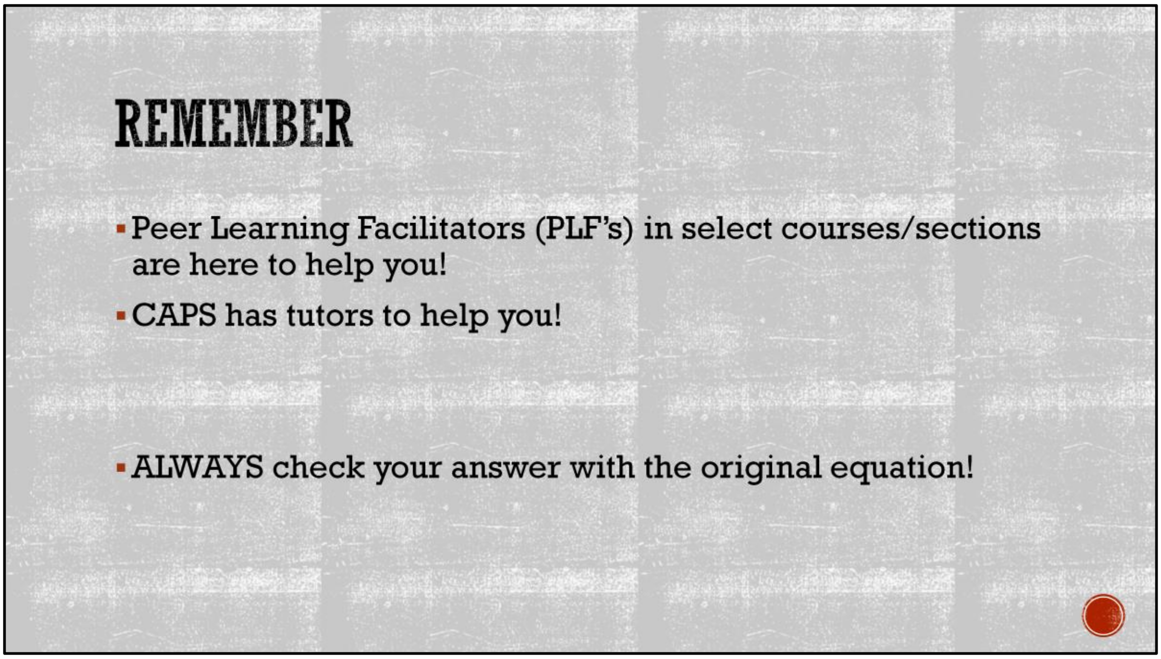
First things first. Welcome to the Math Review workshop, part of the EASE workshop series, organized by the STEM Gateway program and Engineering Student Services.

At the end of the workshop, you'll have to complete a survey for us. If you want to do the survey electronically (which is much appreciated), here are the QR code and short URL. If you'd prefer to do a hard copy version, I'll pass them out at the end of the presentation. To get credit for attending, you'll hand in your assessment sheet, and show me the electronic confirmation, or hand in the paper evaluation, as you leave.

I also want to point out that this Power Point will also be available on the this site through the EASE Workshop series page, so you can always refer back to it at a later time if necessary.



Before we get too far into the Math, I want to point out two tutoring options available to you, if you feel you need more help than this single workshop refresher. ESS and CAPS have tutors that are FREE and can help you if you need it.

With regards to the math, remember that sometimes, there is no real solution, even if you find one. This can occur when you try to find the square root of a negative number. So, ALWAYS check your answer with the original equation.

RATIONAL EQUATIONS

- Problems with an '=' sign
- To solve: $\frac{x-1}{15} = \frac{2}{5}$
  - Multiply through by one

    $$\frac{x-1}{15} = \left(\frac{2}{5}\right)\left(\frac{3}{3}\right) \rightarrow \frac{x-1}{15} = \frac{6}{15} \rightarrow x-1 = 6 \rightarrow x = 7$$

  - or make a common denominator

    $$\frac{x-1}{15}\left(\frac{15}{1}\right) = \frac{2}{5}\left(\frac{15}{1}\right) \rightarrow \frac{x-1}{\cancel{15}}\left(\frac{\cancel{15}}{1}\right) = \frac{2}{\cancel{5}}\left(\frac{\cancel{15}3}{1}\right) \rightarrow$$

    $$x-1 = 2(3) \rightarrow x-1 = 6 \rightarrow x = 7$$

Now on to the math. Let's start with reviewing rational equations. Rational equations are essentially any math problem with an 'equals' sign. We'll go over those with fractions involved.

(*) There are two basic ways to solve a rational equation with fractions, like this one. The first is to make a common denominator. We can multiply 2/5 by 3/3 (which is 1) to get a common denominator of 15. This allows us to get rid of the denominator completely and solve for x through the numerators.

(*) The other option, when a clear common denominator is not visible, is to multiply through by one of the current denominators, in this case, we multiply both sides by 15/1, then cancel out as possible, and solve for x.

Are there any questions at this point?

RATIONAL EQUATIONS

- Now you try! ★ Assessment set 1

$$\frac{3}{x+2} - \frac{1}{x} = \frac{1}{5x}$$

  - Hint: make the common denominator of $5x(x + 2)$
  - Leave final answer in reduced fraction form

Ok, it's your turn to give it a try. Any time you see this red star, it means the question is on your assessment sheet, which I mentioned, you'll have to turn in at the end of the workshop.

A hint in solving this problem, is to make a denominator of 5x(x+2), that means, make fractions equal to 1 for each term that will result in each denominator being 5x(x+2).

RADICAL EQUATIONS

- Problems with a variable INSIDE the radical
- Solve by:
  1. Isolate the radical
  2. Doing the SAME THING to both SIDES (not terms)
- To solve: $\sqrt{x-1} = x-7$

$$\left(\sqrt{x-1}\right)^2 = (x-7)^2 \rightarrow x-1 = (x-7)(x-7) \rightarrow$$

$$x-1 = x^2 - 14x + 49 \rightarrow 0 = x^2 - 15x + 50 \rightarrow$$

$$0 = (x-5)(x-10) \rightarrow x = 5, x = 10$$

Next are radical equations. These are problems that contain the variable INSIDE the radical, whether it is a square, cubed, or other root.

(*) To solve these, first you have to isolate the radical on one side, then make sure that whatever you do to one side, you do to both SIDES, not terms individually.

(*) For example, to solve this problem, the radical is already isolated, so we don't have to worry about that.

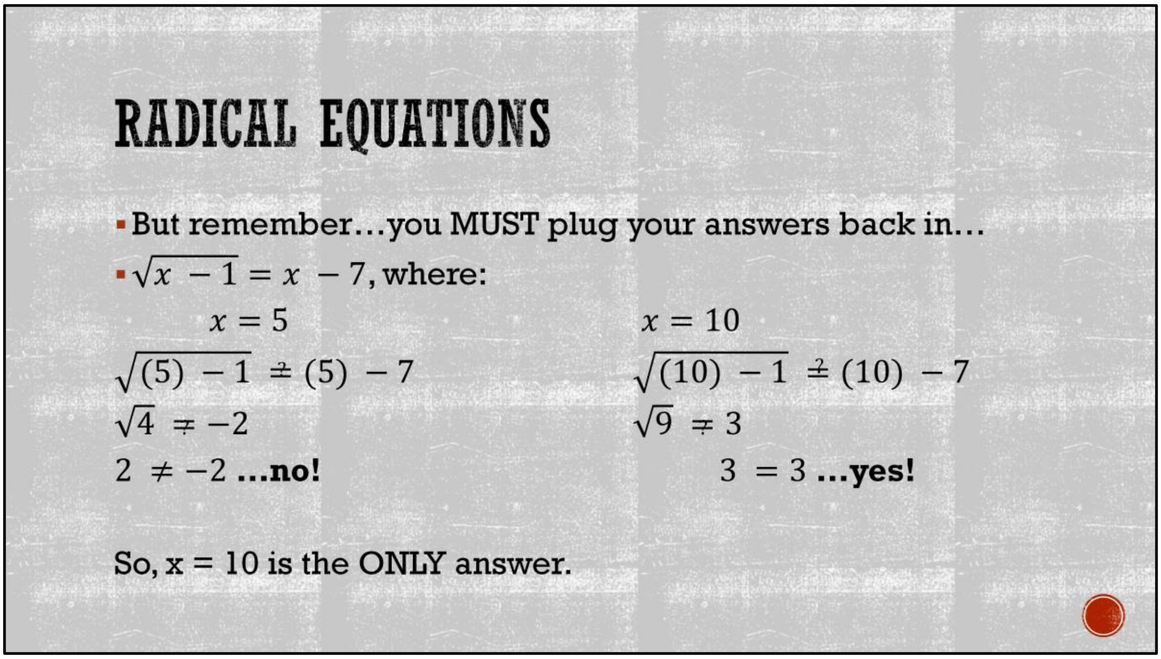
(*) The first thing we will do is get rid of the radical by squaring both sides of the equation. Notice, I didn't square x and -7 separately, but as a single unit.

(*) This results in no radical symbol. And, we can now multiple out and get…

(*) This, which allows us to more easily solve for x. We'll move terms so that like terms are combined
(*) and we set the equation equal to zero so we can solve for x, in this case through factoring the problem.
(*) and setting either term to zero

(*) which gives us $x = 5$, and $x = 10$.

So, that's it, right?



Nope! Remember, you should ALWAYS check your answers with the original equations, especially when you've squared terms.

So, if we take our original equation and plug in both solutions, then work it out, you'll see that x can NOT = 5, so x= 10 is the ONLY answer to the problem.

Are there any questions at this point?

RADICAL EQUATIONS

- Now you try! ★ Assessment set 1

$$\sqrt{9x^2 + 4} = 3x + 2$$

Now it's your turn. Solve this problem on your assessment sheet.

SIMPLE EXPONENTS

- Problems with:

(some base) to (some power) = (same base) to (some other power)

- Solve by converting to the same base → solve for variable
- To solve: $3^x = 9$

  $3^x = 3^2 \rightarrow x = 2$

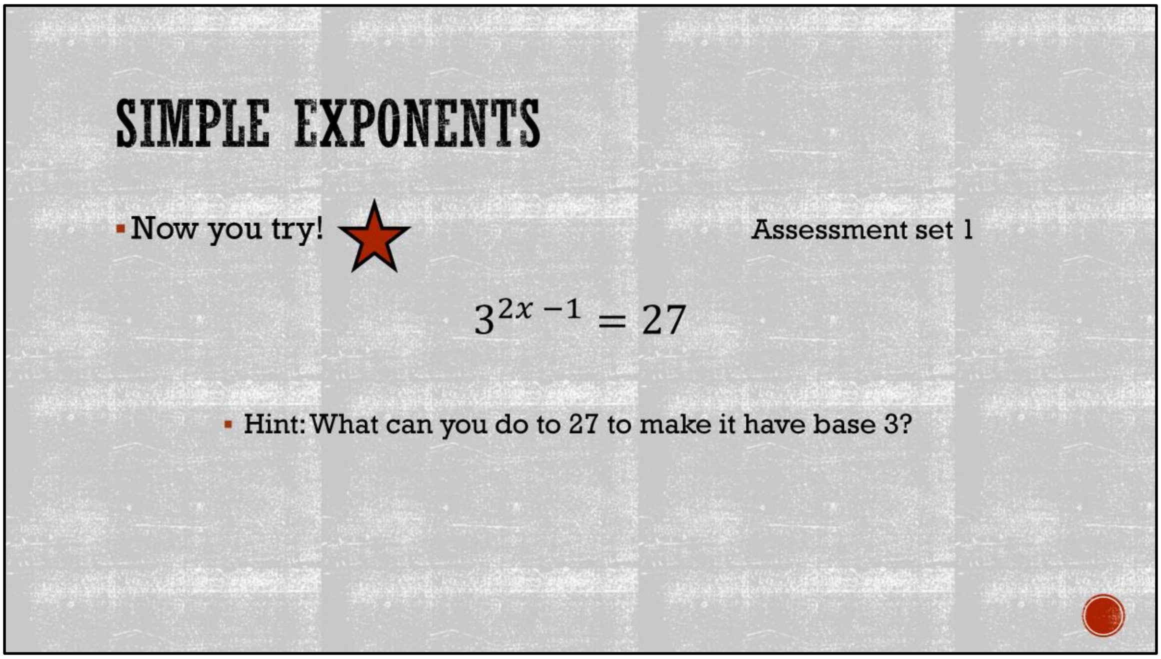
Next is how to exponents. That is, problems with the variable as the power.

We'll start with simple exponents. That is when there are two same bases to two different powers.

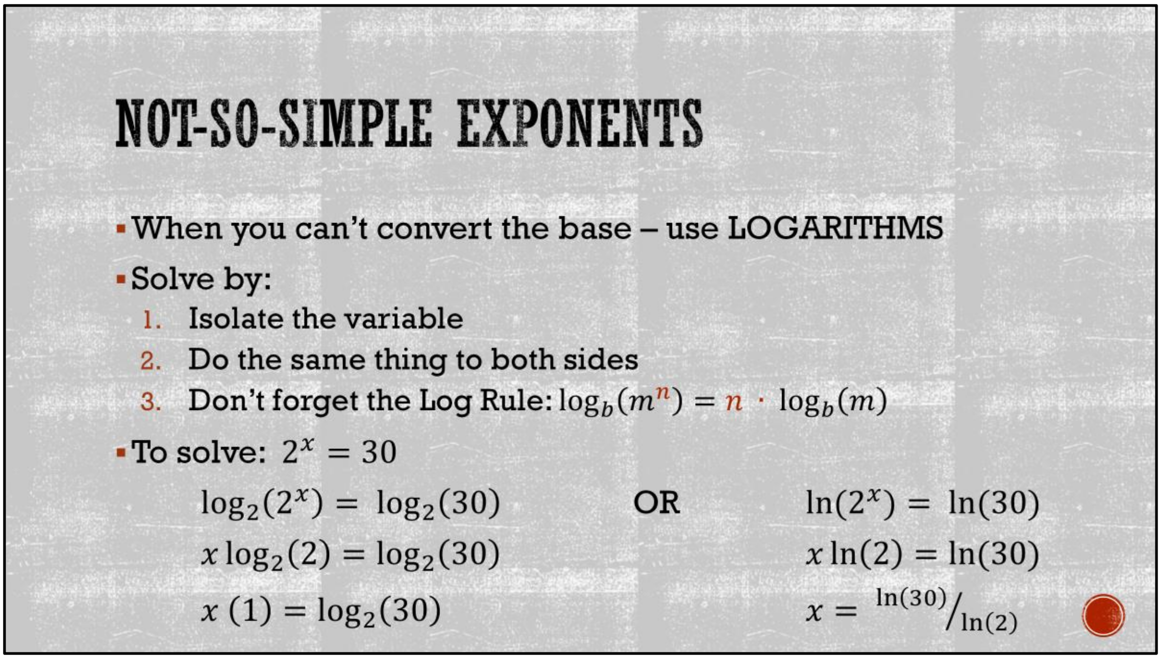
(*) However, it is not always presented as the same base, so sometimes we have to convert to it, and then we solve for the variable.

(*) For example, 3 to the x equals 9. We can convert 9 to match the base of 3, by raising 3 to the 2^{nd}. Then, we just solve the exponents for x like a standard problem.

Are there any questions at this point?



Your turn. What can you do to 27 to make it have base 3?



Now, as you probably suspected by now, not all problems can be converted that easily, so we need another way to solve the problem. That is when we use Logarithms.

(*) The steps to solving via logarithms are to first isolate the variable, and then do the same thing on both sides, as we did when solving radicals. Lastly, don't forget about the log rule.

The Log rule states that anything in the power within the log can be moved as a multiplier outside of it.

(*) So, to solve a problem like 2 to the x = 30, first we isolate the variable. Now, if you'll notice, we can use any base to the log that we want, or natural log. The most common, and best to use because calculators can deal with them are base 10, 2, and natural log. For this example, we can either use log base 2 on both sides, or natural log.

(*) We then apply the log rule, and solve for x.

Are there any questions at this point?

NOT-SO-SIMPLE EXPONENTS

- Now you try!

Assessment set 1

$$3(2^{x+4}) = 350$$

  - Hint 1: Isolate the variable first.
  - Hint 2: Use natural log because of calculator function
  - OK to leave final answer in reduced fraction form

Now it’s your turn to have a go at it. So again, isolate the variable, then solve the problem. In this case, it will be easiest to use natural log.

QUADRATIC EQUATIONS

- Problems with a squared variable; graphed on a curve
- Solve by the quadratic formula

$$\text{from } ax^2 + bx + c = 0 \text{ to } x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

The next topic we'll review are quadratic functions. These are problems with a squared variable, and are graphed on a curve. We'll get to more graphing in a bit, but for now, let's go over how to solve a quadratic function.

The generic equation is ax squared + bx + c = 0. The approach that will work each and every time is to plug numbers into the quadratic equation, which is (read equation).

QUADRATIC EQUATIONS

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

- To solve: $9x^2 + 12x + 4 = 0$

  $a = 9,\ b = 12, and\ c = 4$

$$x = \frac{-(12) \pm \sqrt{(12)^2 - 4(9)(4)}}{2(9)} \rightarrow$$

$$x = \frac{-12 \pm \sqrt{144 - 144}}{18} \rightarrow$$

$$x = \frac{-12 \pm 0}{18} \rightarrow -\frac{2}{3} = x$$

For example, to solve 9 x squared + 12x + 4 = 0, we have to identify which numbers fit in to the quadratic formula, so in this case, a = 9, b = 12, and c = 4.

(*) From there, all we do is plug in our numbers in the correct locations,

(*) do the basic math

(*) and end up with our solution. There are instances where there may be more than one solution for x. Don’t forget to check those answers, as you did before.

Are there any questions at this point?

QUADRATIC EQUATIONS

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

- Now you try!

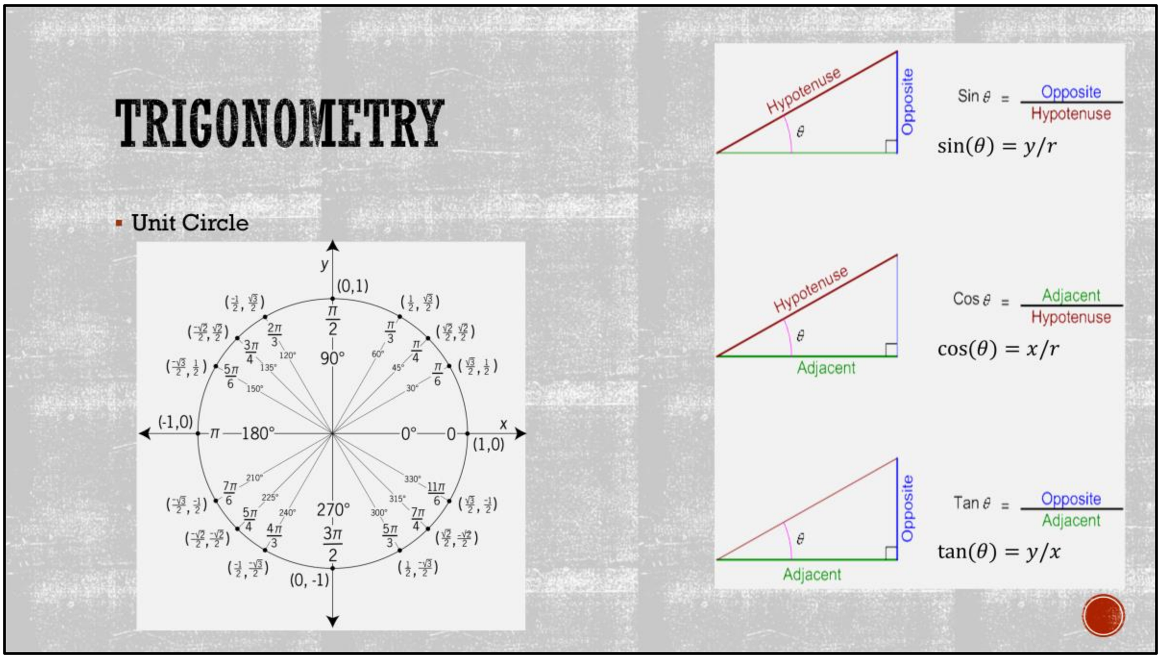
Assessment set 1

$$2x^2 - 4x - 3 = 0$$

- Round answer to 2 decimal places.

Now it's your turn.

Please round your answer to 2 decimal places.

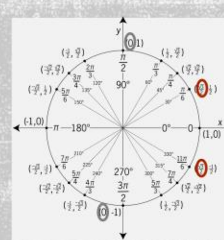


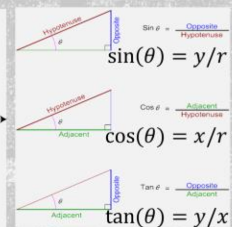
The next topic is trigonometry. That is, any problem that deals with angles. The two main things you need to remember are:

1. The unit circle. This helps us know that at, for example, 0 degrees, the coordinates are (1, 0), or 0 radians, while at 30 degrees, which is equal to pie/6 radians, and has coordinates of , it is an angle of (sq.rt 3/2, ½), etc. and,
2. The sin of angle theta is the opposite side over the hypotenuse, or the y coordinate/radius, cosin is adjacent/hypotenuse or x/r, and tangent is opposite/adjacent, or y/x, where in the unit circle, all r values = 1.

So, to use this in an actual problem…

TRIGONOMETRY





- To solve: $2\,cos^2(x) - \sqrt{3}\cos(x) = 0$

$$cos\ (x)\left(2\cos(x) - \sqrt{3}\right) = 0 \rightarrow$$

$$cos\ (x) = 0 \quad \text{OR} \quad 2\cos(x) - \sqrt{3} = 0 \rightarrow$$

$$cos\ (x) = 0 \quad \text{OR} \quad \cos(x) = \frac{\sqrt{3}}{2} \rightarrow$$

$$x = 30, 90, 270, \text{and } 330$$

We can solve (read equation)
(*) we first eliminate the square by pulling out cos (x)
(*) then, we are able to set the two parts of the equation equal to zero.
(*) and simplify the equations.
(*) At this point, we can reference back to our unit circle and trig functions.
(*) Since cos (x) refers to values of x/r, and remember, r = 1, so we need to location x values where x = 0 (grey) and x = sq.rt3/2 (red)
(*) There are four points where this is true.
(*) so the answer to this problem is that x = 30, 90, 270, and 330.

Are there any questions at this point?

TRIGONOMETRY

- Now you try! ★ Assessment set 1

$$cos^2(x) + \cos(x) = sin^2(x)$$

  - Hint: Use the trigonometric identity to have only 1 trig function:
    $sin^2(t) + cos^2(t) = 1$
  - Leave final answer in "*trig function (x)* = #" form

Alright, now it's your turn. A hint for this one is to use the trigonometric identity to help condense to a single trig function.

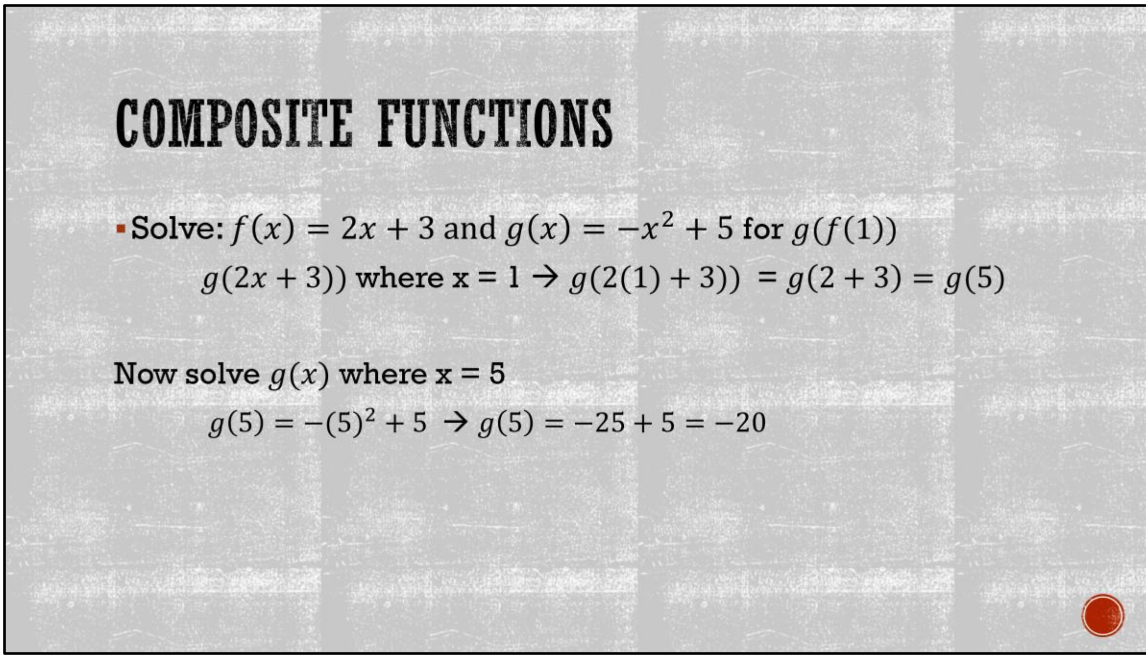
COMPOSITE FUNCTIONS

- Two combined functions where the range of one function is contained in the domain of the second function.
- General format: $f(g(x))$, where $f(x)$ replaces y in a generic equation
- To solve:
  1. Set up and solve the internal function ($g(x)$)
  2. Plug the value for $g(x)$ into $f(x)$ and solve.

The last thing we're going to cover before we get into graphing are composite functions. These are when two functions are combined in such a way that the domain of one function is contained within the domain of the second. We'll get in to more detail of domains when we discuss graphing.

The general format is presented as f of g of x, where f of x takes the place of y, in the format we've used up until this point.

To solve a composite function, we set up the equation to solve the internal function, then plug that value in to the outer function. This will become more clear as we do an example.



So, to solve for g of f of 1, where f of x is 2x + 3, and g of x is –x squared + 5
(*) we plug the f of x function in as x in g of x, then replace x's with 1's, since that is what is desired, and solve that first function. That gives us g of 5.
(*) So now we can solve g of x, where x = 5
(*) by plugging in 5 for any x's in the g of x function. This results in g of f of 1 = 2.

Does that make since or are there any questions at this point?

COMPOSITE FUNCTIONS

- Now you try! ★ Assessment set 1

$$f(x) = 2x + 3 \text{ and } g(x) = -x^2 + 5$$
$$\text{find } f(g(1))$$

Ok, you try.

ADDITIONAL RESOURCES

- Presentation on EASE website (http://goo.gl/rTQmcL)
- Peer Learning Facilitators (PLF's) in select courses/sections are here to help you!
- CAPS Tutors
- www.purplemath.com
- https://www.desmos.com/calculator (online graphing)

Before we wrap up, I want to mention again, this presentation, including the script, is available on the EASE website. So, you can go back and refresh your memory on this at any time.

Also, ESS and CAPS have tutors to help you

And, purplemath.com (which many of these examples came from) is great for more examples, and desmos.com allows you to do online graphing, so you can always check yourself.

Are there any last minute questions?

There is a second set of assessment questions if you want to stick around and get more practice. We will go around and help you as necessary.

Before you go, we need you to complete our survey. You can do it electronically. When you are finished, call me over to see the confirmation page, and you are free to go. If you'd like to check your answers to the assessment, I have them here, you are free to look over those as well.