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Jan 27-10:05 AM

§Laws of Exponents and the Quadratic Formula

Recall from your Grade 9 mathematics course, the Laws of Exponents:

- Exponent Law for Multiplying Powers
- Exponent Law for Dividing Powers
- Power Law

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Exponent Law for Multiplying Powers

When multiplying powers with the same base, the base remains unchanged while the exponents are added.

THINK: Evaluate:

$$(x^4)(x^3)$$

What does this really mean?

(x*x*x*x)*(x*x*x)
x*x*x*x*x*x*x

Ergo;

$$x^7$$

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Exponent Law for Multiplying Powers

A much simpler way to have attacked the previous question would have been to follow the law:

Given: $(x^4)(x^3)$

Recognize that they have the same base (x):

x^{4+3}

x^7

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Exponent Law for Dividing Powers

The same can be said about dividing powers, but first please note that:

$\frac{1}{x} = x^{-1}$

Now THINK and Evaluate:

$\frac{x^4}{x^3}$

What does this really mean?

$\frac{(x*x*x*x)}{(x*x*x)}$

x

Ergo; because recall that x/x = 1.

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Exponent Law for Dividing Powers

A much simpler way to have attacked the previous question would have been to follow the law:

Given: $\frac{x^4}{x^3}$

Recognize that they have the same base (x):

x^{4-3}

x^1

x

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Exponent Law for Dividing Powers

Another approach ... There is no such thing as Division, just the multiplication of fractions!!! Recall that I said that:

$$\frac{1}{x} = x^{-1}$$

Given: $\frac{x^4}{x^3}$

We can say: $(x^4)(x^{-3})$

OR:

x^{4-3}

x^1

x

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The Zero Exponent

By now you probably know that x^0 is equal to 1:

$$x^0 = 1$$

Why?

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The Zero Exponent

By now you probably know that x^0 is equal to 1:

$$x^0 = 1$$

Why? THINK:

Lets say that we have:

$$\frac{x^6}{x^6}$$

We know that this is equal to one, because but lets see why!

$\frac{x*x*x*x*x*x}{x*x*x*x*x*x}$ OR x^{6-6}

x^0

1 1

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The Power Law

If multiplication is fast adding, then exponents are fast multiplying. For example, given:

$$(x^3)^5$$

Why? THINK:

$$(x^3)(x^3)(x^3)(x^3)(x^3)$$

By the law of multiplying exponents, we know that this equals:

$$(x^{15})$$

Is there an easier way? Yes ... multiply the exponents!!

$$(x^3)^5$$
$$x^{3\times5}$$
$$x^{15}$$

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The Quadratic Formula

In grade ten you studied parabolas which are known as quadratic functions. There you learned an equation, known as the quadratic formula which stemmed from the equation:

$$ax^2 + bx + c = 0 \text{ where } a \neq 0.$$

The formula helps us find the zeroes of the function; when it hits the x-axis (if at all). Recall, that we can have a situation where there are two zeroes (it CROSSES the x-axis twice), one zero (it has a minimum or a maximum on the x-axis) or it has zero zeroes (it NEVER touches the x-axis).

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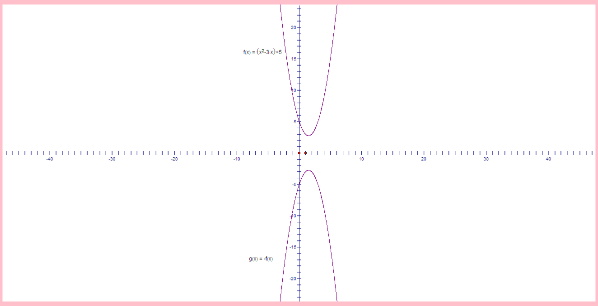
TWO OF THE SIX OUTCOMES!!!

NO REAL SOLUTIONS!!! Note that the quadratic NEVER touches the x-axis!!!



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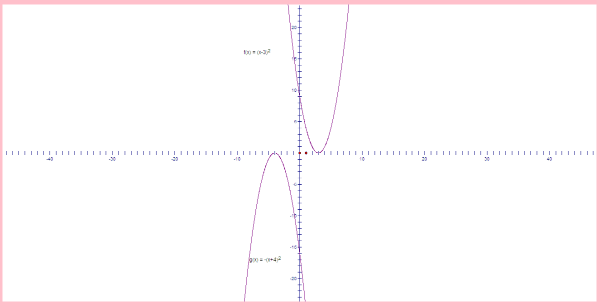
TWO OF THE SIX OUTCOMES!!!

ONE SOLUTION!!! Note that the quadratic either has a minimum and maximum on the x-axis!!!



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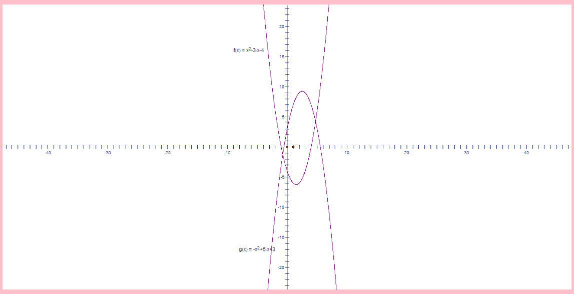
TWO OF THE SIX OUTCOMES!!!

TWO SOLUTIONS!!! Note that the quadratic CROSSES the x-axis twice.



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The Quadratic Formula

The Proof: $ax^2 + bx + c = 0$ where $a \neq 0$.

Divide everything by a:

$$x^2 + \frac{bx}{a} + \frac{c}{a} = 0$$

Subtract c/a from both sides:

$$x^2 + \frac{bx}{a} + \frac{c}{a} - \frac{c}{a} = 0 - \frac{c}{a}$$

Now we complete the square:

$$x^2 + \frac{bx}{a} + \frac{b^2}{4a^2} = -\frac{c}{a} + \frac{b^2}{4a^2}$$

Note the perfect square:

$$\left(x + \frac{b}{2a}\right)^2 = \frac{b^2 - 4ac}{4a^2}$$

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The Quadratic Formula

Recall:

$$\left(x + \frac{b}{2a}\right)^2 = \frac{b^2 - 4ac}{4a^2}$$

Square root both sides:

$$\left(x + \frac{b}{2a}\right) = \frac{\pm\sqrt{(b^2 - 4ac)}}{2a}$$

Solve for x:

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

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

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The Quadratic Formula

Example: Find the zeroes for the equation:

$$4x^2 - 12x = 7$$

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Solution: Find the zeroes for the equation:

$$4x^2 - 12x = 7$$

Let's place this into $ax^2 + bx + c = 0$ format:

$$4x^2 - 12x - 7 = 0$$

Apply into the quadratic formula where a=4, b=-12 and c=-7.

$$x = \frac{-(-12) \pm \sqrt{((-12)^2 - 4(4)(-7))}}{2(4)}$$

$$x = \frac{12 \pm \sqrt{(144+112)}}{8}$$

$$x = \frac{12 \pm \sqrt{(256)}}{8}$$

$$x = \frac{12 \pm 16}{8}$$

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Hence;

$$x = \frac{12 \pm 16}{8}$$

$$x = \frac{28}{8} \qquad x = \frac{-4}{8}$$

$$x = 3.5 \qquad x = -0.5$$

This quadratic has two solutions.

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How do I know how many solutions that I have?

Within the quadratic formula is the discriminant:

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

The discriminant is : $\pm \sqrt{(b^2 - 4ac)}$. Due to the $\pm$ symbol, this determines the number of solutions that we will have. If:

* $\pm \sqrt{(b^2 - 4ac)} = 0$, then there is one sol^n
* $\pm \sqrt{(b^2 - 4ac)} > 0$, then there are two sol^{n}s
* $\pm \sqrt{(b^2 - 4ac)} < 0$, then there are no real sol^{n}s; but they do contain IMAGINARY sol^{n}s.

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Exit Ticket: In class/group activity:

Complete and Hand-In. §1.4 #64 & §7.3 #44

Homework:

§1.4 #5-25 (odd only)

§7.3 #17-25 (odd only)

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