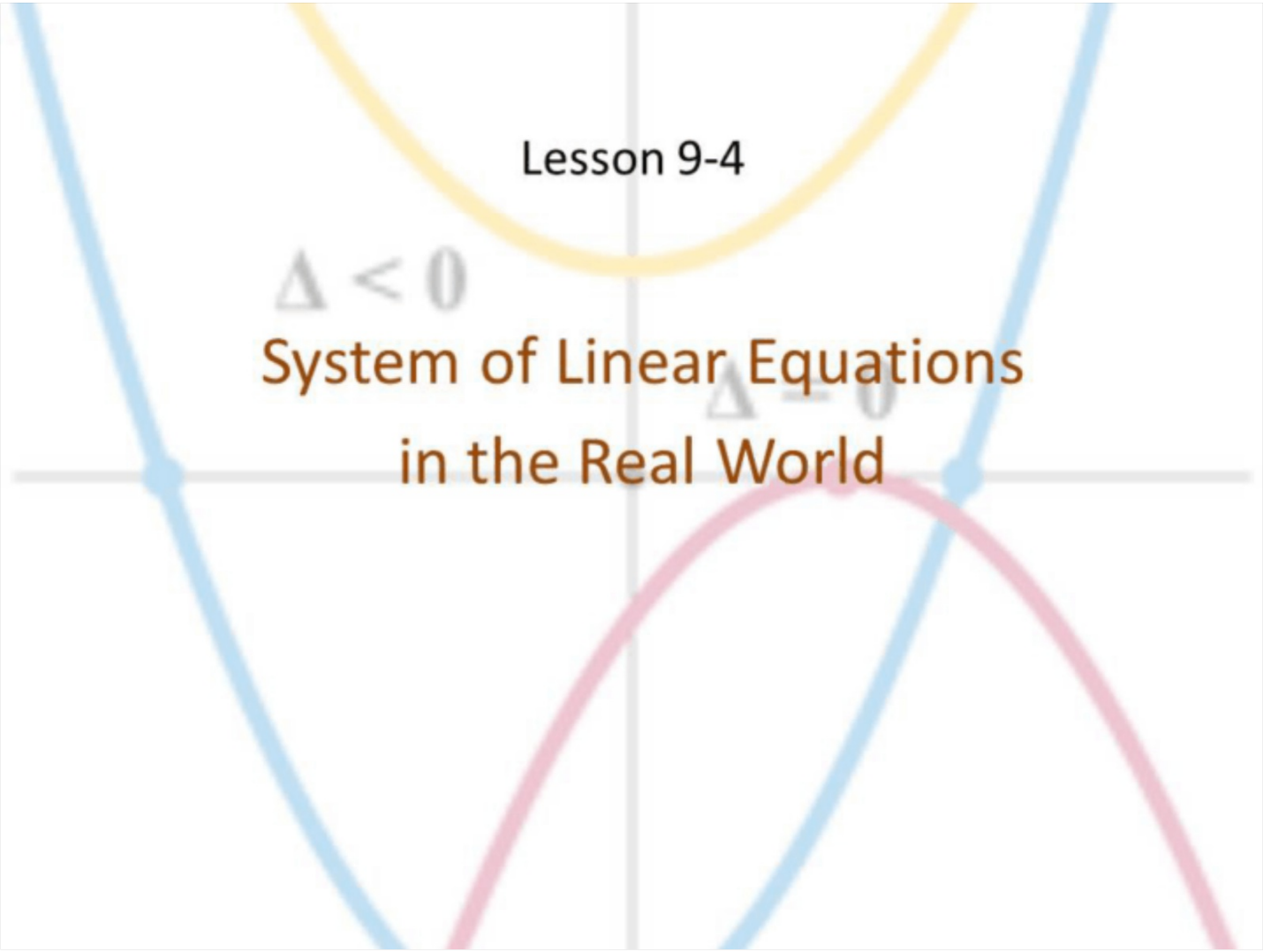
Warm Up 4/28

Solve the following system using row-echelon form

$$\begin{cases} 4x + 8y - 4z = 4 \\ 3x + 8y + 5z = -11 \\ -2x + y + 12z = -17 \end{cases}$$


Lesson 9-4
$\Delta < 0$
System of Linear Equations
in the Real World
$\Delta = 0$

Objective

Students will…

- Be able to model real-life word problems and solve them using system of linear equations.

System of Linear Equations in Real-Life

Linear equations, often containing **hundreds or even thousands** of variables, occur frequently in the applications of algebra to the sciences and to other fields. Of course, we have only been dealing with three variables at most.

We have now acquired two different methods of solving system of linear equations with multiple variables, and it was by using either Gaussian Elimination, or using augmented matrices.

Augmented Matrices of a Linear System

The main reason why we study matrices in this course, is to solve **linear systems** using matrices. The first step to this process is to write a linear system (**system of linear equations**) into an **augmented matrix**, which is made up of the coefficient and the constants of the linear system.

Ex.

Linear system

$$\begin{cases} 3x - 2y + z = 5 \\ x + 3y - z = 0 \\ -x + 4z = 11 \end{cases}$$

Augmented matrix

$$\left[\begin{array}{rrrr} 3 & -2 & 1 & 5 \\ 1 & 3 & -1 & 0 \\ -1 & 0 & 4 & 11 \end{array}\right]$$

As you can see the **lone** constants appear on the **right-most** column.

Note: It's **imperative** that you line up the variables carefully.

John receives an inheritance of \$50,000. His financial advisor suggests that he invest this in three mutual funds: a money-market fund, a blue-chip stock fund, and a high-tech stock fund. The advisor estimates that the money-market fund will return 5% over the next year, the blue-chip fund 9%, and the high-tech fund 16%. John wants a total first-year return of \$4000. To avoid excessive risk, he decides to invest three times as much in the money-market fund as in the high-tech stock fund. How much should he invest in each fund?

Let x, y, z be \$ invested in each fund

$100(0.05x + 0.09y + 0.16z) = (4000)100 \Rightarrow 5x + 9y + 16z = 400000$

$x = 3z$

$x + y + z = 50000 \Rightarrow x + y + z = 50000$

$15z + 9y + 16z = 400000$

$3z + y + z = 50000$

$-5z = -50000$

$31z + 9y = 400000$

$z = 10000$

$x = 30000 \quad y = 10000$

$-(36z + 9y = 450000)$

37. Agriculture A farmer has 1200 acres of land on which he grows corn, wheat, and soybeans. It costs \$45 per acre to grow corn, \$60 for wheat, and \$50 for soybeans. Because of market demand he will grow twice as many acres of wheat as of corn. He has allocated \$63,750 for the cost of growing his crops. How many acres of each crop should he plant?

Let x, y, z = # of acres for each crop.

$x + y + z = 1200$

$45x + 60y + 50z = 63750$

$y = 2x$

$50(x + z) = (1200)50$

$165x + 50z = 63750$

$-(150x + 50z = 60000)$

$15x = 3750$

$x = 250$

$y = 500$

$z = 450$

A nutritionist is performing an experiment on student volunteers. He wishes to feed one of his subjects a daily diet that consists of a combination of three commercial diet foods: MiniCal, LiquiFast, and SlimQuick. For the experiment it's important that the subject consume exactly 500 mg of potassium, 75 g of protein, and 1150 units of vitamin D every day. The amounts of these nutrients in one ounce of each food are given in the table. How many ounces of each food should the subject eat every day to satisfy the nutrient requirements exactly?

x, y, z = # of ounces of each food.

	MiniCal	LiquiFast	SlimQuick
Potassium (mg)	50	75	10
Protein (g)	5	10	3
Vitamin D (units)	90	100	50

$10(5) + 15y + 2(10) = 100$

$y = 2$

$10x + 15y + 2z = 100$

$50x + 75y + 10z = 500$

$2(10x + 15y + 2z) = (100)2$

$3(5x + 10y + 3z) = (75)3$

$\Rightarrow 30x + 30y + 4z = 200$

$\ominus\ 45x + 30y + 9z = 225$

$-15x - 5z = -75$

$5x + 10y + 3z = 75$

$9x + 10y + 5z = 115$

$\ominus\ -4x - 2z = -40$

$4x - 4z = -20$

$x - z = -5$

$x = 5$

$z = 10$

$-6z = -60$

Mixtures A chemist has three acid solutions at various concentrations. The first is 10% acid, the second is 20%, and the third is 40%. How many milliliters of each should he use to make 100 mL of 18% solution, if he has to use four times as much of the 10% solution as the 40% solution?

Let x, y, z = # of mL.

$$x + y + z = 100$$

$$10(0.1x + 0.2y + 0.4z) = (0.18(100))10$$

$$x = 4z$$

$$4z + y + z = 100 \Rightarrow 2(5z + y) = (100)2 \Rightarrow 10z + 2y = 200$$

$$4z + 2y + 4z = 180 \qquad 8z + 2y = 180$$

$$2z = 20$$

$z = 10$

$y = 50$

$x = 40$

Homework 4/28

What??! None?!