

Pratt



Math 150 – Fall 2021

Algebra & Trigonometry

Charles Rubenstein, Ph. D.

Professor of Engineering & Information Science

Preface, Session 1: Monday 8/30/21

6:30pm - 9:20pm

Zoom Sessions via Remote Learning

Rev 1

Not Permitted in Class



Be sure to have all cellphones **OFF**

(unless used as calculator...)

*Although **NOT** required*

please turn on your cameras

Pratt



Math 150

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Syllabus Review

Algebra & Trigonometry

In Today's Class:

- *Download & Review Syllabus, Course Schedule, other files*
- *Download & Review Textbook Chapter 1*
- *Textbook and Calculator needs*
- *Review of the Class Archive Concept (Homework online)*
- *Remote Learning via Lecture and in-class problem solving*

NO CLASS NEXT WEEK – Labor Day

For our next class – Session 2:

- *Session 2 posted online by Friday 10 September*
- *Textbook Readings*
- ***DUE by 12:00 Noon ET Monday 9/13/21: Homework Set #01***
- ***Quiz #01: Three problems 'graded' from Homework Set #01***
- ***(Homework Review Set #01 – Week 3)***

MATH 150
Algebra & Trigonometry

Remote Learning
ZOOM NOTES

About our Zoom Class Meetings

'Live' Zoom class meetings will begin promptly at the start of our 6:30pm ET class and you need to be in class five (5) minutes prior to start of class.

Although sessions might last longer, they will last at least one hour.

During class we will review the lesson materials posted by Friday Noon the week prior to the class. Any homework, etc., will be posted on the web site at that time.

Zoom Tools

If you have never used Zoom before, please know that you are not alone, and we can all learn something from this remote learning tool.

During our first class we will check to see that you know where the ‘thumbs up’ is for answering questions, how to chat, and other simple things.

To lessen your concerns, and to learn more about Zoom in the meantime, please read the files on the websites

[ZoomTipsForStudents.pdf](#)

and

[zoom-quick-reference.pdf](#)

About the Zoom environment

You should NOT have any challenges getting onto the Zoom meeting.

After you download the Zoom app to your laptop, phone, etc., you can setup your name and backgrounds, connect to and test your Audio and Video connections, and so on.

Use the information on the next slide and try to enter the Zoom meeting by clicking the JOIN button and inserting the **Meeting ID** and your name into the next screen. If you then include your **Passcode** on the next screen you will go into a ‘waiting’ area. *When we have class, I will then admit you into the class.*

Zoom Meeting Info

You should plan on logging into the Zoom meeting five (5) minutes before the start of class.

MATH150-01:

MONDAYS 6:30pm Eastern Time (*6:25pm Start*)

Meeting ID: 955 2086 3714

Passcode: Math150

Please see the file **150_Zoom_info.pdf** for further information.

ANY Challenges?

email me at **crubenst@pratt.edu** !

with the subject: **150** or **Math**

Getting to know you...
in our Zoom Class Meetings

Please turn on your Video on so we can see each other...



Who is *Dr. Rubenstein ?*

- Subject Background in
 - Bioengineering
 - Electrical Engineering
 - Systems Analysis
 - Information Science
- Certifications
 - Microsoft Trainer
 - CompTIA A+ Certified
- Professional Society Memberships
 - **ALISE** (*Member*), **IET** (*Fellow, Chartered Engineer*)
 - **IEEE** (*Senior Member*) *Member of the 2010-2011 Board of Directors of this 430,000 member professional engineering organization that produces more than one third of the world's electrotechnology information*



Instructor Contact Information

Dr. Charles Rubenstein <crubenst@pratt.edu>

Professor of Engineering & Information Science

Brooklyn Campus Faculty Office: ARC G-49

Fall 2021 VIRTUAL Office hours ONLY

Thursdays: 10:00am - 1:00pm *Via Zoom*

To make your appointment

Send me an email at least one day in advance:

crubenst@pratt.edu

Subject line: 150 Office Hour

Zoom Office Hours Info

You **MUST** email me, not later than 12:00Noon on Tuesday, with preferred meeting time(s) to arrange for a fifteen (15) minute, one-on-one Zoom session during my Thursday Office Hours:

Thursday Office Hour Zoom Meetings

10:00am – 1:00pm

<https://pratt.zoom.us/j/5691762059?pwd=SnpscEE2NnVQbVNvUE8veEZxTENvUT09>

Meeting ID: 569 176 2059

Passcode: Office

Challenges? email me at **crubenst@pratt.edu** !

with the subject: **150** or **Math**

But... It's really all about ...You!

**Your Pratt Education ...
is founded on choices of**

- **Career**
- **Topics of Study**
- **Background**

BEFORE our first class session ...

Per the email you received, please email me (crubenst@pratt.edu), by 12:00 Noon on Tuesday 31 August (first day of class), the answers to these questions:

1. Your name? What name do you like to be called? (e.g., William might prefer 'Bill' and Susan; "Sue")
2. What time zone will you be physically located in during the semester? (Location is optional)
3. Your major at Pratt?
4. What is your favorite extra-curricular activity (***not your major***)?
5. How do you learn best?
A: Visually; B: Auditory; C: Kinesthetically (doing); D: Reading/writing; E: A mixture.
6. How much math background do you have?
A: High School math; B: Some college-level math;
C: Some math, but many years ago and I have forgotten most of what I thought I knew;
D: math is my nightmare.

Please be prepared to discuss this a bit during our first class...

21 Fall Class Roster : 150-01 (Mon 6:30pm)

MATH150 – 01 Algebra & Trigonometry

Last Name	First Name	Call Me	Time Zone
Garavelo	Naihra	Naihra	ET
Lin	Fanghao	Fanghao	ET
Nguyen	Khanh	Luci	ET
Powers	Tony		
Rakicevic-More	Alek	Alek	ET
Richardson	Janie	Janie	ET
Zawadski	Ela	Ela	ET

My Style of Teaching Math 150

Each class will consist of a mix of

- *Prepared PowerPoint Slides posted to the class website a week prior to each Zoom Class meeting (asynchronous)*
- *A Zoom Class Lecture/Discussion on the week's lesson (synchronous)*
- *Review of Homework Assignments*
- *Interactive Lectures = **Class participation***

Math 150 – Class Topics

- 1. The Foundations of Algebra**
- 2. Equations and Inequalities**
- 3. Functions**
- 4. Polynomial Functions**
- 5. Rational Functions and Conic Sections**
- 6. Exponential and Logarithmic Functions**
- 7. The Trigonometric Functions**
- 8. Analytic Trigonometry**
- 9. Applications of Trigonometry**
- 10. Systems of Equations and Inequalities**
- 11. Matrices, Linear Systems, and Determinants**
- 12. Topics in Algebra**

Draft Schedule: Math 150 – Fall 2021 – Remote Learning

Monday	Notes
30-Aug	1. Introduction: Numbers, Arithmetic Operations, Fractions
6-Sep	<i>Pratt Holiday - NO CLASSES – Labor Day</i>
13-Sep	2. Manipulation of Algebraic Expressions (H/Q1)
20-Sep	3. Solving Linear and Quadratic Equations of One Variable (H/Q2)
27-Sep	4. Solving Equations of Two Variables (H/Q3)
4-Oct	5. <i>Take Home Exam #1</i> ; Creating Equations – Polynomials (H/Q4)
11-Oct	6. Polynomial Functions, continued (H/Q5); <i>Exam #1 Review</i>
18-Oct	7. Functions, Graphing, Exponents and Logarithms (H/Q6)
25-Oct	8. Trigonometric Functions, Pythagorean Theorem (H/Q7)
1-Nov	9. Applications of Trigonometry (H/Q8)
8-Nov	10. Analytic Trigonometry, Identities, Graphing (H/Q9) <i>Exam #2</i>
15-Nov	11. Areas and Volumes of Geometric Solids (H/Q10) <i>Exam #2 Review</i>
22-Nov	12. Systems of Equations and Inequalities
29-Nov	13. Series and Sequences, Review topics
6-Dec	14. Final Examination (3-hour)

NOTE: Take home exams account for the 15th class session...

Questions?

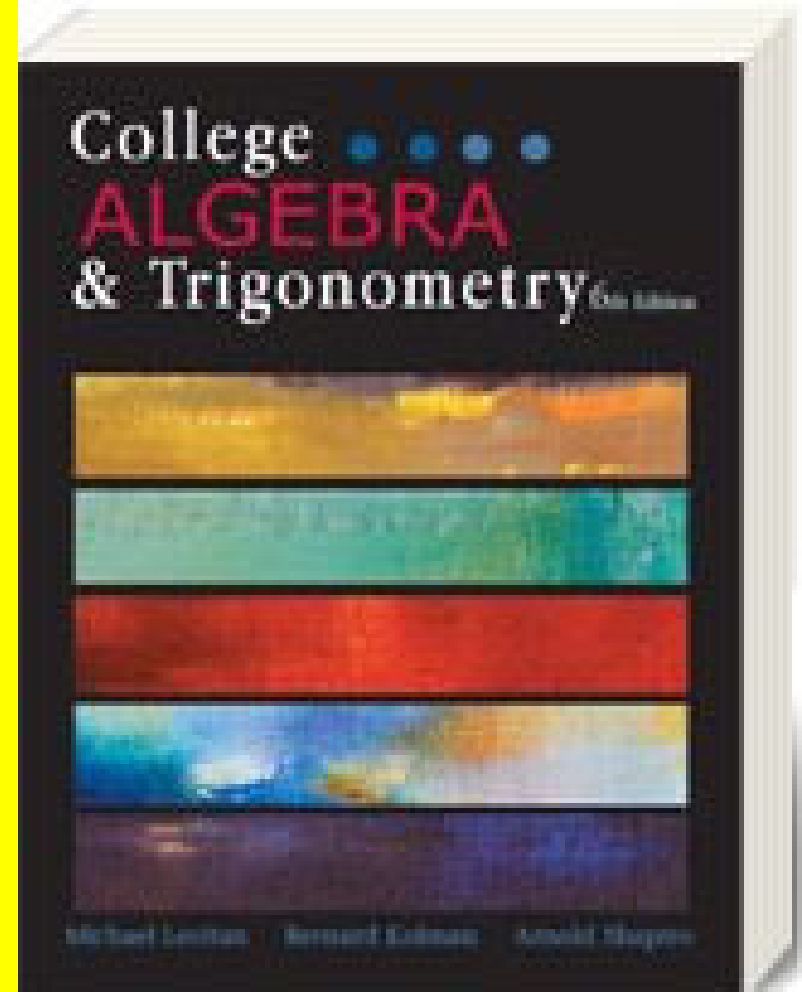
Recommended Textbook:

Pub Date: 2011

Publisher: BVT Publishing

ISBN: 978-1-60229-880-4

(\$45.00)



College Algebra & Trigonometry

Sixth Edition

Michael Levitan, Bernard Kolman, and Arnold Shapiro

Recommended:

***ANY Graphing
Calculator
(hp, TI, etc.)***



Any graphing calculator may be used in this class

I have a TI-83 Plus

Mr. Ramus has loaner units if you don't want to buy one

Your Grade in Math 150

Homework Quizzes (30%)

Two Exams (20% each)

Final Exam (30%)

Your Class Participation (priceless!)

About Homework Assignments

Homework is an essential part of this class.

Doing the assignments will allow you to keep up with the class and your studies.

**Homework must be emailed to me
by 12:00Noon ET on each day of class**

There are TWELVE (12) Homework assignments.

For the first **ten (10)** Homework assignments I will select three (3) problems from each assignment to grade. 1% per correct answer, maximum of **3% per homework**, for a total of 30% of your final grade.

There can be NO make up ‘quizzes’

as we will review the homework problems in class

About Your Exams

- There will be two (2) exams worth 20% each = **40%**
(These will be take home exams that will take about 1 hour to complete and will to make up for any class schedule challenges)
- There will be a take home FINAL exam worth **30%**

These are Open Book exams. Formula sheets will be provided, no need to memorize the formulas – only their use!

Examinations are designed to see what you have learned this semester as well as

*to see what you **DIDN'T** learn*

and prepare you for your next math class

*There will be **NO** make up exams*

*All Materials are available on the
Class Session Archives on Canvas
as well as at:*

www.CharlesRubenstein.com/150

**The next slide indicates the files currently
on these websites**

www.CharlesRubenstein.com/150

- **syllabus.pdf** = *Syllabus & Class Schedule*
 - **Levitan6ed_ch1.pdf**
= *6th Edition Textbook's First Chapter*
 - **HWK1to6.pdf** = *Homework Sets #01-#06*
 - **FormulaSheet.pdf** = *Semester's Formulas*
 - *Other pdf files as noted in Email*
 - **21fa01.pdf** = *This slide set**
 - **21fa01_h.pdf** = *slide set as handouts**
- *Available by Friday 1 week before class*

Questions?

Pratt



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Chapter 1 – Part 1

Foundations of Algebra

On Memorization of Formulas

You are NOT required to memorize anything.

When we do the proof of the Pythagorean Theorem you should want to memorize it unless you are already able to write down an equivalent proof.

All exams will be open book, open notes.

You are responsible for writing all formulas and definitions (sine, cosine, and tangent) on a ***SINGLE sheet*** in your notebook if you do not have them memorized.

After seeing these formulas enough times, you'll quite likely unconsciously memorize them.

Chapter 1.1

The Real Number System

[http://mathworld.wolfram.com/
Polynomial.html](http://mathworld.wolfram.com/Polynomial.html)



At home, on your own,
Google (etc.) the word:

polynomial

Or these others:

**algebraic expression,
or factoring**

Algebra

From Wikipedia:

derived from an Arabic word **Al-Jabr**
in the title of a treatise written in 820
by the Persian mathematician,
Muhammad bin Musa al-Khwarizmi

Let's take a look at some math theory...

Sets

Given that $A = \{4, 5, 6\}$ establishes a set of the three numbers 4, 5, and 6;

$4 \in A$ indicates *4 is in the set A*

$8 \notin A$ indicates *8 is not in the set A*

Similarly, $B = \{\text{Exxon, Ford, Sony}\}$ yields

$\text{Ford} \in B$ indicating *Ford is in the set B*

$8 \notin B$ indicating *8 is not in the set B*

Rational & Irrational Numbers

- **Rational Numbers** are a ratio of two integers:

$$p/q \text{ where } q \neq 0$$

As $q = 1$ is rational, all integers are rational

$$1/2 = 0.500000 \dots \quad 2/11 = 0.181818 \dots$$

where the digit patterns repeat.

- **Irrational Numbers** – *NOT* a ratio of integers:

$$\pi = 3.141592654 \quad \sqrt{2} = 1.414213562$$

- **Real Numbers** = *The set of all Rational and Irrational Numbers*

Real Numbers {Rational, Irrational Numbers}



- **Rational Numbers: {Natural Numbers, Integers}**
 - **Natural Numbers:** 1, 2, 3, → Integers
 - The concept of ‘**Nothing**’ = 0
 - **Negative Numbers:** -1, -2, -3, etc.
 - The set of **Integers:** -2, -1, 0, 1, 2, 3, etc.
- **Irrational Numbers;** decimal numbers never repeating (π)

Graphing Calculator *Alert*

- **Rational Numbers:** *Calculators display only a finite number of digits, therefore they may be susceptible to rounding errors...*

$(1/3 = 0.3333333333)$ → Press: [1][÷][3][=]

- **Irrational Numbers:** *Calculators display only a finite number of digits, therefore they provide a rational decimal approximation for any irrational numbers.*

$(\sqrt{2} = 1.414213562)$ → Press [√][(][2][)]][=]

Questions?

About Real Numbers

- Properties of Real Numbers
- Properties of Equality
- Additional properties

Properties of Real Numbers - 1

Example	Algebraic Expression	Property
$3 + 4$ is a real number.	$a + b$ is a real number.	Closure under addition The sum of two real numbers is a real number.
$2 \cdot 5$ is a real number.	$a \cdot b$ is a real number.	Closure under multiplication The product of two real numbers is a real number.
$4 + 8 = 8 + 4$	$a + b = b + a$	Commutative under addition We may add real numbers in any order.
$3(5) = 5(3)$	$a(b) = b(a)$	Commutative under multiplication We may multiply real numbers in any order.
$(2 + 5) + 3 = 2 + (5 + 3)$	$(a + b) + c = a + (b + c)$	Associative under addition We may group the addition of real numbers in any order.
$(2 \cdot 5)3 = 2(5 \cdot 3)$	$(ab)c = a(bc)$	Associative under multiplication We may group the multiplication of real numbers in any order.
$4 + 0 = 4$	$a + 0 = a$	Additive identity The sum of the unique real number 0 and any real number leaves that number unchanged.

Properties of Real Numbers - 2

Example	Algebraic Expression	Property
$3(1) = 3$	$a(1) = a$	Multiplicative identity The product of the unique real number 1 and any real number leaves that number unchanged.
$5 + (-5) = 0$	$a + (-a) = 0$	Additive inverse The number $-a$ is called the negative, opposite, or additive inverse of a . If $-a$ is added to a , the result is the additive identity 0.
$7\left(\frac{1}{7}\right) = 1$	If $a \neq 0$, $a\left(\frac{1}{a}\right) = 1$	Multiplicative inverse The number $\frac{1}{a}$ is called the reciprocal, or multiplicative inverse, of a . If $\frac{1}{a}$ is multiplied by a , the result is the multiplicative identity 1.
$2(5 + 3) = (2 \cdot 5) + (2 \cdot 3)$ $(4 + 7)2 = (4 \cdot 2) + (7 \cdot 2)$	$a(b + c) = ab + ac$ $(a + b)c = ac + bc$	Distributive laws If one number multiplies the sum of two numbers, we may add the two numbers first and then perform the multiplication; or we may multiply each pair and then add the two products.

Properties of Equality

Example	Algebraic Expression	Property
$3 = 3$	$a = a$	Reflexive property
If $\frac{6}{3} = 2$ then $2 = \frac{6}{3}$.	If $a = b$ then $b = a$.	Symmetric property
If $\frac{6}{3} = 2$ and $2 = \frac{8}{4}$, then $\frac{6}{3} = \frac{8}{4}$	If $a = b$ and $b = c$, then $a = c$.	Transitive property
If $\frac{6}{3} = 2$, then we may replace $\frac{6}{3}$ by 2 or we may replace 2 by $\frac{6}{3}$.	If $a = b$, then we may replace a by b or we may replace b by a .	Substitution property

*Ten (10) Homework Assignment Quizzes (worth 3% each)
for a total of **30%** of your final grade...*

PROOF:

$$10x = 30; 30/10 = x; 3 = x$$

Additional Properties

Example	Algebraic Expression	Property
<p>If $\frac{6}{3} = 2$ then $\frac{6}{3} + 4 = 2 + 4$ $\frac{6}{3}(5) = 2(5)$</p>	<p>If $a = b$, then $a + c = b + c$ $ac = bc$</p>	<p>The same number may be added to both sides of an equation. Both sides of an equation may be multiplied by the same number.</p>
<p>If $\frac{6}{3} + 4 = 2 + 4$ then $\frac{6}{3} = 2$. If $\frac{6}{3}(5) = 2(5)$ then $\frac{6}{3} = 2$. $2(0) = 0(2) = 0$ $2(3) = 0$ is impossible.</p>	<p>If $a + c = b + c$ then $a = b$. If $ac = bc$ with $c \neq 0$ then $a = b$. $a(0) = 0(a) = 0$ If $ab = 0$ then $a = 0$ or $b = 0$.</p>	<p>Cancellation law of addition Cancellation law of multiplication The product of two real numbers can be zero only if one of them is zero. The real numbers a and b are said to be factors of the product ab.</p>
<p>$-(-3) = 3$ $(-2)(3) = (2)(-3) = -6$ $(-1)(3) = -3$ $(-2)(-3) = 6$ $(-2) + (-3) = -(2 + 3) = -5$</p>	<p>$-(-a) = a$ $(-a)(b) = (a)(-b) = -(ab)$ $(-1)(a) = -a$ $(-a)(-b) = ab$ $(-a) + (-b) = -(a + b)$</p>	<p>Rules of signs</p>

Algebra is all about solving problems...

- **Given a set of plans:** How much lumber, paint, etc, will be used to build something.
- **Combined with physics:** Calculation of stresses and strains in building elements; deflections of beams, plates, etc.
- **Creating computer graphics:** algebra & trigonometry are needed to rotate a perspective rendition of an scene on the screen. Every line must be recalculated and hidden portions of lines must be found, erased.
- **With calculus** (a continuation of algebra) used throughout science, engineering, and the financial industry...

Algebra is *symbolic math*

Q1. A car travels 2 hours in the morning and then another 3 hours in the afternoon.

How long was the trip?

Q2. You have 2 apples in your cart and put another 3 in it. How many apples do you have?

Ans: Both problems can be represented as:

$$2x + 3x = 5x$$

where x is a *symbol* rather than an *actual unit*.

Equations are “sentences”

The numerical value of an expression on the left side of the equal sign is equal to the numerical value of the expression on the right side.

Examples : $x + 3 = 7$

x must have the value 4 to satisfy this equation containing one unknown.

$$2x + 3y = 10$$

Many different x,y pairs can satisfy equations containing two unknowns

Main Goal of this Course

Learn to solve practical problems

by

creating

and then solving

an appropriate algebraic equation.

Questions?

Quick Problems

Version 1.

You bought a new car after the dealer lowered the original price by 17%. You paid \$21,000.

Calculate the original price.

You have 10 minutes to solve this problem

Quick Problems - Ans

Version 1.

*... dealer lowered the original price by 17% ,
You paid \$21,000.*

Calculate the original price.

$$x (1 - 0.17) = 21,000$$

$$21,000 \div (1 - 0.17) = x$$

$$x = \$25,301.20$$

Quick Problems

Version 2.

You bought a new car on sale. You paid \$21,000 - which was 83% of the original price. Calculate the original price.

You have 5 minutes to solve this problem

Quick Problems - Ans

Version 2.

... paid \$21,000 = 83% of the original price.
Calculate the original price.

$$0.83x = 21,000$$

$$x = 21,000 \div 0.83$$

$$x = \$25,301.20$$

(This is just another way to state this problem...)

Quick Problems

Question: On sale for 80% of its original price, a car cost \$19,000. What was the original price?

You have 5 minutes to solve this problem

Quick Problems - Ans

... 80% of its original price = \$19,000. What was the original price?

Answer: Let P represent the original price, the “unknown”.

We are given that 80% of P is 19000.

*We can write this immediately as an algebraic equation (“sentence”), **$0.8 P = 19,000$***

Solve for P by dividing each side of the equation by 0.8, so:

$$**$P = 19,000 \div 0.8 = 23,750$**$$

Quick Problems

Question: A car is on sale for 80% of its original price of \$20,000. What is the sale price?

You have 5 minutes to solve this problem

Quick Problems - ANS

...on sale for 80% of \$20,000.

What is the selling price?

$$P = 20,000 (0.80)$$

$$P = \$16,000$$

Quick Problems

- If the width of a rectangle is reduced by 10% and the height is increased by 10%, how much is the new area in terms of the old area?

You have 10 minutes to solve this problem

Quick Problems - ANS

- If the width of a rectangle is reduced by 10% and the height is increased by 10%, how much is the new area in terms of the old area?*

$$A_0 = w \cdot h; \quad A_1 = [(1-.1)(w)] [(1+.1)(h)]$$
$$A_1 = (0.9)(1.1)w \cdot h = 0.99w \cdot h$$

$$A_1 / A_0 = [0.99(w \cdot h)] / (w \cdot h) = 0.99 = 99\%$$

Quick Problems

- Suppose we have a 20 ft board that we want to cut into $\frac{3}{4}$ ft pieces. How many pieces will this board yield?
- If there is one, how long is the fractional piece?

You have 10 minutes to solve this problem

Quick Problems - ANS

... a **20** ft board (is) cut into **3/4** ft pieces.

How many pieces will this rope yield?

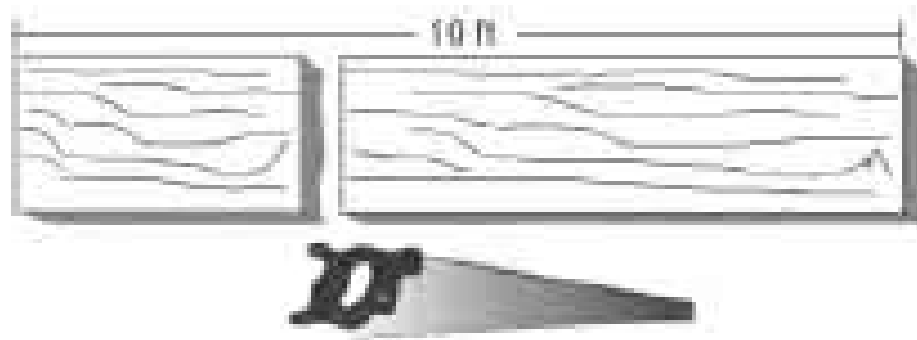
$$\mathbf{20 / (3/4) = 26 \frac{2}{3} \text{ pieces}}$$

... How long is the fractional piece?

$$\mathbf{(2/3) \text{ of } (3/4) = (2 \cdot 3 / 3 \cdot 4) = 6 / 12 = \frac{1}{2} \text{ foot long}}$$

Chapter 1 - Page 12, Problem 59

59. A board 10 feet long is cut into two pieces, the lengths of which are in the ratio of 2:3. Find the lengths of the pieces.



You have 5 minutes to solve this problem

Ch1, Pg 12, Problem 59 - Ans

59. A board 10 feet long is cut into two pieces, the lengths of which are in the *ratio of 2:3*. Find the lengths of the pieces.

Ans: Ratio of 2:3 means the Boards are $2x$, $3x$ long

Equations: $2x + 3x = 10$; $5x = 10$; $x = 2$

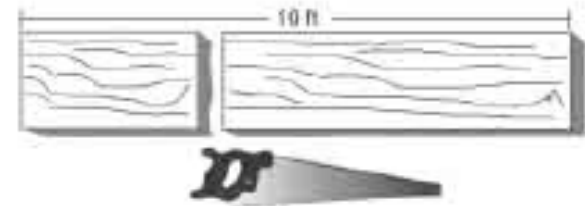
Smaller Board: $2(2 \text{ feet long}) = 4 \text{ feet long}$

Larger Board: $3(2 \text{ feet long}) = 6 \text{ feet long}$

Final Answer: 4 feet long and 6 feet long*

(* Note that units MUST always
be included in your final answer...

(A ratio of 1:2 would yield 3.33 ft; 6.67 ft)



Chapter 1 - Page 12, Problem 60

60. An alloy is $\frac{3}{8}$ copper, $\frac{5}{12}$ zinc, and the balance lead. How much lead is there in 282 pounds of alloy?



Ch1, Pg12, Problem 60 - Ans

60. An alloy is $\frac{3}{8}$ copper, $\frac{5}{12}$ zinc, and the balance lead. How much lead is there in 282 pounds of alloy?

Ans. Equation is: $(\frac{3}{8} + \frac{5}{12}) + x = 1$

a. $\frac{3}{8} \cdot 3 \rightarrow \frac{9}{24}$ and $\frac{5}{12} \cdot 2 \rightarrow \frac{10}{24}$

thus, $\frac{19}{24} + x = 1$ and $x_{\text{lead}} = \frac{5}{24} = 0.208^*$

b. $282 \text{ lbs} \cdot 0.208 = 58.656 \text{ lbs}$ lead in the alloy

Final Answer: 58.656 pounds

****NOTE:*** Using a calculator to find decimals and not using conversion to the lowest common denominator:

$(0.375 + 0.417) = 0.792$ and thus, again $x_{\text{lead}} = 0.208$

NOTE:

We will review this problem and the challenges of rounding errors next class...



Questions?

Homework Assignment Set #1

Section 1.1 (The Real Number System)

- **pages 10-11:**

Problems 9 through 18

Problem 19 (*Hint: If you are stuck, Google on “sum of two irrational”*)

Problems 20, 23, 24, 28, 35

Problem 38 (*Also find values for a and b for which the statement is true.*)

Problems 40, 53, 54, 55, 57, 58, 61, 62

NOTE: *The online homework pdf has the full actual problems written out...*

Due Next Classes:

***NOTE: Next Monday 6 September is Labor Day
Pratt Holiday! No Classes!***

In Session 2 - 13 September:

- ***DUE: Textbook readings***
- ***DUE @ NOON! : Homework Set #01 – QUIZ #1***

Due – Session 3 – 20 September:

- ***Nomenclature, Notes***
- ***Lecture and Problem Review***
- ***DUE @ NOON! : Homework Set #02 – QUIZ #2***
- ***REVIEW: Homework Set #01***

Any Questions?
Send me an email ...

crubenst@pratt.edu

*with subject: **Math or 150***

End