Algebra 2, Part 1

Unit 1 Application Problems

Directions

At the end of each module you will have application problems that will help you apply the skills taught throughout the module. You will only submit your work to these application problems in module 5.

Be sure to save this document where you know how and where to find it. This template is a place for you to show your work and present your solutions. Make sure your work is clear and you show all of your steps that you took to solve the application problem.

You CAN do your work on paper, take an image of your work, and paste that image onto this template.

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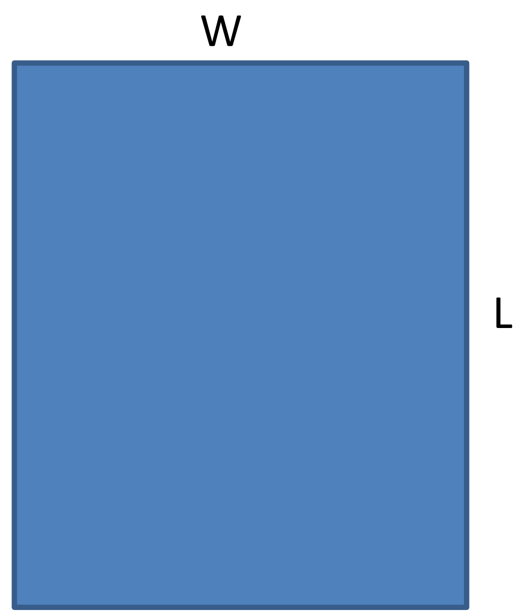
Module 1 Application Problem #1

In this problem you will create a rectangular backyard with a set area. You will set up the variables for the length and width.



Step 1: Choose an area between 600-1000 square feet.

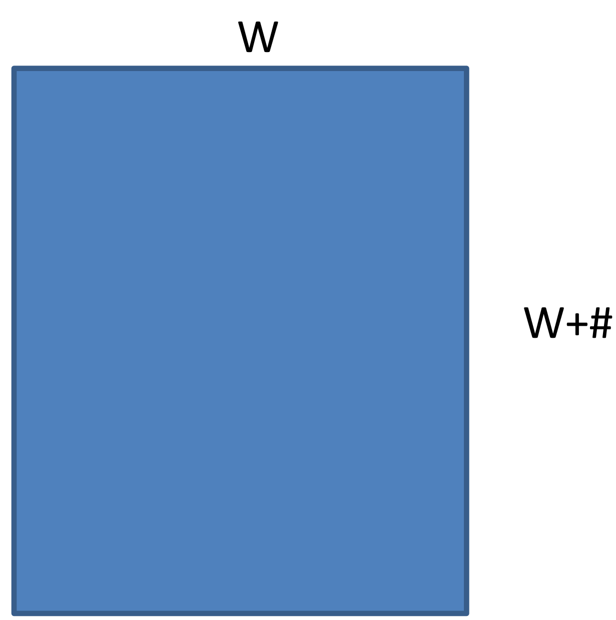
Total Area= 800 Sq ft

Step 2: After you have chosen an area, write down the relationship between length 'L' and width 'W'. We will write the length in terms of the width. In other words, how much longer do you want the length to be than the width?

Width = W = 20 *The value you choose for w*

Length = L = 40 *A number that is a factor with w that will give you your desired area*

Length = W + 20 *The difference between w and l*



Step 3: Write the equation for the area in terms of W by first setting up the regular area formula: Length multiplied by width equals area. But this time, substitute W+# in for L in the equation.

(Length)(Width) = Area

(W+ 20)(W)= 800

Rewrite the total area equation with variable W: w^2+20w = 800

Remember from step 1, the total area should be between 600 and 1000.

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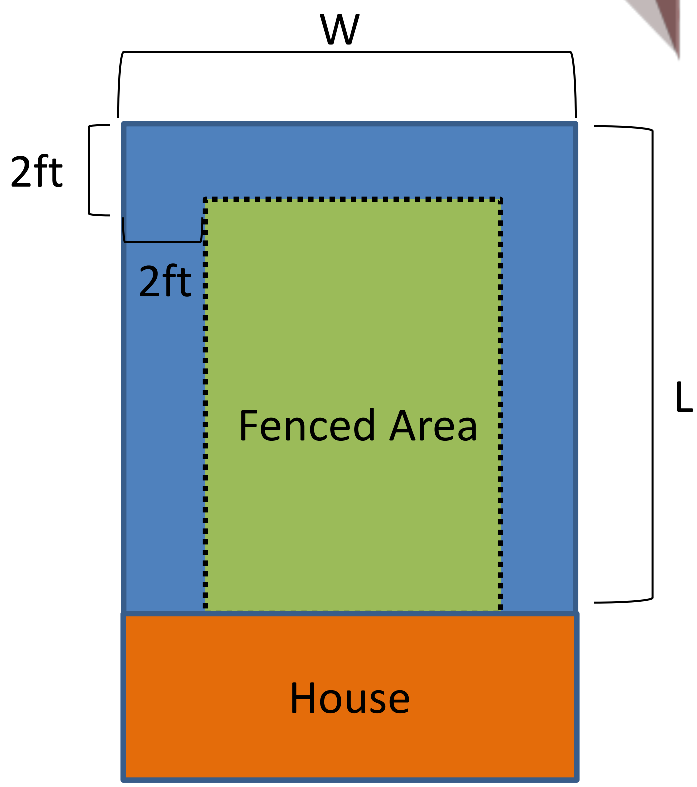
Module 1 Application Problem #2

For this problem you will determine the cost to put a fence around the perimeter of the backyard you worked on in problem #1. To do this, you need to find the perimeter of the part of the yard that will be fenced. The city you live in requires that your fence be 2 feet away from your property line on all sides



Step 1:
Write an equation for the width of the fenced sides using the variable W from problem 1.

If the width of the yard is W, what is the width of the fenced area?

Width of Fenced Area = W — 4

Step 2:
Assume there is a house that will take the place of one width of the fenced area as shown in the picture to the right. How can you describe the length of the fenced area in terms of W using the same L from problem 1?

If the Length of the entire yard is = W + 20

Then the Length of the FENCED yard is = W + 20 — 2

Step 3:
Find the expression for the total length of fencing you will need by adding up the fenced sides.

2w + 20 - 2 - 4
2w+14

Step 4:
If the fencing you plan to use is $6 per linear foot, write an expression for how much the fencing will cost.

6(2w+14)

Step 5:
What is the equation for the fenced area?

12w+84

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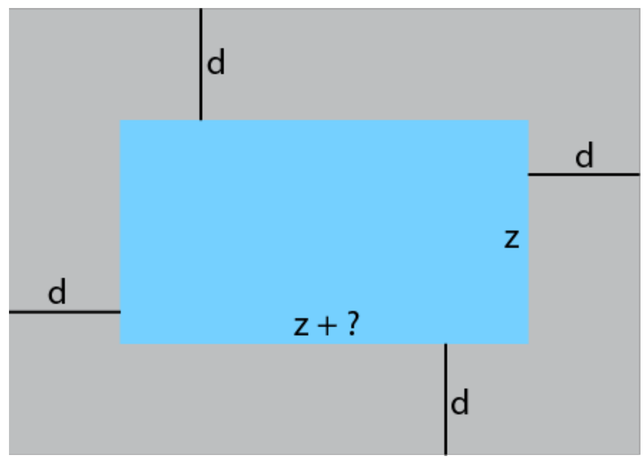
Module 2 Application Problem #3

You decide that you would like to have a pool in your backyard. The pool is also a rectangle, meaning that you must have a length larger than the width. Set the width equal to z and the length equal to z plus however much longer you want your length to be (z+#).

You want to pour a concrete deck that surrounds the pool on all 4 sides evenly. You can choose how wide the deck around the pool will be, represented by the variable d, but you can only afford to have at most 400 square feet of deck. Set the width of your pool equal to z and make the length longer than the width. The width of your deck is represented by the variable d.

Width of Pool (z)= 8

Length of Pool (z+#)= z+4



Width of Deck from pool to edge (d)= 4

Total Width of Deck = 16

Be sure to take into consideration both sides of the deck and the width of the pool

Total Length of Deck = 20

Be sure to take into consideration both sides of the deck and the length of the pool

Now you will need to calculate the area of the just the deck.
Keep in mind it must be under 400sq ft Show your work below

Total Area = 20 * 16 = 320
Area of the Pool = 8 * 12 = 96
Area of the Deck: 320 - 96 = 224

So, the area of the deck is 224 square feet.

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Module 2 Application Problem #4

You want to make a concrete cube to sit on next to the pool. Your cube needs to measure between 1.25 and 2.5 feet on each side. Choose the dimensions of the cube you want to make and calculate how much more concrete you need if you already have 0.75 cubic feet of concrete left over from the previous project.

A. Choose the measurement of your cube to be any measurement between 1.25 and 2.5 feet.

2 ft

B. What is the cubic volume of your cube based on the measurement you chose?

8 cubic ft

C. How much more concrete do you need to purchase if you already have 0.75 cubic feet from the previous project?

7.25 cubic ft

D. How much more concrete would you need if you added 2 more concrete cube seats? (You will end up calculating for 3 seats total.)

8 * 3 - 0.75 = 23.25 cubic ft

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Module 3 Application Problem #5

You have 320 square feet of sod and you have two rectangular areas where you want to place sod. The sides of all the rectangles are in terms of x. For example, area A might be x+3 by x+10. Find the value or values of x that will work for the areas. Also, find all the lengths and widths of your sod rectangles. Be sure to use all the sod so there isn't any left over. At the end, you may round to the nearest tenth if needed. If you eliminate any solutions, justify why.
Example: (x+3)(x+10)+(x+4)(x+7)=320

Step 1: Determine the additional feet for width (this can be any number, I would suggest keeping it below 10)

Area 1 (X+ 2) Area 2 (X+ 4)

Step 2: Determine the additional feet for length (this can be any number, but must be higher than number used for width)

Area 1 (X+ 4) Area 2 (X+ 8)

Step 3: Create equation to show total area of both rectangular portions needing sod.

(X+ 2) (X+ 4) + (X+ 4) (X+ 8) =320

Step 4: the value of X? X= (-18 + 2sqrt(641)) / 4

Work:
(x+2)(x+4) + (x+4)(x+8) = 320
x^2 + 6x + 8 + x^2 + 12x + 32 = 320
2x^2 + 18x + 40 = 320
2x^2 + 18x - 280 = 0
(-18 + sqrt(18^2 - 4(2)(-280)) / 2(2)
(-18 + sqrt(324 + 2240)) / 4
(-18 + sqrt(2564)) / 4
(-18 + 2sqrt(641)) / 4

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Module 3 Application Problem #6

You want to put some fountains around your pool that will shoot out from the side, over the pool, and land somewhere in the water.

Step 1: Pool fountains come in a variety of pressures from 0.1–10. Below is the function that models the distance the water will travel from the point it exits the ground until it comes down to ground level again for any pressure value of p.

$$f(x) = -\frac{1}{p}x^2 + 2x + 1$$

Graph the function on a separate graph in Desmos with a slider for p.

Step 2: Using the function, choose 3 different p values between 0.1 and 10. You may use decimal values.

Pressure Value 1	Pressure Value 2	Pressure Value 3
1	2	3

Step 3: Illustrate the distance the water will travel by graphing the equation for each value of p. Label the intercepts for each line.

Module 3 Application Problem #6 Continued

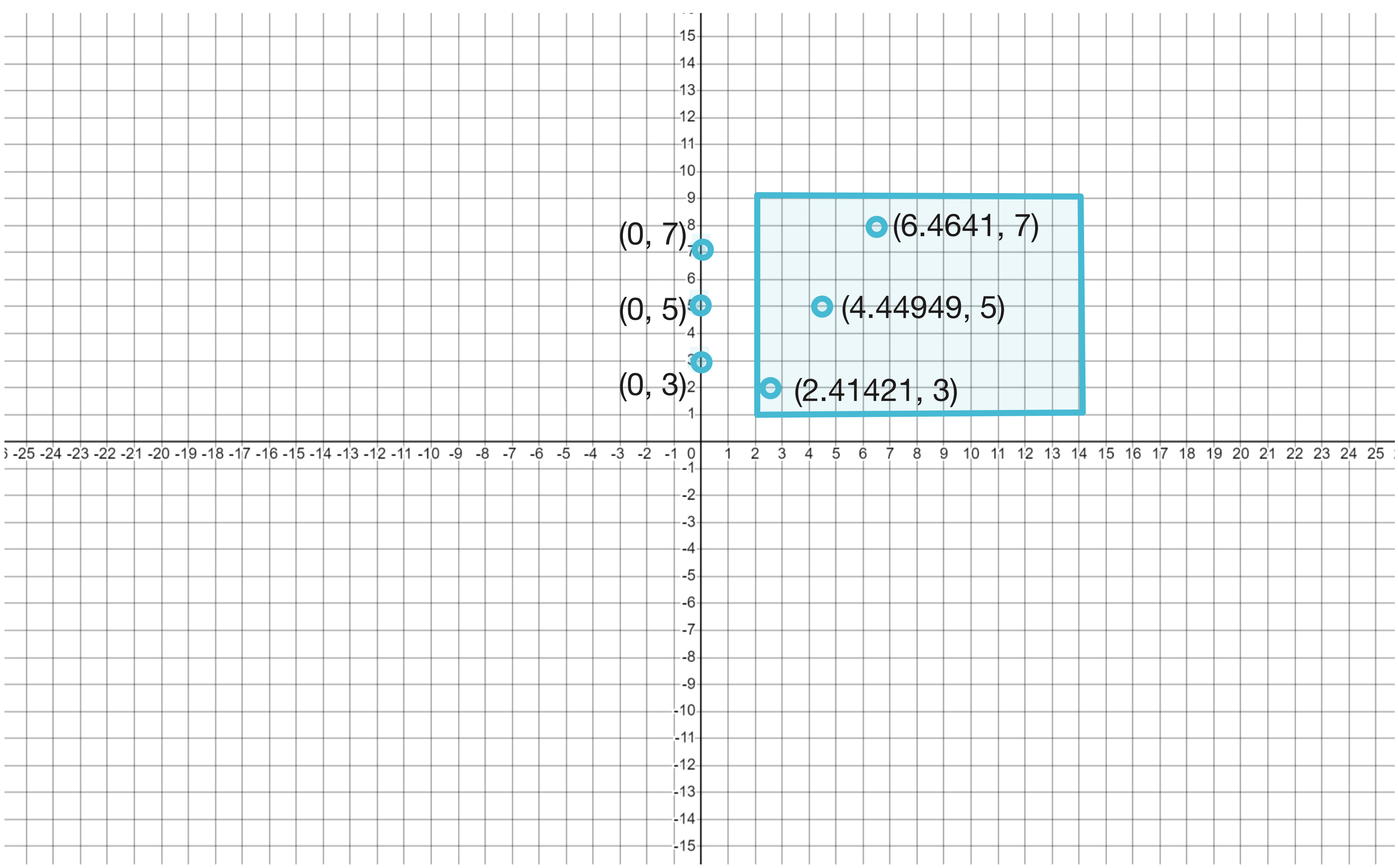
Step 4: Calculate the distance between the x-intercepts to find the distance the water will travel. Show your work.

Pressure value 1 water distance	Pressure value 2 water distance	Pressure value 3 water distance
2.41421	4.44949	6.4641

Step 5: Draw your pool in on the coordinate plane below based on your Module 2 Application Problem #3 dimensions. Use each square to represent a square foot. (If you choose to use a separate piece of graph paper, be sure to include it with your submission.)

Step 6: Label the coordinates for the starting point of each fountain. Be sure to choose points where the fountain will spray into the pool perpendicular to one of the edges.

Step 7: Label the coordinates for the landing point of the water from each fountain. You may have to adjust your p values or the starting point of a fountain to ensure the water always lands in the pool. The pool does not have to be centered on the plane or start on one of the axes.



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Module 4 Application Problem #7

The last piece of your backyard is the composting box. You have decided that the box should be square, meaning all sides have the same measurements. It is made by creating a hollow cube and then surrounding the hollow cube with insulation. In the end, the dimensions of the composting box need to account for the hollow cube's dimensions and the depth of the insulation board completely surrounding it. The insulation can be between 2 to 5 inches deep and completely cover all six sides.

A. How thick will your insulation be? 2 inches

B. If the length of one side of the hollow cube is b, write an expression that represents the length of one side of the finished box with the insulation. Remember the insulation completely surrounds the box.

b + 2 + 2

C. What is the equation for the volume of the box based on the expression you created and using Pascal's Triangle? Be sure to show your work.

(b+4)^3
1(b^3)+3(b^2)(4)+3(b)(4^2)+1(4^3)
b^3+12b^2+48b+64

D. If the length of one side of the hollow, interior cube is 4 feet, what is the total volume of the box, including the insulation? Hint: You will need to do some unit conversions.

4ft -> 48in
48in + 4in = 52in

52^3 in. = 140608in^3

So, the total volume of the box is 140608 inches cubed.

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Module 4 Application Problem #8

Now that you know the dimensions of the compositing box, you need to fill it with compostable trash and make compost. Bags of compostable trash are measured in cubic feet, and the volume V of each bag is $V=s^3$. Due to decay and other things, you will lose 1 foot of volume by the time each bag becomes compost.

A. Considering the loss, what formula would you use to determine how much compost one bag of trash will become?

V = s^3 - 1

B. Write a formula for the volume created by t number of trash bags.

t(s^3 - 1)

C. According to a reliable source, 15 bags of compostable trash will yield 75 cubic feet of compost. Use the equation calculating compost from trash to solve for s.

Show work:
15(s^3-1) = 75
15s^3 - 15 = 75
15s^3 = 90
s^3 = 6
s = 1.8

Round to the nearest tenth or one decimal place.

S= 1.8

D. Return to your composting box from the previous problem where one interior side is 4 feet long. Calculate the interior volume to find the amount of trash you can put into it. Using the value for s, how many bags of trash (t) can fit in it, and how much mulch can you expect to yield from that trash?

Show work:
4^3 feet = 64 cubic feet (the total volume)
64 / (1.8^3) = t (the amount of bags of trash)
t = 64 / 5.832, t = 10.9739368999
So, the amount of trash bags is 10.9739368999.

Since we have 10.9739368999 bags, and there is a loss of -1 per bag, then we subtract 10.9739368999ft^3 from the total space of 64ft^3.
64 - 10.9739368999 =53.0260631
So, the amount of compost is 53.0260631ft^3

t = 11

The number of bags of trash rounded to the nearest tenth.

Compost = 53

Amount of compost the composting box can make in cubic feet, rounded to the nearest tenth.

Course Title: Algebra 2 Part 1

Application Problem Reflection

Idea Design and Refinement

Share how you met the following criteria as you worked to complete these application problems.

1. The student asks thoughtful questions which identify constraints, key benefits, desired functions, and essential features of the desired system. They clearly define the system and how the different parts of the system should interact.
2. The student searches for new ideas and different ways to meet the requirements. They seek many different viewpoints and interpretations to clarify their assumptions. They creatively design an innovative product or model of the system.
3. The student seeks for feedback about the design. They search for changes that will improve the system. They effectively manage their time to get the work completed.
4. The student continuously and effectively refines their ideas and tests assumptions. They actively integrate feedback to improve the design. The end product or model exceeds the system requirements.

In the space provided below be sure to reflect on each of the 4 criteria listed. Additional slides can be used for additional space.

Whenever I was working on a question, I had to think deeply with myself to genuinely engrain it into my head to get through the problem. It wasn't surface level because I had to consider the constraints, the outcome, benefits, drawbacks, and how what I did in a certain step would affect me later on. It made me really think about all the aspects there are to this, and how there's no
straight on way to tackle it as you have to think from all sides at once.

When the problem didn't specify me a single way to solve the problem (for example; using Pascal's Triangle in a recent problem), I would combine different things I knew in order to solve it. If I felt that was the most efficient way, I would do it. There was always a certain set of criteria and constraints but if I was able to meet them using a way I thought up then I would explain it and continue on that way.

I asked a friend to check over my work and let me know if I needed to work on any parts. If he told me something was lacking or he didn't understand it, I would try to look from his perspective and then improve it. I also made sure to dedicate a lot of my time to this. I wake up at 5AM in order to do many hours of Algebra 2 per day since it is my main focus this summer. I keep a clean desk with a notebook and a pencil and work on these projects for many hours.

Even further than improving based on my peer's feedback, I look over it myself and try to polish it as much as possible. I make sure that it is readable and easy to understand as I want it to be easy to think through my thought process. As well as this, I polish up any graphs, text, and images in order to make it easy to look through. Overall, I put a lot of effort into these application problems and learned quite a bit.

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Application Problem Reflection

Idea Design and Refinement Cont.