Pratt

Math 150 – Fall 2021
Algebra & Trigonometry

Charles Rubenstein, Ph. D.
Professor of Information Science

Session 3: Tuesday 9/20/21
6:30pm - 9:20pm
Online – *Revision 2*

Not Permitted in Class

Be sure to have all cellphones **OFF**
(unless used as calculator…)
Although NOT required
please turn on your cameras

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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	Tony	ET
Rakicevic-More	Alek	Alek	ET
Ramirez	Guillermo	Xavier	"- 2"
Richardson	Janie	Janie	ET
Wang	Ke Wei	Ke Wei	ET
Zawadski	Ela	Ela	ET
Zhang	Huiying	Hayley	"+12"

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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***

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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=SnpseEE2NnVQbVNvUE8veEZxTENvUT09
Meeting ID: 569 176 2059
Passcode: Office

Challenges? email me at **crubenst@pratt.edu** !
with the subject: **150** or **Math**

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US Citizens – Student Alert!

To vote in November you must register. Contact **dkahn@nypirg.org**

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Draft Schedule: Math 150 – Fall 2021 – Remote Learning

Monday	Notes
30-Aug	1. Introduction: Numbers, Arithmetic Operations, Fractions
6-Sep	*Pratt Holiday - NO CLASSES – Labor Day*
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. Creating Equations – Polynomials (H/Q4); *Exam #1 Sunday 10/3; 9am*
11-Oct	6. Polynomial Functions, continued (H/Q5); *Exam #1 Review*
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) *Exam #2 Sunday 11/7 9am*
15-Nov	11. Areas and Volumes of Geometric Solids (H/Q10) *Exam #2 Review*
22-Nov	12. Systems of Equations and Inequalities
29-Nov	13. Series and Sequences, Review topics
6-Dec	14. Final Examination (3-hour) *Emailed Sunday 12/5 @ 9am due by 2:00pm*

NOTE: Take home exams account for the 15th class session;
Exams emailed Sunday before date noted by 9:00am – due back by 1:00pm

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This Class Session

- *Due Textbook readings*
- *Due & Review: Homework Set #02 / Quiz#02*
- *Lecture: Solving Linear and Quadratic Equations of One Variable*
- *Review: Homework Set #01 in class*

In class – Session 4:
- *Due: Homework Set #03 / Quiz#03*
- *Lecture: Solving Equations of Two Variables*
- *Review: Homework Set #02 in class*

In class – Session 5:
- *Due: Homework Set #04 / Quiz#04*
- *Lecture: Polynomial Equations*
- *Review: Homework Set #03 in class*

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Class Session Archives

www.CharlesRubenstein.com/150

Photo2Doc_Process.pdf

How to convert photo into doc file

21fa03.pdf *(this slide set)**

21fa03_h.pdf *(slide set as handouts)**

**Available by Thursday evenings…*

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Math 150 – Chapter 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**

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About Your Final Grade

Homework (30%)

For the first **ten (10)** Homework assignments I will select three (3) problems from each assignment to grade. 1% per correct answer, or **3% per homework**

Homework must be emailed to me by 12:00Noon ET on day of class as a doc, rtf, pdf or other file – not as a photo/jpg. The filename MUST be

lastname_hwk##.docx (or **doc, pdf,** etc.)

Exams (70%)

There will be two (2) one-hour exams worth 20% each

There will be a two-hour FINAL exam worth **30%**

Exams will be emailed to you as noted in the schedule on a Sunday not later than 9:00am ET and must be returned to me not later than 1:00pm ET the same day.

There will be NO make up 'quizzes' or exams

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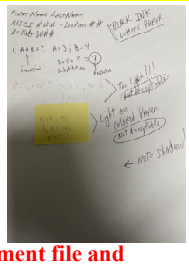
Creating a 'Doc' file for a JPG

1. Take a photo of your work
– BE SURE IT IS IN BLACK INK ON WHITE PAPER – make sure your work is clear and readable. If I can not read it: too light, too sloppy, etc., I will not be able to grade your work!



2. Open a doc, docx, or rtf file.

3. Insert your name, class/section, and date in the file. *(Note: if scanning, make sure this info is on the page and output a pdf.)*

4. Drag your picture file into the document file and make sure it is oriented properly.

5. Save the file: *The filename MUST be styled like*

lastname_hwk##.docx *(or **rtf, doc, pdf,** etc.)*

lastname_exam#.docx *(or **rtf, doc, pdf,** etc.)*

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Questions?

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Topics in Session 3

Ch. 1 The Foundations of Algebra
1.8 Complex Numbers – *NOT PART OF CM/FM*
Chapter 1 Review

Ch. 2 Equations and Inequalities
2.1 Linear Equations in One Unknown
2.2 Applications: From Words to Algebra

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Homework #01 Selected Review Problems

Average Quiz Grade: 3%
(due to holdays I was unable to grade your quiz in a timely manner…)

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Problems – Homework #1

Ch. 1.1, Pg 10-11

In Exercises 37–40, find a counterexample; that is, find real values for which the statement is false.

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

a/b = b/a

NOT TRUE: ½ = 2; 2/4 = 4/2

True: whenever a = b

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Problems – Homework #1

Ch. 1.1, Pg 10-11

In Exercises 37–40, find a counterexample; that is, find real values for which the statement is false.

40 (a + b) (c + d) = ac + bd

NOT TRUE for: a=2, b=3, c=4, d=5:

(2+3)(4+5) = 5*9 = 45

Which is NOT 2*4+3*5 = 8+15 = 23

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Problems – Homework #1

Ch. 1.1, Pg 10-11

57 On a map of Pennsylvania, 1 inch represents 10 miles.

Find the distance represented by 3.5 inches.

Inches/Miles: 1/10 = 3.5/x

1 x = 10 • 3.5

x = 35 miles

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Problem – Homework #1

Ch. 1.1, Pg 10-11

#58. A car travels 135 miles on 6 gallons of gasoline. How far can it travel on 10 gallons of gasoline?

Equation: $\frac{miles}{gallons} : \frac{135}{6} = \frac{x}{10}$

Cross Multiplying: $135 \cdot 10 = 6 \cdot x$

Rearranging terms: $x = 1350/6$

$x = 225$ ***miles***

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Problems – Homework #1

Ch. 1.1, Pg 10-11

#61. Which is the better value: 1 pound 3 ounces of beans for 85 cents, or, 13 ounces for 56 cents?

Convert to ounces:

1 pound, 3 ounces = 16 + 3 ounces = 19 ounces

price per unit of measure:

Compare $\frac{price}{ounce}$: $\frac{85}{19} = 4.47$ ¢/oz.

Compare $\frac{price}{ounce}$: $\frac{56}{13} = 4.31$ ¢/oz.

13 ounces for 56 cents = best buy

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Problems – Homework #1

Ch. 1.1, Pg 10-11

#62. A piece of property is valued at $28,500. What is the real estate tax at $75.30 per $1000.00 evaluation?

Equation: $\frac{tax}{value} : \frac{75.30}{1000} = \frac{x}{28500}$

Cross Multiplying: $(75.30)(28500) = 1000\ x$

$2146050 = 1000\ x$

$2146.05 = x$

The real estate tax is **$2146.05**

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Questions?

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In Chapter 2

Equations and Inequalities
2.1 Linear Equations in One Unknown
2.2 Applications: From Words to Algebra
2.3 The Quadratic Equation
2.4 Applications of Quadratic Equations
2.5 Linear and Quadratic Inequalities
2.6 Absolute Value in Equations and Inequalities

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Chapter 2

2.2 Applications: From Words to Algebra

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From Words to Algebra

1. Read the problem through the first time to get a general idea of what is being asked.
2. Read the problem a second time to recognize what may be important in determining that which is to be found.
3. If possible, estimate the solution to this problem, and then compare this estimate with your final answer.
4. Let some algebraic symbol denote the quantity to be found.
5. If possible, represent other quantities in the problem in terms of the algebraic symbol designated in Step 4.
6. Find various relationships (equations or inequalities) in the problem.
7. Use relationships established in Step 6 to find the solution to the problem.
8. Verify that your answer is, indeed, the solution to the problem.

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Key Word Translations

Word or Phrase	Algebraic Symbol	Example	Algebraic Expression
Sum	+	Sum of two numbers	$a + b$
Difference	−	Difference of two numbers	$a - b$
		Difference of a number and 3	$x - 3$
Product	× or ·	Product of two numbers	$a \cdot b$, $(a)(b)$, or ab
Quotient	÷ or /	Quotient of two numbers	$\frac{a}{b}$, a/b, or $a \div b$
Exceeds		a exceeds b by 3	$a = b + 3$
More than		a is 3 more than b	or
More of		There are 3 more of a than of b.	$a - 3 = b$
Twice		Twice a number	$2x$
		Twice the difference of x and 3	$2(x - 3)$
		3 more than twice a number	$2x + 3$
		3 less than twice a number	$2x - 3$
Is or equals	=	The sum of a number and 3 is 15.	$x + 3 = 15$

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Typical Word Problem Types

- Prices Problems and Discounts Problems
- Coin Problems
- Interest Problems
- Distance Problems
- Travel Problems
- Mixture Problems
- Work Problems
- Formulas

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Prices and Discounts Problems

"If you pay for something after receiving a discount, what was the price before the discount?"

SOLUTION:

Let **p** = PRICE before the discount.

Let **d** = DISCOUNT as a fraction

Then: **(d)p** = Amount discounted and

C = COST (the price AFTER the discount)

$$C = p - (d)p$$

If you pay $6000 for a car after receiving a 25% discount, what was the price of the car before the discount?

$6000 = p – (0.25)p 0.75p = $6000 p = $6000/.75

p = $8000 ***final answer MUST include units…***

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Coin Problems

Always distinguish between the number of coins and the value of the coins. You may also find it helpful to use a chart.

"You have AMOUNT in VALUE of coins. If there are n more of one than the other, how many coins of each type are there?"

SOLUTION:

Let A= Amount in cents , q represents the number of VALUE, $\mathbf{V_1}$,

Then q = Quantity V_1 and (q – n) = Quantity V_2 and

$$\mathbf{A = V_1\, q + V_2\, (q - n)}$$

$$A = q\,(V_1 + V_2) - n\,V_2 \quad \text{and} \quad A + n\,V_2 = q\,(V_1 + V_2)$$

$$\mathbf{q = \frac{(A + n\,V_2)}{(V_1 + V_2)}} \qquad \textit{Then solve for (q-n)}$$

Coin	Number	Value	Total Value
Coin #1	q	V_1	V_1 q
Coin #2	(q – n)	V_2	V_2 (q – n)

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Coin Problem Example

"You have $32.00 in quarters and dimes. If there are 30 more quarters than dimes, how many coins of each type do you have?

SOLUTION:

Let A= Amount in cents, q represents the number of one VALUE, $\mathbf{V_1}$,

Then q = Quantity V_1 and (q – n) = Quantity V_2 and

$$\mathbf{3200 = 25\ q\ + 10\ (q - 30)}$$

$$3200 = q\,(25 + 10) - 300 \quad \text{and} \quad 3200 + 300 = q\,(35)$$

$$\mathbf{q = \frac{(3500)}{(35)}} \qquad \mathbf{q = 100\ Quarters,\ and\ thus\ 70\ dimes}$$

Coin	Number	Value	Total Value
Quarters	q	$V_1 = 25$	25 q
Dimes	(q – n)	$V_2 = 10$	10 (q – 30)

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Interest Problems

Simple Interest: Interest is the fee charged for borrowing money.

Simple interest assumes the fee to be a fixed percentage ***r*** of the the principal ***P*** (the amount borrowed) for one time period, ***t***.

The interest due at the end of each year is Pr, and the total interest ***I*** due at the end of t years is

$$I = Prt$$

If ***S*** is the total amount owed at the end of ***t*** years, then

S = P + I such that: $S = P + Prt$

since both the principal and interest need to be repaid.

Often problems include multiple loans.

Interest Problem Example

"A part of $7000 was borrowed at 6% simple annual interest and the remainder at 8%. If the total amount of interest due after 3 years is $1380, how much was borrowed at each rate?"

SOLUTION: using *I = Prt*

Let s = amount borrowed at 6%

Then 7000 - s = the amount borrowed at 8%

Loan	P	r	t	I
6% portion	*s*	*0.06*	*3*	*0.18s*
8% portion	*7000 - s*	*0.08*	*3*	*0.24(7000-s)*

$1380 = 0.18s + 0.24(7000 - s)

$1380 = 0.18s + 1680 - 0.24s

0.06s = $300 and s = **$5000 at 6%**

and therefore $7000-5000 = **$2000 at 8%**

Distance & Travel Problems

Distance problems take the form of

Distance = (Rate) (Time)

$$d = r \cdot t$$

Setting up distance problems requires you to evaluate:

1. Are the distances equal?
2. Are the sum/difference of the distances constant?

Distance & Travel Example

*"Two trains leave New York for Chicago. The **first train** travels at an average speed of **60 mph**. The **second train**, which **departs an hour later**, travels at an average speed of **80 mph**. **How long will it take the second train to overtake the first train?**"*

***t** = the number of hours the second train travels*

***t + 1** = the number of hours the first train travels*

Train	Rate	Time	Distance
t_1	60	*t + 1*	*60(t + 1)*
t_2	80	*t*	*80t*

They travel same amount when they meet:

$60(t + 1) = 80t$ thus $60t + 60 = 80t$

$60 = 20t$ and $3 = t$

ANS: It takes Train 2 3 hours to catch up…

Mixture Problems

Mixture problem involve mixing varieties of a commodity, say two or more types of metal, to obtain a mixture with a desired value.

If the commodity is measured in pounds, the relationships we need are as follows:

(Number of pounds)(Price per pound) = Value of commodity

Sum of weights of all varieties = Weight of mixture

Sum of values of all varieties = Value of mixture

Mixture Problem Example

"How many pounds of Brazilian coffee worth $10 per pound must be mixed with 20 pounds of Colombian coffee worth $8 per pound to produce a mixture worth $8.40 per pound?"

SOLUTION:

Let B = number of pounds of Brazilian coffee. We display all the information, using cents in place of dollars.

Type of Coffee	Number of pounds	Price/pound	Value (cents)
Brazilian	*B*	*1000*	*1000B*
Columbian	*20*	*800*	*16,000*
Mixture	*B + 20*	*840*	*840(B + 20)*

value of mixture = (value of Brazilian) + (value of Colombian)

$840(B + 20) = 1000B + 16{,}000$

$840B + 16{,}800 = 1000B + 16{,}000$

$800 = 160B$

thus 5 = B and we must **add 5 pounds of Brazilian coffee**

Work Problems

Work problems typically involve two or more people or machines working on the same task.

Work done = (Rate)(Time)

The key to these problems is to express the rate of work per unit of time, whether an hour, a day, a week, or some other unit.

For example, if a machine can do a job in **n** days, then:

rate of machine = **1/n** job per day

If machine is used for **d** days, it performs **d(1/n)** = **d/n** of the job.

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Work Problem Example

"Using a small mower, at 12 noon a student begins to mow a lawn, a job that would take 9 hours working alone. At 1 P.M. another student, using a tractor, joins the first student and they complete the job together at 3 P.M. How many hours would it take to do the job using only the tractor?"

SOLUTION:

t = number of hours to do the job by tractor alone.

small mower works from 12 noon to 3 P.M., or 3 hours.

tractor is used from 1 P.M. to 3 P.M., or 2 hours.

Machine	Rate	Time	Work Done
Mower	**1/9**	***3***	***3/9 = 1/3***
Tractor	**1/t**	***2***	***2 / t***

Work done by small mower + Work done by tractor = 1 Whole job

1/3 + 2/t = 1

(1/3 + 2/t) (3t) = 1 (3t)

t + 6 = 3t; t = 3

Thus Tractor alone can do in 3 hours

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Formula Problems

There are many formulas in mathematics that define the example.

Circumference of a circle in terms of its radius, ***r***:

$$C = 2\pi r$$

Circumference of a circle in terms of its diameter, ***d***:

$$C = \pi d$$

The perimeters and areas of polygons and other shapes also have formulas associated with them.

Other than being given the formula, they are solved in the same way as the problems noted earlier…

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Questions?

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Quick Problems

Ch. 2.2, #54. Write formulas for each of the following:

a. "*the charge in cents for a telephone call between two cities lasting n minutes, n greater than 3, if the charge for the first 3 minutes is $1.20 and each additional minute costs 33 cents.*"

You have 4 minutes to solve this

$$\textbf{\textit{Charge}} = 120 + (n - 3)(33)$$

$$= 120 + 33n - 99$$

C = 21 + 33*n* ***final answer for all $n \geq 3$***

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Quick Problems

Ch. 2.2, #54. Write formulas for each of the following:

b. "the taxi fare for m miles, if the initial charge is $2.50 and the driver charges 70 cents for every 1/5th mile traveled."

You have 3 minutes to solve this

$$Fare = \$2.50 + \$0.70(\ m/(1/5)\ )$$

$$F = \$2.50 + \$3.50m$$ ***final answer***

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Quick Problems

Ch. 2.2, #54. Write formulas for each of the following:

c. "*the amount in an account at the end of a year, if simple interest is paid at the rate of 16%, and the account contains d dollars at the beginning of the year.*"

You have 3 minutes to solve this

$$d + 0.16d = d(1.00 + 0.16)$$

Amount in Account = 1.16d final answer

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Quick Problems

Ch. 2.2, #54. Write formulas for each of the following:

d. "*the fine a company paid for dumping acid into the Mississippi River for d days, if the U.S. Environmental Protection Agency fined the company $150,000 plus $1000 per day until the company complied with the federal water pollution regulations.*"

You have 3 minutes to solve this

Fine = $150,000 + $1,000d *final answer*

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Quick Problems

Ch. 2.2, #55. "***Find three consecutive even numbers such that twice the first plus 3 times the second is 4 times the third.***"

You have 4 minutes to solve this

1st consecutive , even number: x
2nd consecutive, even number: $x + 2$
3rd consecutive, even number: $x + 4$

$$2x + 3(x + 2) = 4(x + 4)$$
$$2x + 3x + 6 = 4x + 16$$
$$5x + 6 = 4x + 16$$
$$x = 10; \quad x + 2 = 12; \quad x + 4 = 14$$

The numbers are 10, 12, and 14 *final answer*

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Quick Problems

Ch. 2.2, #56. "***When exercising, Mary walks a distance to warm up, jogs 3 ½ times as far as she walks, and sprints 3 1/3 times as far as she jogs. If she covers 4171 meters, find the distances that she walked, jogged, and sprinted.***" You have 4 minutes to solve this

Walking distance $= x$; *Jogging distance* $= (3\frac{1}{2})(x) = \frac{7}{2}x$; *and*

Sprinting distance would be: $(3\frac{1}{3})(\frac{7}{2}x) = (\frac{10}{3})(\frac{7}{2}x) = \frac{35}{3}x$

Solving for x: $x + \frac{7}{2}x + \frac{35}{3}x = 4{,}171$

$$6\left[x + \frac{7}{2}x + \frac{35}{3}x\right] = 6(4{,}171)$$
$$6x + 21x + 70x = 25{,}026$$
$$97x = 25{,}026$$
$$x = 258$$

So, she Walks 258m

$\frac{7}{2}x = 903$ ***Jogs 903m and***

$\frac{35}{3}x = 3{,}010$ ***Sprints 3,010m***

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Quick Problems

Ch. 2.2, #57. "***A 10-quart radiator has 30% antifreeze. How much of the fluid should be drained and replaced with pure antifreeze to double the strength of the mixture?***"

You have 3 minutes to solve this

30% antifreeze		100% antifreeze		2(30%) antifreeze
$10 - x$	+	x	=	10

Thus: ***0.30 (10-x) + 1 (x) = [2(0.30] (10) = 0.6(10)***

$$(3 - 0.3x) + x = 6$$
$$0.7x = 3$$
$$x = 4.29$$

So… 4.29 quarts should be drained and replaced

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Questions?

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Chapter 2

2.3 The Quadratic Equation
$ax^2 + bx + c = 0$

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Solving by Factoring

We can factor the left hand side of the Quadratic Equation

$ax^2 + bx + c = 0$

into two linear factors to solve the equation.

So for the quadratic, $x^2 - 5x + 6 = 0$

Factoring into: $(x - 2)(x - 3) = 0$

This is only true for $(x - 2) = 0$ *or* $(x - 3) = 0$

Thus we have two possible results:

$x = 2$ *AND* $x = 3$

that will satisfy the equation

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Common Factors

We can also factor the left hand side of the Quadratic Equation where c=0 :

$ax^2 - bx = 0$

into two linear factors to solve the equation.

So for the general case, $x(ax - b) = 0$

$(ax - b) = 0 / x$

This is only true for $(ax - b) = 0$

Thus we have ONE possible result:

$x = b/a$

that will satisfy the equation

(x=0 is a useless answer)

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Special Cases $x^2 - p = 0$

Some quadratic equations do not necessarily require the use of factoring when finding solutions.

Here we see a difference of squares:

$x^2 - p = 0$

Because of their special form, we may use the method of taking roots.

Where $x^2 - 3 = 0$ $x^2 = 3$ $x = +\sqrt{3},\ x = -\sqrt{3}$

this is often abbreviated: $x = \pm\sqrt{3}$

You might also 'see' this as difference of squares and write:

$(x + \sqrt{3})(x - \sqrt{3}) = 0$

So for the general case, $x^2 - p = 0$

is solved as: $x^2 - p = (x + \sqrt{p})(x - \sqrt{p}) = 0$

for $p > 0$

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Special Cases: $x^2 + p = 0$

Where $x^2 + p = 0$

You might also 'see' this as sum of squares and write:

$x^2 + p = (x + \sqrt{pi})(x - \sqrt{pi}) = 0$

for $p > 0$ *and where* $i = \sqrt{-1}$

$i = \sqrt{-1}$ ***is a representation of an IMAGINARY NUMBER***

However, please NOTE!!!

Imaginary Numbers

are *NOT* part of your CM/FM studies…

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Questions?

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In Class Session #04

- ***Due:** Homework Set #03 / Quiz#03*
- ***Lecture: Solving Equations of Two Variables***
- ***Review:** Homework Set #02 in class*

***In class* – Session 5:**
- ***Due:** Homework Set #04 / Quiz#04*
- ***Lecture: Polynomial Equations***
- ***Review:** Homework Set #03 in class*

EXAM 1

Covering Homework #01-#03 and Sessions 1 - 5

Emailed to you not later than 9:00am ET SUNDAY 3 October 2021

Must be returned to me same day not later than 1:00pm ET

***In class* – Session 6:**
- ***Due:** Homework Set #05 / Quiz#05*
- ***Lecture: Creating Equations - Polynomials***
- ***Review:** Homework Set #04 in class*

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Any Questions?
Send me an email …

crubenst@pratt.edu

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End

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