume Example**

**Question:** What is the volume of a 6 in. × 6 in. × 4 in. box? ► **Figure 10-13**

- (a) 134 cu in. (b) 144 cu in. (c) 154 cu in. (d) 164 cu in.



► **Figure 10-13**

**Solution:**

**Volume = Length (L) × Width (W) × Depth**

Volume = 6 in. × 6 in. × 4 in.

Volume = 144 cu in.

**Answer:** (b) 144 cu in.

**10.14 Reciprocal**

A reciprocal is the value of 1 divided by the number. All whole numbers shown as a fraction are over 1, a reciprocal flips the top number and puts it on the bottom for the mathematical function.

**► Reciprocal Example**

**Question:** What is the reciprocal of 0.80?

(a) 0.80      (b) 1.10      (c) 1.25      (d) 1.50

**Solution:**

$$1/0.80 = 1.25$$

**Answer:** (c) 1.25

**10.15 Testing Your Answer**

Never assume a mathematical calculation you have done is correct. Always do a “reality check” to be sure your answer makes sense. Even the best of us makes mistakes. You may have part of the problem jotted down incorrectly, or perhaps you pressed the wrong key on the calculator. Always examine your answer to see if it makes sense.

# UNIT 10

## REVIEW QUESTIONS

The following questions are based on the material you just reviewed. If you struggle with any of the answers, go back and review that unit again, or refer to Mike Holt's Understanding Electrical Theory Video Library.

### 10.2 Whole Numbers

- \_\_\_\_\_ numbers do not contain any fractions, decimals, or percentages.
  - Decimal
  - Fractional
  - Real
  - Whole

### 10.3 Fractional Numbers

- Parts of a whole number are called "\_\_\_\_\_" from the Latin word "fractus," meaning broken into parts.
  - decimals
  - fractions
  - percentages
  - integers

### 10.4 Decimal Numbers

- A(An) \_\_\_\_\_ number is a number that is a fractional part of a number separated by a decimal point.
  - decimal
  - fractional
  - percentage
  - integer

- To change a fraction to a decimal or whole number, \_\_\_\_\_ the top number of the fraction by its bottom number.
  - divide
  - multiply
  - add
  - subtract
- The decimal equivalent for the fraction " $\frac{1}{2}$ " is \_\_\_\_\_.
  - 0.20
  - 0.50
  - 2
  - 5
- The approximate decimal equivalent for the fraction " $\frac{4}{18}$ " is \_\_\_\_\_.
  - 0.22
  - 2.52
  - 3.52
  - 4.52
- The decimal system places numbers to the \_\_\_\_\_ of a decimal point to indicate values that are a fraction of "one."
  - left
  - right
  - left or right
  - none of these

**10.5 Percentages**

8. To change a percent value to a decimal or whole number, drop the percentage sign and move the decimal point two places to the \_\_\_\_\_.  
(a) right  
(b) left  
(c) right or left  
(d) none of these
9. The decimal equivalent for “75 percent” is \_\_\_\_\_.  
(a) 0.075  
(b) 0.75  
(c) 7.50  
(d) 75
10. The decimal equivalent for “225 percent” is \_\_\_\_\_.  
(a) 0.225  
(b) 2.25  
(c) 22.50  
(d) 225
11. The decimal equivalent for “300 percent” is \_\_\_\_\_.  
(a) 0.03  
(b) 0.30  
(c) 3  
(d) 30.00

**10.6 Parentheses**

12. Whenever numbers are \_\_\_\_\_, complete the mathematical function within the parentheses before proceeding with the remaining math functions.  
(a) in brackets  
(b) in parentheses  
(c) underlined  
(d) none of these
13. What is the sum of 5 and 10 added to the product of 5 and 10?  
(a) 26  
(b) 32  
(c) 46  
(d) 65

**10.7 Squaring a Number**

14. Squaring a number means multiplying the number by \_\_\_\_\_.  
(a) itself  
(b) two  
(c) four  
(d) none of these
15. The numeric equivalent of 42 is \_\_\_\_\_.  
(a) 2  
(b) 8  
(c) 16  
(d) 32
16. The numeric equivalent of 122 is \_\_\_\_\_.  
(a) 3.46  
(b) 24  
(c) 144  
(d) 1,728

**10.8 Square Root**

17. Deriving the \_\_\_\_\_ of a number is the number that, if squared, would equal the number requested to be square rooted.  
(a) square root  
(b) square  
(c) multiplier  
(d) area
18. What is the approximate square root ( $\sqrt{\quad}$ ) of 1,000?  
(a) 3  
(b) 32  
(c) 100  
(d) 500

**10.9 Kilo**

19. What is the “k” value of 75,000?  
(a) 0.07k  
(b) 0.75k  
(c) 7.50k  
(d) 75k

### 10.10 Rounding

20. The sum of 2, 7, 8, and 9 is approximately \_\_\_\_.
- (a) 20
  - (b) 25
  - (c) 30
  - (d) 35

### 10.11 Surface Area of a Rectangle or Square

21. What is the surface area of a bedroom that is 10 ft by 20 ft?
- (a) 100 sq ft
  - (b) 150 sq ft
  - (c) 200 sq ft
  - (d) 250 sq ft

### 10.12 Surface Area of a Circle

22. What is the surface area of a 10-in. pizza?
- (a) 25.50 sq in.
  - (b) 55.50 sq in.
  - (c) 64.50 sq in.
  - (d) 78.50 sq in.
23. What is the surface area of a 20-in. pizza?
- (a) 255 sq in.
  - (b) 275 sq in.
  - (c) 299 sq in.
  - (d) 314 sq in.

### 10.13 Volume

24. The volume of an enclosure is expressed in \_\_\_\_, and it is calculated by multiplying the length, by the width, by the depth of the enclosure.
- (a) cubic inches
  - (b) weight
  - (c) inch-pounds
  - (d) none of these

25. What is the volume (in cubic inches) of a 4 in.  $\times$  4 in.  $\times$  1.50 in. box?
- (a) 20 cu in.
  - (b) 24 cu in.
  - (c) 30 cu in.
  - (d) 33 cu in.

### 10.14 Reciprocal

26. What is the reciprocal of 1.25?
- (a) 0.80
  - (b) 1.10
  - (c) 1.25
  - (d) 1.50

### 10.15 Testing Your Answer

27. Never assume a mathematical calculation you have done is correct. Always do a “\_\_\_\_” to be sure your answer makes sense.
- (a) reality check
  - (b) quick scan
  - (c) fast review
  - (d) none of these