North Bennet Street School

CARPENTRY MATH

Version 8 – 7/2024

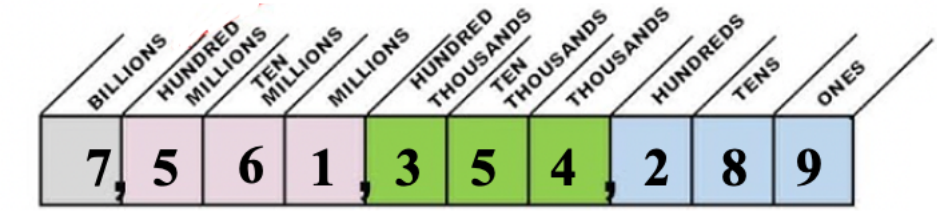
Table of Contents

Ch. 1 - Number Basics

Reading numbers:

1, 354, 289	One million three hundred fifty-four thousand, two hundred eighty-nine
354, 289	Three hundred fifty-four thousand, two hundred eighty-nine
54, 289	Fifty-four thousand two hundred eighty-nine
4, 289	Four thousand two hundred eighty-nine
289	Two hundred eighty-nine
89	Eighty-nine
9	Nine

Place Values: A whole number is made up of digits from 0-9 and does not include any decimals. The value of a digit is determined by its location in the whole number (e.g. the place value). For example, the number 7,561,354,289 has the following place values.



To make numbers easier to read, a comma is inserted after every third digit counting from the LEFT.

Key Skills: Addition, Subtraction, Division, Multiplication, Exponents (ex. ft^2 or ft^3).

Knowing your multiplication tables (especially the twelves) can save you a lot of time. Why are the twelves key? Because there are 12 inches in a foot so you will do this conversion often as a carpenter.

MULTIPLICATION CHART

X	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	66	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

How to read the chart:

$6 \times 6 = 36$

← Know the 12s!

Units: Remember that units must be the same to have meaningful results. For example, 20 feet + 3 inches gives you neither 23 feet nor 23 inches. To work with different units, you must first convert all values to the same unit. In our example, we can convert to both values to inches or both to feet:

All Inches:	All Feet
20 feet x 12 inches per foot = 240 inches 240 inches + 3 inches = 243 inches	3 inches /12 inches per foot = ¼ foot = 0.25 ft 20 feet + 0.25 feet = 20.25 feet

As a check, divide 243 inches by 12 inches and you get 20.25 feet so you know these two values are equivalent.

This is just an introduction to units and conversions. We will do a lot more on conversions in the following sections as this is a critical skill so for now just be aware of units. Always label your values and results to avoid confusion.

Note: In carpentry feet are represented by a single quote (‘), inches by a double quote (“): 3 feet is written as 3’; 3 inches as 3”.

Square Units/Cube Units: When multiplying two measurements together, such as feet, the result is in square feet (sq ft) or ft^2. This is an area. For example, a plywood board that is 4ft by 8ft has an area of $32ft^2$ ($4ft \times 8ft = 32ft^2$). When we multiply three measurements together again such as feet, the result is ft^3. This is a volume. We will discuss area and volume more fully in a future section; however this is just a reminder to watch the units and how they describe what you are measuring.

Rounding: Often, when doing calculations, we can simplify the math by rounding the number. When calculating measurements, for example, we can ROUND TO THE NEAREST portion of an inch (ex. 16ths). When estimating materials, we often ROUND UP our estimates to the unit the material is sold in to determine how much to order. For more on rounding see the Appendix.

Example: Roof shingles are sold in 100 sq. ft bundles. Our roof is 1,320 sq. ft. How many bundles should we order? *Solution: Since we must order whole bundles, we round 1,320 sq. feet UP to the nearest 100 so 1,400. Then we divide by 100. We need to order 14 bundles.*

We will practice with some problems.

Let's Practice Number Basics(Perform without a calculator. Check with one)

Place Values

Use the number 3,673,412 to answer the following questions:

1. Which digit is in the hundreds place? _____4_____
2. Which digit is in the ten thousands place?_____
3. Which digit is in the tens place? _____
4. Which digit is in the hundred thousands place? _____
5. Which digit is in the thousands place? _____
6. Which digit is in the millions place? _____

Rounding (to the nearest)

1. Round 82,737 to the tens place value _____
2. Round 64,613 to the thousands place value_____
3. Round 161,729 to the ten thousands place value_____
4. Round 643 to the hundreds place value _____

Rounding (UP)

5. Round Up 7,517,314 to the thousands place value _____
6. Round Up 9,462 to the hundreds place value _____
7. Round Up 32,433,468 to the million place value _____
8. Round Up 434 to the hundreds place value. _____

Addition

Add the following quantities

1.
5 feet
10 feet
+ 12 feet

2.
$220
+ 94

3.
9 inches
18 inches
+ 111 inches

4.
1,312'
811'
+ 94'

5. 17' + 81' + 44' + 192' =

6. A house is framed using 114 – 2"x4" studs on the east wall, 126 – 2"x4" studs on the west wall, 88 -2"x4" studs on the north wall, 92 – 2"x4" studs on the south wall. How many 2"x4" studs were used in framing the house?

7. A small deck is built with the following materials. What is the total cost?

Materials & Labor	Cost
6 - 6”x6”x 8’ PT	$186
20 – 2”x6”x10’ PT	$360
40 hours labor	$1,800
Total Cost	

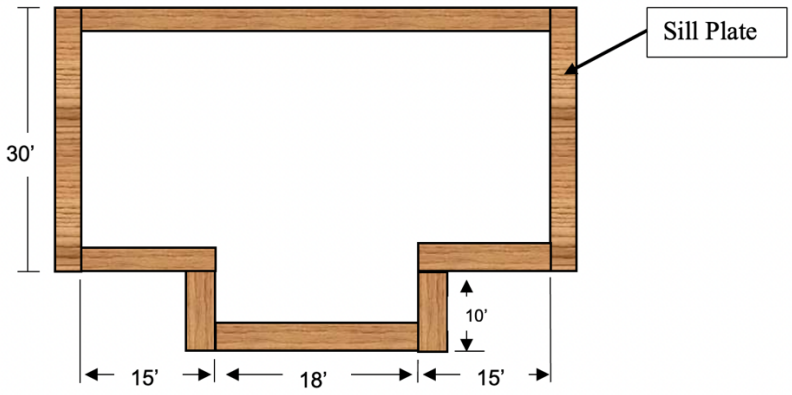
8. A carpenter lays 1,300 wood shingles the first day, 1,400 the second day and 1,500 the third day. How many shingles does he use over the 3 days?

9. A crew works the following hours. What are the total hours worked?

	Carpenter 1	Carpenter 2
Week 1	40	38
Week 2	35	30
Week 3	40	40

10. A carpenter is laying a finished floor in a house and is given the following room information: Living room/dining room, 288 square feet; bedroom, 168 square feet; hall, 45 square feet; and kitchen, 180 square feet. What is the total area to be floored?

11. In the following image, how many lineal feet of pressure-treated boards are needed for the sill plate on the foundation? Note the “sill plate” is the board that sits on the foundation.



12. A new home is estimated to require the following amount of concrete: 38 cubic yards (cu yd) for the foundation walls, 22 cu yd for the basement, 12 cu yd for the driveway and 6 cu yd for the pool. How many cu yds are needed in total?

Let's Practice Number Basics (Perform without a calculator. Check with one)

Subtraction

Subtract the following quantities

1.	48 feet	2.	$300	3.	2,225"	4.	15,437'
	- 12 feet		- $84		- 111"		- 3,494'

5. You purchased 310 12' studs for a shed project you are working on. You only used 288. How many do you have left after the project?

6. Subtract 5,821 from 8,634

7. A truck holding 530 pallets leaves 165 at its first drop-off. How many pallets are left on the truck?

8. From a board 96" long, 3 pieces are to be cut: 24", 28" and 36" in length. How long is the piece that remains (assume no kerf – i.e. no loss of length due to saw blade)?

9. A carpenter has bid $22,000 on a construction project. After spending $1,500 on an electrician, $8,138 on materials and $327 on permits, how much is left over for his labor.

10. An excavator must dig a trench 6 feet 9 inches (81 inches), if it has already dug 4 feet 8 inches (32 inches), how may more INCHES must be dug?

Let's Practice Number Basics(Perform without a calculator. Check with on)

Multiplication (note: x and * both indicate multiplication)

1. 12 x 9 = ; 4 x 12 =. ; 7*12 = ; 6 x 9 = ; 4 x 8 = ; 5 * 12 =

2. 5 x 7

3. 31 x6

4. 24 x10

5. 73 x53

6. 80 x26

7. A business sells sheds for a profit of $312 per shed. If they sell 22 sheds, what is their profit?

8. If a carpenter can average driving 63 nails in an hour, how many nails can he drive in 30 hours?

9. It takes a crew 5 hours to install cabinets in one office. How long will it take the crew to install cabinets in 17 offices?

10. A deck is 20' x 10'. What is the total area of the deck? (Note: Area = length x width)

11. A roofing crew installs 4 squares of shingles per hour. At this rate, how many squares will they install in two 8 hour days?

12. A painter needs to paint 12 offices, each with 250sq ft of wall space. What is the total square feet that needs to be painted?

13. A 5lb box of deck screws has 310 screws. A carpenter buys 6 boxes. How many screws has he purchased?

14. It takes 1 gallon of paint to cover an area of 400sq ft. How many square feet can you cover with 4 gallons of paint? How many square feet with 3 gallons of paint?

15. Use a calculator: A builder pays a project manager $35 per hour for 20 hours, two carpenters at $32 per hour for 48 hours and a helper at $18 per hour for 44 hours. What is the total the builder paid in labor costs?

Let's Practice Number Basics (Perform without a calculator. Check with one)

Division

Remember that division can be written in different ways. Each of the below is read as 18 divided by 3 which equals 6.

$= 18 \div 3$

$= 3\overline{)18}$

$= \frac{18}{3}$

$= 18/3$

1. 24 ÷ 6 =
2. 72 ÷ 9 =
3. 35 ÷ 5 =
4. 60 ÷ 12 =
5. 36/6 =
6. 48/12 =
7. $\frac{108}{9}$ =
8. 29 ÷ 7 = (answer in whole number with remainder. Ex. 11 ÷ 5 = 2 remainder 1)
9. 699 ÷ 30 = (answer in whole number with remainder)
10. $8\overline{)4{,}975}$ = (answer in whole number with remainder)

11. How many pieces of lumber 12 inches long can be cut from a piece of lumber 144 inches long? (ignore any kerf – e.g. loss due to sawblade)

12. One thousand and ninety-two sheets of sheet rock are used in an office building. If it takes an average of 52 sheets per office, how many offices are there in the building?

13. How many sheets of plywood will it take to cover 1,728 sq. ft. if each sheet covers 32 sq. ft?

14. A carpenter makes $1,240 for a 40 hr week (8 hr/day). What is his hourly wage rate? What are his wages for a week where he is rained out 2 days (and doesn't get paid)?

15. It takes 1 gallon of paint to cover an area of 400sq ft. How many full gallons of paint must you buy to paint a 1,350 sq ft. room?

Ch. 2 - Measuring: “Measure twice, Cut once”

Measuring precisely is a critical skill in carpentry. Incorrect measurements can easily lead to increased costs, extra work, and missed deadlines. Measuring correctly will save you time and money and showcase the quality of your workmanship.

The tape measure is a tool that has a special place in your tool belt. You will use it constantly to size, layout and square. To get the cut you want, you must master the tape measure!

Let’s look at the parts of a tape measure:

Tape measures may differ in some features, but most fall into these general categories:

- **Housing**: the plastic or metal case that the blade rolls back into
- **Overmold**: rubberized material on the housing that adds comfort and drop protection
- **Lock**: the sliding piece on the front of the tape that stops it from coming back in when you press it down
- **Blade**: the “tape” in a tape measure that has the measurements printed on it
- **Hook**: the end of the tape that grabs or pushes against material
- **Clip (or Belt Clip)**: a metal piece on the side that clips the tape to your belt, pocket, or bag. (Not shown above).

How To Read a Tape Measure in Inches & Feet

The tape measures we use do their most basic work in inches and feet. These are the clearest, boldest markings you'll see. Starting at the hook, it has number markings for every inch, followed by additional numbered markings for every foot.

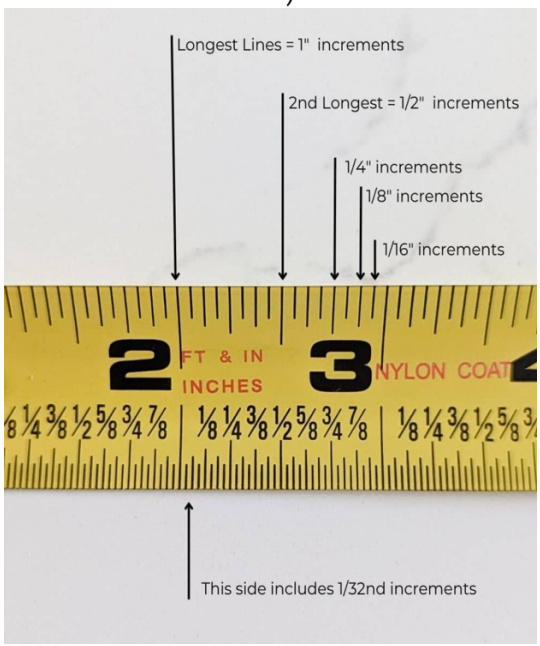
Notation:

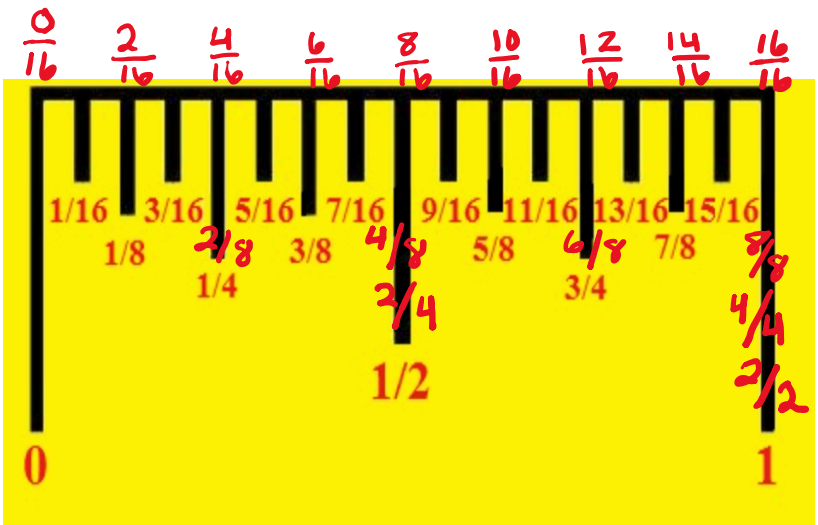
1 foot = 1'	1 inch = 1"
2 feet = 2'	2 inches = 2"
2 feet, 1 inch = 2'-1"	

Once you get beyond 1 foot (12 inches), the inch markings keep increasing with 13, 14, 15, etc. rather than starting over at 1. Some tapes have additional smaller numbers (in red above) that go with the last foot mark you hit. For example, it shows you that 25 inches is also equal to 2ft and 1 inch (2'-1").

In between each long inch marking, there are a series of smaller ones. They are different sizes to help you easily identify the unit. The majority of tape measures, break each inch into 16 sections. In other words, you can read a tape measure with 1/16-inch accuracy. The 1/2-inch mark line is the longest, followed by the 1/4-inch marks, then the 1/8-inch marks. The 1/16-inch marks are the shortest.

Reading from the beginning of an inch forward, here's what the pattern looks like (the marks will be solid on the blade):

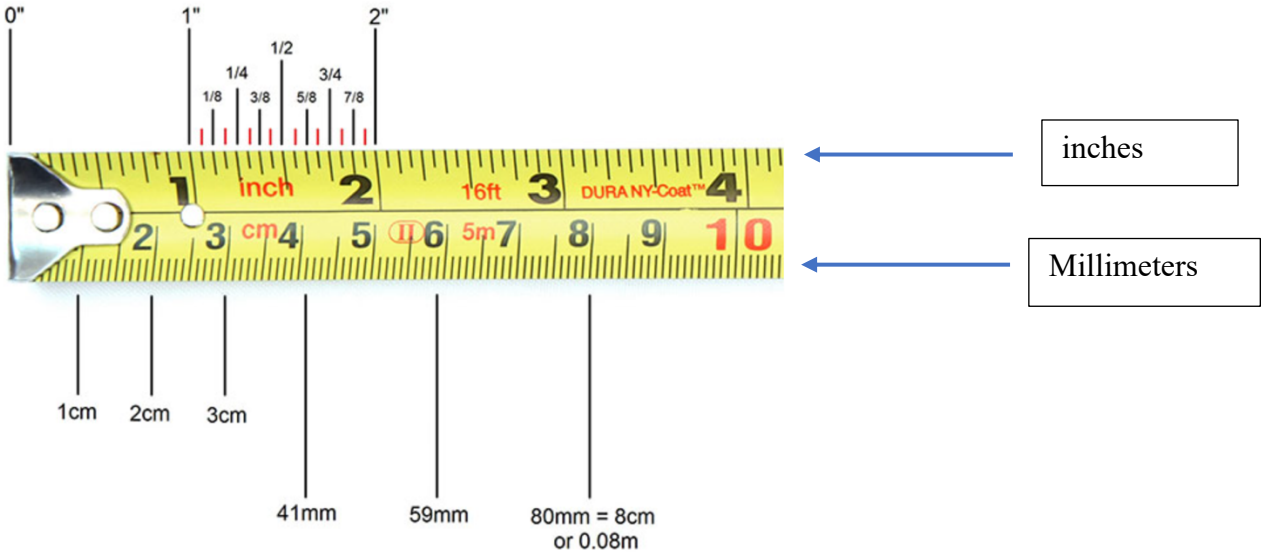




Tip: say "quarters" not "fourths"

How To Read a Tape Measure in Metric

If you're learning how to read a tape measure in millimeters, things change a bit. Metric tape measures break down into 10 millimeters for every centimeter. Counting up just like a standard tape, these don't have indicators for feet, but every 10th centimeter is red or has some other way to stand out. They also may have meters marked



As you read between each centimeter mark, every short mark is 1 millimeter and the 5th is typically longer to help your eyes find the middle easily. Because the metric system is based in 10s, it is a far easier decimal conversion. 13 cm and 4 mm is simply 13.4 cm.

Some tape measures provide both measurements on the same tape like the above. While this can be handy, it also clutters up the visibility of the markings. We rarely need both metric and standard at the same time. If you work with materials that require metric unit measurements—make sure you have at least one of these tapes handy. In either case—pay attention to the labeling on the tape itself and buy the right one!

How to Read a Tape Measure Special Markings

Why are Some Big Numbers Red on a Tape Measure?

You might notice some special markings as you read your tape measure. Every 16 inches (16, 32, 48…), there's a bold, red, or colored-in mark that's different from the others. These, helpfully, mark a standard 16-inch stud placement which you will use, for example, in wall framing.

What are the Black Diamonds on a Tape Measure?

Then there's the mysterious floating black diamond. The measures aren't on an exact inch like the stud markings. These are at 19 3/16, 38 3/8, 57 9/16, and 76 3/4. They're for setting trusses. Specifically, they're for setting six trusses on an 8-foot span—the length of a sheet of plywood. The 0 mark and 8-foot mark make up two and there are four black diamonds in between.

Does the Hook Affect Tape Measure Accuracy?

The hook slides back and forth at the front of the blade and that's intentional. It slides the exact width of the hook so whether you're pushing it against material or pulling from the side, you get an accurate measurement.

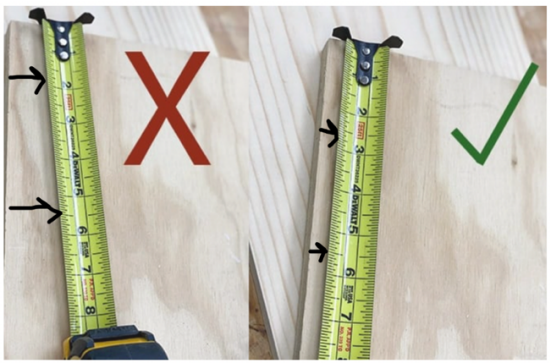
Measurement Terms, Tips & Resources

Terms

- "Burning an inch" – starting your measurement at the 1" mark of your measuring tape to make sure the measurement is accurate (REMEMBER: subtract an inch from your length)

- "Check for square" – To check if a frame is square, measure each diagonal. They should be equal.

Tips

Ensure your measuring tape is level, if your measuring tape is at a diagonal, the measurement will be off	
Sharpen your pencil!	# 3 Dixon Ticonderoga (hard lead) works well or a mechanical pencil
Make a bold chevron!	
Mark the waste side of a cut	

Videos

a. “Marking and Cutting Pro Tips”
https://www.youtube.com/watch?v=_ugkCBG1PSY

b. “How to read a tape measure easy and figure fractions on a measuring tape”
https://www.youtube.com/watch?v=9caqSJ4sN8Y

Other Resources

a. Measuring Tricks and Tips for DIY-ers
https://www.familyhandyman.com/list/measuring-tips-and-techniques-for-diyers/

b. Woodworking Measuring Tips To Avoid Costly Mistakes
https://pacificcoastwoodcrafts.com/woodworking-measuring-tips/

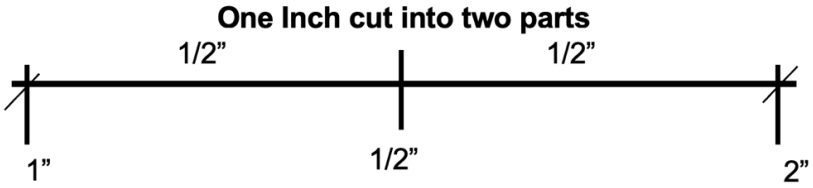
c. Measure and Mark for Better Accuracy
https://www.woodmagazine.com/woodworking-tips/techniques/layout-measuring-marking/accuracy

Reading a Tape Measure (Inches) - Review

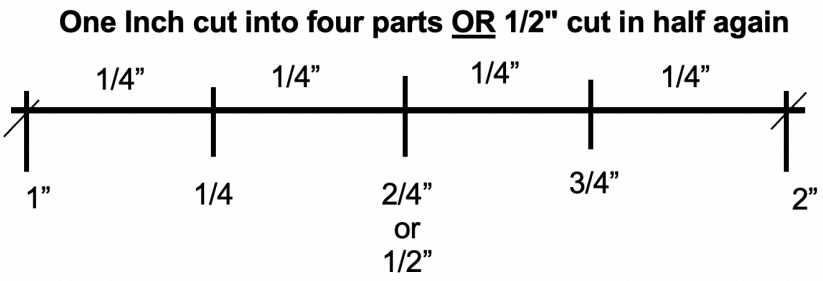
Fractions on a tape measure are nothing more than taking one inch and cutting it into smaller parts, or smaller and smaller measurements:

#1

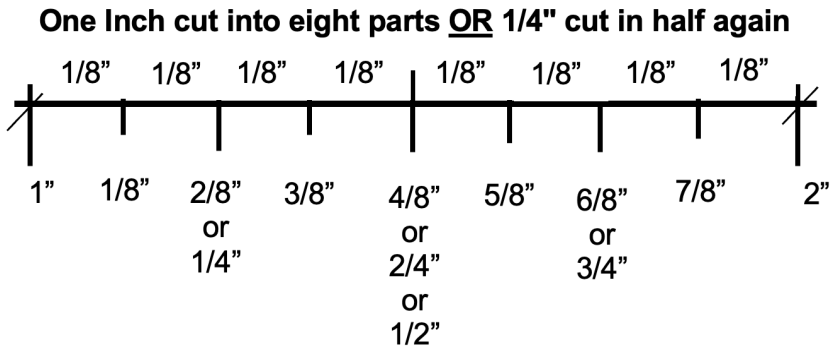
#2



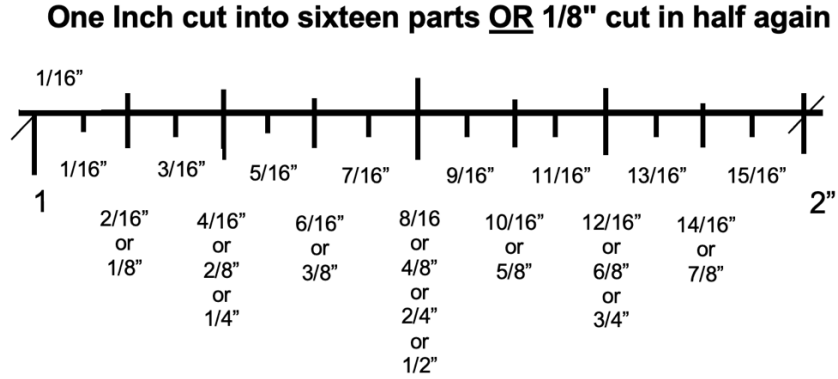
#3



#4



#5



More fractions to come but let’s practice reading a tape measure!

PRACTICE READING A TAPE MEASURE (INCHES)

1) 

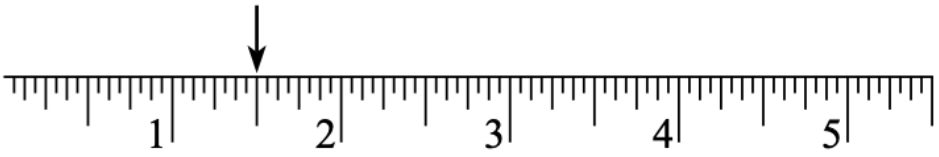
_____

2) 

_____

3) 

_____

4) 

_____

5) 

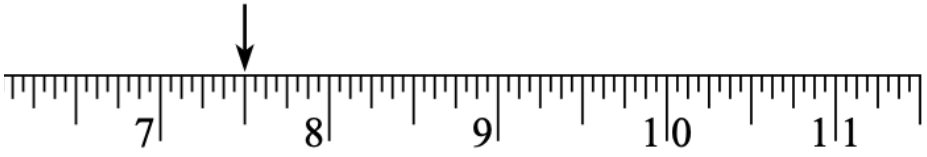
_____

6) 

_____

7) 

_____

8) 

_____

LET'S PRACTICE READING A TAPE MEASURE (INCHES) – CONT.

9) 

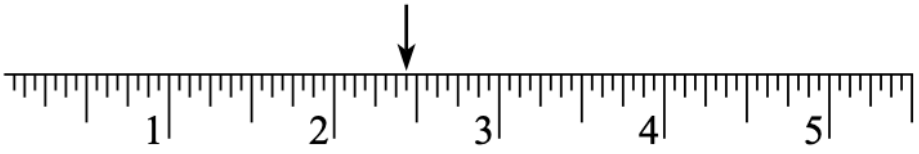
_____

10) 

_____

11) 

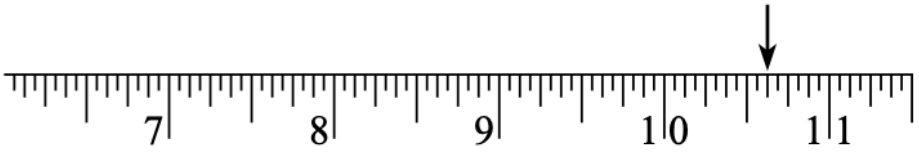
_____

12) 

_____

13) 

_____

14) 

_____

15) 

_____

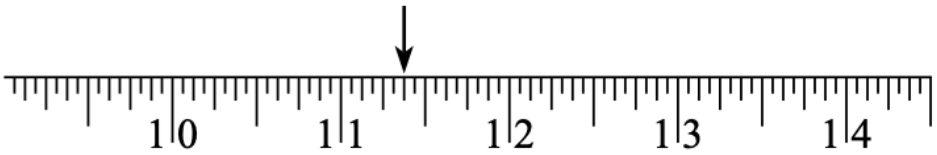
16) 

_____

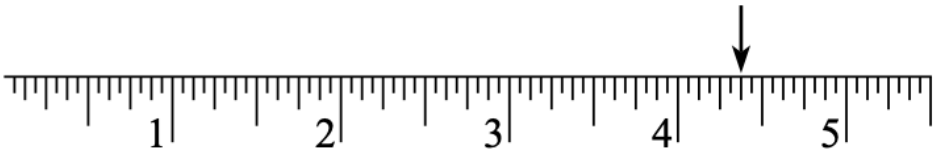
LET'S PRACTICE READING A TAPE MEASURE (INCHES) – CONT.

17) 

_____

18) 

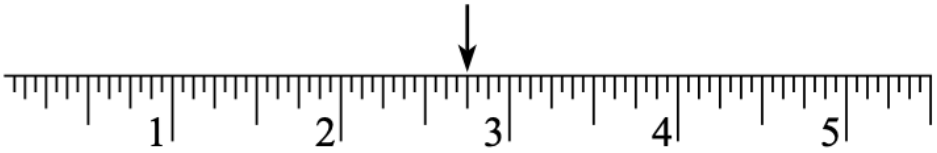
_____

19) 

_____

20) 

_____

21) 

_____

22) 

_____

23) 

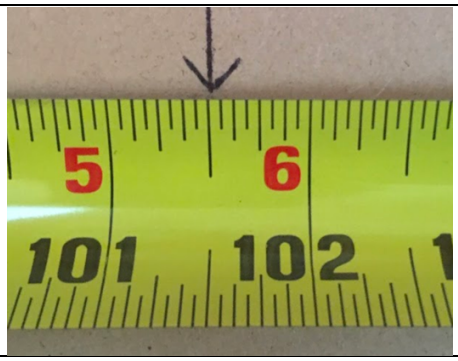
_____

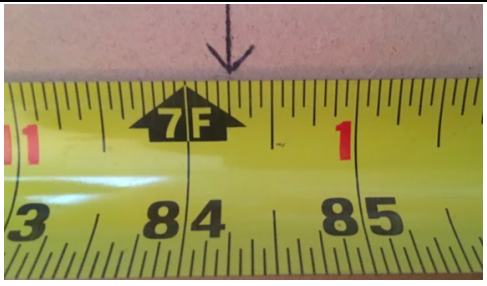
24) 

_____

LET'S PRACTICE READING A TAPE MEASURE (FEET & INCHES)

When reading the tape below, remember that we are looking at feet and inches. The number in black can be divided by 12 to get feet and the number in red is the remaining inches (plus partial inches).

1. For example, 27/12 = 2 with 3 remainder (red #) plus ¼" Answer: **2 feet 3 ¼ inches or 2' - 3 ¼"** When writing feet & inches, best practice is to insert a dash. Additionally, if the inches are less than 1 insert a zero: Ex. 2'-0 ¼".	
2. Answer: ____feet ___inches or _____	
3. Answer: ____feet ___inches or _____	
4. Answer: ____feet ___inches or _____	

5. Answer: ____feet ___inches or _____	
6. Answer: ____feet ___inches or _____	
7. Answer: ____feet ___inches or _____	
8. Answer: ____feet ___inches or _____	
9. Answer: ____feet ___inches or _____	

10. Answer: ____feet ___inches or _____	
11. Answer: ____feet ___inches or _____	
12. Answer: ____feet ___inches or _____	
13. Answer: ____feet ___inches or _____	
14. Answer: ____feet ___inches or _____	
15. Answer: ____feet ___inches or _____	

Ch. 3 - Fractions

Most measurements that you work with in carpentry express length – and are measured with your measuring tape. Given that the tape is split up into fractions, you need to fully understand adding, subtracting, multiplying and dividing fractions. As you practice you will find you are able to perform these calculations quickly and in your head.

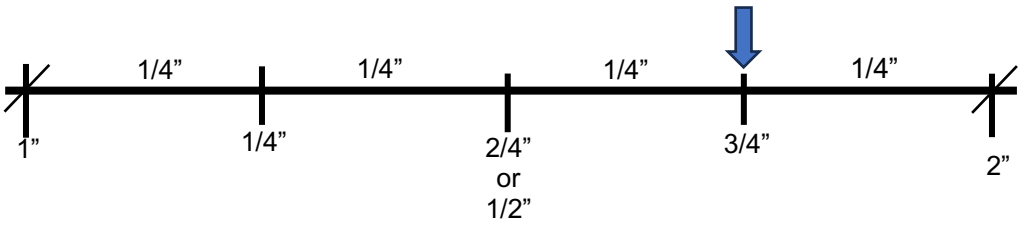
A fraction represents part of a whole number. The top of the fraction is the numerator and indicates the number of equal parts taken. The bottom of the fraction is the denominator and indicates the number of equal parts into which a unit is divided.

Numerator
(# of parts)

$$\frac{3}{4}$$

Denominator
(Total parts in whole)

Back to our tape measure, we see that ¾" means we have 3 (# of parts) of 4 (total parts in whole):



Proper Fraction: The numerator is smaller than the denominator such as 3/4

Improper Fraction/Mixed Number: The numerator is larger than the denominator such as 5/4. Improper fractions can be converted to a mixed number 5/4= 4/4 plus ¼ = 1 ¼ (mixed number). To convert to a mixed number, divide the denominator (bottom number) into the numerator (top number); the result is a whole number plus a remainder. The remainder is then placed over the denominator to show the fractional piece. Another example: 9/4 as a mixed number is 2 1/4. (Divide 9 by 4 to get 2 with a remainder of 1).

Simplifying or Reducing: Fractions are typically expressed in their lowest form: instead of expressing a measurement as 2/4", it is ½". **To reduce a fraction**, **divide both the numerator and denominator by their GCF (greatest common factor)**. Let's look at a couple examples:

Example 1: Reduce $\frac{2}{8}$: 2 and 8 are divisible by 2 (GCF). Thus, $\frac{2}{8}$ can be reduced to: $\frac{1}{4}$ by dividing both the numerator - 2 and the denominator- 8 by 2 to get 1 and 4, respectively.

Example 2: Reduce $\frac{12}{16}$: 12 and 16 are divisible by 4 (GCF). Divide both by 4: $\frac{12}{4}$ = 3; $\frac{16}{4}$ = 4 to get a reduced fraction of: $\frac{3}{4}$.

Addition & Subtraction of Fractions

To add and subtract fractions, we need to find a common denominator and then we can add/subtract the numerators, keeping the denominator the same.

Example 1:

$\frac{1}{4}+\frac{1}{8}=$	The Lowest Common Denominator (LCD) of 4 and 8 is 8 (e.g. 8 is divisible by both 4 and 8 with no remainder)
$\frac{1}{4}x\frac{2}{2}+\frac{1}{8}=\frac{2}{8}+\frac{1}{8}=$	Thus, we need to convert ¼ to eighths. We can do this by multiplying the numerator (1) and the denominator (4) by 2 to get 2/8.
$\frac{2}{8}+\frac{1}{8}=\frac{3}{8}$	Now both denominators are the same and we can simply add the numerators
$\frac{1}{4}+\frac{1}{8}=\frac{3}{8}$	¼ +1/8 = 3/8. 3/8 is a fully reduced, proper fractions*
***Fully Reduced** means that numerator and the denominator are not divisible by a common factor; **Proper Fraction** means the numerator is smaller than the denominator (ex. ¾).	

Following similar methodology above:

Example 2 – Addition: $\frac{1}{2}+\frac{7}{8}$; LCD is 8 and result is an improper fraction/mixed number:

$\frac{1}{2}+\frac{7}{8}=\frac{1}{2}x\frac{4}{4}+\frac{7}{8}=\frac{4}{8}+\frac{7}{8}=\frac{11}{8}=1\frac{3}{8}$

The improper fraction, 11/8, can be switched to the mixed number 1 3/8

Example 3 – Subtraction: $\frac{1}{4}-\frac{1}{8}$: LCD is 8 and result is a proper fraction:

$\frac{1}{4}-\frac{1}{8}=\frac{1}{4}x\frac{2}{2}-\frac{1}{8}=\frac{2}{8}-\frac{1}{8}=\frac{1}{8}$ This is a fully reduced, proper fractions

Example 4 – Subtraction. LCD 8 and improper fraction/mixed number:

$1\frac{1}{2}-\frac{7}{8}=\frac{3}{2}x\frac{4}{4}-\frac{7}{8}=\frac{12}{8}-\frac{7}{8}=\frac{5}{8}$

To start convert the mixed number 1 ½ to 3/2. Then adjust 3/2 to 12/8 to get to a common denominator of 8.

Example 5 – Now try 3 terms. We still need to get an LCD. In this case, it is 16 as 2 and 8 both go into 16.

$\frac{1}{2}+\frac{7}{8}+\frac{1}{16}=\frac{1}{2}x\frac{8}{8}+\frac{7}{8}x\frac{2}{2}+\frac{1}{16}=\frac{8}{16}+\frac{14}{16}+\frac{1}{16}=\frac{23}{16}=1\frac{7}{16}$

PRACTICE FRACTIONS: REDUCING, ADDITION & SUBTRACTION

Fully reduce all answers and show as proper/mixed numbers.

1) Reduce the following fractions:
   a. 2/4” =
   b. 4/8” =
   c. 2/16” =
   d. 12/16” =
2) Express the following improper fractions as mixed numbers *(remember to reduce the remaining fraction, if needed)*
   a. 7/4” =
   b. 17/4” =
   c. 12/8”=
   d. 25/8” =

Solve (remember to reduce the remaining fraction, if needed):

3) 1/2" + 1/2" =
4) 1/4" + 1/4” =
5) 1/8” + 1/8” =
6) 1/2” + 1/4" +1/8” =
7) 3/8” + 1/8" =
8) 3/16” +3/16 + 7/16” =
9) 3/4" + 3/16" =
10) 1/4" + 1/16” =
11) 1/2" + 5/2” =
12) 3 1/4” + 4 1/8” =
13) 5 3/4” + 2 3/4" =
14) 2 3/4” + 5 5/8” =
15) 7/8” - 5/8” =
16) 3/4" – 1/8” =
17) 1/2" - 1/4" =
18) 1 3/4” – 1/4" =
19) 13/16” – 2/8” – 1/4"=
20) 3 5/8” – 2 3/8” =
21) 3 5/8” – 2 7/8” =

22) What is the total thickness of three pieces of stacked plywood: 5/8 inch, 3/8 inch and 3/4 inch thick?

23) Drywall partitions (interior walls) separate the rooms of a house. If the partition studs are 3 ½ inches thick, and the drywall on each face of the stud is ½ inch thick, what is the thickness of the partition?

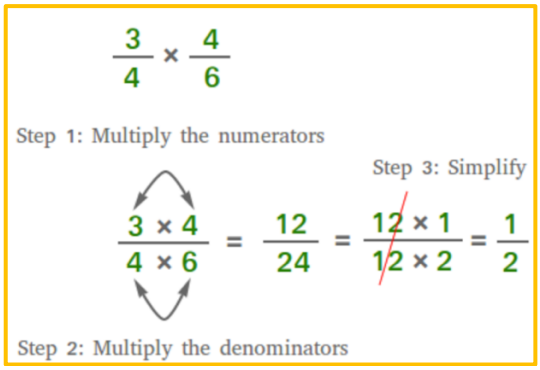
24) What is the thickness of a board ¾” thick after 1/16” is planed off one side?

25) What is the thickness of a floor consisting of ¾” plywood, 5/8” concrete board, 3/16” adhesive and 3/8” tile?

26) CHALLENGE: A carpenter cuts three pieces from a 144” length of 2” x 6”, the lengths of the pieces are 33 3/8”, 56 5/8” and 39 7/8”. What is left over from the full length, if the saw kerf is 1/8” wide? (remember 12” are in 1’)

Multiplication & Division of Fractions

Multiplication of Fractions



Tip: Simplifying before you multiply out can save time. In the example, you can cancel the 4's and divide the 3 and the 6 by 3.

$\frac{1\ 3 \times 4}{4 \times 6\ 2} = \frac{1}{2}$

Example: $\frac{1}{2}$ x $\frac{7}{8}$ = ?

Multiply numerator and denominator: $\frac{1 \times 7}{2 \times 8} = \frac{7}{16}$

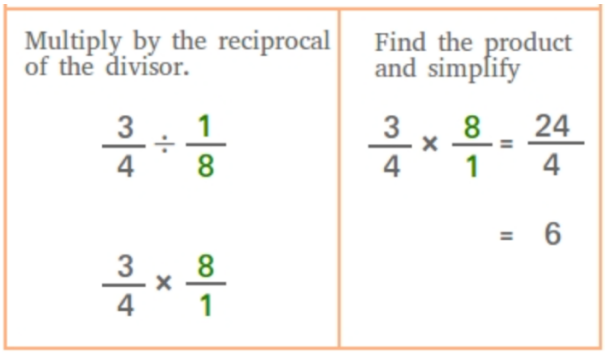
For mixed numbers, convert them to improper fractions and then multiply:

Example: $1\frac{1}{4}$ x $\frac{3}{4}$ = ?

Convert 1 1/4 to 5/4 (note: 1=4/4 then add 1/4).

Multiply numerator and denominator & simplify (if needed): $\frac{5}{4}$ x $\frac{3}{4}$ = $\frac{15}{16}$

Division of Fractions



Tip: Carpenters often have to find a center line by dividing a measurement by 2 (i.e. multiplying by ½). When dealing with a fraction simply keep the numerator the same and double the denominator. Examples: Half of ½ is ¼. Half of ¾ is 3/8.

Example: 3/4 ÷ 1/2 = ?

Flip divisor and multiply: 3/4 x 2/1 = (3x2)/(4x1) = 6/4; Simplify: 3/2 = 1 ½

For mixed numbers, convert them to improper fractions.

Example: $1\frac{1}{2} \div 2\frac{3}{4}$ = ?

Convert 1 1/2 to 3/2. Convert 2 ¾ to 11/4.

Flip divisor (11/4 to 4/11), multiply & simplify (if needed): $\frac{3}{2}$ x $\frac{4}{11}$ = $\frac{6}{11}$

PRACTICE FRACTIONS: MULTIPLICATION & DIVISION

Fully reduce all answers and show as proper fractions/mixed numbers. Watch units.

1) $\frac{3}{8} \times \frac{1}{2}$ =	11) 4' ÷ 8 =
2) 1/4" x 1/4 =	12) 8' ÷ 5 =
3) 3/4" x 3/4 =	13) 3/4" ÷ ½ =
4) 7/8" x 1/4 =	14) 3/4" ÷ 2 =
5) 1 1/4" x 1/2 =	15) 1/2" ÷ ¼" =
6) 36 1/2' x ½ =	16) 2 1/4' ÷ 3 =
7) 6 3/4" x 5 =	17) 7/16" ÷ 5/8" =
8) 8 ¼' x ½' =	18) 4 ÷ 3/8 =
9) 24" x ¾" x 2" =	19) 16' ÷ 2 ½ =
10) 48" x ½ x 1/3 =	20) 7/8" ÷ 4 =

21. What is half of 1/8"?

22. What is a quarter of 4 1/4"?

23. What do you get when you double 5/8"?

24. A wall is finished with 14 horizonal panels, each measuring 7 ¼". What is the height from the floor to the upper edge of the top panel?

25. A retaining wall is to be constructed out of 5 ½" thick blocks and will be 8 rows high. What is the finished height of the wall?

26. How may 6 ½" blocks can be cut from a 45 ½" board? (ignore kerfs)

27. How many 2 ¼" boards are needed to cover a floor that measures 88 ¾" wide?

Ch. 4 - Decimals & Conversions

A decimal, like a fraction, is a number that expresses part of a whole. Decimals show a portion of a number after the decimal point. Each number to the left and right of the decimal point has a specific place value. As we saw before, the numbers to the left of the decimal point are whole numbers. The numbers to the right of the decimal point, however, indicate that there is a portion of a number (e.g. a fraction) as well.

Identify the place values for 5,916.975:

We read this number as "five thousand, nine hundred and sixteen POINT nine, seven, five". OR "five thousand, nine hundred and sixteen and nine hundred and seventy five thousandths"

Remember that the .975 represents the fraction 975/1000 or 9/10 + 7/100 + 5/1000. Thus, decimals and fractions can be interchangeable.

Conversion: Decimals into Fractions & Fractions into Decimals

Sometimes it is easier to work with decimals and sometimes with fractions. Or you may be given a decimal and need a fraction or vice versa. Thus, it is important to understand how to convert one into the other.

Converting a decimal into a fraction: Let's look at 0.25.

Step 1: Put the decimal into fraction form such that the decimal is over 1:

$$\frac{0.25}{1}$$

Step 2: Take both the numerator and the denominator and multiply each by 10 for every digit to the right of the decimals place. In this case we have two decimal places to the right. Therefore, we multiply each by 100 (10x10)

$$\frac{0.25}{1} = \frac{0.25}{1} x \frac{100}{100} = \frac{25}{100} = \frac{1}{4}$$

Alternatively, shortcut the steps above by using the place values to write the 25/100 and then reduce the answer.

Note: In carpentry, we often want to convert a decimal to a fraction that we can read on our tape measure such as to quarters, 8ths or 16ths. The prior example worked nicely for a quarter but what about more complex decimals? Simply multiply the decimal by 16 and round to the nearest whole number, simplify/reduce if needed.

Examples: Convert the following decimals to sixteenths (1/16's) and then reduce, if needed:

1. .0625. → Multiply by 16 → .0625 x 16 = 1 → 1/16"
2. .4375 → Multiply by 16 → .4375 x 16 = 7 → 7/16"
3. .8332 → Multiply by 16 → .8332 x 16 = 13.332 → Round to 13/16"
4. .375 → Multiply by 16 → .375 x 16 = 6 → 6/16" reduces to 3/8"
5. 13.4375 → Multiply after decimal by 16 → .4375 x 16 = 7 → 13 7/16"

Note the use of rounding and reducing.

Converting a fraction to a decimal:

Simply, divide the numerator (top number) by the denominator (bottom number). You will usually do this with a calculator, although many will become common to you as you work with them. For example, ½=0.5, ¼ = 0.25 or ¾=0.75 will become second nature! Note: the first zero is often added to make the decimal point clear.

Example: Convert 1/8 to a decimal. Long hand below. Easy with a calculator!
Divide 1 by 8, adding zeros after the decimal point until you have no remainder. 1/8=0.125

$\frac{1}{8} = 1 \div 8$

$$8 \overline{)\,1 \cdot {}^{1}0\,{}^{2}0\,{}^{4}0} \quad 0 \cdot 1\ 2\ 5$$

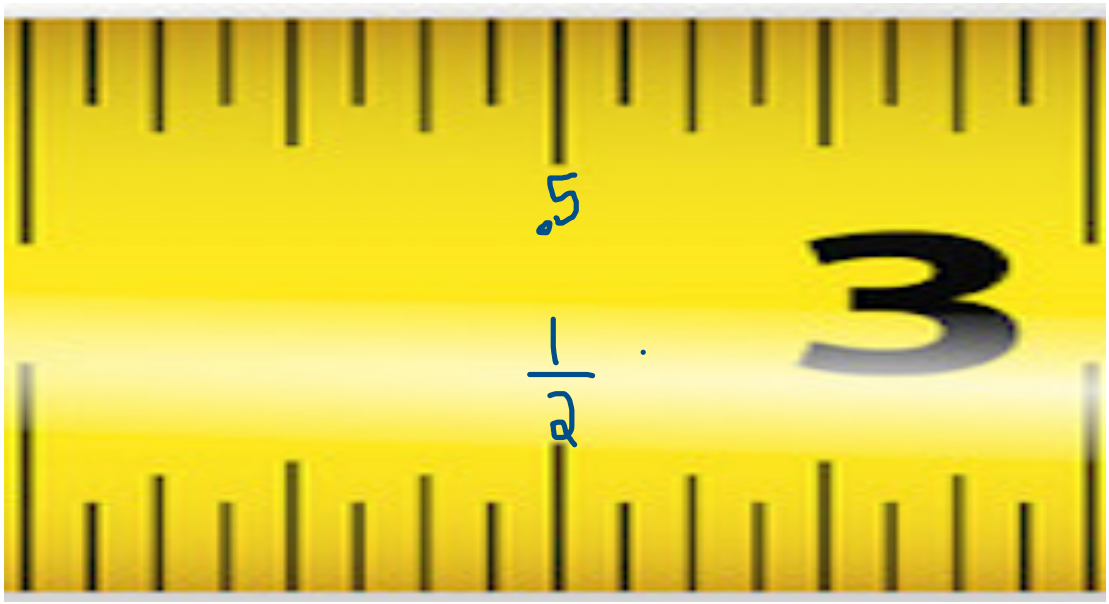
$\frac{1}{8} = 0{\cdot}125$

Note: Standard calculators generally require decimals so when working with measurements in fractions (and using a calculator), it is often easiest to convert them to decimals and then convert them back to 16ths (and reduce). Alternatively, there are calculators such as the Construction Master Pro that allow you to input fractions and give the results in fractions. We will practice with these calculators in class.

CONVERT FRACTIONS TO DECIMALS (WORK IN ALL INCHES)

1) 1/2" = _____0.5”_____
2) 1/4" = _____
3) 3/4" = _____
4) 1/8” = _____
5) 3/8” = _____
6) 5/8“ = _____
7) 7/8” = _____
8) 1/16” = _____
9) 3/16” = _____
10) 5/16” = _____
11) 7/16” = _____
12) 9/16” = _____
13) 11/16” = _____
14) 13/16” = _____
15) 15/16” = _____
16) 3 1/2" = _____
17) 6 13/16” = _____
18) 14 7/8” = _____
19) 24 9/16” = _____
20) 96 3/8” = _____
21) 1 7/16" = _____
22) 11 15/16" = _____
23) 2 2/4” = _____
24) 16 5/8” = _____
25) 9 9/16” = _____
26) 47 1/16“ = _____
27) 32 7/8” = _____
28) 84 3/4” = _____
29) 60 1/4” = _____
30) 21 5/16” = _____

COMPLETE THE DIAGRAM: Write in Fractions of an Inch & Decimal Values for Each Tick Mark on the tape Measure



CONVERT DECIMALS TO FRACTIONS OF AN INCH (remember to round and reduce your answer to a value on your tape measure: 16ths, 8ths, 4ths, half). We are just working in inches now. No feet (yet).

1) 0.75" = _____
2) 0.5" = _____
3) 0.625" = _____
4) 0.0625" = _____
5) 0.9375" = _____
6) 13.6875" = _____
7) 3.4375" = _____
8) 21.1875" = _____
9) 7.6875" = _____
10) 3.375" = _____
11) 13.875" = _____
12) 10.625" = _____
13) 28.125" = _____
14) 42.50" = _____
15) 14.75" = _____
16) 1.56" = _____

Ch. 5 - More Measurement Conversions: Working with Feet and Inches - Fractions

As a carpenter, you will not only deal with inches but also in a combination of feet and inches. Sometimes it is easy to just add the feet and the inches separately, remembering there are 12" in every foot:

Example: Add 3 feet 7 inches and 6 feet 8 inches:

	3 feet.	7 inches
+	6 feet	8 inches
	9 feet.	15 inches (1 foot 3 inches)

Answer: 10 feet 3 inches

For more complex problems it is often easier to convert all measurements to inches, perform the operations needed and then convert back to feet and inches.

To Convert Feet to Inches: Multiply feet by 12 and add left over inches

Example:

1) 2 feet = 2' x 12" = 24" inches. *Note: multiply feet by 12 because 1 foot = 12 inches*
2) 2 feet 3 ¼ inches = 2 feet x 12 inches + 3 ¼ inches = 24" + 3 ¼" = 27 ¼"

After all quantities to be worked are converted to inches, perform the operations. The result will be in inches.

To Convert Inches Back to Feet and Inches: Divide by 12 with remainder kept in inches:

Example:

1) Convert 28 inches to feet:
   - Divide 28" by 12" to get 2 with a remainder of 4;
   - Answer is 2 feet and 4 inches or 2' - 4"
   - Reference your measuring tape to confirm

2) Convert 39 ½" to feet:
   - Divide 39 ½"/12 = 3 with remainder of 3 ½";
   - Answer is 3 feet, 3 ½ inches or 3'-3 ½"

More Measurement Conversions: Working with Feet and Inches – Fractions to Decimals to Fractions!

There may be times when you are working with your traditional calculator and need to use decimals. Then after you perform the operations, you must convert back to fractions to read your measuring tape. We did this with inches in the prior section. It gets a bit more complicated when we add feet in!

Example: After doing a calculation, we have 28.675 feet. We need to be able to mark this distance with our tape measure so we must convert it to feet and inches (and partial inches).

1) Convert 28.734 feet to feet and inches:
    a. Remove the whole feet (28) from **28.**734 to get 0.734' – this is the partial foot
    b. Since there are 12" in one foot: Multiply 0.734 x 12 to get inches
        0.734' x 12" = 8.808 inches. So 8 whole inches and .808 partial inches.
    c. Remove the whole inches from 8.808" to get .808" – this is the partial inches
    d. Like our prior decimal to inch conversions, multiply 0.808 by 16 to get how many 16ths of an inch our partial inch is: 0.808 x 16 = 12.928.
    e. Rounding 12.928 to 13, we get our partial inch is 13/16" – this cannot be reduced so we are done
    f. The final answer is 28.734 equals 28 feet 8 13/16 inches. Also written as 28'-8 13/16".

As you can see, there are quite a few steps to go through when converting a decimal given in feet to something readable on a tape measure. In summary, remember the following:

1. The decimal after the whole feet is partial feet and must be converted to inches by multiplying by 12
2. The decimal in the resulting number is, therefore, partial inches and must be converted to 16ths of an inch by multiplying by 16 (and then reducing if required)

It will get easier with practice! We will use this type of conversion a lot in our roofing calculations.

Other Conversions:
3ft = 1 yard

Remember to label your results!!!

PRACTICE MEASUREMENT CONVERSIONS

1. Convert feet to inches (remember multiply feet by 12 and add inches):

a. 6’ – 2”	_____74”_____	f. 33’ – 4 $\frac{5}{8}$	_____
b. 9 feet	_____	g. 8’ – 3”	_____
c. 2 feet 3 inches	_____	h. 3’ – 8”	_____
d. 11’ - 6”	_____	i. ¼ of a foot	_____
e. 4’ – 2”	_____	j. Half a foot	_____

2. Convert inches to feet & inches

a. 14 inches	_____1’ - 2”____	f. 121 inches	_____
b. 18 inches.	_____	g. 27 3/4 inches	_____
c. 24 inches	_____	h. 38 $\frac{5}{8}$ inches	_____
d. 39”	_____	i. 48 inches.	_____
e. 16 ½ inches	_____	j. 52”	_____

3. Convert decimal inches to fractional inches (review) – Use 16ths of an inch and reduce

a. 25.8901”	____25 7/8”____	e. 16.2500”	_____
b. 0.625”	_____	f. 83.3333”	_____
c. 4.3590”	_____	g. 0.9359”	_____
d. 39.7243”	_____	h. 44.1621”	_____

4. Convert decimal feet to feet and fractional inches - Use 16ths of an inch and reduce

a. 11.786241’	____11’ - 9 7/16”_	e. 33.85298’	_____
b. 12.2536 feet	_____	f. 1.6748 feet	_____
c. 6.7534’	_____	g. 8.189023’	_____
d. 20.3821’	_____	h. 102.22222’	_____

5. How many yards in 330'? (remember there are 3 feet in a yard)

6. How many feet in 12 yards?

7. Practice with 12 times tables

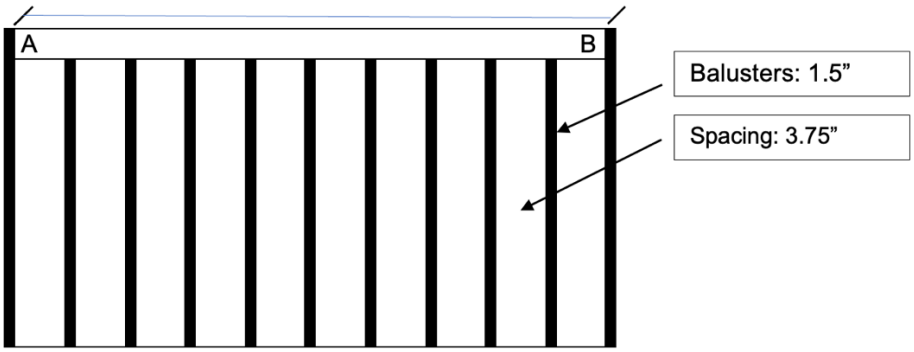
1 x 12 =	6 x 12 =	11 x 12 =	2 x 12 =
9 x 12 =	3 x 12=	8 x 12 =	7 x 12 =
4 x 12 =	10 x 12 =	5 x 12 =	12 x 12 =

PRACTICAL APPLICATIONS OF MEASUREMENT CONVERSIONS & OPERATIONS

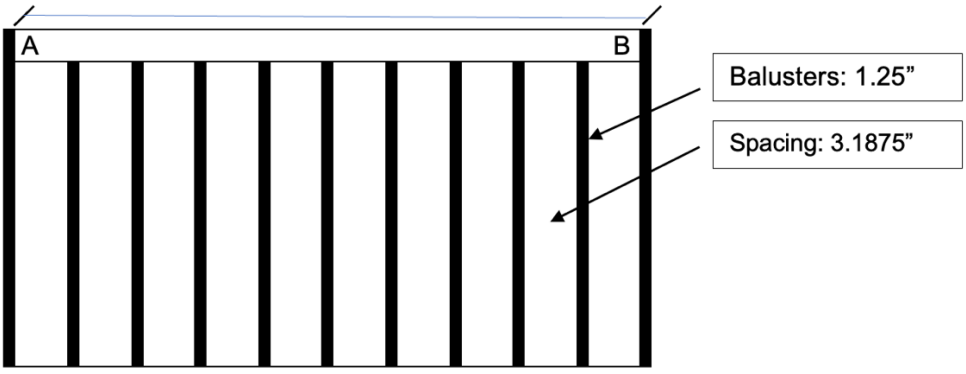
1. The actual width of a pine board is 11 ¼". Write the width in inches in decimal form.

2. How much would have to be cut from the end of a 12-foot piece of lumber to leave a piece 6 feet 4 inches long?

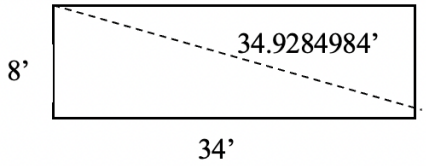
3. What is the distance between post A and post B on the deck shown below? What would you read for feet and inches on your measuring tape? (Ex. 3ft 5 ½ inches or 3'- 5 ½")



4. What is the distance between post A and post B on the deck shown below? What would you read on your measuring tape? (i.e. in feet and fractional inches)



5. You are checking if an 8' x 34' wall is square by calculating the diagonal. Your answer is: 34.9284984'. Convert this decimal to feet and fractional inches so you can read it on your tape measure. We will do more on checking square in our triangle unit!



Ch 6. – Percent & Ratios

Percent

Percent is another way to write decimals or fractions. For example:
40% = 0.40 = 40/100

Percent Problems: In each percent problem, we are looking for the **whole**, or the **part** or the **percent (%)**

- Part = Whole x Percent
- Percent = Part ÷ Whole
- Whole = Part ÷ Percent

Example 1: A project is expected to take 100 hours. You have completed 30 hours. What percent of the project is complete (based on hours)?
Solution: We are solving for the percent complete: Percent = Part ÷ Whole
Percent = 30 hours ÷ 100 hours = .30 or 30%

Example 2: As a rule of thumb, a carpenter will order 20% more 2x6 boards than needed to account for defects. If the project requires 50 boards, how many extra boards will they order?
Solution: We are solving for the extra boards needed or the part. Part = Whole x Percent. 50 boards x 20% = 50 boards x 0.20 = 10 boards. In total, therefore, the carpenter will order 60 boards (50 planned and 10 extra)

Ratios, Proportional Relationships

Ratios are used to show the relationship between two quantities.

For example, you will see ratios used in architectural plans where 1" on the plans might represents 10'. This ratio can be applied to other measurements in the plan/building. For example, a 30' hallway is 3" on the plan.

Or you may be asked to mix a cement using a ratio of 3 cups of dry cement to 1 cup of water. Depending on how much cement you need you may do 6 cups dry cement to 2 cups of water or 9 cups to 3 cups, etc.

A **proportion** is an equation of two ratios. It can be written in two ways:

$\frac{a}{b} = \frac{c}{d}$ and a:b = c:d

Ratio & Proportions Video HTTPS://WWW.YOUTUBE.COM/WATCH?V=Z-694NJXGH4

PRACTICING PERCENT & RATIOS

1. Write 16% as a decimal number and a fraction. (reduce to lowest terms)

2. An item sells for $63.59. What is the total cost for that item after a 6.2% sales tax is applied?

3. 12.9 is 15% of what number?

4. What is 12% of 63?

5. 17 is what percent of 26?

6. You need to buy 19 sheets of plywood for a job. Each sheet costs $24. If sales tax is 5.5%, what is the total cost to purchase the plywood?

7. You need to by 320 2”x 4” x 10’ to frame a shed. Each board costs $5.25. If you need to build in 20% waste to your order, how many boards will you order and how much will it cost?

8. You are looking at an architectural plan that is 1” for every 10’. If the room you are framing is 2” x 1 ½” on the plan, what is the actual size of the room?

EXPONENTS

An exponent is a symbol representing how many times a quantity should be multiplied by itself. For example, $3^2 = 3 \times 3 = 9$. The exponent is 2 and represents multiplying the base, 3, by itself two times. Terminology: An exponent of 2, is also called "squaring a number" with 3^2 referred to as 3 "squared".

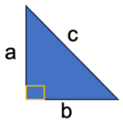
Another example, $4^3 = 4 \times 4 \times 4 = 64$. The exponent is 3 and represents multiplying the base, 4, by itself three times. Terminology: An exponent of 3, is also called "cubing a number" with 4^3 referred to as 4 "cubed".

In carpentry, the exponents 2 and 3 are frequently used in measurements of area and volume respectively. You will see square feet (ft^2) for areas such as floors or wall surface or roofing. You will see cubic feet (ft^3) for volumes such as concrete or sand. We will explore area and volume more in the next chapter.

SQUARE ROOTS

The square root is the number that, when multiplied by itself produces the given number. The symbol for square root is: $\sqrt{\ }$. For example, the square root of 9 is 3. $\sqrt{9} = 3$. Usually you will use a calculator to figure out the square root of a number. Most calculators have the root symbol on them – for the Iphone: open the calculator app and turn it on its side to see the $\sqrt{\ }$ or, equivalently, the $\sqrt[2]{\ }$ function. In our example, put in 9 and then hit the $\sqrt{\ }$ button to get the result 3.

Carpenters will use square roots when dealing with triangles and the Pythagorean Theorem:



$$a^2 + b^2 = c^2$$

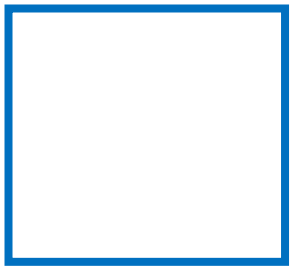
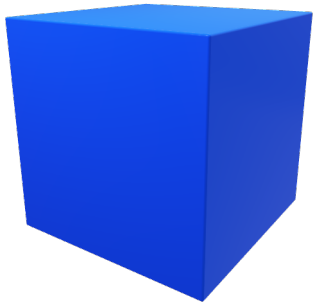
In order to find c, you need to take the square root of a^2+b^2: $\sqrt{a^2 + b^2}$. We will cover this more in the Chapter on Triangles.

PRACTICING SQUARES, CUBES & SQUARE ROOTS

1. 5^2 = _____
2. 4^2 = _____
3. 2^3 = _____
4. 3^3 = _____
5. $3^2 + 4^2$ = _____
6. $\sqrt{4}$ = _____
7. $\sqrt{25}$ = _____
8. $\sqrt{100}$ = _____
9. $\sqrt{12}$ = _____
10. $\sqrt{32}$ = _____

PERIMETER, AREA & VOLUME

For many projects you will need to understand the concepts and how to calculate perimeter, area and volume.

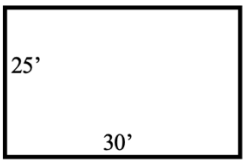
Perimeter	Area	Volume
		
Distance around the outside of a shape or total length of sides	Amount of space covering the flat surface of a shape	Amount of space inside a 3-dimensional shape
Measured in ft and inches	Measured in ft^2 and in^2	Measured in ft^3 and in^3
Use examples: • Amount of baseboard needed for a room; • Amount of fencing to enclose a yard	Use examples: • Amount of oak floor needed for a hallway; • Amount of paint needed for a wall	Use examples: • Concrete need for a foundation • HVAC systems capacity • Board feet (144 in^3)
Calculating basic shapes: • For most shapes, add the sides • For circles: $2\pi r$ (π = 3.14, r=radius); also called the circumference	Calculating basic shapes: • Rectangle: length x width • Triangle: ½ x base x height • Circle: πr^2 (r= radius)	Calculating basic shapes: • Cube/Rectangular prism: length x width x height • Triangle prism: ½ length x width x height • Cylinder: πr^2x height

<u>When you calculate perimeter, area and volume, you must make sure that the units for each measurement are the same</u>; in other words, use all inches or all feet. Often feet and inches are converted to decimals for calculating purposes.

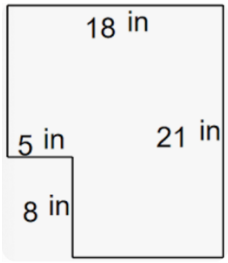
Your constructions projects may have abnormal shapes; however, it is usually possible to break them down into more basic geometric shapes so you can get to your final answer. Doors, windows or other openings may also require modifications.

PRACTICING PERIMETER, AREA AND VOLUME

1) You need to build a <u>frame</u> for a concrete foundation that is 25' x 30'. You plan to use 2'x6' boards. How many <u>feet</u> of 2'x 6' boards do you need? (in other words – what is the perimeter of the below foundation)



2) What is the perimeter of the following shape? What is the area? (note: find missing sides for perimeter and break the shape down into rectangles for area)



3) What is the area of a room that is 11' x 12'?

4) You are painting a room with 4 walls and must calculate the wall area so you can order the paint. Your room is 10'x10' with 11' ceilings, 2 windows (2'x2' each) and one door (7' x 3'). What is the total <u>wall</u> area you will be painting?

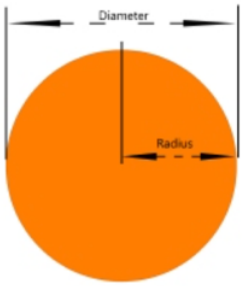
5) How many 4'x8' sheets of plywood would you need to cover a rectangular floor surface measuring 20' in width and 30' in length?

6) What is the area of a triangle with a base of 4' and a height of 8'?

7) What is the area of a triangle with a base of 6' and a height of 2'3"?

8) What is the area of a circle with a 3' radius? What is the "perimeter" or circumference? (assume $\pi = 3.14$)

9) What is the area of a circle with an 8' diameter (note the radius of a circle is ½ the diameter)? (assume $\pi = 3.14$)



10) What is the perimeter and area of a 3' x 12' rectangular sand box? If you want to fill it with 1 ½" feet of sand, how much sand will you need? If sand is purchased, in 3 cubic feet bags ($3ft^3$), how many full bags will you need?

11) A cord of wood is 128 cubic feet ($128ft^3$). How many cords of wood will fit into a shed that is 8' long, 4' wide and 8'high.

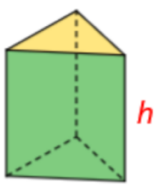
12) Challenge Question: A carpenter is building a rectangular shed with a fixed perimeter of 54 feet. What are the dimensions of the largest shed that can be built? What is the area?

More Volume Questions

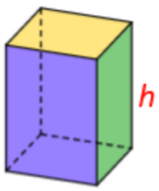
Volume of Prisms

$V = Bh$

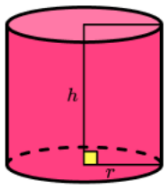
where $B =$ area of base



Triangular Prism
V = area of triangle x h



Rectangular Prism
V = area of rectangle x h



Cylinder
V= area of circle x h

Remember:
Area of triangle = ½ bh
Area of rectangle = bh
Area of circle = πr^2

13) What is the volume of a rectangular prism 3 feet high, 2 feet thick and 10 feet long?

14) What is the volume of a 10in cube?

15) What is the volume of a triangular prism that has a 3 inch base, 2 inch height and 5 inch depth?

16) What is the volume of a cylinder with a diameter of 11 feet and a height of 10 feet?

17) If you needed cement to fill the foundation of a room that measures 100 feet square at a depth of 6 inches, what volume of cement would you need? (pay attention to units).

18) If gravel needs to be distributed across an area measuring 10 feet square and the gravel needs to be 3 inches thick, the volume of gravel needed would be:

19) The volume of a round pool with a diameter of 10 feet and a depth of 9 feet is?

20) A planters boxes dimensions are 5’ x 4’ x 2’. How many bags of soil will you need to buy if each bag has 2 cubic feet of soil?

Board Feet:

Board Foot: The basic unit of measurement for rough sawn stock. It is defined as the equivalent of a piece of wood measuring one foot wide, one foot long and one inch thick.

Board feet = T x W X L where Thickness is in inches, and Width and Length are in feet.

Example: How many board feet are in a board 1 in thick x 12 in wide x 6 ft long?
Answer: First convert width to feet: 12 inches = 1 foot
Multiply 1" x 1' x 6' = 6 board feet

21) 1" x 6" x 4' _1 x 6/12 x 4 = 2 board feet___

22.) 1" x 6" x 18' _____

23.) 12 pcs/ 2" x 4" x 16' _____

24.) 12 pcs/ 1" x 10" x 18" (note dimensions)_____

25.) 24 pcs/ 1/2" x 4" x 10' _____

26.) 11 pcs/ 1 1/2" x 3" x 12' _____

27.) 10 pcs/ 3/4" x 3" x 16' _____

28.) 12 pcs/ 1" x 12" x 10'. _____

TRIANGLES

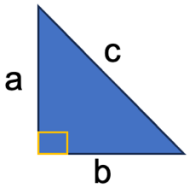
A basic knowledge of angles is key for carpenters. Where will you use it:

- Cutting an angle
- Finding the pitch of a roof
- Determining if a corner is square
- Calculating a stair layout
- Laying out building foundation or elevations
- …..

Triangle facts:
Angles sum to 180°
A Right triangle has one 90° angle
Area= base x height x 1/2

Pythagorean Theorem

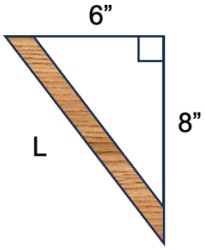
The Pythagorean theorem is used extensively in carpentry and construction. Almost every carpentry project involves some combination of squares and triangles. The Pythagorean Theorem is a relation in geometry between the length of the three sides of a right triangle



$$a^2 + b^2 = c^2$$

For any right triangle **abc, $a^2 + b^2 = c^2$** where **a** and **b** are the sides of the triangle that meet at a 90 degree angle.

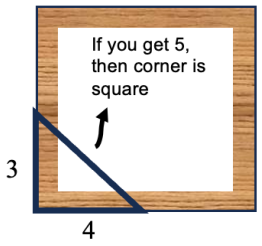
Example: Using the Pythagorean Theorem to determine the length (L) of a diagonal brace that projects 6" out from the surface of a wall to support a shelf, and 8" down from the bottom surface of the shelf.



$$6^2 + 8^2 = L^2$$
$$36 + 64 = 100$$
$$L^2 = 100$$
$$L = 10$$

To find L given $L^2=100$, take the square root of 100. This is the function $\sqrt[2]{\ }$ or $\sqrt{\ }$ on your calculator. Put in 100 and then function $\sqrt[2]{\ }$ to get 10. $\sqrt[2]{100} = 10 = L$

Note: The above is referred to as a 3-4-5 triangle (6, 8, 10 are 3,4,5 multiplied by 2) which, in carpentry, is often used to check if a corner is square. Measure 3 on one side of the corner, 4 on the other and connect them. You know the corner is square (i.e. a right angle) if you get 5.

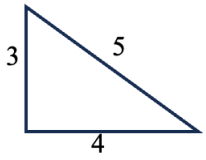


PRACTICING ANGLES

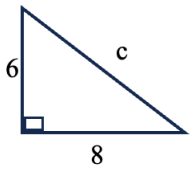
1) A right angle triangle contains one angle of 46°; calculate the size of the other small angle.

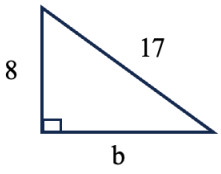
2) What the area of a right angle triangle having a base dimension of 3 feet and a height of 4 feet?

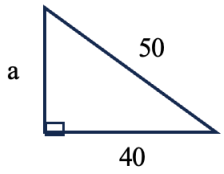
3) Use the Pythagorean theorem to show the following triangle is a right triangle



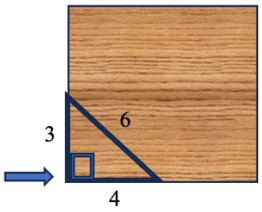
4) Use the Pythagorean theorem to find the missing sides of the following right triangles:





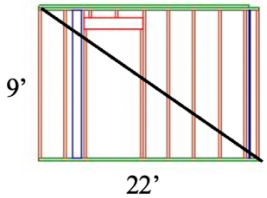


5) Is the following corner square (i.e. 90 degrees)? Why or why not?



6) Given the two shorter sides of a right triangle below, find the 3rd side.
   i. 12, 16,
   ii. 300, 400,
   iii. 3, 4,
   iv. 9, 12,
   v. 10, 20 (answer is a decimal)

7) You are trying to confirm if the below wall is square. What should your diagonal measure? Put your answer so you can read it on your tape measure (feet & fractional inches).



APPENDIX

Rounding Whole Numbers

Sometimes when we are working with numbers, we do not need to be exact like when we are giving a rough quote for a job or estimating materials for a project. In this case, we can round our numbers to a certain place value.

Steps to Round

1. Identify the place value to which the number is being rounded (e.g. tens, hundreds, thousands…)
2. Identify the digit to the right of that place value
3. If the digit to the right is 5 or more, increase the place value number by 1, and zero out the following digits.
4. If the digit to the right is below 5, keep the place value number, and zero out the following digits.

Note: When ordering materials, we often need to **round up** our estimate. In this case, step 3 above would apply regardless of whether the digit to the right was greater than or less than 5. See Example 3 below.

Example 1: Round 54,289 to the nearest thousands.
Solution:

1) Identify the place value to round to: ***Thousands (The digit in the thousands place is 4)***
2) Identify the digit to the right of that place value: ***The digit to the right of the 4 is 2***
3) If the digit to the right is below 5, keep the place value number (4) and zero out the following digits: ***54,000. Effectively, the 4,289 within the number 54,289 becomes 4,000.***

Example 2: Round 54,289 to the nearest hundreds
Solution:

1) Identify the place value to round to: ***Hundreds (The digit in the Hundreds place is 2)***
2) Identify the digit to the right of that place value: ***The digit to the right of the 2 is 8***
3) If the digit to the right is 5 or more, increase the place value number (**2**) by 1, and zero out the following digits: ***54,300. Effectively, the 289 within the number 54,289 becomes 300.***

Example 3
A practical application: We have a roof that is 1,320 square feet. Roof shingles are sold in 100 square foot quantities. We cannot split a package of shingles so we must buy more than what we need rather than less. This requires we ROUND UP.

Solution:

1) In order to calculate how many packages of shingles we need we can round 1,320 **UP** to the nearest 100.
2) Identify the place value to round: ***Hundreds (The digit in the Hundreds place is 3). Note: We are rounding to 100s because that is how roof singles are sold.***
3) Identify the digit to the right of that place value: ***The digit to the right of the 3 is 2***
4) Since we are ROUNDING UP, we **INCREASE** the place value number **(3)** by 1, and zero out the following digits: ***1,400.***
5) Thus, we will need 14 packages of roof shingles to cover our roof of 1,320 sq. ft. If we only ordered 13 packages we would be 20 sq ft short (1300-1320). Instead, we will have 80 sq ft. extra (1,400-1,320).

ANSWER KEY

Ch. 1 - Number Basics: Addition, Subtraction, Multiplication, Division – Practice

Place Values 1. 4 ; 2. 7; 3. 1; 4. 6; 5. 3; 6. 3

Rounding 1. 82,740; 2. 65000; 3. 160,000; 4. 600; 5. 7,518,000; 6. 9,500; 7. 33,000,000; 8. 500

Addition 1. 27 feet; 2. $314; 3. 138 inches; 4. 2,217' (remember ' means feet); 5. 334'; 6. 420 studs; 7. $2,346; 8. 4,200 shingles; 9. 223 hours; 10. 681 ft^2; 11. 176 feet; 78 cubic yards or 78 yd^3

Subtraction 1. 36 feet; 2. $216; 3. 2,114"; 4. 11,943'; 5. 22 studs; 6. 2,813; 7. 365 pallets; 8. 8"; 9. $12,035; 10. 49 inches

Multiplication 1. 108, 48, 84, 54, 32, 60; 2. 35; 3. 186; 4. 240; 5. 3,869; 6. 2,080; 7. $6,864; 8. 1,890 nails; 9. 85 hours; 10. 200 ft^2 (remember ft x ft = ft^2); 11. 64 squares; 12. 3,000ft^2; 13. 1,550 screws; 14. 1,600 ft^2 with 4 gallons of paint, 1,200ft^2 with 3 gallons of paint;15. $4,564

Division 1. 4; 2. 6; 3. 7; 4. 5; 5. 6; 6. 4; 7. 12; 8. 4 remainder 1; 9. 23 remainder 9; 10. 621 remainder 7; 11. 12 pieces; 12. 21 offices; 13. 54 sheets of plywood; 14. $31 per hour, $744; 15. 4 gallons

Ch. 2 - Measuring

Practice Reading a Tape Measure in Inches. 1. 6 ½"; 2. 3"; 3. 9"; 4. 1 ½"; 5. 2"; 6. 5 ¼"; 7. 8 ½"; 8. 7 ½"; 9. 11 ¼"; 10. 7 5/8"; 11. 3 ¼"; 12. 2 7/16"; 13. 4 1/8"; 14. 10 5/8"; 15. 6 3/8"; 16. 8 5/16"; 17. 6 ¾"; 18. 11 3/8"; 19. 4 3/8"; 20. 10 1/16"; 21. 2 ¾"; 22. 1 7/16"; 23. 3 ¾"; 24. 9"

Practicing Reading a Tape Measure in Feet & Inches 1. 2'- 3 ¼"; 2. 1'- 7 5/16"; 3. 6'- 4 11/16"; 4. 8'- 5 ½"; 5. 9'- 4 ¼"; 6. 1'- 0 5/16" (remember the leading zero if less than 1 inch); 7. 2'- 0 3/8"; 8. 5'- 4 ¼"; 9. 7' – 0 ¼"; 10. 1' – 3 5/8"; 11. 3'- 6 13/16"; 12. 9'- 5 3/16"; 13. 1'-10 1/8"; 14. 8'- 9 ¾"; 15. 11'- 8 ½"

Ch. 3 - Fractions

Practice Fractions: Reducing, Addition & Subtractions. 1. a. ½", b. ½", c. 1/8", d. ¾"; 2. a. 1 ¾", b. 4 ¼", c. 1 ½", d. 3 ½"; 3. 1"; 4. 2/4" = ½" (reduced); 5. 2/8" = ¼" ; 6. 7/8"; 7. ½"; 8. 13/16"; 9. 15/16"; 10. 5/16"; 11. 3"; 12. 7 3/8"; 13. 7" + ¾"+ ¾" = 7"+6/4" = 8 ½"; 14. 8 3/8"; 15. ¼"; 16. 5/8"; 17. ¼"; 18. 1 ½"; 19. 5/16"; 20. 1 ¼"; 21. ¾"; 22. 5/8"+3/8"+3/4" = 5/8"+3/8"+6/8"=14/8"=1 6/8"=1 ¾"; 23. Drywall + Stud + Drywall = ½"+3 ½"+1/2" = 4 ½" (total thickness); 24. 11/16"; 25. ¾"+5/8"+3/16"+3/8"= 1 ¾"; 26. 144" – 33 3/8"- 56 5/8"-39 7/8" -1/8"-1/8"-1/8"= 14 ¼"

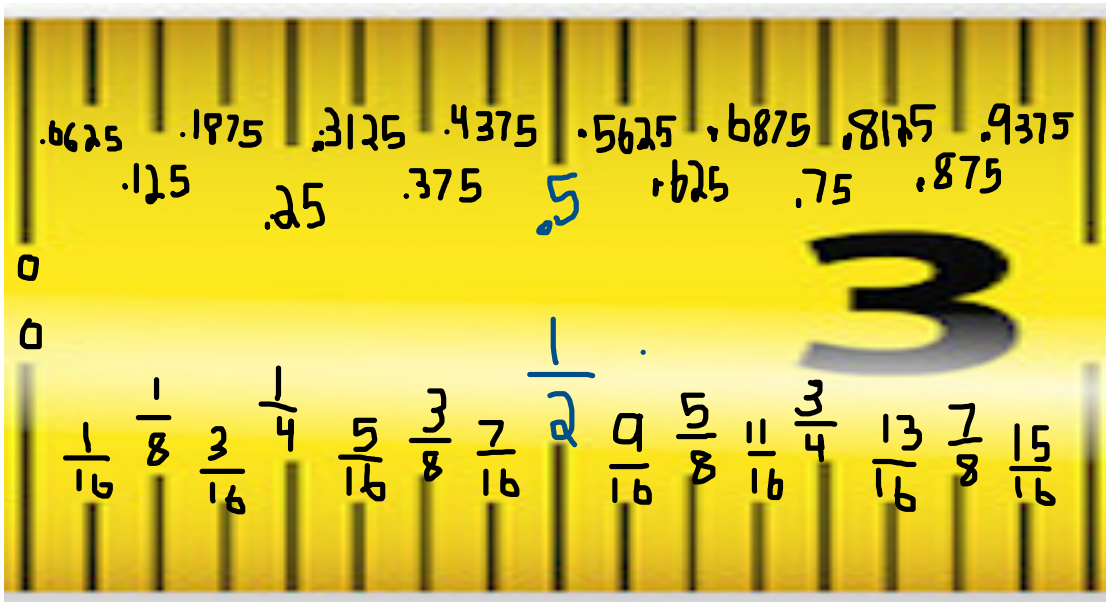
Practice Fractions: Multiplication & Division. 1. 3/16”; 2. 1/16”; 3. 9/16”; 4. 7/32”; 5. 5/4 x ½ = 5/8”; 6. 18 ¼”; 7. 30”+ 15/4” = 33 ¾”; 8. 4 1/8 ft^2; 9. 36 in^3; 10. 8”; 11. 6”; 12. 1 3/5 ft.; 13. 1 ½”; 14. 3/8”; 15. 2; 16. ¾”; 17. 7/10; 18. 32/3= 10 2/3; 19. 32/5’ = 6 2/5’; 20. 7/32”; 21. 1/16”; 22. 1 1/16”; 23. 1 ¼”; 24. 101 ½”; 25. 44”; 26. 7; 27. 39 4/9

Ch. 4 - Decimals & Conversions

Convert Fractions to Decimals (Work in all inches)

1) 1/2" = 0.5”
2) 1/4" = 0.25”
3) 3/4" = 0.75”
4) 1/8” = 0.125”
5) 3/8” = 0.375”
6) 5/8“ = 0.625”
7) 7/8” = 0.875”
8) 1/16” = 0.0625”
9) 3/16” = 0.1875”
10) 5/16” = 0.3125”
11) 7/16” = 0.4375”
12) 9/16” = 0.5625”
13) 11/16” = 0.6875”
14) 13/16” = 0.8125”
15) 15/16” = 0.9375”
16) 3 1/2" = 3.5”
17) 6 13/16” = 6.8125”
18) 14 7/8” = 14.875”
19) 24 9/16” = 24.5625”
20) 96 3/8” = 96.375”
21) 1 7/16" = 1.4375”
22) 11 15/16" = 11.9375”
23) 2 2/4” = 2.5”
24) 16 5/8” = 16.625”
25) 9 9/16” = 9.5625”
26) 47 1/16“ = 47.0625”
27) 32 7/8” = 32.875”
28) 84 3/4” = 84.75”
29) 60 1/4” = 60.25”
30) 21 5/16” = 21.3125”

COMPLETE THE DIAGRAM: Write in Fractions of an Inch & Decimal Values for Each Tick Mark on the tape Measure



CONVERT DECIMALS TO FRACTIONS OF AN INCH (remember to round and reduce your answer to a value on your tape measure: 16ths, 8ths, 4ths, half). We are just working in inches now. No feet (yet).

To convert: multiply by 16 to get how many 16ths of an inch. Round answer and put over 16. Reduce as needed. Ex. 0.75*16=9. 9/16 = ¾ reduced.

1) 0.75” = ____12/16” = 3/4”_____
2) 0.5” = _____1/2”_____
3) 0.625” = ____10/16”=5/8”_____
4) 0.0625” = ____1/16”_____
5) 0.9375” = ____15/16”_____
6) 13.6875” = __13 11/16_____
7) 3.4375” = ____3 7/16”_____
8) 21.1875” = __21 3/16”_____
9) 7.6875” = _____7 11/16”____
10) 3.375” = _____3 3/8”_____
11) 13.875” = _____13 7/8”_____
12) 10.625” = _____10 5/8”_____
13) 28.125” = _____28 1/8”_____
14) 42.50” = _____42 ½”_____
15) 14.75” = _____14 ¾”_____
16) 1.56” = _____1 9/16”_____

Answer Key

Ch. 5 - More Measurement Conversions

PRACTICE MEASUREMENT CONVERSIONS

1. Convert feet to inches:

a. 6' – 2"	_____74"_____	f. 33' – 4 $\frac{5}{8}$	_396+ 4 5/8 = 400 5/8"_
b. 9 feet	_____108"_____	g. 8' – 3"	__99"_____
c. 2 feet 3 inches	_____27"_____	h. 3' – 8"	__44"_____
d. 11' - 6"	_____138"_____	i. ¼ of a foot	___3"_____
e. 4' – 2"	_____50"_____	j. Half a foot	___6"_____

2. Convert inches to feet & inches

a. 14 inches	_____1' - 2"____	f. 121 inches	____10' – 1"_____
b. 18 inches.	_____1' - 6"____	g. 27 3/4 inches	_____2' – 3 3/4"__
c. 24 inches	_____2'_____	h. 38 $\frac{5}{8}$ inches	_____3' – 2 5/8"__
d. 39"	_____3' - 3"_____	i. 48 inches.	_____4'_____
e. 16 ½ inches	_____1' – 4 1/2"__	j. 52"	_____4' – 4"_____

3. Convert decimal inches to fractional inches (review) – Use 16ths of an inch and reduce

a. 25.8901"	____25 7/8"____	e. 16.2500"	____16 1/4"_____
b. 0.625"	_____5/8"____	f. 83.3333"	____83 5/16"____
c. 4.3590"	_____4 3/8"____	g. 0.9359"	_____15/16"____
d. 39.7243"	_____39 3/4"____	h. 44.1621"	____44 3/16"____

4. Convert decimal feet to feet and fractional inches

a. 11.786241'	____11' - 9 7/16"_	e. 33.85298'	____33' - 10 1/4"_
b. 12.2536 feet	____12' - 3 1/16"_	f. 1.6748 feet	_____1' - 8 1/8"_
c. 6.7534'	____6' - 9 1/8"_	g. 8.189023'	_____8' - 2 1/8"_
d. 20.3821'	____20' – 4 3/4"_	h. 102.22222'	___102' - 2 11/16"_

Solution to 4 a.:
11ft + .786241 partial ft;
Multiply .786241 by 12" to get inches: 9.434892";
9 inches + .434892 partial inches;
Multiply .434892 by 16 (16ths of an inch) = 6.9583 which rounds to 7/16
Answer: 11' – 9 7/16"

5. How many yards in 330'? (remember there are 3 feet in a yard) – 110 yards

6. How many feet in 12 yards? 36'

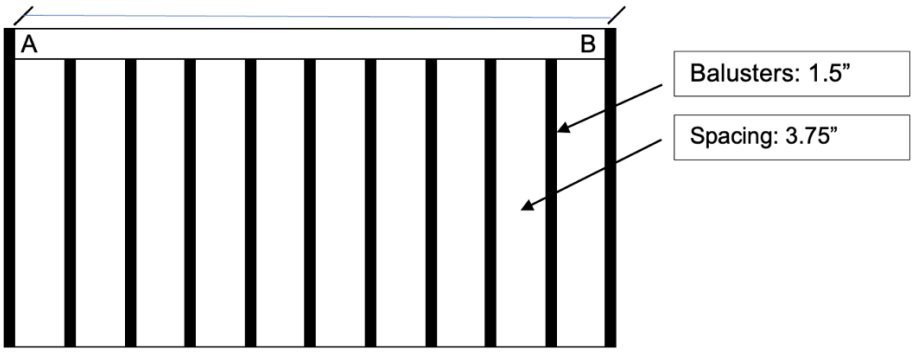
7. Practice with 12 times tables

1 x 12 = 12	6 x 12 =72	11 x 12 = 132	2 x 12 = 24
9 x 12 = 108	3 x 12= 36	8 x 12 = 96	7 x 12 = 84
4 x 12 = 48	10 x 12 = 120	5 x 12 = 60	1. x 12 = 144

PRACTICAL APPLICATIONS OF MEASUREMENT CONVERSIONS & OPERATIONS

1. The actual width of a pine board is 11 ¼". Write the width in inches in decimal form. 11.25"
2. How much would have to be cut from the end of a 12-foot piece of lumber to leave a piece 6 feet 4 inches long? 68" or 5'-8"

3. What is the distance between post A and post B on the deck shown below? What would you read for feet and inches on your measuring tape? (Ex. 3ft 5 ½ inches or 3'-5 ½")



Space: 10 x 3.75 = 37.5"
Balusters: 9 x 1.5 = 13.5"
Total 37.5" + 13.5" = 51" or 4'-3"

5. What is the distance between post A and post B on the deck shown below? What would you read on your measuring tape? (i.e. in feet and fractional inches)

Space: 10 x 3.1875 = 31.875"
Balusters: 9 x 1.25 = 11.25"
Total 31.875" + 11.25" = 43.125" = 43 2/16" = 43 1/8" = 3' – 7 1/8"

6. You need to check if your 8' x 32' wall is square by calculating the diagonal. Your answer is: 34.9284984'. Convert this decimal to feet and fractional inches so you can read it on your tape measure. We will do more on checking square in our triangle unit!

34 feet plus .9284984 partial feet.
Convert to inches by multiplying by 12: 12 x .9284984 = 11.1419808 inches
Convert to partial inches by multiplying by 16: 16 x .1419808 = 2.2716928; Rounds to 2.
Reduce 2/16" to 1/18"
Answer: 34' – 11 1/8"

Ch. 6 – Percentages & Ratios

1. Write 16% as a decimal number and a fraction. (reduce to lowest terms)

   Decimal: **0.16**; Fraction: 16/100 = **4/25** (both 16 and 100 are divisible by 4)

2. An item sells for $63.59. What is the total cost for that item after a 6.2% sales tax is applied?

   $63.59 x .062 = $3.94 (tax);
   $63.59 + $3.94 = **$67.53** (total cost with tax)

3. 12.9 is 15% of what number?

   Trying to find the "whole": percent x whole = part
   .15 x whole = 12.9
   12.9/.15 = **86**

4. What is 12% of 63?

   Trying to find part: percent x whole = part
   .12 x 63 = 7.56

5. 17 is what percent of 26?

   Trying to find percent: percent x whole = part
   Percent x 26 = 17
   17/26 = 65.38%

6. You need to buy 19 sheets of plywood for a job. Each sheet costs $24. If sales tax is 5.5%, what is the total cost to purchase the plywood?

   Tax: 19 x $24 x .055 = $25.08; Cost: 19 x $24 = 456; Total cost: $481.08

7. You need to by 320 2"x 4" x 10' to frame a shed. Each board costs $5.25. If you need to build in 20% waste to your order, how many boards will you order and how much will it cost?

   Extra boards: 320 x .2 = 64
   Total boards: 320 + 64 = 384
   Total cost: 384 x $5.25 = $2,016

8. You are looking at an architectural plan that is 1" for every 10'. If the room you are framing is 2" x 1 ½" on the plan, what is the actual size of the room?

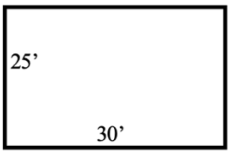
   1" = 10'; 2" = 2 x 10' = 20'; 1 ½" = 1.5"; 1.5" = 1.5 x 10' = 15'. Room is 20' x 15'

Ch. 7 – Exponents & Square Roots

1. 5^2 = __5 X 5 = 25_____
2. 4^2 = ___4 X 4 = 16_____
3. 2^3 = ____2 X 2 X 2 = 8_____
4. 3^3 = ____3 X 3 X 3 = 27_____
5. $3^2 + 4^2$ = _9 + 16 = 25 _____
6. $\sqrt{4}$ = _____2_____
7. $\sqrt{25}$ = _____5_____
8. $\sqrt{100}$ = _____10_____
9. $\sqrt{12}$ = _____3.4641_____
10. $\sqrt{32}$ = _____5.6569_____

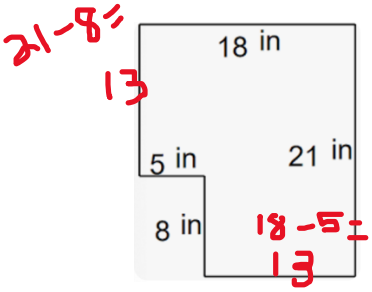
Ch. 8 - Perimeter, Area & Volume

1) You need to build a <u>frame</u> for a concrete foundation that is 25' x 30'. You plan to use 2'x6' boards. How many <u>feet</u> of 2'x 6' boards do you need? (in other words – what is the perimeter of the below foundation)



25' + 25' + 30' + 30' = **110'**

2) What is the perimeter of the following shape? What is the area? (note: find missing sides for perimeter and break the shape down into rectangles for area)



Perimeter: 18"+21"+13"+8"+5"+13" = **78"**
Area: Break shape into 2 rectangles: 13" x 18" + 8" x 13" = 234in^2 + 104in^2 = **338in^2**

3) What is the area of a room that is 11' x 12'? **132ft^2**

4) You are painting a room with 4 walls and must calculate the wall area so you can order the paint. Your room is 10'x10' with 11' ceilings, 2 windows (2'x2' each) and one door (7' x 3'). What is the total <u>wall</u> area you will be painting?

4 walls: base of wall is 10', height is 11'. 10' x 11' x 4 = 440ft^2
subtract 2 window: 2'x2'x2 = 8ft^2 and 1 door: 7' x 3' = 21ft^2
440ft^2-8ft^2-21ft^2 = 411ft^2

5) How many 4'x8' sheets of plywood would you need to cover a rectangular floor surface measuring 20' in width and 30' in length? **$600ft^2/32ft^2 = 18.75$ sheets**

6) What is the area of a triangle with a base of 4' and a height of 8'? ½ x b x h = **$16ft^2$**

7) What is the area of a triangle with a base of 6' and a height of 2'3"? **$6.75ft^2$**

8) What is the area of a circle with a 3' radius? What is the "perimeter" or circumference?

$A = \pi r^2$ = 3.14 x 3^2 = 3.14 x 9 = **$28.26ft^2$**; $circumference = 2\pi r$ = 2 x 3.14 x 3 = **18.84'**

9) What is the area of a circle with an 8' diameter (note the radius of a circle is ½ the diameter)? Radius = 4'; $A = \pi r^2$ = 3.14 x 4^2 = 3.14 x 16 = **$50.24ft^2$**

10) What is the perimeter and area of a 3' x 12' rectangular sand box? If you want to fill it with 1 ½" feet of sand, how much sand will you need? If sand is purchased, in 3 cubic feet bags ($3ft^3$), how many full bags will you need?
Perimeter: 3+3+12+12 = 30ft
Area: 3 x 12 = $36ft^2$
Volume, amount of sand: $36ft^2$ x 1.5ft = $54ft^3$
$54ft^3/3ft^3$ = 18 bags

11) A cord of wood is 128 cubic feet ($128ft^3$). How many cords of wood will fit into a shed that is 8' long, 4' wide and 8'high. **Volume of shed: 8' x 4' x 8' = $256ft^3$ divide this by $128ft^3$: $256ft^3/128ft^3$ = 2 cords of wood**

12) Challenge Question: A carpenter is building a rectangular shed with a fixed perimeter of 54 feet. What are the dimensions of the largest shed that can be built? What is the area? **The largest area is a square so 4 sides are equal (54/4 = 13.5' per side). 13 ½' x 13 ½'. Area= $182.25ft^2$**

13) What is the volume of a rectangular prism 3 feet high, 2 feet thick and 10 feet long? 3' x 2' x 10' = **$60ft^2$**

14) What is the volume of a 10in cube? 10" x 10" x 10" = **$1{,}000in^3$**

15) What is the volume of a triangular prism that has a 3 inch base, 2 inch height and 5 inch depth? Area of triangle x height: ½ x 3" x 2" x 5" = **$15in^3$**

16) What is the volume of a cylinder with a diameter of 11 feet and a height of 10 feet? Area of circle = $A = \pi r^2$; radius = diameter/2=5.5'; Area=5.5 π; Volume = height x area = 10 x 5.5 π = 10 x 5.5 x 3.14 = **$172.7ft^3$**

17) If you needed cement to fill the foundation of a room that measures 100 feet square at a depth of 6 inches, what volume of cement would you need? (pay attention to units). 6 inches = .5 feet; Volume = $100ft^2$ x .5ft = **$50ft^3$**

18) If gravel needs to be distributed across an area measuring 10 feet square and the gravel needs to be 3 inches thick, the volume of gravel needed would be: 10' x 10' x 3/12' = **$25ft^3$**

19) The volume of a round pool with a diameter of 10 feet and a depth of 9 feet is? Radius = diameter/2=5; $A = \pi r^2 = 25\pi$; Volume = area x height (e.g. depth in this case) = 9' x 25π = 9' x $25ft^2$ x 3.14 = **$706.5ft^3$**

20) A planters boxes dimensions are 5' x 4' x 2'. How many bags of soil will you need to buy if each bag has 2 cubic feet of soil? 5' x 4' x 2' = $80ft^3$; $80ft^3/2ft^3$ = 40 bags

Board Feet:

Board feet = T x W X L where Thickness is in inches, and Width and Length are in feet.

Example: How many board feet are in a board 1 in thick x 12 in wide x 6 ft long?
Answer: First convert width to feet: 12 inches = 1 foot
Multiply 1" x 1' x 6' = 6 board feet

21) 1" x 6" x 4' _1 x 6/12 x 4 = 2 board feet_____

22.) 1" x 6" x 18' _1 x 6/12 x 18 = 9 bd. ft._____

23.) 12 pcs/ 2" x 4" x 16' _12 x 2 x 4/12 x 16 = 128 bd. ft.___

24.) 12 pcs/ 1" x 10" x 18" _12 x 1 x 10/12 x 18/12 = 15 bd. ft._

25.) 24 pcs/ 1/2" x 4" x 10' _24 x ½ x 4/12 x 10 = 40 bd. ft._____

26.) 11 pcs/ 1 1/2" x 3" x 12' _11 x 1.5 x 3/12 x 12= 49 ½ bd. ft.__

27.) 10 pcs/ 3/4" x 3" x 16' _10 x ¾ x 3/12 x 16 = 30 bd. ft._____

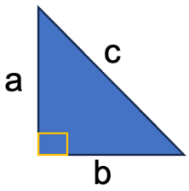
28.) 12 pcs/ 1" x 12" x 10'. _12 x 1 x 12/12 x 10 = 120 bd. ft.___

Ch. 9 - Triangles

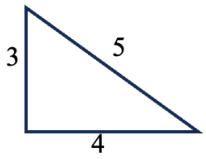
1) A right angle triangle contains one angle of 46°; calculate the size of the other small angle. 180° - 90° - 46° = **44°**

2) What the area of a right angle triangle having a base dimension of 3 feet and a height of 4 feet? ½ x base x height = ½ x 3 x 4 = 6ft^2

3) Use the Pythagorean theorem to show the following triangle is a right triangle

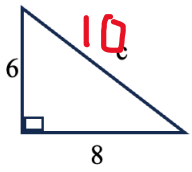


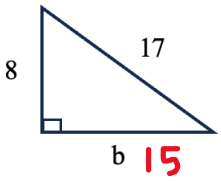
$$a^2 + b^2 = c^2$$

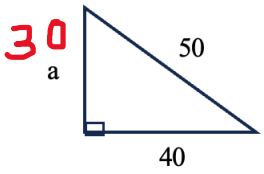


$3^2 + 4^2 = 9 + 16 = 25 = c^2$ c= $\sqrt{25}$ = 5

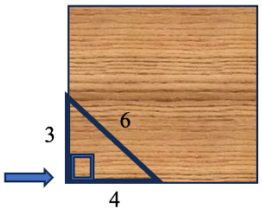
4) Use the Pythagorean theorem to find the missing sides of the following right triangles:







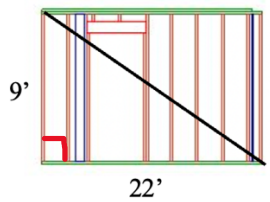
5) Is the following corner square (i.e. 90 degrees)? Why or why not?



No, the corner is not square because: $3^2 + 4^2$ ***does not equl*** **. In order for the corner to be 90 degrees the long side would need to be 5.**

6) Given the two shorter sides of a right triangle below, find the 3rd side.
   i. 12, 16, **20**
   ii. 300, 400, **500**
   iii. 3, 4, **5**
   iv. 9, 12, **15**
   v. 10, 20, answer is a decimal: **22.3607**

7) You are trying to confirm if the below wall is square. What should your diagonal measure? Put your answer so you can read it on your tape measure (feet & fractional inches).



This problem uses a few chapters in the book!

Use the Pythagorean Theorem to get the length of the diagonal	$9^2+22^2=$ diagonal$^2=565$ Diagonal = $\sqrt[2]{565}$ = 23.7697 feet
Convert the answer from a decimal to feet and inches	
23.7697 feet:	23 full feet plus .7697 partial feet
Multiply partial feet by 12" to get inches	.7697 x 12 = 9.2367 inches
	9 full inches plus .2367 partial inches
Multiply partial inches by 16 to get how many 16ths of an inch	.2367 x 16 = 3.7829 – round to 4. So 4 16ths of an inch… 4/16"
Reduce 4/16"	4/16 is reduced to ¼"
Final Answer:	23 feet 9 ¼ inches; 23' – 9 ¼"

The wall is square if the diagonal measures 23' – 9 ¼".