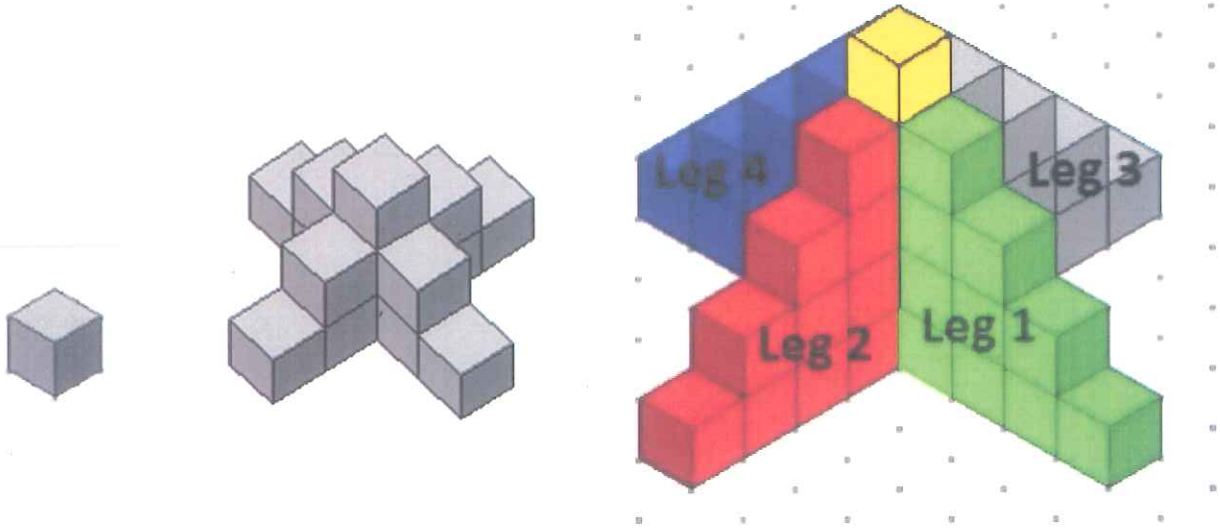
Building Towers (Green Worksheet) +4/10
10 points possible

Name: Megan LaCalameto
Date: _____

Directions: *Consider the cube towers illustrated below, then answer each of the 4 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** http://bit.ly/towerhint1 http://bit.ly/towerhint2



Height 1 Height 3 Height 5

1. **(1 point)** Use the figures above and the table below to help you determine how many cubes are needed to build these and similar figures.

Height of Tower	Number of Cubes in Center Column	Number of cubes in one leg	Total number of Cubes
1	1	0	1
3	3	3	15
5	5	10	45

2. **(1 point)** List at least two patterns that you see from the images and/or the table above (0.5 pts. for each pattern).

1. The building is increasing by odd numbers.

2. Each number in the center column is increasing by 2 each time.
1+2=3 3+2=5

ok, but what about # of cubes? Is there a pattern there?

2. Consider a tower of **height 50 cubes**. Answer the questions (a) - (c) below.

a) **(0.5 points)** How many cubes are in the **center column**?

50 cubes

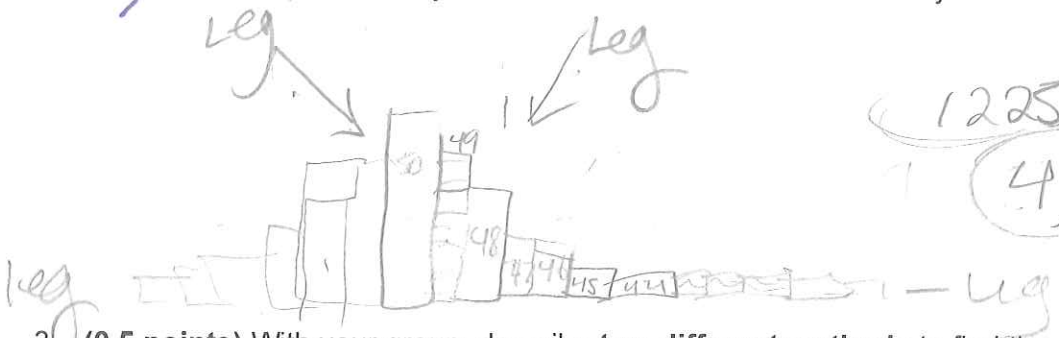
b) **(1 point)** How many cubes are in **one leg**? Show your work.

If the height of 5 has 10 cubes in one leg then 50 should have 100 cubes in one leg.

$5 \cdot 2 = 10$ $50 \cdot 2 = 100$

how can there only be 100 cubes in each leg, but 4900 total?

c) **(1 point)** How many **total cubes** are in the tower? Show your work.



$1225 \cdot 4 =$

4,900

+50

what about the center column?

3. **(0.5 points)** With your group, describe **two different methods** to find the cubes in problem 2(c). Write them below.

1. Adding every number down from 50 and then multiplying by 4.

remember to add middle column!

2. $49 \cdot 50 = 2,450 \quad (2) = 4,900$

4. **(5 points - see rubric)** Use the information you found above to create an equation (function) to calculate the total number of cubes in a tower with **height *n***, where *n* can be any positive integer. Use your function to calculate the number of cubes in a tower of height 5. **Show all work.**

-4

$4+3+2+1 = 10(4) = 40+5 = 45$

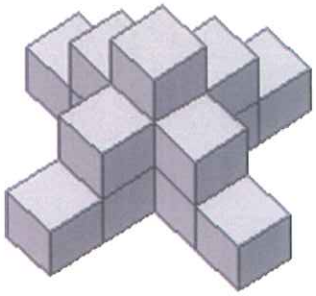
What about a general formula? One that we can plug 300 in for n and find the number of cubes?

Building Towers (Green Worksheet) 8/10
10 points possible

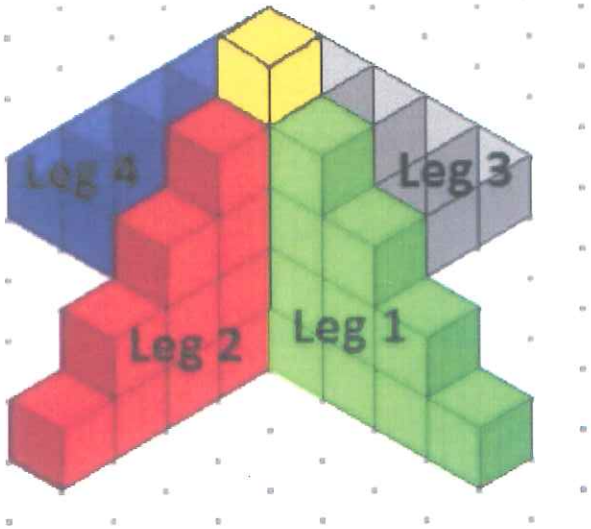
Name: Taylor Wilkinson
Date: 3-5-14

Directions: *Consider the cube towers illustrated below, then answer each of the 4 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** http://bit.ly/towerhint1 http://bit.ly/towerhint2

Height 1



Height 3



Height 5

1. **(1 point)** Use the figures above and the table below to help you determine how many cubes are needed to build these and similar figures.

Height of Tower	Number of Cubes in Center Column	Number of cubes in one leg	Total number of Cubes
1	1	0	1
2	2	1	6
3	3	3	15
4	4	6	28
5	5	10	45

Awesome!

+1, +2, +3, +4 (0, 1, 3, 6, 10)
+5, +9, +13, +17 (1, 6, 15, 28, 45)
+4 (1, 2, 3, 4, 5)

(height)
(4+3+2+1)
(10·4+5)

2. **(1 point)** List at least two patterns that you see from the images and/or the table above (0.5 pts. for each pattern).

- As the height of the tower increases by 1, the total number of cubes increases by 4 from the previous amount.

A little confusing... The difference in cubes increases by 4

- The Number of cubes in one leg increases by 1 each time from the previous amount.

Again, the difference in cubes from one height to the next increases by one.

2. Consider a tower of **height 50 cubes**. Answer the questions (a) - (c) below.

   a) **(0.5 points)** How many cubes are in the **center column**? 50

   b) **(1 point)** How many cubes are in **one leg**? Show your work.

1,225
(49+48+47+46...)

Did you really add all those numbers? ☺

   c) **(1 point)** How many **total cubes** are in the tower? Show your work.

$1{,}225 \cdot 4 + 50 = 4{,}950$

3. **(0.5 points)** With your group, describe **two different methods** to find the cubes in problem 2(c). Write them below.

• Multiply the number of cubes in one leg by four & add the number of cubes in the center column.

good!

4. **(5 points - see rubric)** Use the information you found above to create an equation (function) to calculate the total number of cubes in a tower with **height *n***, where *n* can be any positive integer. Use your function to calculate the number of cubes in a tower of height 5. **Show all work.**

-2

$t = 4l + n$

$45 = 4(10) + 5 = 45$

l = number of cubes in one leg } how would you find l?

t = total number of cubes

n = height of tower

We want 1 variable "n"! Can l be written in terms of "n"?

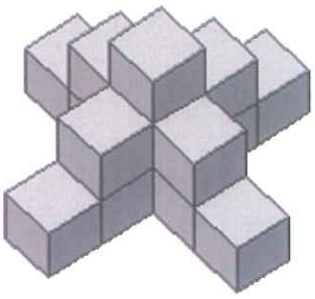
3.5/10

Building Towers (Green Worksheet)
10 points possible

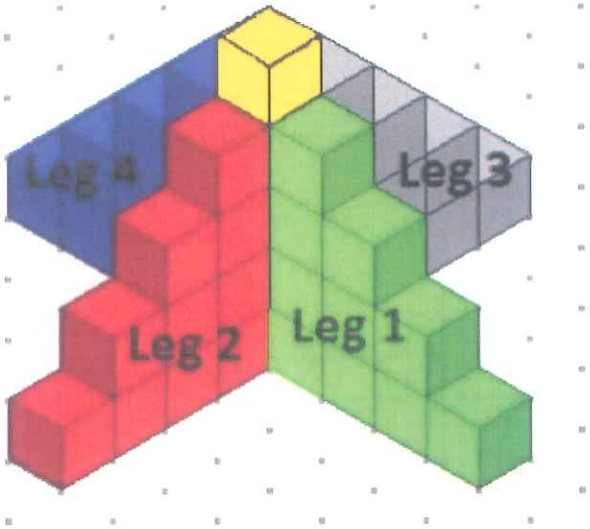
Name: Carol Campos
Date: _____

Directions: *Consider the cube towers illustrated below, then answer each of the 4 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** http://bit.ly/towerhint1 http://bit.ly/towerhint2

Height 1



Height 3



Height 5

1. **(1 point)** Use the figures above and the table below to help you determine how many cubes are needed to build these and similar figures.

Height of Tower	Number of Cubes in Center Column	Number of cubes in one leg	Total number of Cubes
1	1 x0 =	0	1
3	3 x1 =	3	15
5	5 x2 =	10	45

2. **(1 point)** List at least two patterns that you see from the images and/or the table above (0.5 pts. for each pattern).

- The total number of cubes goes up by 4 then multiplied by the height of the tower
- The number of cubes in center column is multiplied by continued numbers (0,1,2,3..) starting with 0.

ok, so #cubes in center column multiplied by (0,1,2,...) to get #cubes in one leg.
awesome observation!

2. Consider a tower of **height 50 cubes**. Answer the questions (a) - (c) below.

a) **(0.5 points)** How many cubes are in the **center column**? 50

b) **(1 point)** How many cubes are in **one leg**? Show your work. 100

$1225 = \frac{(50)(49)}{2}$

(where did you get 100?

c) **(1 point)** How many **total cubes** are in the tower? Show your work.

50.5? 250 total cubes

4(# of cubes in one leg) + (# cubes in center column)

3. **(0.5 points)** With your group, describe **two different methods** to find the cubes in problem 2(c). Write them below.

multiply height of tower by 5

why?

What is another method? Could it be similar to a method used on the front to fill out the table?

4. **(5 points - see rubric)** Use the information you found above to create an equation (function) to calculate the total number of cubes in a tower with **height *n***, where *n* can be any positive integer. Use your function to calculate the number of cubes in a tower of height 5. **Show all work.**

-4

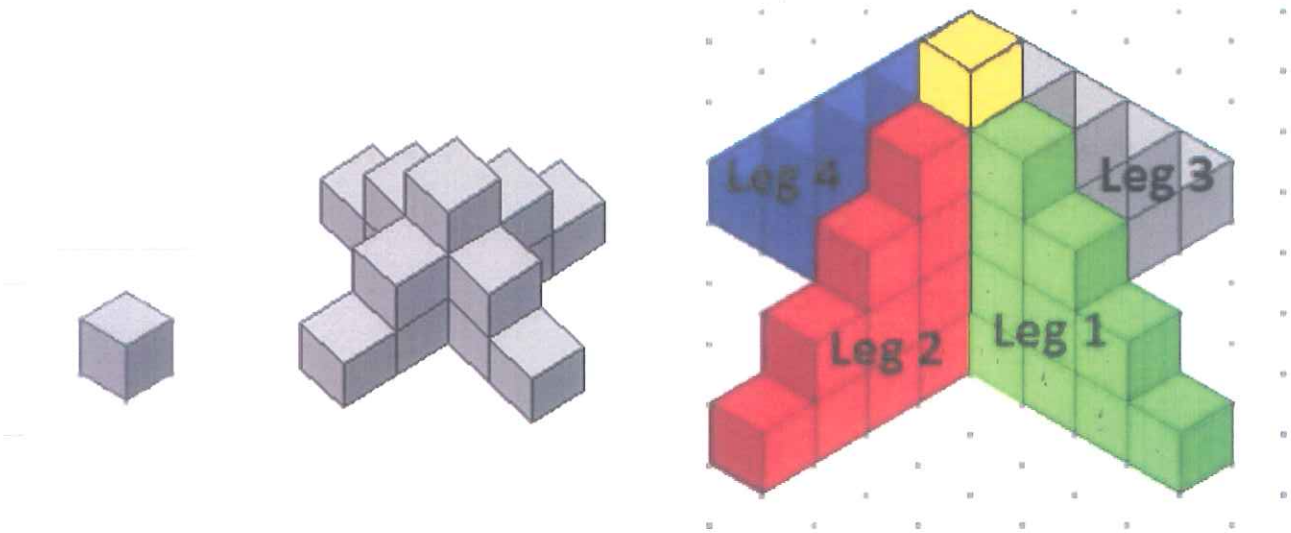
$n + 4(n) =$ Total number of cubes

45

What does n stand for? Where did 45 come from? Does your equation work with n=1? n=3?

Building Towers (Green Worksheet) 8/10 **Name:** Jenna Inskeep
10 points possible **Date:** _____

Directions: *Consider the cube towers illustrated below, then answer each of the 4 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** http://bit.ly/towerhint1 http://bit.ly/towerhint2



Height 1 Height 3 Height 5

1. **(1 point)** Use the figures above and the table below to help you determine how many cubes are needed to build these and similar figures.

Height of Tower	Number of Cubes in Center Column	Number of cubes in one leg	Total number of Cubes
1	1	0	1
3	3	3	15
5	5	10	45

2. **(1 point)** List at least two patterns that you see from the images and/or the table above (0.5 pts. for each pattern).

① the higher the tower the higher (more) ~~the number of~~ cubes on one leg, ② The number of center column cubes & the height of the tower is the same.
Is this important to know?

2. Consider a tower of **height 50 cubes**. Answer the questions (a) - (c) below.

   a) **(0.5 points)** How many cubes are in the **center column**? 50

   b) **(1 point)** How many cubes are in **one leg**? Show your work.

good!

50+49+48+47+46+45+44+43+42+41+40+39+38+37+36+35+34+33
+32+31+30+29+28+27+26+25+24+23+22+21+20+19+18+17+16+15+14+13+12
+11+10+9+8+7+6+5+4+3+2+1 = [illegible] 1225

   c) **(1 point)** How many **total cubes** are in the tower? Show your work.

1225 x 4 = 4900 + 50 = 4950 cubes

3. **(0.5 points)** With your group, describe **two different methods** to find the cubes in problem 2(c). Write them below.

① (1225) (50) (4950)
1 leg x 4 + cubes in center column = total

② count
↘ wasn't adding 49 to 1 like counting? Is there an easier way to "count"

4. **(5 points - see rubric)** Use the information you found above to create an equation (function) to calculate the total number of cubes in a tower with **height *n***, where *n* can be any positive integer. Use your function to calculate the number of cubes in a tower of height 5. **Show all work.**

-2

L x 4 + n = T

10 x 4 + 5 = 45 ✓

L = leg cubes
[illegible]
T = total cubes

how would you find L?

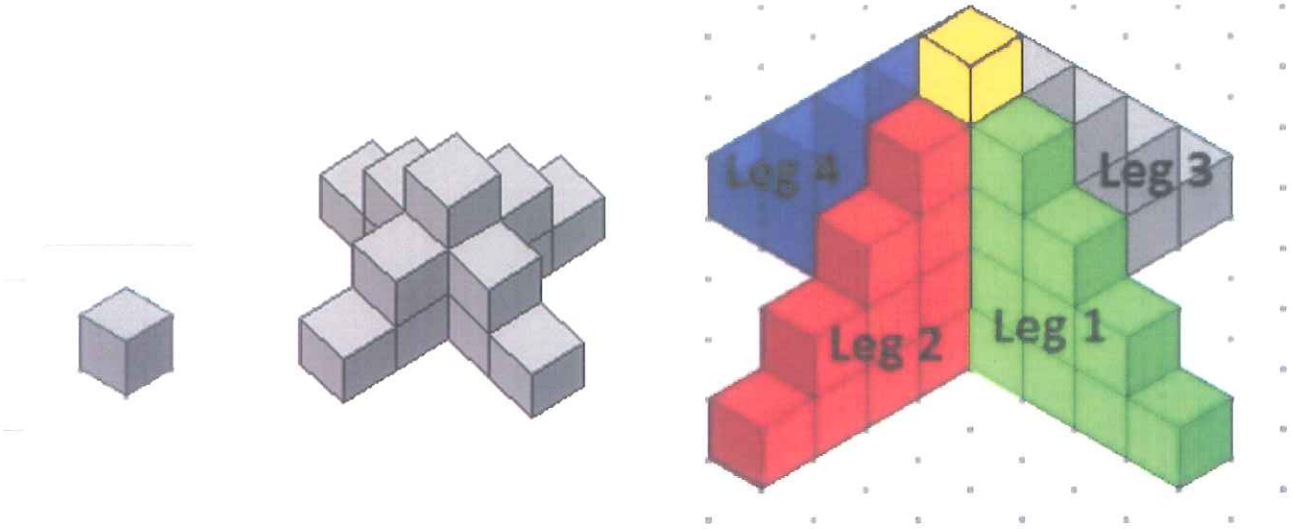
we just want one variable, n!

49.49 ÷ 2 = 1200.5 x 4 =
4802 + 50 =

Building Towers (Green Worksheet) +5.5/10
10 points possible

Name: Corinne Mathngly
Date: _____

Directions: *Consider the cube towers illustrated below, then answer each of the 4 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** http://bit.ly/towerhint1 http://bit.ly/towerhint2



Height 1 Height 3 Height 5

1. **(1 point)** Use the figures above and the table below to help you determine how many cubes are needed to build these and similar figures.

Height of Tower	Number of Cubes in Center Column	Number of cubes in one leg	Total number of Cubes
1	1	0	1
3	3	3	15
5	5	10	45

2. **(1 point)** List at least two patterns that you see from the images and/or the table above (0.5 pts. for each pattern).

15
3
45

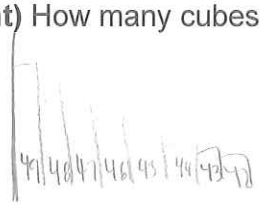
The number of blocks is tripled, and the number of cubes in the center column was the same as the height of the tower.

good!
do you think these are important patterns?

2. Consider a tower of **height 50 cubes**. Answer the questions (a) - (c) below.

   a) **(0.5 points)** How many cubes are in the **center column**? 50

   b) **(1 point)** How many cubes are in **one leg**? Show your work.

-½ 50  = 1,225

where did this number come from?

   c) **(1 point)** How many **total cubes** are in the tower? Show your work.

1225
4
4,900 total cubes

3. **(0.5 points)** With your group, describe **two different methods** to find the cubes in problem 2(c). Write them below.

1. adding every number down from 50, and then multiplying that by 4.

(2) 49·50 = 2,450 (2) = 4,900

How did you know that this would work?

+50 (for center column)

4. **(5 points - see rubric)** Use the information you found above to create an equation (function) to calculate the total number of cubes in a tower with **height *n***, where *n* can be any positive integer. Use your function to calculate the number of cubes in a tower of height 5. **Show all work.**

-4

(4+3+2+1) = 10(4) = 40 + 5

45

Could you use this method to write a formula?

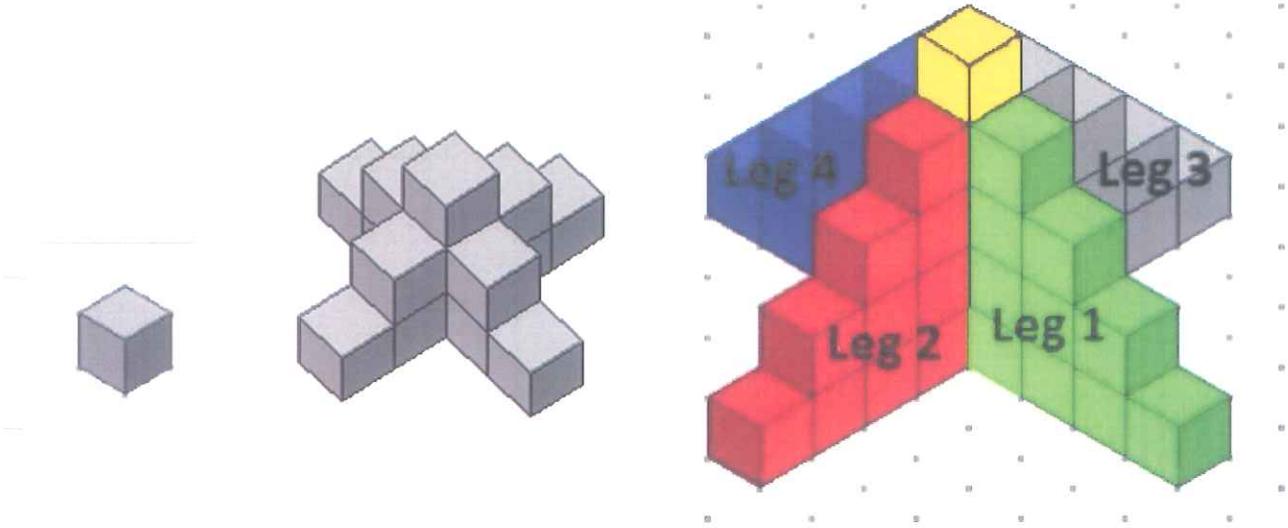
What about the generic formula?

Building Towers (Green Worksheet)
10 points possible

+18 /10

Name: Claire Hess
Date: _____

Directions: *Consider the cube towers illustrated below, then answer each of the 4 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** http://bit.ly/towerhint1 http://bit.ly/towerhint2



Height 1 Height 3 Height 5

1. **(1 point)** Use the figures above and the table below to help you determine how many cubes are needed to build these and similar figures.

Height of Tower	Number of Cubes in Center Column	Number of cubes in one leg	Total number of Cubes
1	1	0	1
3	3	3	15
5	5	10	45

2. **(1 point)** List at least two patterns that you see from the images and/or the table above (0.5 pts. for each pattern).

the # of cubes in the center column increases by 2. the height of the lower 1's = to the # of cubes in the center column

technically correct based on table but the height towers given are random

2. Consider a tower of **height 50 cubes**. Answer the questions (a) - (c) below.

a) **(0.5 points)** How many cubes are in the **center column**? 50

b) **(1 point)** How many cubes are in **one leg**? Show your work.

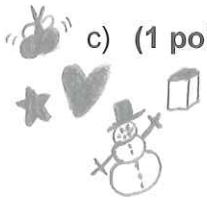
50 cubes 100 cubes

-.5

49+48+47+46.... = 1225

sum of

how did you add the first 49 integers?



c) **(1 point)** How many **total cubes** are in the tower? Show your work.

100·4=400

400+50=450

1225·4 = 4900 450 total cubes

4900+50 = 4950 total cubes

3. **(0.5 points)** With your group, describe **two different methods** to find the cubes in problem 2(c). Write them below.

add all #'s (49+48+47...). then multiply it by 4 because it's the # of legs then add the height.

-.25

4. **(5 points - see rubric)** Use the information you found above to create an equation (function) to calculate the total number of cubes in a tower with **height *n***, where *n* can be any positive integer. Use your function to calculate the number of cubes in a tower of height 5. **Show all work.**

P= previous numbers ?

P·4+n

-3.75

(4+3+2+1)·4+5

10·4+5

40+5

45

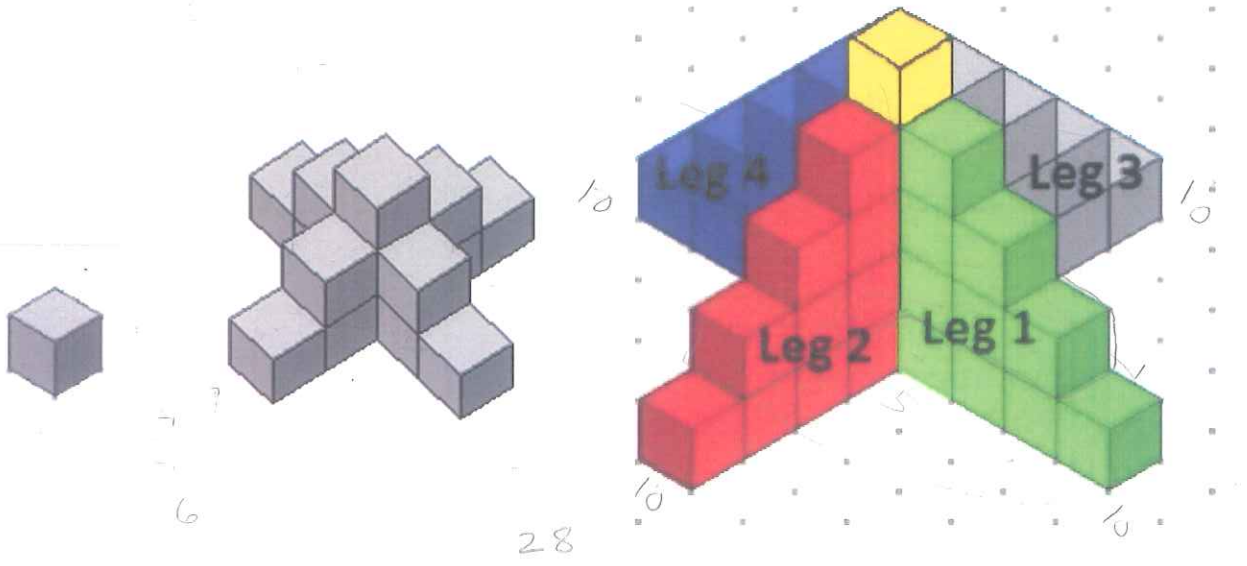
What is previous number, P? We just want one variable n! Is there a relationship between the height and the # of cubes in a leg?

Building Towers (Green Worksheet) +8/10
10 points possible

Name: Savannah Arno
Date: 3/5/14

Directions: *Consider the cube towers illustrated below, then answer each of the 4 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** http://bit.ly/towerhint1 http://bit.ly/towerhint2

H1) 1
H2) 6
H3) 15
H4) 28
H5) 45



Height 1 | Height 2 (2 tall) | Height 3 | Height 4 (4 tall) | Height 5

4+3+2+1=10
10x4=40+5=45

1. **(1 point)** Use the figures above and the table below to help you determine how many cubes are needed to build these and similar figures.

Height of Tower	Number of Cubes in Center Column	Number of cubes in one leg	Total number of Cubes
1	1	0	1
3	3	3	15
5	5	10	45

2. **(1 point)** List at least two patterns that you see from the images and/or the table above (0.5 pts. for each pattern).

good!

Pattern #1: Duplicate the model and then add to each of the legs. Ex) Height 1 you would duplicate it (2 blocks tall) and then add one to each of the legs which totals 6, the number of blocks in Height 2. And same with Height 2 to Height 3, you start with 6, duplicate and then add one to each of the legs and then add two so it would look like: and get a total of 15.

•The rule for this pattern is duplicate the center column then add on (the number of the Height) and then add an increasing number to each leg as shown in my example.

Pattern #2: Do the Height (Ex: Height 5 - 1 = 4) and do the number plus each decreasing number (Ex: 4+3+2+1=10) →

pattern 2 (cont.): the third step is that you multiply by the number of legs (Ex: 4) and then add the height (Ex: Height 5) I used the Height 5 model and did 4+3+2+1=10 then mult. by the legs (4) and then added the Height (5) totaling in the correct answer of 45.

2. Consider a tower of **height 50 cubes**. Answer the questions (a) - (c) below.

a) **(0.5 points)** How many cubes are in the **center column**?

50 cubes are in the center column

b) **(1 point)** How many cubes are in **one leg**? Show your work.

1225 cubes are in each leg. The way I found this is by doing 1225 mult. by 4 (for each leg) and add the height (50) = 4950 which is the total

1225 x 4 = 4900 + 50 = 4950

c) **(1 point)** How many **total cubes** are in the tower? Show your work.

49+48+47+46+etc. = 1225 x 4 = 4900 + 50 = 4950

Does this go in (c)?

how do you know what this is?

3. **(0.5 points)** With your group, describe **two different methods** to find the cubes in problem 2(c). Write them below.

method 1: 49+48+47+46+45+44+43+42+41+40+39+38+37+36+35+34+33+32+31+30+29+25+27+26+25+24+23+22+21+20+19+18+17+16+15+14+13+12+11+10+9+8+7+6+5+4+3+2+1 = 1225 x 4 = 4900 + 50 = 4950

OK ✓

subtract 1 from the height 50-1=49 and add all of the numbers together then mult. by the number of legs (4) and then add the height (+50)

method 2: Duplicate the model previously and add the previous number to each one of the legs.

4. **(5 points - see rubric)** Use the information you found above to create an equation (function) to calculate the total number of cubes in a tower with **height *n***, where *n* can be any positive integer. Use your function to calculate the number of cubes in a tower of height 5. **Show all work.**

-2

p = previous number

l = legs

n = Height

(4) p+3+2+1 = 10 x 4l = 40 + n = 45

p·4+n

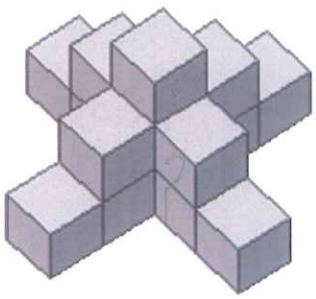
where do you get this "previous number"? what is previous number? is it related to n?

Building Towers (Green Worksheet) 6.5/10
10 points possible

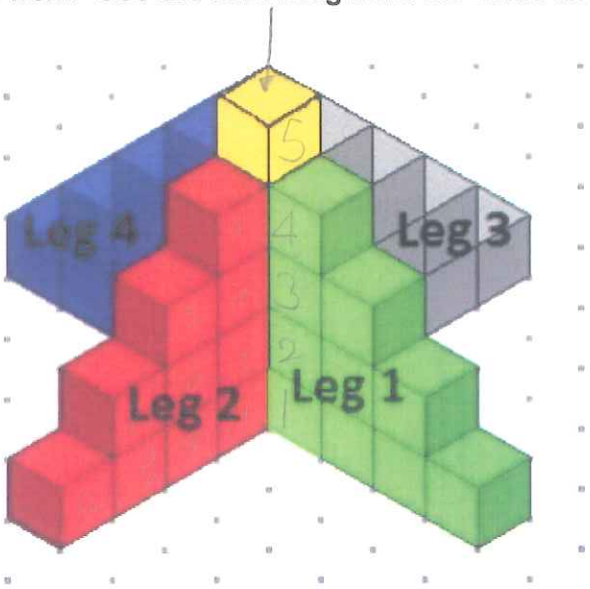
Name: Brent Mauger
Date: 3.5.14

Directions: *Consider the cube towers illustrated below, then answer each of the 4 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** http://bit.ly/towerhint1 http://bit.ly/towerhint2

Height 1



Height 3



Height 5

1. **(1 point)** Use the figures above and the table below to help you determine how many cubes are needed to build these and similar figures.

Height of Tower	Number of Cubes in Center Column	Number of cubes in one leg	Total number of Cubes
1	1	0	1
3	3	3 3+3=15	15
5	5	10	45

10·4=40+5=45

2. **(1 point)** List at least two patterns that you see from the images and/or the table above (0.5 pts. for each pattern).

Straight across... each level is one block higher the closer it gets to the center which is always the highest point.

The longer the picture gets the longer it becomes?

Confusing!

2. Consider a tower of **height 50 cubes**. Answer the questions (a) - (c) below.

   a) **(0.5 points)** How many cubes are in the **center column**? 50

   b) **(1 point)** How many cubes are in **one leg**? Show your work. 1,275

   1,225

   I think you added the center column of 50 too soon!

   c) **(1 point)** How many **total cubes** are in the tower? Show your work.

   -1/2

   $(1,225 \cdot 4) + 50$ Right idea, wrong numbers!

   $5,100 + 50$

   5,150 in the tower

3. **(0.5 points)** With your group, describe **two different methods** to find the cubes in problem 2(c). Write them below.

   the equation: $n4 + w$

   n = Number of cubes in one leg

   w = number of cubes in center column

   In order to find 1,275 you could've done 50+49+48+47+46...

   Why should we include 50?

4. **(5 points - see rubric)** Use the information you found above to create an equation (function) to calculate the total number of cubes in a tower with **height *n***, where *n* can be any positive integer. Use your function to calculate the number of cubes in a tower of height 5. **Show all work.**

   -2

   $n4+w$

   $n4+5$

   $10 \cdot 4 + 5$

   45

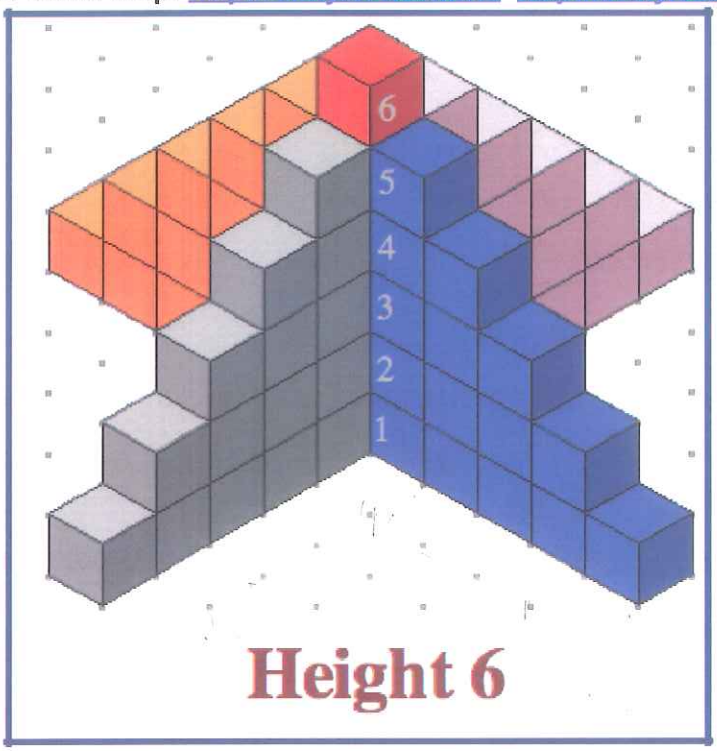
   $10 = n$

   Is there a formula for "n"? Does your formula work for n=1?

Building Towers (Blue Worksheet) 9.5/10
10 points possible

Name: Stephen Qwee
Date: _____

Directions: Work on question 1 and 2 individually, then get into groups and complete the worksheet together.
See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2



1. **(1 point)** How many cubes are needed to make the figure above? **Show your work**.

15 × 4 = 60
+6
66
What is this? Explain !!

2. **(2 points)** Suppose you built a similar figure 4 cubes high. How many cubes are needed to make this figure? **Show your work.**

6 × 4 = 24
+4
28

4+3+3+2+2+1+1 = 16
16 + 3 + 2 + 2 + 2 + 1 + 1 + 1 + 1
2
1

3. **(1 point)** Using the methods you came up with above, find the amount of cubes in a figure with height 150. **Show your work.**

n-1
149, 148 ... 1
E good!

$\left(\frac{150(150-1)}{2}\right)(4) + 150 = x$

11175(4) + 150 = 44850

$\left(\frac{n(n-1)}{2}\right) \cdot 4 + h = x$
↳ does h=n?

4. **(1 point)** With your group, describe **two different methods** to find the cubes in problem 3. Write them below.

1) add up all the numbers then multiply them by 4 then add the original height of the object to it

2) $\left(\frac{n(n-1)}{2}\right)(4)+h=x$

formulas

How did you get this fancy formula?

5. **(5 points - see rubric) Generalize** one of the above methods to determine a formula for the number of cubes in a similar tower *n* cubes high. (Hint: Try to use a table to organize your thoughts). Using the formula that your group came up with, choose a figure from the front side of the worksheet and check your answer.

-1/2

$\left(\frac{n(n-1)}{2}\right)(4)+n=x$

Check your answer :)

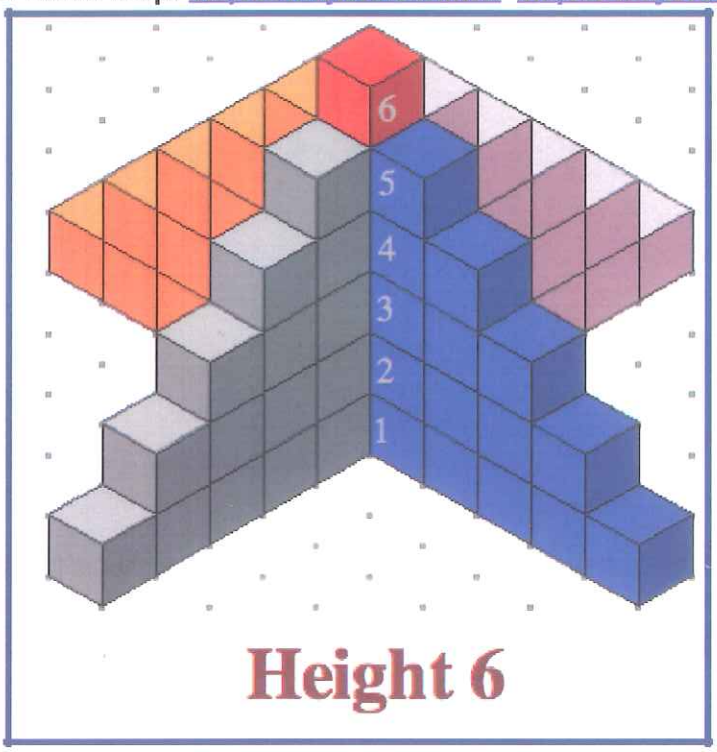
n = # of cubes high, n-1 = the top height of the wings/sides. then divide it by 2 for the upper missing half of the sides then multiply by 4 (in this case), then add the original height for the row in the middle

9.5/10

Building Towers (Blue Worksheet)
10 points possible

Name: Buzz Berlowman
Date: _____

Directions: Work on question 1 and 2 individually, then get into groups and complete the worksheet together.
See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2



1. **(1 point)** How many cubes are needed to make the figure above? **Show your work.**

$15 \times 4 = 60 + 6$

60: outside blocks; 6: 6 red blocks in the middle

66 cubes needed

2. **(2 points)** Suppose you built a similar figure 4 cubes high. How many cubes are needed to make this figure? **Show your work.**

$6 \times 4 = 24 + 4 = 28$

How did you get 24?

28 cubes needed

3. **(1 point)** Using the methods you came up with above, find the amount of cubes in a figure with height 150. **Show your work.**

what does this mean?

$x = 4\left(\frac{h(h-1)}{2}\right) + h$

$x = 4\left(\frac{150(150-1)}{2}\right) + 150$

$4(11175) + 150 = x$

$44700 + 150 = x$

$44850 = x$

good!

44850 cubes needed

4. **(1 point)** With your group, describe **two different methods** to find the cubes in problem 3. Write them below.

1st method

a formula: $x = 4\left(\frac{h(h-1)}{2}\right) + h$

2nd method

ha! brute force, count the blocks on a leg, times it by 4 and add the middle column.

5. **(5 points - see rubric) Generalize** one of the above methods to determine a formula for the number of cubes in a similar tower *n* cubes high. (Hint: Try to use a table to organize your thoughts). Using the formula that your group came up with, choose a figure from the front side of the worksheet and check your answer.

-1/2

method 1

a formula: You times the height of the tower (n) to the height of it minus one. Then you divide it by two and times the whole thing by four. Finally, you then just add the height (n) to that to get your answer.

awesome!

$$x = 4\left(\frac{n(n-1)}{2}\right) + n$$

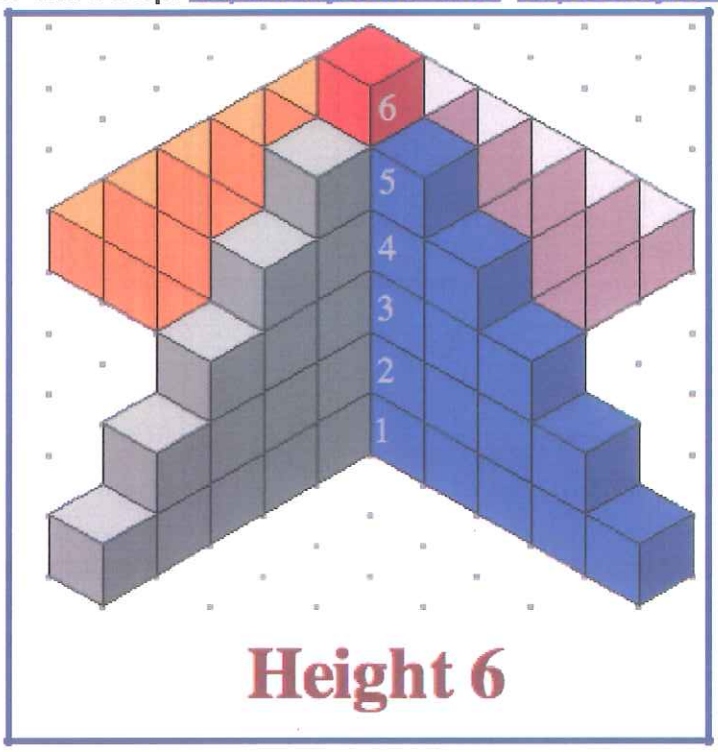
Check answer with example from front! We want to make sure it works :)

9.5/10

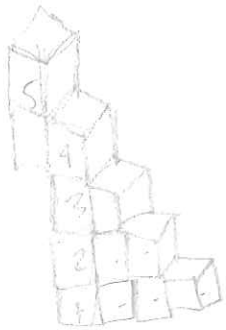
Building Towers (Blue Worksheet)
10 points possible

Name: Tanya C.
Date: _____

Directions: Work on question 1 and 2 individually, then get into groups and complete the worksheet together.
See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2



10×9 90 5 95



1 x 1
2 x 3
3 x 5
4 x 7
5 x 9
6 x 11

1. **(1 point)** How many cubes are needed to make the figure above? **Show your work**.

15 x 4 = 60 + 6 = 66

Explain where your numbers come from

2. **(2 points)** Suppose you built a similar figure 4 cubes high. How many cubes are needed to make this figure? **Show your work.**

6 x 4 = 24 + 4 = 28

good picture!

3. **(1 point)** Using the methods you came up with above, find the amount of cubes in a figure with height 150. **Show your work.**

$\left(\frac{(n)(n-1)}{2}\right) \cdot 4 + n = X$

Show more work!

X = 44,850

4. **(1 point)** With your group, describe **two different methods** to find the cubes in problem 3. Write them below.

1) add all numbers together multiply by 4 add height number

2) $\left(\frac{(n)(n-1)}{2}\right) \cdot 4 + n = x$

what does this mean in terms of the tower?

5. **(5 points - see rubric) Generalize** one of the above methods to determine a formula for the number of cubes in a similar tower *n* cubes high. (Hint: Try to use a table to organize your thoughts). Using the formula that your group came up with, choose a figure from the front side of the worksheet and check your answer.

-1/2

$\left(\frac{(n)(n-1)}{2}\right) \cdot 4 + n = x$

n represents number of cubes high. n-1 is for top height of the wings. I divided it by two for the missing top half of wings, then mutiplied by 4 for the wings. Lastly I added by the height number again for the middle row (column) good!

Loved your explanation!

3.5/10

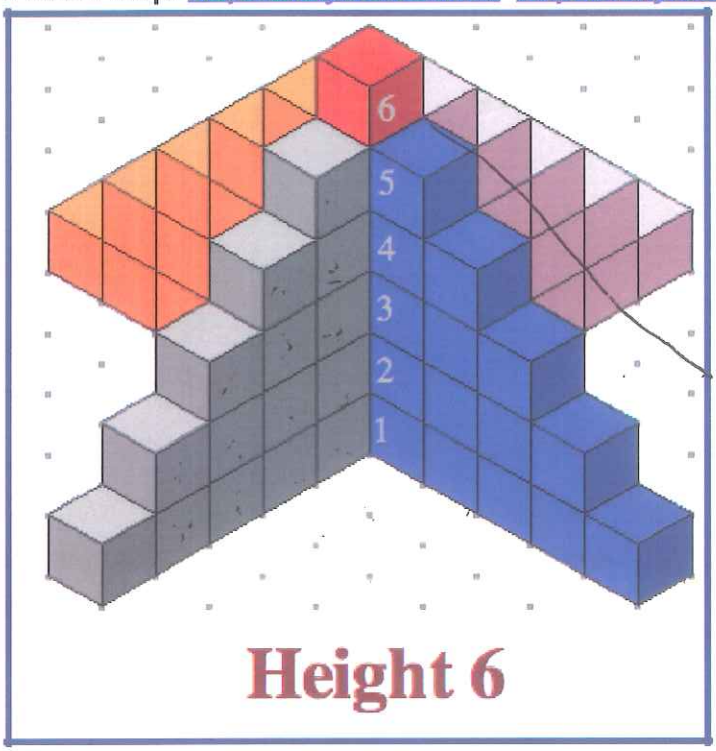
Building Towers (Blue Worksheet)
10 points possible

Name: Paxston Robinson
Date: 3-5-14

Directions: Work on question 1 and 2 individually, then get into groups and complete the worksheet together.
See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2

15
x 4
60
+ 6
66

+5



1. **(1 point)** How many cubes are needed to make the figure above? **Show your work**.

-1/2

66

2. **(2 points)** Suppose you built a similar figure 4 cubes high. How many cubes are needed to make this figure? **Show your work.**

4 5

-1

3. **(1 point)** Using the methods you came up with above, find the amount of cubes in a figure with height 150. **Show your work.**

150
x 3
450
x 4
1800

11,355
44,850
1800
+151
1951

11,355
x 4
45,420
+5,571

4. **(1 point)** With your group, describe **two different methods** to find the cubes in problem 3. Write them below.

5 $\overline{)150}$ 30

×30
150

5 is 30 of 150
So I just multiplied
The answers of one side of 5 times 30 & multi that by 4 add 5 & 1

5. **(5 points - see rubric) Generalize** one of the above methods to determine a formula for the number of cubes in a similar tower *n* cubes high. (Hint: Try to use a table to organize your thoughts). Using the formula that your group came up with, choose a figure from the front side of the worksheet and check your answer.

-3

$\frac{n(4(n-1)+2)}{2} = n(2n-1) = 2n^2-n$ ✓

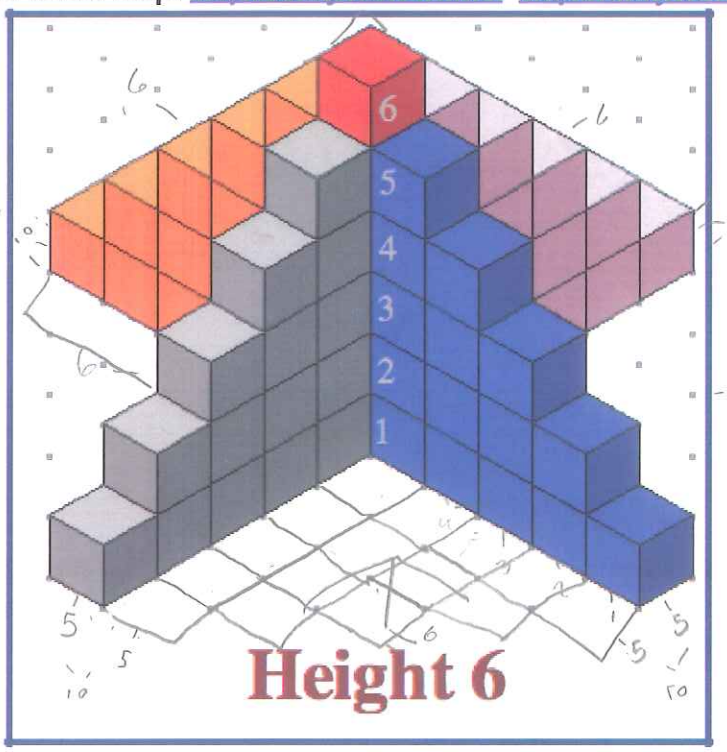
Check formula!
What does n stand for?

8/10

Building Towers (Blue Worksheet)
10 points possible

Name: Rody DeLeon
Date: _____

Directions: Work on question 1 and 2 individually, then get into groups and complete the worksheet together.
See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2



6x4=24
5x8=40

1. **(1 point)** How many cubes are needed to make the figure above? **Show your work.**

How did you get this? (6x4=24, 5x8=40)

64 cubes

66

2. **(2 points)** Suppose you built a similar figure 4 cubes high. How many cubes are needed to make this figure? **Show your work.**

6x4=24
+4
28 ok

3. **(1 point)** Using the methods you came up with above, find the amount of cubes in a figure with height 150. **Show your work.**

$\left(\frac{150\times(150-1)}{2}\right)\times 4+150=14{,}850$

good!

$\frac{(150-1)}{2}\times(4)+150=X$

$\frac{n^2-n}{2}\cdot 4+n=X$

awesome formula! how did you get it?

$\left(\frac{n(n-1)}{2}\right)\cdot 4+n=X$

4. **(1 point)** With your group, describe **two different methods** to find the cubes in problem 3. Write them below.

Add up all the numbers then multiply them by 4 then up original height of the figure

2. $\left(\frac{n(n-1)}{2}\right)(4)+n=x$

5. **(5 points - see rubric) Generalize** one of the above methods to determine a formula for the number of cubes in a similar tower *n* cubes high. (Hint: Try to use a table to organize your thoughts). Using the formula that your group came up with, choose a figure from the front side of the worksheet and check your answer.

$\left(\frac{n(n-1)}{2}\right)(4)+n=x$

-1

n=h of cubes high. n-1= the top height of the sides, then divide it by 2 for the upper missing half of the sides then multiplying by 4 then add the original height for the row in the middle

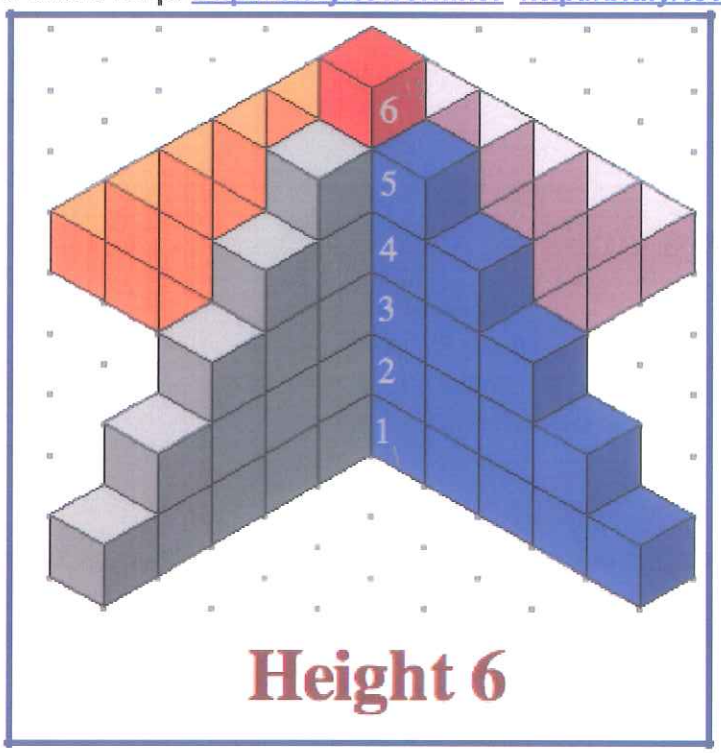
yes!

Never forget to check your formula!

Building Towers (Blue Worksheet) 9/10
10 points possible

Name: Sabrina Fricke
Date: _____

Directions: Work on question 1 and 2 individually, then get into groups and complete the worksheet together.
See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2



1. **(1 point)** How many cubes are needed to make the figure above? **Show your work**.

15·4 60 + 6 66

What do these numbers represent?

2. **(2 points)** Suppose you built a similar figure 4 cubes high. How many cubes are needed to make this figure? **Show your work.**

6·4 24 + 4 28

3. **(1 point)** Using the methods you came up with above, find the amount of cubes in a figure with height 150. **Show your work.**

44,850 Cubes

n(4)+150
11174(4) = 44700
+ 150
44850

we added up all the #'s
How?
150·149 / 2 ·4
+150

9955
11325
11175

4. **(1 point)** With your group, describe **two different methods** to find the cubes in problem 3. Write them below.

- Adding them all together, multiplying by 4 & adding 150 — 4nth

- $\frac{150 \cdot (150-1)}{2} \cdot 4 + 150$

n = height of cubes

OK

5. **(5 points - see rubric) Generalize** one of the above methods to determine a formula for the number of cubes in a similar tower *n* cubes high. (Hint: Try to use a table to organize your thoughts). Using the formula that your group came up with, choose a figure from the front side of the worksheet and check your answer.

-1

Where did this come from? What does it mean?

$\frac{n \cdot (n-1)}{2} \cdot 4 + n$

more descriptive! correct answer, but what does each term represent?

$\frac{6 \cdot (6-1)}{2} \cdot 4 + 6$

$\frac{6 \cdot 5}{2} \cdot 4 + 6$

$\frac{30}{2} \cdot 4 + 6$

$15 \cdot 4 + 6$

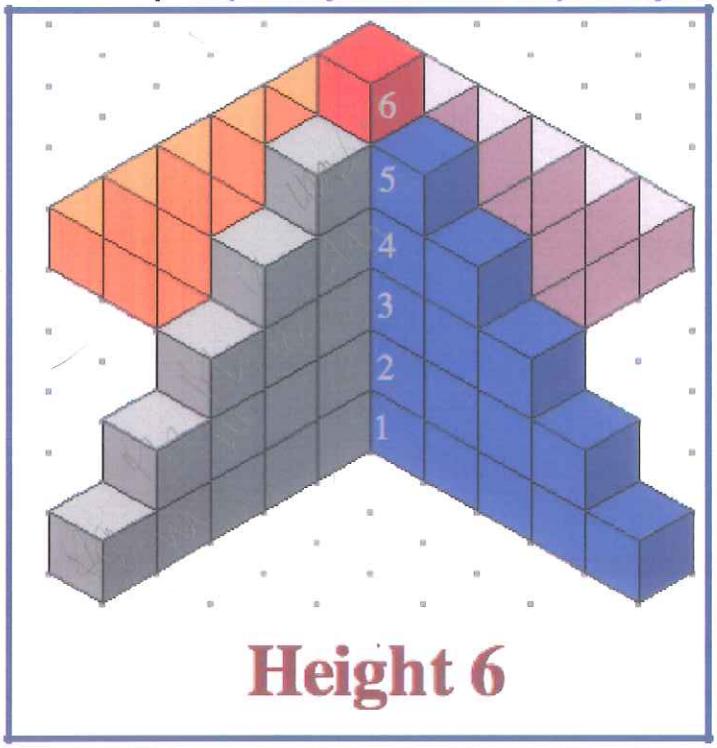
$60 + 6$

66 Cube ✓

Building Towers (Blue Worksheet) +9/10
10 points possible

Name: Casey Sroay
Date: 3/5

Directions: Work on question 1 and 2 individually, then get into groups and complete the worksheet together.
See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2



1. **(1 point)** How many cubes are needed to make the figure above? **Show your work**.

15 · 4 + 60 = 60

what does each mean?

2. **(2 points)** Suppose you built a similar figure 4 cubes high. How many cubes are needed to make this figure? **Show your work.**

6 · 4 + 4 = 28

3. **(1 point)** Using the methods you came up with above, find the amount of cubes in a figure with height 150. **Show your work.**

(n) · 4 + 150 = $\frac{n \cdot n-1}{2} \cdot 4 + n$

we added all the numbers up to 150 up = 11325

+ 11175

× 4

44,850 cubes

manually? or used a formula?

$\frac{150 \cdot 149}{2} \cdot 4 + 150 = 44,850$ cubes

4. **(1 point)** With your group, describe **two different methods** to find the cubes in problem 3. Write them below.

1) by adding them all then multiplying by 4, then adding 150 $4n+150 = x$

2) $\frac{150 \cdot (150-1)}{2} \cdot 4 + 150$

5. **(5 points - see rubric) Generalize** one of the above methods to determine a formula for the number of cubes in a similar tower *n* cubes high. (Hint: Try to use a table to organize your thoughts). Using the formula that your group came up with, choose a figure from the front side of the worksheet and check your answer.

-1

n = height of cubes

$\frac{n \cdot (n-1)}{2} \cdot 4 + n$

1 leg

center column

be more descriptive! what does each term represent?

$\frac{6 \cdot (6-1)}{2} \cdot 4 + 6$

5

$\frac{6 \cdot 5}{2}$

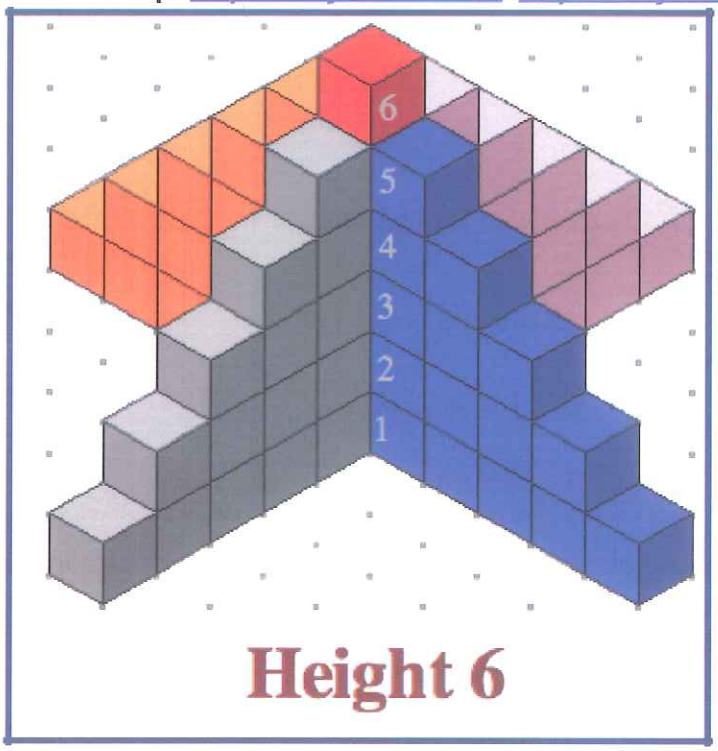
$15 \cdot 4 = 60$

$60 + 6 = 66$ ✓

Building Towers (Blue Worksheet) +9/10
10 points possible

Name: Sonja Vidovic
Date: March 5, 2014

Directions: Work on question 1 and 2 individually, then get into groups and complete the worksheet together.
See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2



1. **(1 point)** How many cubes are needed to make the figure above? **Show your work**.

6 + 15 + 15 + 15 + 15 = 66

66 blocks

2. **(2 points)** Suppose you built a similar figure 4 cubes high. How many cubes are needed to make this figure? **Show your work.**

-1

4 + 6 + 6 + 6 = 28

where is the 4th leg?

28 blocks

3. **(1 point)** Using the methods you came up with above, find the amount of cubes in a figure with height 150. **Show your work.**

$\frac{150 \cdot 149}{2} \cdot 4 + 150$ 44850 blocks

How did you come up with this?

4. **(1 point)** With your group, describe **two different methods** to find the cubes in problem 3. Write them below.

n = height
C = # cubes in leg

1) $4C + n$

or

$n + (n-1) + (n-2) + (n-3) \ldots$ & so on until $n-(n-1)$

2) $\frac{n \cdot (n-1)}{2} \cdot 4 + n$

n = height

way to be descriptive!

5. **(5 points - see rubric) Generalize** one of the above methods to determine a formula for the number of cubes in a similar tower *n* cubes high. (Hint: Try to use a table to organize your thoughts). Using the formula that your group came up with, choose a figure from the front side of the worksheet and check your answer.

n = 6

n = height

$6 \cdot 5 = 30$ → base × height of one leg to get rectangle

$30 \div 2$ → divide by 2 b/c only half of the rectangle is shown

$15 \cdot 4$ → multiply by 4 b/c that's how many legs there are

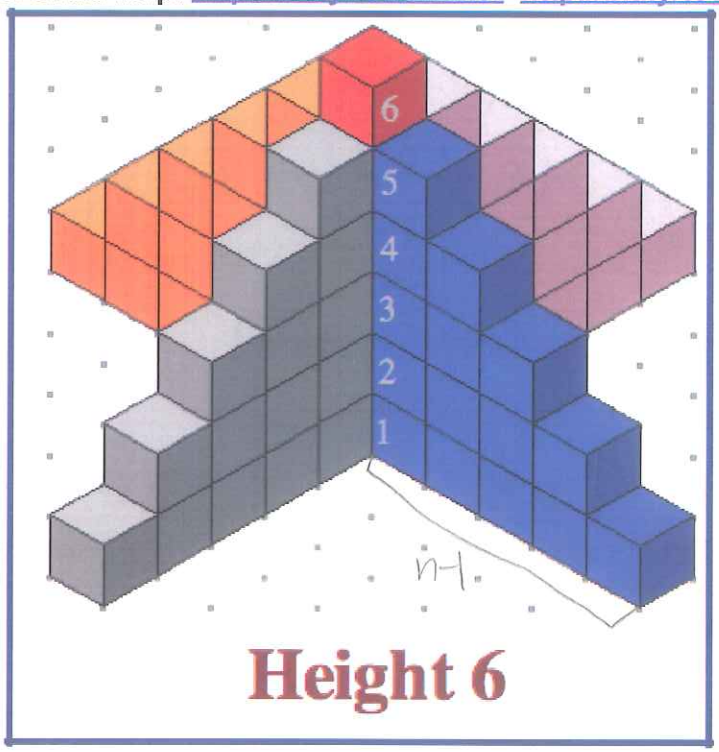
$60 + 6$ → add 6 b/c that is the center column

66 cubes

Building Towers (Blue Worksheet) 10/10
10 points possible

Name: Susie Dunlea
Date: _____

Directions: Work on question 1 and 2 individually, then get into groups and complete the worksheet together.
See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2



1. **(1 point)** How many cubes are needed to make the figure above? **Show your work.**

$6+15+15+15+15$

66 cubes

2. **(2 points)** Suppose you built a similar figure 4 cubes high. How many cubes are needed to make this figure? **Show your work.**

$4+(6\cdot4)$

28 cubes

3. **(1 point)** Using the methods you came up with above, find the amount of cubes in a figure with height 150. **Show your work.**

$\frac{150\cdot149}{2}\pm1175\cdot4=44700+150$

Why did you decide to do this?

44850 cubes ✓

4. **(1 point)** With your group, describe **two different methods** to find the cubes in problem 3. Write them below.

long way: $4c + n$ c = the counted number of cubes in one leg
n = height

Love that you're specifying variables!

or

$n + (n-1) + (n-2) + (n-3) + \ldots$ etc. until you get to $(n-(n-1))$

oh!

Short way: $4\left(\frac{n \cdot (n-1)}{2}\right) + n$ n = height

↑ OK

5. **(5 points - see rubric) Generalize** one of the above methods to determine a formula for the number of cubes in a similar tower *n* cubes high. (Hint: Try to use a table to organize your thoughts). Using the formula that your group came up with, choose a figure from the front side of the worksheet and check your answer.

I'm assuming this is your formula?

$n = 6$ ▷ n = height

$6 \cdot 5 = 30$ ▷ base x height of one leg to get rectangle

$\frac{30}{2} = 15$ ▷ divide by 2 b/c only half of the rectangle is shown

$15 \cdot 4$ → multiply by 4 b/c there are 4 legs

$60 + 6$ → add 6 because there are 6 cubes in the center column.

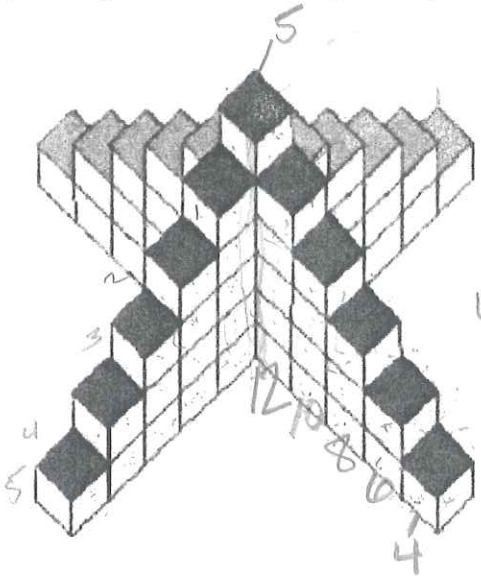
66 cubes total

Building Towers (Yellow Worksheet)
10 points possible

11.5/10

Name: Jackson Tinsley
Date: 3/6/14

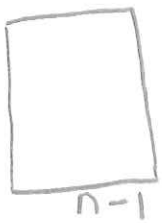
Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



2 staircases = 1 rectangle

$n-1 + n-2 + n-3 + n-4 + n-5$

$4(n-1)$



1) **(1 point)** Describe what you notice about the structure of the tower above.

The tower is composed of four "staircases" with 15 blocks each. There is an additional tower in the middle between all four staircases. 60 + 6 = 66 total blocks

+1

2) Reference the diagram shown above:

a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1

There are four identical staircases with 15 blocks each plus an extra 6 blocks in the middle of the four staircases. $15 \times 4 = 60 + 6 =$ 66 total blocks

b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1

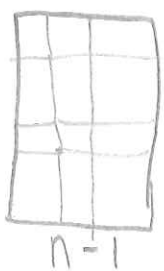
Your strategy would work but it isn't the most efficient.

Yes, you know the highest number of the staircase is one less than the height. If each staircase is 299 then you can add 299 + 298 + 297... then multiply by 4 then add 300. This would not work easily for n.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

+1.5

Check your formula w/ n = 6



Good labeling

2 rectangles

$n(n-1)$ $2(n^2-n)$ $2n^2-2n$ + extra tower in middle $+n = 2n^2-n$

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

+5

n=height

Formula → $2n^2 - n$

$19{,}900 = 2n^2 - n$

$0 = 2n^2 - n - 19{,}900$

$\frac{1 \pm \sqrt{1 - 4(2)(-19{,}900)}}{2(2)}$

$\frac{1 \pm \sqrt{159201}}{4}$

$\frac{1 \pm 399}{4}$

$\frac{400}{4} = 100$

$100 = n$

$\frac{-398}{4}$

The height is 100 cubes.

I set the equation equal to zero to use the quadratic equation. The negative answer does not work because height cannot be negative.

Good Work!

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

W/ bottom painted

Each staircase has an area of 45

$5 + 7 + 9 + 11 + 13 = 45$

4 staircases → $4(45) = 180$

each stair on staircase has 5 painted faces.

The lone block on top of the tower has 5 painted faces. There is also a face in the middle of the bottom of the tower that is not a part of any staircase. $5 + 1 = 6$

$180 + 6$

186 units^2

+2

Area of n:

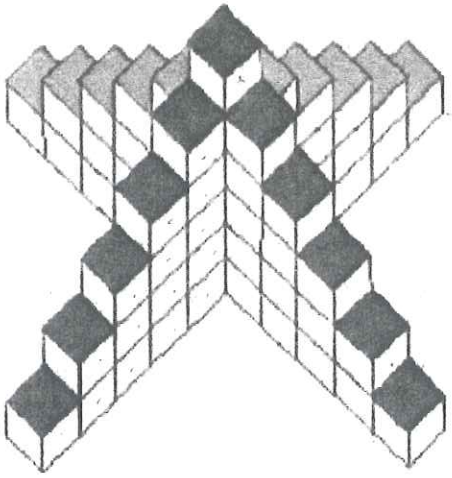
Good Job!

Building Towers (Yellow Worksheet)
10 points possible

11.5/10

Name: Aaron Beglin
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



2h+1

$\frac{1}{2h+1}h(2h-1)^2$

$4h(h-1)+4(2h-1)+1$

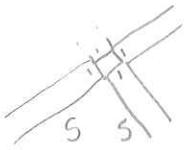
1) **(1 point)** Describe what you notice about the structure of the tower above. +1

In the center there is a one by six tower of blocks four staircase structures attach to the center on four of its sides one block shorter than the center tower. The stairs cases decrease by one block at a time as it travels away from the center.

base layer = 0
(height from base layer) = h
[(5-h) x 4] +1 = # of blocks per layer

2) Reference the diagram shown above:

a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.



base layer 5x4+1 = 21
2nd layer 4x4+1 = 17
3rd layer 3x4+1 = 13
4th 2x4+1 = 9
5th 1x4+1 = 5

6th 0x4+1 = 1

21
+17
+13
+ 9
+ 5
+ 1 = 66

(5-h) = length of the staircase from center
x4 = # of staircases
+1 = one block per layer in the center

+1

b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

It would work because you could plug 300 in for the 5 in step a. and work up to the top height.

h = height from base layer → (300-h) +1 = # of blocks for that layer

+1 Would not be the easiest but it does work.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

How do you know this? Show work/process

$h(2h-1)$ = area of 4 tower

*2

$6(2(6)-1) = 66$

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

+4.5

[redacted]

I would like to see more written explanation. Your math and work is sound.

$19,900 = h(2h-1)$

$2h^2 - h - 19,900$

$\frac{1 \pm \sqrt{1-4(2)(-19,900)}}{2(2)}$

$\frac{1 \pm 399}{4}$

100 or ~~-99.5~~

Showing work allows the [redacted] reader to understand your process.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

presuming the bottom isn't part of surface area.

165

$[4h(h-1)] + [4(2h-1)] + 1$

$4h^2 - 4h + 8h - 4 + 1$

$4h^2 - 4h + 8(h-1) + 5$

$4h^2 - 4h + 8h - 8 + 5$

$+ 8h - 3$

$4h^2 + 4h - 3$

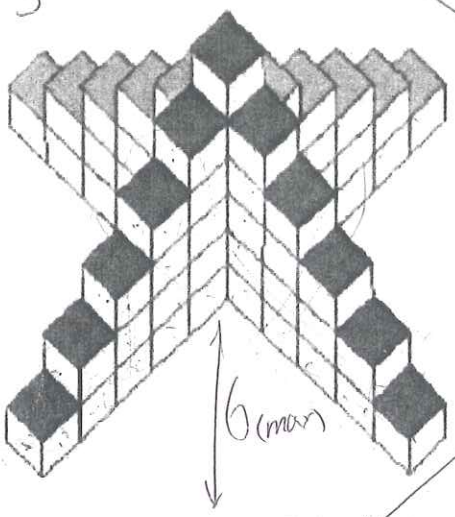
10.5/10

Building Towers (Yellow Worksheet)
10 points possible

3h-1
4n(n-1)+4(n-1)+1

Name: Connor Miller
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



4(n-1)+1
8(n-1)+5
2n-1
(2n-1)²
4·2·3·1
3·2·1=0

+1 1) **(1 point)** Describe what you notice about the structure of the tower above.

It has symmetry in 3 dimensions (has radial symmetry) Could be considered to contain 5, 3-dimensional coordinate points of blocks, each one percieved as a "unit block" in which the 4 external points connect to the center one while ever increasing a single unit in two directions but spanning 3 axes, until they reach the center point, or collide with each other

+1 2) Reference the diagram shown above:

a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

Break the figure into 5 parts, the center and each of the 4 congruent steps. The middle tower is 6x1x1 based upon the steps continual increase in height. each step is a sequence 5+4+3... 5 being replaced by the highest point of a step system excluding the center 6x1x1 tower piece That equals 15, multiply by 4, get 60 and add the six middle blocks to get 66.

+1 b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

Possibly depending upon ones definition of "easily", it is very easy to do x + x-1 + x-2, etc. but time consuming. (x being less than the height) A possible equation could be determined with it but

where x-# > 0

Very true point

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$\frac{1}{4}h(2h-1)^2$

$\frac{1}{4}(6)(2\cdot6-1)^2$

$\frac{1}{4}(12-1)^2$

$12-1=11^2=$

$h(2n-1)(2n-1)$

$h(2n-1)$

$2h^2-h$

+1.5 Didn't check

Show work/ process

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$2h^2 - h - 19,900 = 0$

quadratic → $\frac{1 \pm \sqrt{1 - 4(2)(-19,900)}}{2(2)}$ (399)

$\frac{1 \pm 399}{4} =$ 100 or ~~-99.5~~

+4.5
Would like more explanation.

Showing Work will help the reader understand your process and understand your logic.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+1.5 explain

* presuming bottom is not included SA

$4h^2 - 4h$ ✓
sides

$8(h-1) + 5$ ✓
steps

$4h(h-1) + 4(h-1) + 1$

$4h(h-1) + 4(2h-1) + 1$

$8h - 4 + 5$
$8h + 1$

$4h^2 - 4h + 8h - 4 + 1$

$4h^2 + 4h - 3$

Provide work.

165

$[4h^2 - 4h] + 8h - 8 + 5$ (15)
$8h - 3$

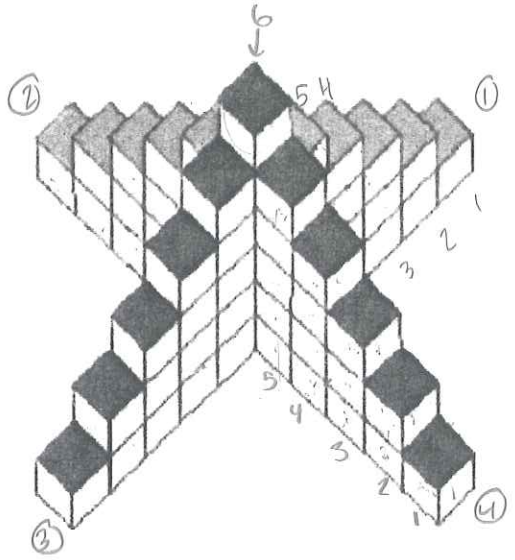
$4h^2 + 4h - 3$

Building Towers (Yellow Worksheet)
10 points possible

5.5/10

Name: Isabelle Tessier
Date: 3/6/14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



1+2+3+4+5=15
15(4)=60+6=66

1) **(1 point)** Describe what you notice about the structure of the tower above.

+1 The tower is symmetrical, one cube is added to each step, 66 cubes used,

2) Reference the diagram shown above:

a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1 1+2+3+4+5 = 15(4) = 60+6 = 66 cubes used
There are four sides, each with 15 cubes, & one column of 6 cubes. There is one column of 6 cubes, 4 columns of 5 cubes, 4 columns of 4 cubes, 4 columns of 3 cubes, 4 columns of 2 cubes, and 4 columns of 1 cube. 1(4)+2(4)+3(4)+4(4)+5(4)+6 = 66 cubes

b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1 It would not be easy because you would have to added a lot of numbers and then multiply by 4. There is a lot of room for error. ← Great Point!

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

n	#cubes
1	1
2	6
3	15
4	28
5	45
6	66

n	Base
1	1
2	5
3	9
4	13


5/9

? +0.5

4n-3 Generalized Equations should work for all entries
Check n=1, n=2, n=3...
if n=6, this equation won't work.
1+(n-1)(4n-3)

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

+0

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

$15(8) + 2(20) + 5 = 165 + 11 + 10 = \boxed{186 \text{ units}^2}$

SA Base

SA of one side (8 sides) + 2 sides (20 cubes) + SA top cube

15

8 × 15 + 2 sides for each top cube + 5 sides of the Top cube

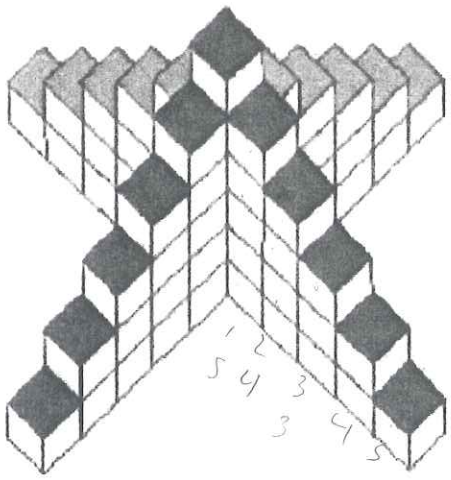
Good Work!

5/10

Building Towers (Yellow Worksheet)
10 points possible

Name: Priya Thomas
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** , **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

+1

symmetric, increasing height → less cubes per layer, resembles stairstep

Good Observation!

2) Reference the diagram shown above:

+1

a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

n	# of cubes total
1	1
2	6
3	15
4	28
5	45

)5)4)9)13)4)17)4

$6 + (5 \cdot 4) + (4 \cdot 4) + (3 \cdot 4) + (2 \times 4) + (1 \times 4) = x$

$6 + 20 + 16 + 12 + 8 + 4$

$26 + 16 + 24 \quad 66$

Good Equation

666 cubes

b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

no, the work is tedious & arduous without a formula. Manual labor is taxing. There are many components to the way I solved it.

+1

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

ratio of blocks filled per layer w/ full layer +4

13/49 9/25 5/9 1/1

7^{n-3} 5^{2n-2} 3^{n-1}

n=4 n=3 n=2

$n + ([n-1] \cdot 4) + ([n-2] \cdot 4) + ([n-3] \cdot 4) + ([n-4] \cdot 4) + ([n-5] \cdot 4) = 6$

$n + 4n - 4 + 4n - 8 + 4n - 12 + 4n - 16 + 4n - 20 = 666$ $4n - 3$

n	# of blocks on base
1	1
2	5
3	9
4	13

$4n - 3$

Generalized formula should work for all n's.

$1 + (n-1)(4n-3)$ $1 + (n-1)(4n) - 3$

$2 + (4n^2 - 4n)$

Only works for n=6

+1 check n=1, n=2, n=3...

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

+0

If you have questions, ask Mr. Drumm or a classmate.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+1

$(15 \times 8) + 2(20) + 5 = 165 + 21$ → SA of bottom

186 units

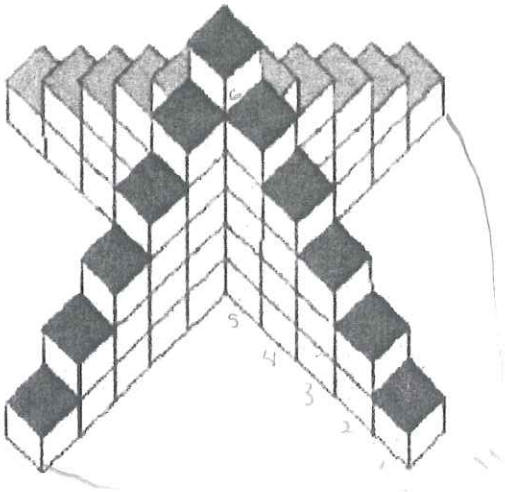
Show your work and process to help the reader follow your steps.

Building Towers (Yellow Worksheet)
10 points possible

11/10

Name: Ansley Layman
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



$8(2n-1)+4(2n-1)+5$

1) **(1 point)** Describe what you notice about the structure of the tower above.

+1

it's staircase-like on its 4 points.
it goes up by 1 for each step.
all of the staircases meet at the highest step.

Good Observations.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1

$1+2+3+4+5=15$ cubes for 1 staircase
$15 \cdot 4 = 60$ cubes for the 4 staircases
$60+6=66$ cubes total
(the 4 staircases; the tallest stack of cubes)

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1

no because it would involve adding each step (1+2+3+4 ... 299) and that is efficient, but it takes a while

Great finding.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

+1.5

I would like to see how you found $n(2n-1)$, but this is correct.

$n(2n-1)$ $6(2(6)-1)$
$6(11)$
66

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19900 = n(2n-1)$

$19900 = 2n^2 - n$

$0 = 2n^2 - n - 19900$

$0 = (2n+199)(n-100)$

$n = -199/2$ (can't be negative) $\quad n = 100$

The height is 100 cubes.

+4.5
More written explanation

Written explanation helps the reader follow your process/understanding.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

$15 \cdot 8 = 120 + 10 \cdot 4 = 160 + 5$

15: surface area of 1 side; 8: # of sides; 10: 4 sides; 4: 4 sides; 5: surface area of top

Surface area is 165 cubes

Nice labels & description

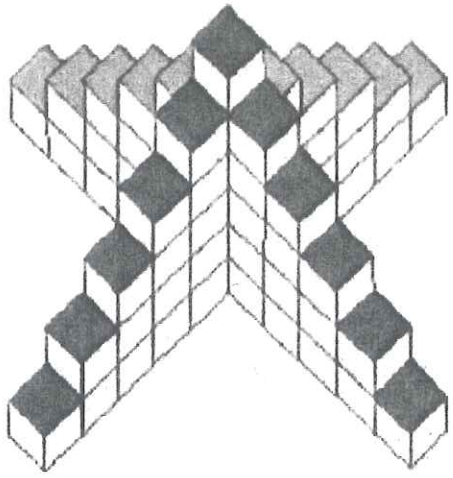
6. Additional bonus! Find a way to find the surface of a tower of height n.

Building Towers (Yellow Worksheet)
10 points possible

10/10

Name: Annie Musser
Date: 3/6/14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

+1

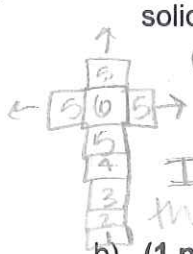
X shaped base with steps building up towards the center, tallest in center then 1 less in each step out in 4 directions

2) Reference the diagram shown above:

+1

a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

$6+5(4)+4(4)+3(4)+2(4)+1(4)=$ 606 blocks



← Good Diagram.

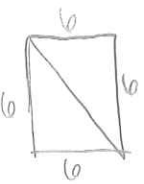
I looked at the structure as if I was above it & determined there was one stack of 6, 4 stacks of 5, 4 stacks of 4, etc. so I added 1-5 & multiplied each # by 4

b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1

no, it would take too long to add every number counting up to 300 (multiplied by 4). A formula would be easier

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.



+1.5

$2(300)-6=606$

$2(300)^2-300=179700$

$4(1/2n^2)$

$2n^2-n$

Showing work allows the reader to understand your process.

Provide more explanation of how you got $2n^2-n$

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$2n^2-n=19900$

$2n^2-n-19900=0$

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

$\frac{-(-1)\pm\sqrt{(-1)^2-4(2)(-19900)}}{2(2)}$

$\frac{1\pm\sqrt{1+159200}}{4}$

$\frac{1\pm399}{4}$ $\frac{400}{4}=100$ cubes tall

started by using # of blocks formula on #3 & set equal to 19,900

+4.5
Show more explanation

Label your steps, so the reader knows what you are doing.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

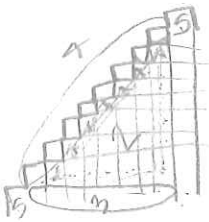
+1
Good Process but incorrect final answer

$4\left[5+4(3)+2(3)+3(3)\right]+6=134$
(4, 6, 4)

# of sides of the blocks that would be painted

$4(n^2+n)+6$

I believe you forgot the other two legs.



$3(n-2)+4(n-2)+(n-3)(n-3)$

$3n-6+4n-8+n^2-6n+9$

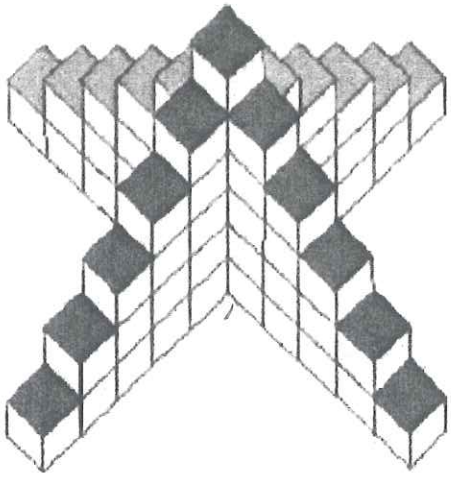
$4(n^2+n-5+5)+6$

Building Towers (Yellow Worksheet)
10 points possible

9.5/10

Name: Lauren Reder
Date: 3/6/2014

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

+1

It is made of 4 right triangles, each w/ a base & height of 5 cubes. There's also a tower in the middle.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1

$n=4(5+4+3+2+1)+6=$ 86 cubes

Found each triangle, added heights.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1

No, the addition would be too tedious. ← Good Point.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

+1.5

$4(\frac{1}{2}n^2)-n$

$2n^2-n$

$2(6)^2-6=66$

← showing your work allows the reader to follow your process.

Would like more explanation on how you found $2n^2-n$

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19900 = 2n^2 - n$

$2n^2 - n - 19900 = 0$

$n = \frac{1 \pm \sqrt{(-1)^2 - 4(2)(-19900)}}{2(2)}$

$n = 100$ cubes

+4.5

More explanation

Great work, but a written explanation would help support your work better.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+0.5

you started with the right process, but you should check the # of sides showing on 1 triangle.

# of sides showing on 1 triangle: 32

$32 \cdot 4 = 128$

add 5 for top cube + 1 for bottom

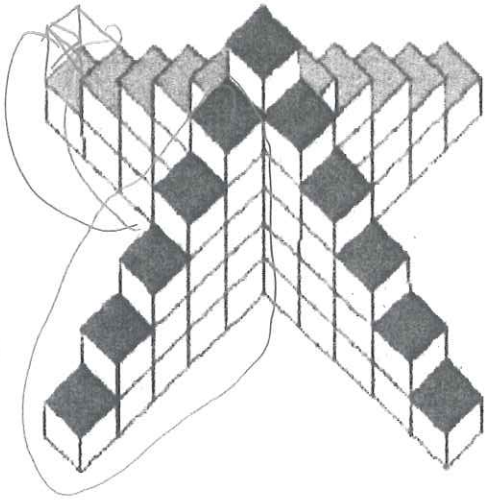
134

Building Towers (Yellow Worksheet)
10 points possible

10/10

Name: Adam Sparks
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



$8(2n-1)+4(2n-1)+5$
$16n-8+8n-4+5$
$24n-7$

1) **(1 point)** Describe what you notice about the structure of the tower above.

+1 The structure has a pyramid-like shape. It is six units tall, and 11 units from one corner to another.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1 $6+4(5)+4(4)+4(3)+4(2)+4(1)$

66

1 6 15 28 45 66
5 9 13 17 21

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1 It would work easily, but it is lengthy to do.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

+1.5 more explanation/work to find $n(2n-1)$ → $n(2n-1)$
$6(12-1)$
$6(11)$

Work will help the reader understand your process.

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19900 = n(2n-1)$

$2n^2 - n - 19900 = 0$

$(2n+199)(n-100)$

$2n = -199 \quad n = 100$

+4.5 more explanation

How do you know $2n^2 - n - 19900 = (2n+199)(n-100)$?

$n = -99.5$ or 100

can't be negative

$h = 100$ units

$4\overline{)19900}$ → 4975

$50\overline{)19900}$ → 498

$60\overline{)19900}$ → 331 R 40

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+1 Right answer but no work.

$8(2(6)-1) + 4(2(6)-1)$

$88 + 45$

165

additional bonus: Find surface of a tower of height n.

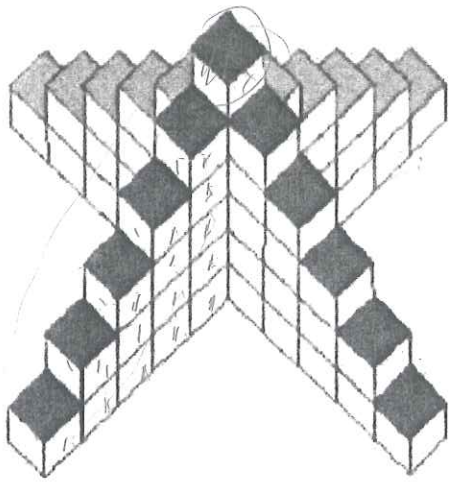
$12(2n-1)+5$

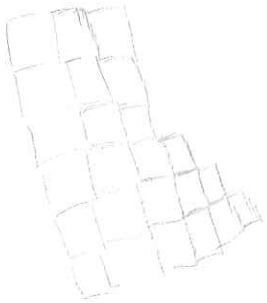
Building Towers (Yellow Worksheet)
10 points possible

11.5/10

Name: Kaetlin McVaugh
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**





6=n

1) **(1 point)** Describe what you notice about the structure of the tower above.

+1 the above tower is in the shape of a pyramid, resembling a square pyramid. It has a stair step design, making it not so much like a typical ⊠ pyramid

Good Observation.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1 So really, each "wing" of the pyramid is five high ... so because the pyramid has the stair step thing going on, I know it goes 5 in a row 4 in a row, 3 in a row etc. So I ended up with 5+4+3+2+1 = 21 in one wing. I multiply that by four to get 60 and then I added 6 to get 66 in the tower

15

Good answer; just watch your math

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1 I think it would work moderately well. The person would need a calculator and they would do 299+298 ... all the way down to 1. There are probably ways to do it without so much addition, which is why this is only a way that looks moderately well. It involves more work than necessary.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

+1.5 How did find n(2n-1)?

$n(2n-1) = y$

$6(2(6)-1)$

$6(12-1)$

$6(11)$

$66 = x$

Showing your work will help the reader follow your process.

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19,900 = n(2n-1)$

$19,900 = 2n^2 - n$

$0 = 2n^2 - n - 19,900$

$0 = \frac{1 \pm \sqrt{1^2 - 4(2)(-19,900)}}{2(2)}$

$0 = \frac{1 \pm \sqrt{1 - 4(-39,800)}}{4}$

$0 = \frac{1 \pm \sqrt{159201}}{4}$

$\frac{1 \pm 399}{4}$

$\frac{400}{4}$ or $-\frac{398}{4}$

100 cubes

I used my formula and plugged in 19,900 for X. A quadratic equation formed so I used the quadratic formula to solve it & got 100

+5

Good Process. Easy for the reader to follow.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

40 on one wing X 4 for four wings = 160 surfaces needing paint +5 faces of top cube

The surface area is 165

$(2n) + n + 1$

Surface area equation

$4(2n + n + 1)$ ← How did get from this step to the next.

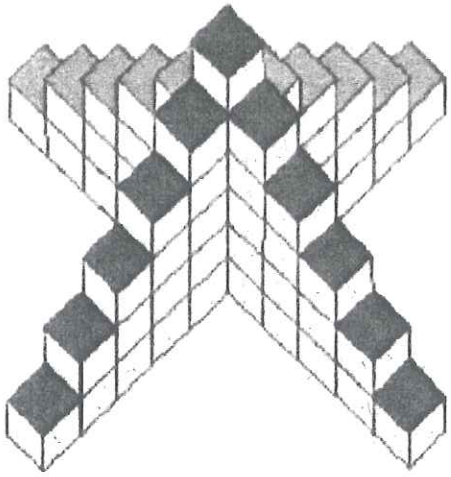
$4(n^2 + 4) + 5 = X$

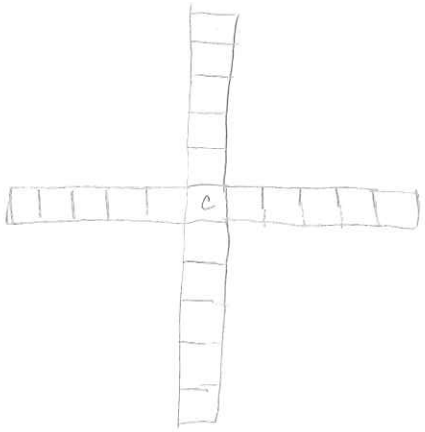
Building Towers (Yellow Worksheet)
10 points possible

11.5/10

Name: Amy Saunders
Date: 3/6/14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**





1) **(1 point)** Describe what you notice about the structure of the tower above.

+1

- It is six cubes high in the middle
- cross shaped
- steps down one cube at a time
- unfilled step pyramid

2) Reference the diagram shown above:

a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1

bottom 5 x 4 = 20
4 x 4 = 16
3 x 4 = 12
2 x 4 = 8
1 x 4 = 4
top 1 x 4 = 4

= 60 + 6 = 66
middle

I excluded the center column * multiplied # of cubes per row by four (four arms).

Good Explanation.

b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1

Not really, you'd get the right answer, but would have to add up 299 steps. However, an equation based on my strategy would help

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

+1.5

Solid work but provide more steps before n(2n-1)

$X = n(2n-1)$

$X = 6((2)(6)-1)$

$X = 6(11)$

$X = 66$ cubes

Nice Diagram!

11 x 6 = 66

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

+5

$19,900 = n(2n-1)$

$19,900 = 2n^2 - n$

$2n^2 - n - 19,900$

we plugged 19,900 into the equation as y and solved for n, which was 100 cubes.

$$n = \frac{-(-1) \pm \sqrt{(-1)^2 - 4(2)(-19,900)}}{2(2)}$$

$$\frac{1 \pm \sqrt{1 + 159200}}{4}$$

$$\frac{1 \pm 399}{4} \qquad \frac{400}{4} \qquad \frac{398}{4}$$

100 cubes

Great job showing your work. Very easy to follow!

+2

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

two sides shown

(5x2) 4 40

(4x2) 4 32

(3x2) 4 24

(2x2) 4 16

(1x2) 4 8

top cube = 5

+ 40

10 faces on top - 4 sides

$10 \times 4 = 40$

165 square faces

6. surface area of tower height h

$x = (2n + 2(n-1), 4 + 5$

$2n - 2$

Building Towers (Yellow Worksheet)
10 points possible

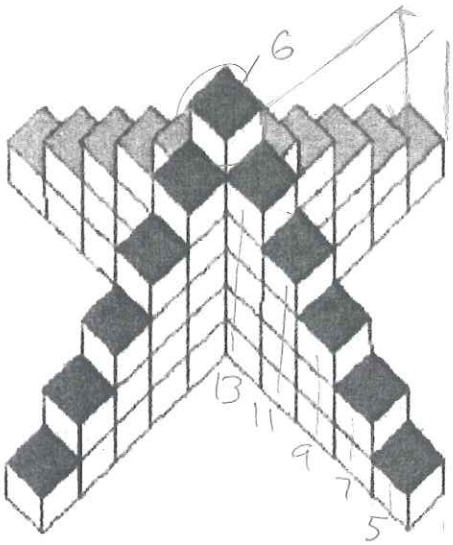
12/10

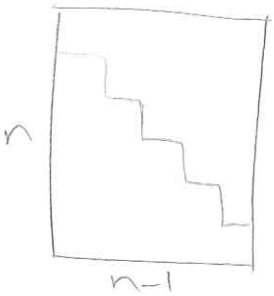
Name: Riley Hunter
Date: 3/6/14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**

5A steps
$[2(h-1)+3]+[2(h-2)+3]+[2(h-3)+3]$
$2h+1 \quad 2h-1 \quad 2h-3$

2 sets of stairs x 2
↓
2 rectangles





1) **(1 point)** Describe what you notice about the structure of the tower above.

+1

There is a column in the midde, with steps descending outward from each of the four sides of the column.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1

$4(15)+6=66$ cubes

I multiplied the number of cubes in a set of steps by four (there are four sets), and then added that to the number of cubes in the center column.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1

It wouldn't work easily because it's too tedious, a formula would be efficient to determine the number of blocks in a tower of any height

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

+2

height = h

middle column: $h+2(h)(h-1)$
$h+2(h^2-h)$
$h+2h^2-2h$

Formula: $2h^2-h$

$2(6)^2-6$
$72-6$
66 ✓

Great job!

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19900 = 2h^2 - h$

$2h^2 - h - 19900 = 0$

$h = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$ $\quad h = \frac{1 \pm \sqrt{1-4(2)(-19900)}}{2(2)}$

$h = 100$ or $h = -99.5$

+5

The height is 100 cubes. I set the equation equal to zero, then solved for "h" using the quadratic formula. I obtained two answers, but the height can't be negative, so only one of them was correct.

Correct reasoning and logic!

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

$13+11+9+7+5 = 45 \cdot 4 = 180 + 6 = 186$ faces covered (6 ↓ middle column)

+2

The middle column has 5 faces on top, plus one on the bottom. Each of the steps has 45 faces, multiplied by 4, since there are 4 sets of steps. When added together, the number of faces covered with paint will be 186.

Great Explanation.

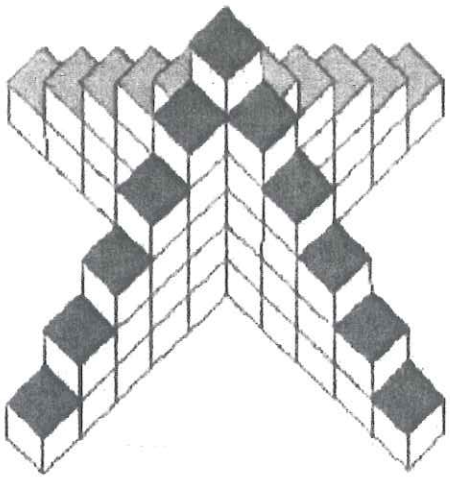
middle column SA → $6 + 4[$

Building Towers (Yellow Worksheet)
10 points possible

11/10

Name: Vill nguyen
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

It seems to be made completely up of cubes. Using a staircase like shape on each side, (1 cube, then ...etc) up to 6. There is only one tower of 6, the center tower, but

+1

2) Reference the diagram shown above: 4 towers of 5 cubes 4, 3, 2, and 1 cube

+1

a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

I just multiplied # of cubes per stack by 4, since there's 4 of each, except for seven of 6 then added

1 stack of 6 = 6 cubes 4 stacks of 3 = 12
4 stacks of 2 = 8 cubes 4 stacks of 2 = 8
4 stacks of 1 = 4 cubes 4 stacks of 1 = 4
6 6 cubes

b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not? no, my strategy would not work well, because 300 is a much larger number than 6, and I basically just counted all the cubes for that structure, using the same strategy for 300 would eventually work but it's inefficient, and time-exhausting

+1

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$n+2(n(n-1)$

+1

Show work of how you found that → Also, check your equation.

$n+2(n(n-1)$

n = height

Showing work allows the reader to follow your process.

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

+5

We set our formula for # of cubes to the # of cubes given, 19,900. We distributed and got a quadratic formula. We used the quadratic formula to get the height (or n).

$n + 2(n(n-1)) = 19{,}900$

$2n^2 - n - 19{,}900 =$

$\frac{1 \pm \sqrt{1 - 4(2)(-19{,}900)}}{4}$

$\frac{1 \pm \sqrt{+159201}}{4}$

$\frac{1 \pm 399}{4} = \frac{400}{4} = 100$

100 cubes is the height

We also know the height of a shape can't be negative, so $1 - 399$ can't be an answer.

Great explanation.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

$12 + 10 + 8 + 6 + 4$

We counted how many faces were on one stack, multiplied by 4 to cover all 4 staircases, then added the 5 faces of the cube at the top.

10 each staircase, $40 \times 4 = 160$ for all staircases, then add 5 for the 5 faces at the top of the center stack.

165 cube faces (surface area)

5 faces for top cube always

$5 + 4[2(n-1) + n(n-1)]$ times $4 = 4$ staircases

1 = top block

$2(n-1)$ = layering on front of each block

$n(n-1)$ = area of side rich

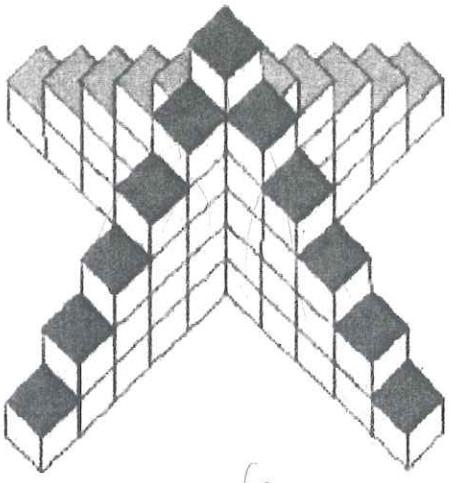
Building Towers (Yellow Worksheet)
10 points possible

11.5/10

Name: Yash Patel
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**

n=height of tower



$n+4[(n-1)+(n-2)+(n-3)+(n-4)\ldots]$

1) **(1 point)** Describe what you notice about the structure of the tower above.

+1 The tower has a stair-step structure coming in to a central tower of cubes. The tower essentially is a pyramid like structure.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1 $6+4(5+4+3+2+1)$ 66 cubes

I take the central tower (6 cubes in height) and add it to one set of steps ($5+4+3+2+1$) multiplied by four, for the four sets of steps.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1 No it wouldn't be easy to find the number of cubes for a tower of 300 because you would have to find the sum of all the integers from 300 to 1, which isn't all that easy. ← & time consuming.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

+1.5 n=height of tower $n+2(n-1)$ $n+2(n)(n-1)$

Provide more work to show how you got $n+2(n)(n-1)$

$6+2(6)(6-1)$ 66 ✓

Work allows the reader to follow your process.

$x=1$
$(x-1)\ldots$
$x=1+x$

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

+5

$19900 = n + 2(n)(n-1)$

$19900 - n = 2n^2 - 2n$

$2n^2 + n - 19900 = 0$

$\frac{-1 \pm \sqrt{1 - 4(2)(-19900)}}{2(2)}$

$\frac{+1 \pm 399}{4} = \frac{400}{4} = 100$

$n = 100$ $\quad n = -99.5$

We set our equation from number 3 to the # of cubes, 19900.

We got a quadratic, so we used the quadratic formula and got $n = 100$.

The other answer was -99.5, but the height can't be negative, so the answer is 100 blocks.

Great Explanation and Logic.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

$5 + 4[15(2) + 5(2)] = 165$ faces

Take 1 staircase, and find the faces on the two sides, which is 15(2), then take the 5 blocks layering the staircase and include 2 faces for each of those (5x2) and multiply that by 4 for each staircase, then add five for the very top block.

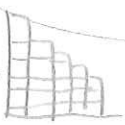
5 faces for top block $\quad 5 + 4(2(5) + 10(9))$

$A = 5 + 4[2(n-1) + n(n+1)]$

5 = top block

$2(n-1)$ = the layering blocks on each staircase

$n(n-1)$ = the area of the blocks from a horizontal view →



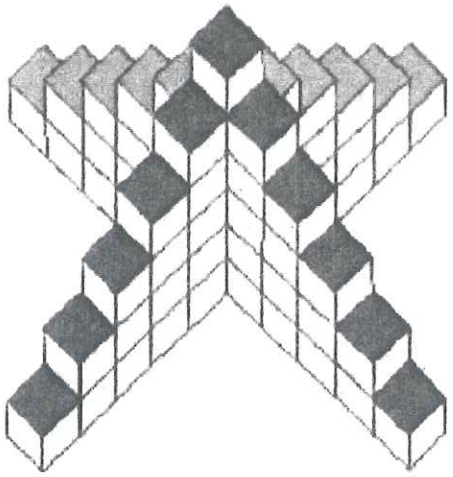
4 = 4 staircases

Building Towers (Yellow Worksheet)
10 points possible

9/10

Name: Bailey Edcele
Date: 3-6-14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

+1

There's a tower of six blocks in the center, and attached to each side of the tower is a "staircase" with five towers of decreasing height

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1

5+4+3+2+1=15

15(4)=60+6=66

in each arm · # of arms · center tower

66 blocks

Good Diagram.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1

Not really since I had to add 5+4+3+2+1 to find the number of blocks in each arm, which would be a tedious process with a larger height.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

I found the volume of the rectangular prism created by filling the negative space, and the ratio of that volume to the number of blocks was the height plus one less than the height. So the equation is volume $n(n+1)$ or $2n^2-n$.

$V = n+(n-1)$

$V = n(n+(n-1))^2$

$V = n(2n-1)^2$

4: 196, 28
7:1

← Interesting Approach!

$\frac{n(2n-1)^2}{2n-1} = n(2n-1)^3$

$2n^2-n$

5 : 15

5) 405 45 - 9:1

5 : 12

tower: 15

5:1

+1.5

Make sure you check your height

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19{,}900 = 2n^2 - n$

$2n^2 - n - 19900 = 0$

$(2n + 199)(n - 100) = 0$

$2n + 199 = 0 \quad n - 100 = 0$

$n = \frac{-199}{2} \quad n = 100$

height is 100 blocks

+4.5

Provide More explanation.

Showing work/written explanation helps the reader understand your process better!

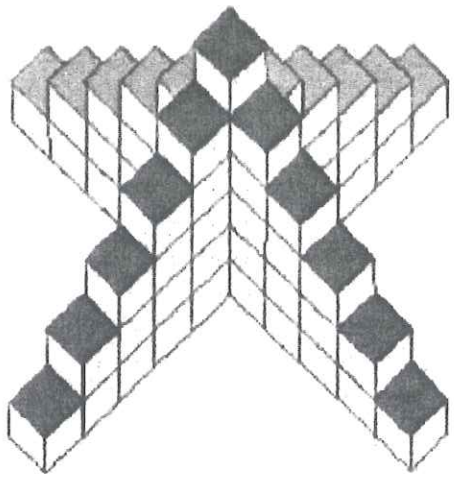
5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

Building Towers (Yellow Worksheet)
10 points possible

9.5/10

Name: Katie Anderson
Date: 3-6-14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.
looking above it is the shape of a cross.
+1

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1
6-middle column 2(4) I started in the center
5(4)- Good job! 1(4) with the tallest of 6 cubes,
4(4) total of then worked my way out
3(4) 66 cubes. 5 to 4 to 3 to 2 to 1 cube
in each column and multiplied by 4 for each end of cross.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1
most likely not, it would be too much multiplacation and too long of a process.
↗ Good job stating why it would be a long process.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

+2 Awesome!

ratio Volume to # of cubes
3 cubes tall - 5:1
4 cubes tall - 7:1
5 cubes tall - 9:1

$V=(n+n-1)^2 n$
$V=(2n-1)^2 n$
6
$x=(2(6)-1)6$
$x=11(6)=66$ ✓

Interesting Approach.
$\text{cubes}=\frac{(2n-1)^2 n}{(2n-1)}$
$\text{cubes}=(2n-1)n$

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19{,}900 = (2n-1)n$

$19{,}900 = 2n^2 - n$

$2n^2 - n + 19{,}900 = 0$

$(2n+199)(n-100) = 0$

$2n+199=0$ $\quad n-100=0$

$2n=-199$ $\quad n=100$

$n=-99.5$

the height is 100 cubes.

+4.5 Provide more explanation

Showing written explanation provides extra support for the reader.

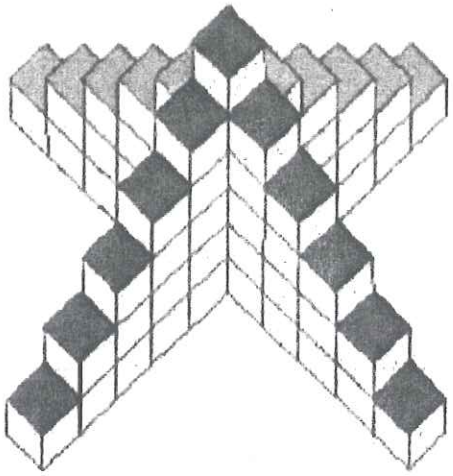
5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

Building Towers (Yellow Worksheet)
10 points possible

10.5/10

Name: Emily Aaron
Date: 0

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

+1 It has a center column surrounded by 4 congruent walls composed of columns of decreasing height in relation to their distance from the center column. ← Interesting Observation!

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

1+4(H2+3+4+5) = 161.

+1 it looks like you erased your explanation, but right answer.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1 The strategy from part a would be rather cumbersome when used to calculate the number of cubes involved in a tower of 300 cubes. However, it is a relatively simple strategy suitable for smaller numbers.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

# of cubes = y

+1 $y = n + 2n(n-1)$

Show your process on how you got your equation. Also check your formula for n=6.
It helps the reader to follow your process.

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19900 = n + 2n(n-1)$

$0 = 2n^2 - 2n + n - 19900$

$0 = 2n^2 - n - 19900$

$0 = (2n + 199)(n - 100)$

$n = -99.5$ $n = 100$

$n = 100$

would have a height of 100 cubes

Using 19900 cubes as the number of cubes yields a height of 100.

+4.5

Provide more step by step explanation.

How do you know this can be factored? Did you use a certain process?

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

1 wall = $\frac{n(n-1)}{2}$

4 walls = $2n(n-1)$

Top = 5

$SA = 6 + \frac{8n(n-1)}{2} + 12(n-1)$

$SA = 6 + \frac{8(6)(6-1)}{2} + 12(6-1)$

$SA = 186$ cubes^2

+2

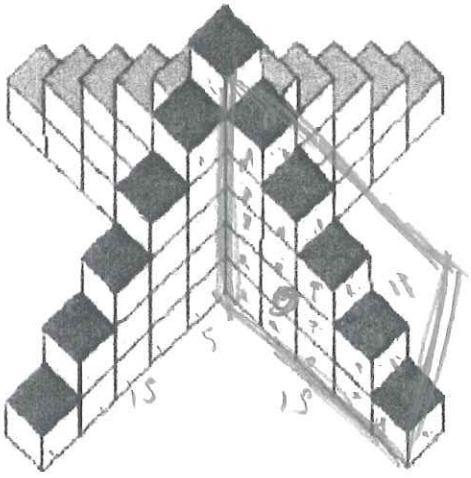
Good Work!

Building Towers (Yellow Worksheet)
10 points possible

11.5/10

Name: Logan Brown
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

+1

a center stack of cubes with four descending sets of five stacks of cubes on each side.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1

$6+4(5+4+3+2+1)=66$ cubes
$6+4(15)$
$6+60$
66

The center is 6 and the four sets each have a total of 15 which I times'ed by 4 since there are four sets.

Nice Process!

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not? No, there would be far too much addition to do simply and efficiently.

+1

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of ~~height 6 units~~.

+2

$a=n+4\frac{(n-1)^2}{2}$

$a=n+2n(n-1)$

a= amount of cubes

$a=6+12(5)$

$a=66$

X $a=n+2(n-1)^2$

~~$66=6+2(5)^2$~~

Good process.

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19900 = n + 2n(n-1)$

$19900 = 2n^2 - 2n + n$

$19900 = 2n^2 - n$

$0 = 2n^2 - n - 19900$

$0 = (2n + 199)(n - 100)$

$n = \frac{199}{2}$ or 100

↑ can't be negative

$n = 100$

the height is 100 cubes, I simply plugged 19900 into the formula I found in #3

How did you do this?

← Nice Explanation!

+4.5 Provide more explanation

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

5 cubes² always on top plus the 1 on bottom each

$6 + 4[6(5)]$

$6 + 8\left(\frac{h(h-1)}{2}\right)$

$SA = 6 + 4h(h-1) + 12(h-1)$

186 cubes²

$6 + 8h(h-1) + 12(h-1)$

center ↑ (2) ↑ tops and sides and bottom

$6 + 6(6)(5) = SA$

$6 + 180$

$186 = SA$

$6 + 8h(h-1) = SA$

$6 + 12h(h-1) = SA$

$2 + 12(1) = SA$

$2 + 12$

14

5
36
·5
180

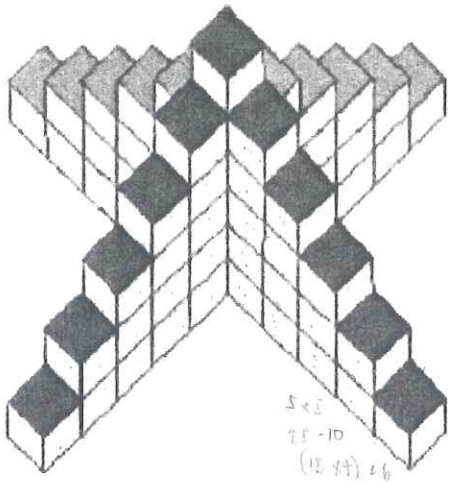
~~we counted~~ the bottom

Building Towers (Yellow Worksheet)
10 points possible

9/10

Name: Benjamin Davies
Date: 03/06/2014

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

+1 The cube tower has equal stacks on each of the four sides and shares a common stack in the middle. I noticed that the number of cubes reduced by one as it rises.

What reduced by one?

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1
$6^2 + (6-1)6$
$= 6^2 + 5(6)$
$= 36 + 30$
$= 66$

- I multiplied the number of rows by the number of columns of one stack.
- Subtract the total number of rows and columns from the product.
- Multiply the answer by four to find the number of cubes on the other stacks and add 6 to get the middle inclusive.

Great work/explanation

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1
- My strategy would work easily to find the number of cubes for a tower with height of 300.
- Following this strategy can lead to finding the answer despite the several steps involved.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$n = 6$
$= n^2 + (n-1)n$
$= 6^2 + (6-1)6$
$= 36 + (5)6$
$= 36 + 30$
$= 66_u$

+1.5 show more work how you got $n^2+(n-1)n$

How did you get this? Show work allows the reader to follow your process.

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$n^2 + (n-1)n = 19,900$

$n^2 + n^2 - n = 19,900$

$2n^2 - n = 19900$

$n(2n-1) = 19900$

$= 2n^2 - n - 19900$

$(2n+199)(n-100)$

$n = 100$.

+4.5

Provide more explanation.

Written Explanation would be great for the reader. It helps the reader follow your process and help troubleshoot if you went wrong somewhere.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

$= 15 \times (8)$

120.

$= 120 + (4)$!

$480 + 36$

$= 516$.

+0

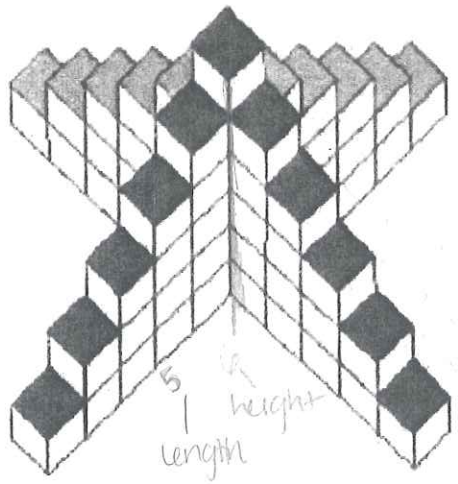
Building Towers (Yellow Worksheet)
10 points possible

7/10

Name: Chalaun Lomax
Date: 3/5/14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**

originally a 5×5 but missing 10 cubes
so, area = 25 units²
# of cubes is n^2-2n
for each branch
+ 6 for the tower in center
$4(n^2-2n)+6$ = total #



1) **(1 point)** Describe what you notice about the structure of the tower above.

+1

The length of the sides of the structure is one less than the height of the tower (if you exclude the center column of the tower).

2) Reference the diagram shown above:

a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1

height - 1 = length of sides
$h = n+1$
1 # of cubes

The sides surrounding the tower when it created a square with sides 5 units long. However, there are 10 cubes missing so the area would be 5×5 = 25 or n^2. It's missing 10 cubes so 2(5) or 2n

4 sides
# of cubes per side is (n^2-2n)
$4(n^2-2n)+h = 4(25-10)+6$
height
adding 6 (cubes) because of the height of the cubes

$4(15)+6$
60+6
= 66 cubes needed

b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1

The strategy wouldn't work easily because since the tower is so large, it would be more difficult to find the number of cubes needed for each side. Formula only works easily when given a diagram and tower is smaller

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

x = length of cubes (measured in cubes)

height = n
$x+1 = n$

ex. n = 6
$n = x+1$
$6 = x+1$
$-1 \quad -1$
$x = 5$

$4(x^2-2x)+n$ = # of cubes

$4((6)^2-2(5))+6$
$4(25-10)+6$
$4(15)+6$

60+6
66 = # of cubes

← Wouldn't work if n=2

When creating a generalized formula you should only use 1 variable. This situation you are looking for # of cubes using the height.

+1

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

Total # of cubes = $\frac{19,900}{4 \text{ sides of the structure}}$

$= 4975$ cubes

$n = x - 1$

$4(x^2 - 2x) + n = \#$ of cubes

$4(x^2 - 2x) + n = 19900$

$\frac{4(x^2 - 2x)}{4} + \frac{(x-1)}{4} = \frac{19900}{4}$

$x^2 - 2x + \frac{x-1}{4} = 4975$

$\frac{4x^2 - 8x + x - 1}{4} = 4975$

$\frac{4x^2 - 7x - 1}{4} = 4975$

$4x^2 - 7x - 1 = 19900$

-19900

$4x^2 - 7x - 19901 = 0$

$x = \frac{-(-7) \pm \sqrt{-7^2 - 4(4)(-19901)}}{2(4)}$

$\frac{7 \pm \sqrt{49 + 318416}}{8}$

$\frac{7 \pm \sqrt{318465}}{}$

$4(x^2 - 2x) + n = 19900$

$4x^2 - 8x - 19900 = -n$

This should have prompted you to recheck your formula in #3.

+3

Correct strategy and work but the ~~strategy~~ equation wasn't correct.

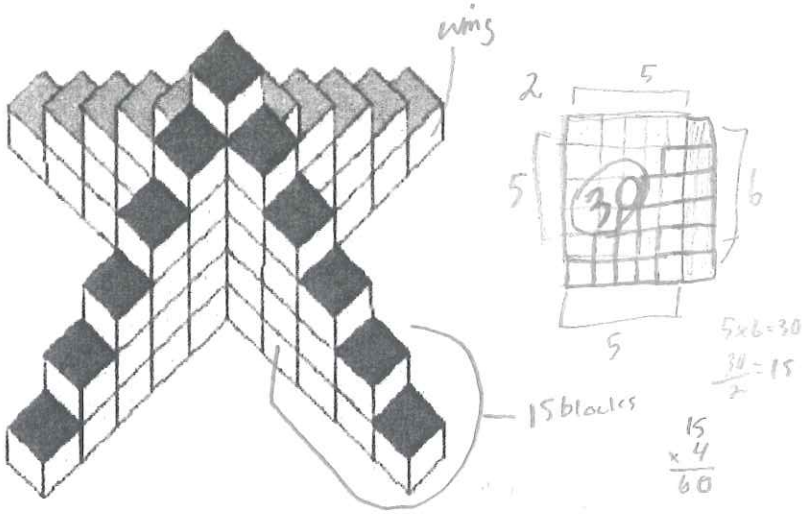
5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

Building Towers (Yellow Worksheet)
10 points possible

8.5/10

Name: Katelyn Georgopoulos
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

+1

The structure is symmetrical, with four branches or segments (wings) off of the center. Each wing has the same amount of blocks and the same structure or shape.

Good Observation.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1

I divided the tower into 5 groups, a straight tower of 6 cubes and the 4 remaining sections. Each of the four have a base + height of 5. If one wing of the tower was put on another, a rectangle that is a 5×6. A rectangle like this has an area of 30 cubes, so one wing has 15 cubes. Multiply that by 4, and the total of blocks on all the wings is 60. Then the remaining 6 is added. The total is 66 cubes.

Great Explanation!

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1

Not necessarily, because it technically doesn't give the base of the "wings". However, it may be assumed the height is always one taller than the length of the wing extensions, so the base could be found and then the rest can be found from that. However, its definitely not an "easy" method time-wise.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

+1.5

n=height
C=cubes amount

$n+2((n-1)(n))=C$ or $n+2(n^2-n)=C$

$6+2((6-1)(6))=66$
$6+2(5(6))=66$
$6+2(30)=66$
$6+60=66$
$66=66$

Where did you get this? More work.

Show your steps and process will help strengthen your answer.

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

C = cubes
n = height

C = 19,900
n = ?

$n + 2(n^2 - n) = C$

$n + 2(n^2 - n) = 19900$

$n + 2n^2 - 2n = 19900$

$2n^2 - n = 19900$

$2n^2 - n - 19900 = 0$

$(2n - \quad)(n + \quad) = 0$

$2n - \quad = 0 \qquad n + \quad = 0$

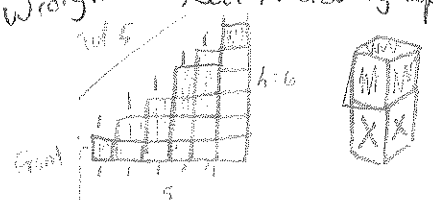
$10^2 + 99 = 19900$
-99
$10^2 + 99 = C$
$n = 10$

The method is to use the formula from previous question and then fill in what is known. Using the formula $n + 2(n^2 - n) = C$ and the variables n = height & c = amount of cubes total, we know the height should be found. The number of cubes is already known to be 19900, which replaces C while the variable n remains. The formula then becomes $n + 2(n^2 - n) = 19900$. Then I carried out the 2, making it $2n^2$. Then I combined the equation to $2n^2 - n = 19900$. Which changes the equation to $2n^2 - n - 19900$. After that, subtract the 19900 and factor it out.

+3 Good start, you are on the right path. The quadratic equation should help you find the factors.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)* ~~excluding the bottom of the tower?~~

+1 Wrong Answer, but interesting approach,



$\frac{5}{1}$
$\frac{1}{20} \times 1 = 21$

$\frac{15}{2}$
$\frac{}{30}$ for each side of wings

$\frac{30}{5}$
$\frac{1}{36} \times 4 = 144$

$144 + 5 = 149$
$149 + 21 = 160$

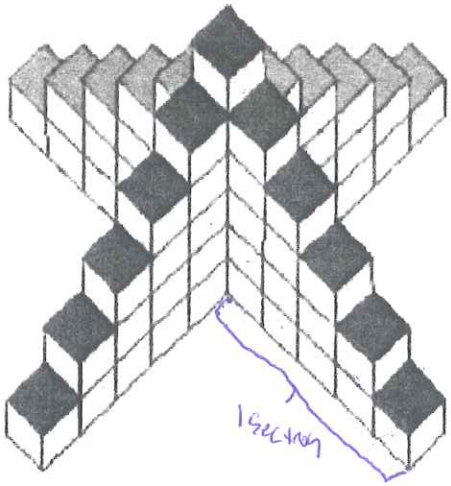
The original tower has one central tower piece of 6 stacked cubes with 4 wings of 15 blocks extending outwards. Based on how they are connected to the middle, only the top and four sides of the middle towers top most cube will be painted, a total of 5 faces. Each wing has 15 blocks, so on the side (showing all 15 blocks) there are 15 faces to be painted. This is multiplied by 2 for each side of the wings, with 30 faces. Then on top, 5 faces are showing and one on the front, for a total of 6 faces. So on each wing, 36 faces are painted. There are 4 wings, so 144 faces are painted. This is added to the 5 faces from the top cube and in all, excluding the bottom, 149 faces are painted. Including the bottom, there are 5 bottom faces on each wing and 30 on all the wings. In addition the middle column has one bottom face. So including the bottom 160 faces are painted.

Building Towers (Yellow Worksheet)
10 points possible

10.5/10

Name: Mirelle Gallette
Date:

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

+1 Each successive layer of the pyramid shaped structure is one more block wider than the last. Starts with 1 block ends in 6 blocks.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1 $1+2+3+4+5 = 15 \cdot 4 = 60 + 6 = 66$ blocks

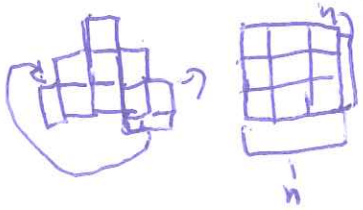
1+2+3+4+5 = one section's worth of blocks; 4 = # of sections; 6 = center section

← Great equation.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1 No because it would take a long time to add up the 300 blocks per section.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.



$2n^2 - n$

$2(6)^2 - 6$

$2(36) - 6$

$72 - 6 = 66$

+2 To just be careful show more work to help show your process

Other reasons saying $6n - n$ due to all rows being counted in other parts

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

quadratic equation

$2n^2 - n = 19{,}900$ n = # of blocks

$2n^2 - n - 19{,}900 = 0$

Solve for n

How did you find this?

$(2x + 199)(x - 100)$

$\frac{199}{2} = 99.5$

$n = 100, -99.5$

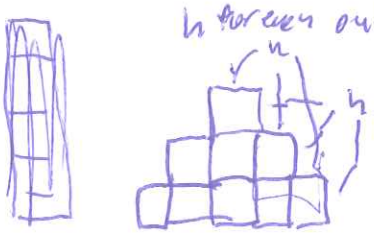
$n = 100$

+4.5

Provide more support.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+1



n for each outer edge of cross section

$4n + n + 3(n-1)$

Right Answer but I don't know how you got there.

$4(6) + 6 + 3(6-1)$

$24 + 6 + 15$

45

165 unit² = Surface Area

$4(2(n^2-n))$

$8(n^2-n) + 4n +$

$2(n^2-n)$

$8(n^2-n) + 5n + 3(n-1)$

$8(30) + 30 + 3(6-1)$

$8(30) + 30 + (5)$

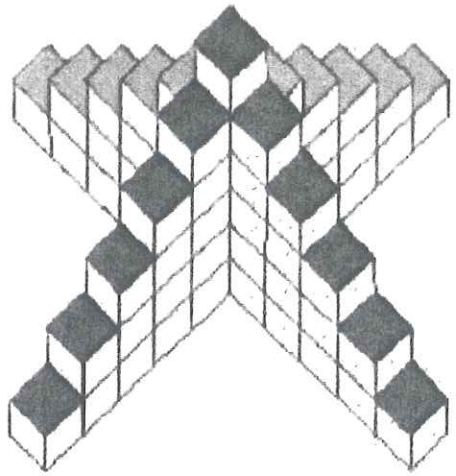
240 + 30 + 15

Building Towers (Yellow Worksheet)
10 points possible

11/10

Name: Andy Cress
Date: March 5th, 2014

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



6×5=30
5×1=30

1) **(1 point)** Describe what you notice about the structure of the tower above.

+1 There is one stack of cubes in the middle that is 6 cubes tall. There are four equal sections of cubes surrounding it. The four sections are built like stairs and contain 15 cubes each.

Using your observation to answer #2

2) Reference the diagram shown above:

a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1
$6 + 4(15)$
$6 + 60$
66

It takes 66 cubes to build the tower.

b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1 No. I counted the cubes on one of the sections. It would take way longer if it had a height of 300.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$n + 4(1+2+3+4...X) \quad X < n$

Count by ones until you get to one less than n.

← This is a formula but is it the most efficient?

$6 + 4(1+2+3+4+5)$
$6 + 4(15) = 66$

+2 Series aren't that efficient. Your equation in #4 would be a better formula.

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$n+4(1+2\ldots)n = 19{,}900$

If you move the cubes, you can make two squares. One will be $n \times n$ if n = height, and the other will be $(n-1) \times n$.

$n^2+(n-1)(n) = 19{,}900$

$n^2+n^2-n = 19{,}900$

~~$2n^2-n-19{,}900=0$~~

Where did you get this formula?

Nevermind

$n=100$

How did you get n=100? What process did you do?

$2(100)^2-100$

$2(10000)-100$

$20{,}000-100 = 19{,}900$

+4

The height of the tower is 100 cubes.

More explanation would people follow your work and understand.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

The stack in the middle is covered except for 5 faces on top and one on bottom.

Good job!

$6+4(45)$ ← There are 45 faces showing on each of the 4 remaining sections.

$6+4(45)$

$6+(180)$

SA = 186

Add to Bonus

There will always be 6 faces showing on the middle stack.

$6+4((3n-1)+2(n-1)+2+2(n-2)+2\ldots$ until $n=0$ $+2(n-3)+2\ldots+2(n-4)+2$.

↑ bottom rows

4 sections = to each other

bottom row of 4 sections

$3(n-1)+2$

$3n-3+2$

$3n-1$

rest of the rows of each section

x = number in row

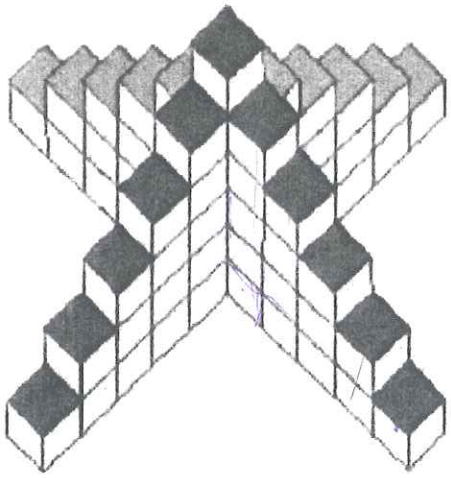
$2x+2$ = cubes showing

Building Towers (Yellow Worksheet)
10 points possible

3/10

Name: Ricky Owen
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

+1

It has 6 levels, all with a height of 7-n if n is the first level (at the top) and 2n is the 2nd level, etc.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1

$6 + 5(4) + 4(4) + 3(4) + 2(4) + 1(4) = 6+20+16+12+8+4 = 66$

6: center; 5(4): 2nd level; 4(4): 3rd level; 3(4): 4th level; 2(4): 5th level; 1(4): 6th level

← Nice labeling.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1

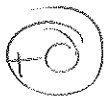
No because it would take forever to write the equation.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

+6

If you have questions, make sure to ask the teacher or a fellow classmate.

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.



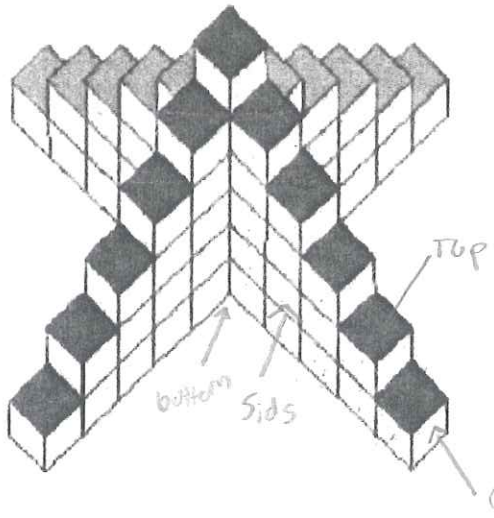
5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

Building Towers (Yellow Worksheet)
10 points possible

10.5/10

Name: Corey Denham
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



Good Observation.

1) **(1 point)** Describe what you notice about the structure of the tower above.

+1 The block tower has both horizontal, vertical, & radial symmetry. It follows a continuous pattern of adding one block until it reaches the peak of the structure.

2) Reference the diagram shown above:

a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1 Each section of the structure has 15 cubes (excluding the 6 in the middle). Thus $15 \times 4 = 60$ blocks + the additional 6 = 66 blocks in total.

b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1 No it would not because I found the block numbers through observation. A formula is required to find one with a height of 300 blocks. ← Great Point!

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

+1.5

Are you including the center tower?

Total $= 4\left(\frac{1}{2}(n-1)(n)\right)+h$ The area of the branches is $(n-1)\cdot(n)$ and dividing by 2 will give the amount of blocks. Then multiply by 4 & add the center piece h.

Make sure you check your formula with n=6.

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

The formula used to determine the total # of blocks can now be used in reverse order.

Then multiply the equation out & solve using quadratic formula one answer is negative, which is an impossibility within the realm of the real world. Therefore, the answer must be 100 block high.

$19900 = 4\left(\frac{1}{2}(n-1)(n)\right)+n$

$19900 = 2n^2-2n+n$

$19900 = 2n^2-n$

$2n^2-n-19900=0$

$(2n+99)(n-100)=0$

$n=100$

+5

Good Job!

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+1

Good Attempt but didn't provide an answer for height of 6.

The surface area can be found by using height n as a variable.

$SA = 8\left(\frac{1}{2}(n-1)(n)\right) + \left(4(n-1)+1\right) + \left(4(n-1)+1\right) + \left(4(n-1)+4\right)$

Sides — bottom — Top — sides (other)

Simplified version =

By multiplying $(n-1)(n)$ an area is acheived then multiply by 8 to account for all the sides

d=4

S	n
1	1
6	2
15	3

S	n
1	1
5	6
9	15

$S = \frac{n}{2}(2($ 6,66

3/10

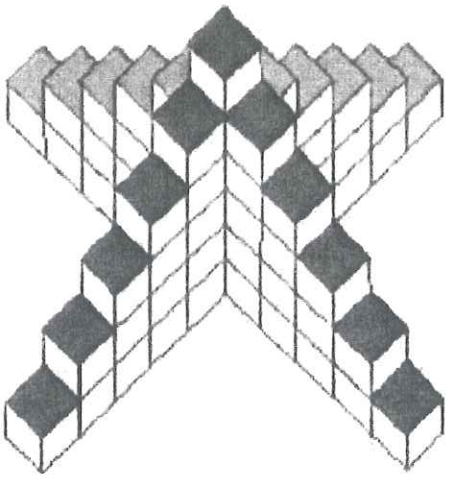
Building Towers (Yellow Worksheet)
10 points possible

$4(n-1)+n$

Name: Mark Lienhardt
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**

$x = d(n-1)+n$



S	n
1	1
6	2-10
15	3-27
28	9-52

$(4n-3)$

$n(4-\frac{3}{n})$

$n^2[4n-3]$

$1+(4(n-1))^n$ $n(4n-3)^{n-1}$

$n(4n-3)-$

1) **(1 point)** Describe what you notice about the structure of the tower above.

+1

- There are four congruent legs to the tower
- Each leg contains 15 blocks
- There is a stack of 6 blocks in the middle of the tower
- The tower has 66 blocks

2) Reference the diagram shown above:

a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1

Each layer of the tower contains 4 blocks less than the previous, The bottom layer contains 21 blocks(5 on each leg, and 1 in the middle. $21+17+13+9+5+1=$ 66 blocks

Good Job!

b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1

Yes, the equation to solve for the total number of blocks is $(n+4)$ where n is the hieght. You can do this because each layer is a number in an arethmetic series.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

+0

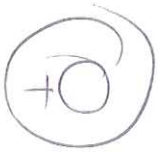
C = # of cubes

$C = 4n-3$ ← n=6, would get you 21 cubes. Not 66 cubes.

For generalized formulas, the formula should work for all n's. Check with n=1, n=2, ... Also provide work. It helps people seeing where you might have possibly went wrong.

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

If you have questions, ask Mr. Drumm or a classmate.



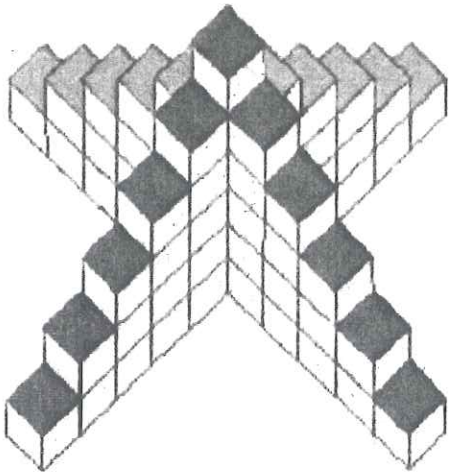
5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

Building Towers (Yellow Worksheet)
10 points possible

10.5/10

Name: Ashley Lee
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



Great observations!

1) **(1 point)** Describe what you notice about the structure of the tower above.

+1

Starting from the column of cubes in the very middle (top cube), the structure changes from a six-cube column all the way to a one-cube column as it "stretches out". Eliminating the top cube of the six-cube column in the middle, each side of the middle column is bounded by a five-cube colum of the "side walls". Again, eliminating the top cube of the middle column, each layer of cubes increases by a number of four as you go from top to bottom.

2) Reference the diagram shown above:

a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1

There's 6 layers in total, eliminating the top cube of the middle column, the first layer has 5 cubes. As I wrote above, the # of cubes each layer has increases by four everytime you more down a layer. 6 layers in total

∴ 1 (Top cube) + 5 (1st layer) + 9 (2nd) + 13 (3rd) + 17 (4th) + 21 (5th) = 66 (cubes)

b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1

It won't be easy to find the # of cubes for a tower that has a height of 300 with my strategy unless I make it into a formula using n as a representation for real numbers.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

~~how did you find this~~

+2

		change
n = 1	# 1	× 1
2	6	× 3
3	15	× 5
4	28	× 7

∴ Formula: $n(2n-1)$ = # of cubes

Plug in 6

$6(2\times6-1) = 66$ (cubes) (✓)

Good job using the table help you find the formula.

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

+5

Using the formula: $n(2n-1) = \#$ of cubes,

$n(2n-1) = 19,900$ [Plug in 19,900 cubes]

$2n^2 - n = 19,900$ [Solve]

$2n^2 - n - 19,900$ [Quadratic Formula]

$n = 100$ $n_2 = -99.5$ (nonreal) (x)

∴ The height of this tower would be 100.

Awesome step by step explanation!

Strategy: Plug Given information into formula

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+0.5

Good start, but your strategy wasn't complete.

If each side is 1. Area of 1 side of a cube is $1^2 = 1$.

A of Top cube = 5. add up side of cubes

$5 + (12+4) + (4+16)$.

$5 + (4\times3+4) + (4+4\times4) + (4+6\times4) + (4+8\times4) + (4+10\times4)$

$= 5 + 16 + 20 + 28 + 36 + 44$.

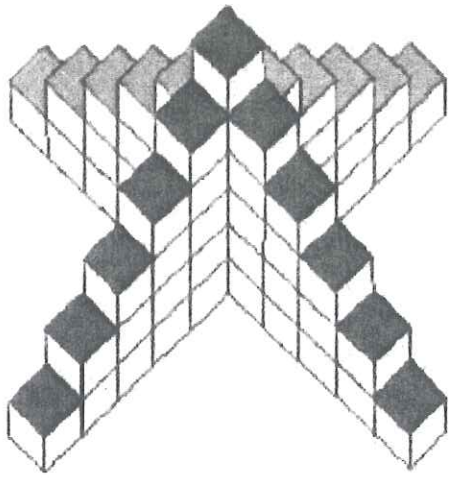
$= 149$. Area of tower is 149.

Building Towers (Yellow Worksheet)
10 points possible

5.5/10

Name: Lukas Leininger
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

+1

The tower above is a single tower of 6 blocks surrounded by four structures made up of 5 towers of blocks, for each block outward, their height is reduced by one.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+0.5

66

Please Provide your work/process.

$6 + 4\left(\frac{1}{2}(5^2+5)\right)$

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not? yes, n+1 could be substituted for 6, and n for 5

+0.5

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units. n= height

+0.5

$(n+1)+4\left(\frac{1}{2}(n^2+n)\right)$ ← Wouldn't work if n=1 or n=6

Make sure you check your generalized formula. If your formula is incorrect, 3-5 checks will probably show an incorrect output.

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19900 = n+1+2n^2+2n$

$19900 = 2n^2+3n+1$

$0 = 2n^2+3n-19899$

$0 = (2n+201)(n-99)$

99 blocks

To find the height I simply set 19900 equal to my formula and solved for n, which represents height.

+3

Used the equation from 3, but it was the incorrect formula. If you check n=6, you wouldn't get 66.

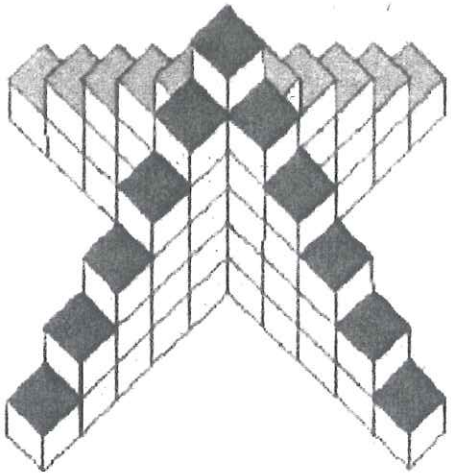
5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

Building Towers (Yellow Worksheet)
10 points possible

11/10

Name: Shawn Lienhardt
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

+1 The structure is in a pyramid-like shape and the number of blocks in row, increases by 4 as a new row is observed.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1 1+5+9+13+17+21=66 I used my formula to find the number of blocks in the nth row, then added the sum of blocks in each row together.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1 No because my strategy works well for finding smaller heights for the number of cubes in a row. Good Observation.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

+1 Work helps support your formula. You would need $2n^2-n$ cubes to construct a tower of height n. This formula shows works on a tower of height 6 units.

the work for n=6. Also how did you create $2n^2-n$?

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

+5

$0 = 2n^2 - n - 19900$

$(n-100)(2n+199) = 0$

$n = 100$

I set my equation equal to zero using the formula that I created. Then, I used the quadratic formula, $\frac{-b \pm \sqrt{b^2-4ac}}{2a}$, to find two answers, $-\frac{199}{2}$ and 100. A tower cannot be composed of negative rows, so the tower is 100 rows tall.

Good Job!

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)* Note: My tower is built on the ground and the bottom will not be painted.

+2

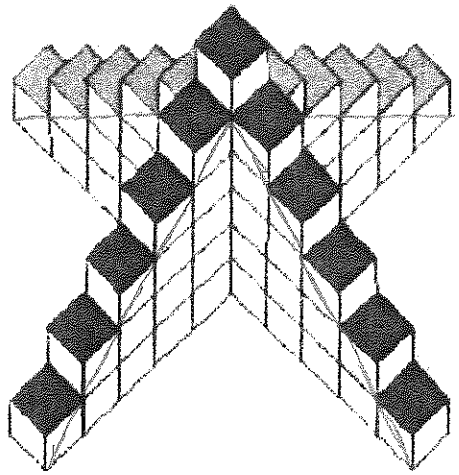
The surface area is 165 units^2. I found that the difference of the difference between each row is 2. I used this to find the surface area of a tower with a height of 6.

Building Towers (Yellow Worksheet)
10 points possible

9/10

Name: Grant Meyer
Date: 3-5-14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

+1 The tower consists of a center n units tall and four sets of steps, each $n-1$ units long at the base, connected to the faces of the tower. The steps start one unit shorter than the tower, and become one unit shorter for each unit they extend.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1 $6+4\left(\left(\frac{(6-1)^2}{2}\right)+\frac{6-1}{2}\right)$

$6+4\left(\left(\frac{25}{2}\right)+5/2\right)$

$6+4(15)$ $6+60$ 66 cubes

The height of the central column — $6+4\left(\left(\frac{(6-1)^2}{2}\right)+\frac{6-1}{2}\right)$ — The number of cubes of one set of steps, if the top cubes had been cut into a slant.

There are 4 sets of steps

The other half of the cut cubes.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1 Yes. The hardest part would be calculating $(299)^2$, but that can be multiplied fairly easily.

Are there easier ways?

3. **(2 points)** How many cubes would be needed to construct a tower of height n? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$\#cubes = n+4\left(\left(\frac{(n-1)^2}{2}\right)+\frac{n-1}{2}\right)$

$\#cubes = 6+4\left(\left(\frac{(6-1)^2}{2}\right)+\frac{6-1}{2}\right)$

$\#cubes = 6+4\left(\left(\frac{25}{2}\right)+\frac{5}{2}\right)$

$\#cubes = 6+4(15)$

$\#cubes = 6+60$

$\#cubes = 66$

+2 Saw work in 2a.) but make sure you include work down here.

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19{,}900 = n + 4\left(\left(\frac{(n-1)^2}{2}\right) + \frac{n-1}{2}\right)$

$19900 = n + 2(n-1)^2 + 2(n-1)$

$19900 = n + 2n^2 - 4n$

$19900 = 2n^2 - 3n$

$0 = 2n^2 - 3n - 19900$

$0 = (2n - \quad)(n - \quad)$

Be careful with your math operations. +2

Quadratic Equation

$2n^2 - n - 19900.$

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2 Good Job!

$SA = 8(15) + 4(5) + 4(5) + 5$

$SA = 120 + 20 + 20 + 5$

SA = 165
Not including the bottom
SA = 165 + 21
SA = 186, if including the bottom.

$SA = 8(15) + 4(5) + 4(5) + 5 + (4(5) + 1)$

- $8(15)$: One side of one set of steps.
- $4(5)$: The tops of each step in one set.
- $4(5)$: The fronts of each step in one set.
- 5: The open faces of the top block.
- $(4(5) + 1)$: The bottom faces if included.

To find the surface area of a tower with height n.

$SA = 4\left[2\left(\frac{(n-1)^2}{2} + \frac{n-1}{2}\right) + (n-1) + (n-1)\right] + 5 + (4(n-1) + 1)$

- 4 sets of steps
- 2 faces per set
- The area of one side of a set
- Tops of one set
- Fronts of one set
- The open faces of top block
- If bottom is included.

$SA = 4(n-1)^2 + 12(n-1) + 5 + (4n - 4 + 1)$

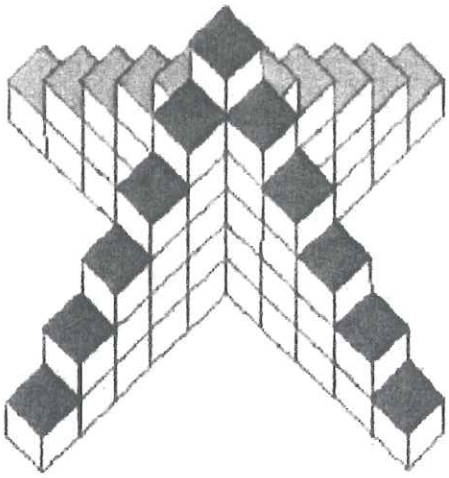
$SA = 4n^2 + 4n - 14 + (4n + 3)$ General Equation

Building Towers (Yellow Worksheet)
10 points possible

10/10

Name: Nick Zahneis
Date: 3/5/14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

+1

It is a 3-D structure with radial symmetry as well as vertical & horizontal. It has 4 sections starting with 1 cube, and increases until it reaches a height of 6 cubes, where all 4 sections connect.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1

$6+4(5+4+3+2+1)$
$6+4(15)$
$6+60$
66

There is one height of 6, and four heights of 5-1. So, I added 1-5 together (15), multiplied that by the number of heights (4), then added 6.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1

No, my strategy would not. There would be lots of adding (1-299) before I could get to the answer.

Good Observation.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

+1.5

$n(2n-1)$ ← how did you get this? Show work.
$6(12-1)$
66

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19900 = n(2n-1)$

$19900 = 2n^2 - n$

$2n^2 - n - 19900 = 0$

$\frac{-B \pm \sqrt{B^2-4AC}}{2A}$

$\frac{1 \pm \sqrt{1-4(2)(19900)}}{4}$

$\frac{1 \pm \sqrt{1+159200}}{4}$

$\frac{1 \pm \sqrt{159201}}{4}$

$\frac{1 \pm 399}{4}$

$\frac{400}{4} = 100$

+5

Great Work!

The height is 100. If the formula previously used results in the number of cubes in the tower, you can set the formula equal to 19,900 and solve for n. I set one side equal to 0, then used the quadratic formula to reach 100.

Great Explanation.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

n=1 n=2 n=3

0 26 50 78 110 146

20 24 28 32 36

$20+4(n-1)$

146 faces. The difference between each height's surface area starts at 20 and increases by 4 from there.

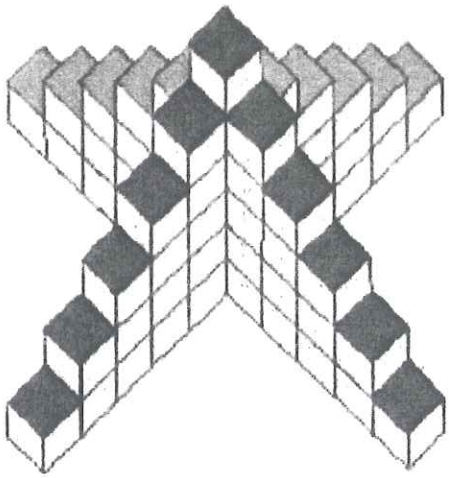
+0.5 Good start of strategy but check again. Not correct solution.

Building Towers (Yellow Worksheet)
10 points possible

11/10

Name: Meghan Ullrich
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

+1 The height of the center is 6 cubes with stacks of cubes coming from 4 sides, each decreasing in height by 1 cube.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1 $6+4(5)+4(4)+4(3)+4(2)+4(1) =$ **66 cubes**

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1 no because it would require writing out 4(x) for every integer from 1-299 ← Great Observation.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units. $n+2n(n-1)$ or $2n^2-n$

+1.5 Each side of the tower is half of a $n \times (n-1)$ rectangle, cut down the diagonal. $n(n-1)$ is divided in half for the half rectangle and then multiplied by 4 for the 4 sides. n is added because the center stack wasn't included in any of the rectangles. This creates the formula $n+2n(n-1)$, which can be simplified into $2n^2-n$.

Check with $n=6$.

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work. height = n, $19,900 = 2n^2 - n$

$2n^2 - n - 19,900 = 0$

$\frac{1 \pm \sqrt{1 - 4(2)(-19,900)}}{4}$

$\frac{1 \pm 399}{4}$

$\boxed{n = 100}$

+4.5

Show Process and steps.

Provide explanation (i.e. quadratic formula)

The height is 100 cubes, which comes from setting the formula for the number of cubes, with height n, equal to the given number of cubes, 19,900.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

Good Job!

$8\left(\frac{n(n-1)}{2}\right) + 8n - 3$ $\boxed{165 \text{ square units}}$

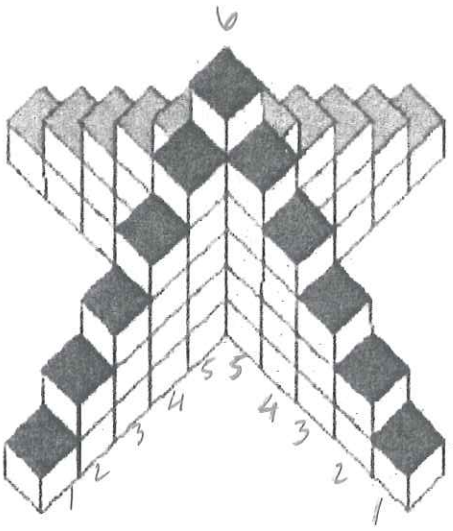
The same half rectangle method was used, this time multiplying by 8 for the 2 lateral sides of the 4 sections. The 8n-3 comes from the 2 exposed surfaces of the top cubes. n cubes in each section x 2 exposed surfaces x 4 sections. 3 is subtracted because the top surface of the center cube was counted 4 times when it should be counted once.

Building Towers (Yellow Worksheet)
10 points possible

12/10

Name: Linh Do
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



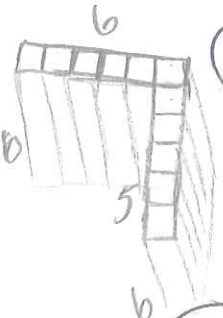
1) **(1 point)** Describe what you notice about the structure of the tower above.

+1

The structure above is a tower with a height of 6. This tower has 4 legs of 15 cubes that creates a stairway of 1 step, 2 steps, 3, 4, 5 steps. to a center of 6 cubes.

2) Reference the diagram shown above:

a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.



+1

If combine two legs (of the 4) it will form a perfect square of 6x6. If I do it to the other two I will also get a 6x6, however the two square share 1 row. ← using the picture on the left. I can multiply 6x6=36 and a 6x5=30 and add them together. 36+30=66 cubes

The two legs get you a 6x5 rectangle

The perfect square comes from the center column

b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1

yes, with a tower of 300. I can form two square of 300x300 that shares one row. To find the numbers of cubes I can multiply 300x300=90000 and a 300x299=89700 add them together. 90000+89700=179700 cubes

Good Justification.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

+2

tower of 6

$n^2 + n^2 - n$

$2n^2 - n$ = # of cubes

$(6 \cdot 6) + (6 \cdot 6) - 6$

$6^2 + 6^2 - 6$

$36 + 36 - 6$

66 ✓

$2(6^2) - 6$

$2(36) - 6$

$72 - 6$

66 ✓

You ~~don't~~ showed your work above but make sure you reference it down here to explain why!

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

using my formula. if $2n^2-n = \#$ of cubes I can substitute 19,900 for the # of cubes and solve for n.

+5

Reference the quadratic formula for this step.

$19{,}900 = 2n^2-n$

$2n^2-n-19900=0$

$(2n-200)(n+99.5)=0$

$2n-200=0 \quad n+99.5=0$

$n=100 \quad n=-99.5$

Awesome!

We can eliminate the negative answer because we can't have a negative height. Therefore the answer is 100. (height)

Excellent Observation

check answer

$2(n^2)-n = \#$ of cubes

$2(100^2)-100$

$2(10000)-100$

$20000-100$

19900

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

answer is 165 units^2 is the surface area, not including the base. if I include the base. theres

$(5\times4)+1=20+1$

$=21$

so $165+21=$

186 units^2 surface area including the top and bottom.

surface area of a 6 height tower each leg has two faces. with rows of 5,4,3,2,1 if I add them together. I get 15. each leg has 2 sides so $15\cdot2=30$ at the top of each steps there is a surface for each row. and an edge. $5=5$ surface, 5 edge $=5$ more surface $5(2)=10$

Great Explanation and showing your thought process!

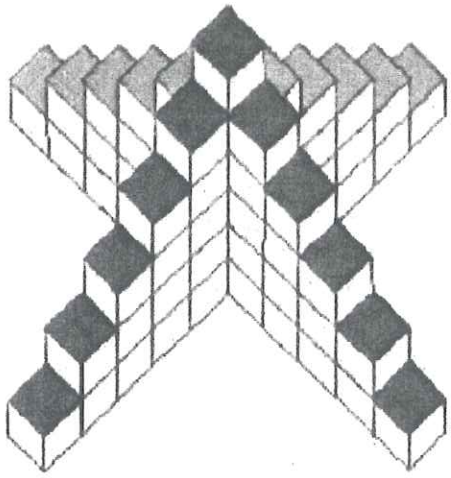
each leg has $(30+10)=40$ cube surface. 40×4 (b/c there are 4 legs. $=160$. but there is also 4 cube at the center that has one surface cover so 5 surface shown. $160+5=165$

Building Towers (Yellow Worksheet)
10 points possible

3.5/10

Name: Eddales Hochwald Naumann
Date: 3/5/14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



3.

height	total number of cubes
2	6
3	15
4	28
5	45

Height 2: $6 = 2 + 4(2-1)$
Height 3: $15 = 3 + 4\frac{(3-1)(3-2)}{2}$ $12 = 4x$, $x = 3$

Height 2: 1 cube on each side
Height 3: 3 cubes cubes on each side
Height 4: 6 cubes on each side
Height 5: 10 cubes on each side

Good job taking time to understand the structure.

1) **(1 point)** Describe what you notice about the structure of the tower above.

+1

The tower is built with two congruent towers of blocks that intersect at the middle column, creating a single tower with four points coming off of it, 90° apart.

2) Reference the diagram shown above:

a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1

1 column of 6 = 6 cubes
4 colums of 5 = 20 cubes
4 columns of 4 = 16 cubes
4 colums of 3 = 12 cubes
4 columns of 2 = 8 cubes
4 colums of 1 = 4 cubes

$6+20+16+12+8+4 =$ 66 total cubes

I found the total number of cubes by finding the number of columns with a given number of cubes. Once I found the number of cubes in each alike column, I added the total number of cubes together to get my answer.

b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1

This would not be an easy way to find a tower with a height of 300 because counting all of the cubes and then adding them all together would not be efficient or logical.

Good job seeing how this strategy would be inefficient.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

number of cubes = $n + 4(n-1)$

+0.5

Check with n=6, you would only get 26.

When creating a formula or generalized equation, you should test it to see if it works. Usually you will see an issue after two or three checks.

Start of the process, but incomplete equation!

1 + 1 + 1 + 1
3 + 2 + 2 + 2 + 1 + 1 + 1 + 1
3 + 4 · 2 = 4 · 1

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

number of cubes = 19 900 + 4 (19900 - 1)

= 99446 cubes

total

Find the height

+0

Be careful to read the ~~direct~~ directions.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

$3 + 4n = 17$

Height of 2 cubes: $2 + 4 \cdot 1$; $4 \cdot 1$

3. Height of 3 cubes: $3 + 4 \cdot 2 + 4 \cdot 1$

$8 \quad 4 \quad = 12$; $4 \cdot 3$

Height of 4 cubes: $4 + 4 \cdot 3 + 4 \cdot 2 + 4 \cdot 1$

$12 \quad 8 \quad 4 \quad = 24$; $4 \cdot 6$

Height of 5 cubes: $5 + 4 \cdot 4 + 4 \cdot 3 + 4 \cdot 2 + 4 \cdot 1$

$16 \quad 12 \quad 8 \quad 4 \quad = 40$; $4 \cdot 10$

Height of 6 cubes: $6 + 4 \cdot 5 + 4 \cdot 4 + 4 \cdot 3 + 4 \cdot 2 + 4 \cdot 1$

$20 \quad 16 \quad 12 \quad 8 \quad 4$

$$n = h + 4(6 + 5 + 4 + 3 + 2 + 1)$$

$$h + 4(21)$$

5 cubes: $5 + 4(4 + 3 + 2 + 1)$ 4 cubes: $4 + 4(3 + 2 + 1)$

$10 \qquad\qquad 5$

$h + 4 \cdot h - 1$

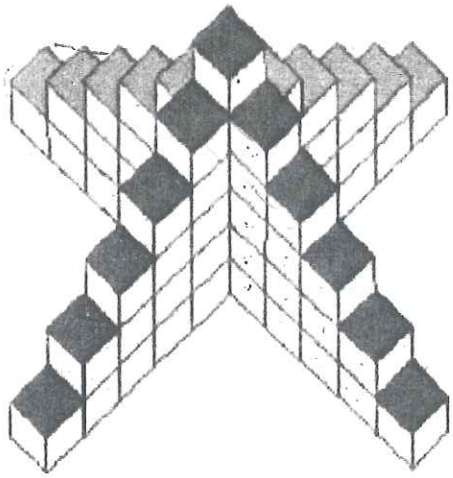
21, 17, 13, 9, 5, 1

Building Towers (Yellow Worksheet)
10 points possible

11.5/10

Name: Braman Muha
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

+1

- The tower has rotational symmetry at intervals of 90° ← Didn't see this until grading. Nice Observation!
- has a height of six cubes
- each leg has a high and width of 5 and built like a stairs

2) Reference the diagram shown above:

a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1

$15(4)+6$
$60+6$
66 cubes

First I counted the area of 1 leg. Then, since each of the 4 legs are the same, I multiplied the # of cubes in 1 leg by 4 then added the 6 cubes in the middle of the tower.

b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1

My strategy would not easily work for a tower with a height of 300 because I counted the # of cubes in 1 leg. This would take a long time for a leg that has a height of 299 cubes

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

1: 1 h×1
2: 6 h×3
3: 15 h×5
4: 28 h×7
5: 45 h×9

$A = h(2h-1)$ A = # of cubes, h = height

$A = 2h^2 - h$

$A = 2(6)^2 - 6$
$A = 2(36) - 6$
$A = 66$

+1.5

Provide more work to explain how you got $A = 2h^2 - h$

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19{,}900 = 2h^2 - h$

$2h^2 - h - 19900 = 0$

$(2h + 199)(h - 100) = 0$

$h = \frac{-199}{2}, 100$

$h = 100$

Great Job stating this.

Using my equation, I could solve for the height. I got a quadratic equation and factored. Of the two answers I found, one was negative. The height cannot be negative so therefore the height is 100. Good job!

+5

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

Good job stating this.

In painting the tower I will not paint the bottom.

The total surface area is 165 units^2

To find the surface area of the tower I did almost the same thing as I did for the # of cubes. I multiplied the surfaces area of 1 leg (40) by 4. So I got 160. Then the surface area of the middle spine is 5 at each height so I added 5 to get a total of 165

1: 5, 16, 0
2: 21, 4
3: 45, 40
4: 77, 32, 18, 40, 8
5: 117, 28, 10

Good job using a pre-existing strategy.

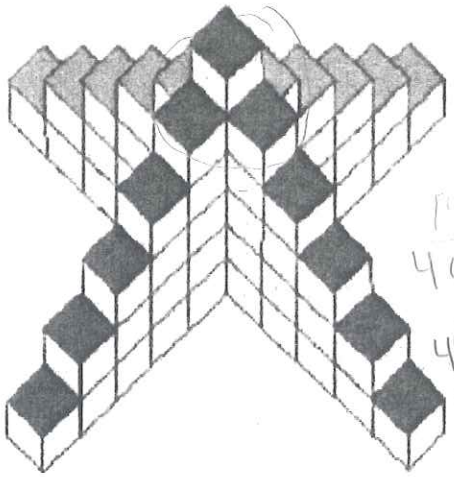
$4((n^2 - (2-n)) + 5$

Building Towers (Yellow Worksheet)
10 points possible

11.5/10

Name: Josh Peters
Date: _____
Per. 3

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



$n=2$
$5+9+3\cdot4+4+1=26$
~~$5+5.1+1$~~

$40\cdot4+5+21$

$4(n(n+1)-2)+(n-1)+4n-3$
$4(n^2+n-2)+n-1+4n-3$
$4n^2+4n-8+n-1+4n-3$
$4n^2+9n-12$

SA
$5(4\cdot12+4\cdot10+4\cdot8+4\cdot6+4\cdot4$
$(+5.4+1)$

1) **(1 point)** Describe what you notice about the structure of the tower above.

+1 The tower is like a pyramid but not completely. It is like 4 sets of steps that lead up to a block.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1 $1\cdot6+4\cdot5+4\cdot4+4\cdot3+4\cdot2+4\cdot1=$ 66 Cubes are needed
I knew there was 1 length of 6 and 4 lengths of everything else, so I just added them up after that.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1 Yes, the strategy would work but it would take a lot of button pushing in a calculator.
↖ true, it is "easy" but highly inefficient.

+2 3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$2n(n-1)+n=$ # of cubes

I got this because there is 1 block of height N and 2 rectangles of block $N\times(N-1)$. The 2 sets of steps make a rectangle of 6X5,  . This also works if the height(N) is 7. It would make 1 ▯ (block) 7+2 ▭ (rectangles) of 7X6 which gives you 91 blocks, just like it would in my equation.

Great Illustration

↖ Awesome job expanding but 7 gives you 84 not 91.

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19,900 = 2n(n-1)+n$

$19,900 = 2n^2-2n+n$

$19,900 = 2n^2-n$

$0 = 2n^2-n-19,900$

$n = 100$

The height would be 100 cubes and I found this by using my equation from the number before. I multiplied everything out, made it simpler and used the quadratic equation on my calculator to find the height to be 100 cubes.

+4.5

Provide the step of the quadratic formula.

Calculators are helpful for answering questions, but usually other work/processes are better ways to show/explain work.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

$4+1+(4+3\cdot4)+(4+5\cdot4)+(4+7\cdot4)+(4+9\cdot4)+(4+11\cdot4)+4.5+1=$

$5+16+24+32+40+48+21=$ 186 squares

Then would be 186 squares painted because I took one row at a time to figure out how many squares were showing and I added them together and then added the bottom of the tower.

6. Find a formula to find the surface area of a tower of height n. (Bonus added)

$4(n \quad 6\times1-1 \quad 6\times2+4 \quad 6\times3+6 \quad 6\times4+8$

$5+4\cdot12+4\cdot10+4\cdot8+4\cdot6+4\cdot4+(5\cdot4+1)$

$5 \quad 48 \quad 40 \quad 32 \quad 24 \quad 16 \quad (21)$

$4(2n-2r)$

$SA = 4n^2+9n-12$

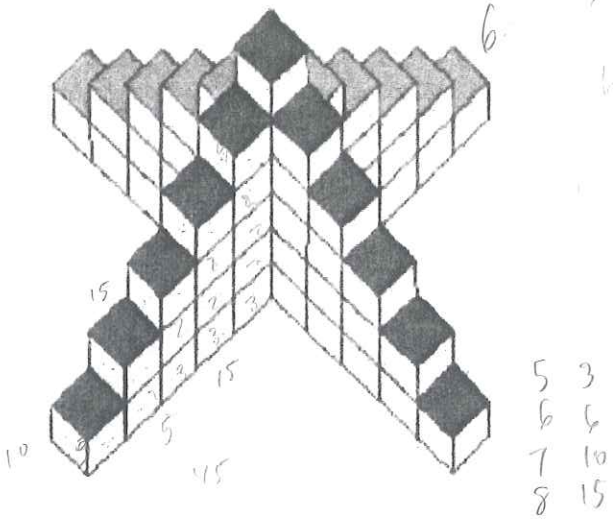
Look at my work next to the diagram on the front.

Building Towers (Yellow Worksheet)
10 points possible

10/10

Name: Christian Lytle
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



5 3
6 6
7 10
8 15

1) **(1 point)** Describe what you notice about the structure of the tower above.

+1

- 4 steps of blocks all leading to one highest point
- made of blocks
- each set of steps is identical

← Good Observation

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1

66 blocks. Each set of stairs (not including the middle) has 15 blocks so I did 4x15 and then added the remaining 6 blocks in the middle. Used your observation here. Nice!

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1

No, You would have to find out how many blocks are in each side which would take a very long time.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

Total blocks $= n + (n-1)(n)(2)$

$n + 2n^2 - 2n$

$2n^2 - n$

+1.5 Don't forget to check your formula with $n=6$.

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19900 = 2n^2 - n$

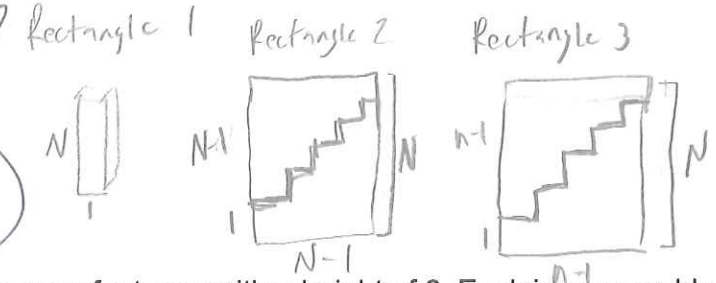
$0 = 2n^2 - n - 19900$

$0 = (2n + 199)(n - 100)$

$n = 100$ or $\frac{-199}{2}$

The hight is 100 blocks

I found the formula $2n^2 - n$ by turning the tower into 3 rectangles. I made the highest point a rectangle of $n \times 1$ cubes. I then put together 2 sides with eachother to make another rectangle of cubes $N \times (N-1)$. There were two of these rectangles. I added all the rectangles up to get a final formula of $2n^2 - n$



+4,5

How do you know $2n^2 - n - 19900 = (2n+199)(n-100)$

Show all steps

This is for #3

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+1

6t

Show your work and process.

186

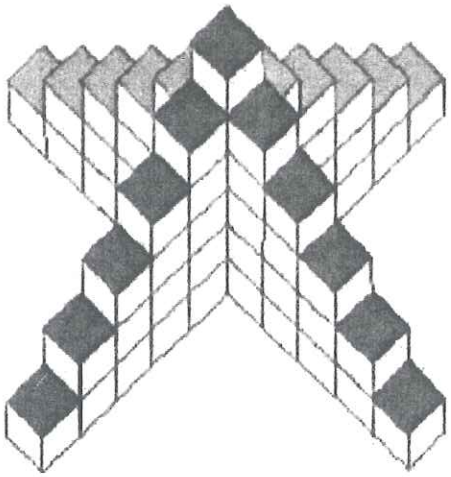
How did you come up with this?

Building Towers (Yellow Worksheet)
10 points possible

11.5/10

Name: JT Hollon
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

+1 The four sides of the tower are congruent. The sides are symmetrical to each other

Good Observation.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1 $(15 \cdot 4) + 6 = 66$

Each side requires 15 cubes and that number is multiplied by 4 to account for each side. Then the six blocks in the center must be added.

Great job showing your equation and written explanation.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1 No because it would be more difficult to find the number of cubes required for each side.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

+1.5 where does this come from?

$2n(n-1)+n$

$2n^2 - n$ = total # of cubes

$2(6^2) - 6$

$2(36) - 6$

$72 - 6 = 66$

This formula provides the same answer that I found in question 2 pt a.

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$2n^2 - n = 19900$

$2n^2 - n - 19900 = 0$

$\frac{1 \pm \sqrt{1-4(2)(-19900)}}{2(2)}$

$\frac{1 \pm \sqrt{159201}}{4}$

$\frac{1 \pm 399}{4}$ ← Discarded the negative, which is correct but make sure you explain why.

$\frac{1+399}{4} \quad \frac{400}{4} = \boxed{100 = n}$

The height of this tower is 100 cubes. The method I used to find this was to use the formula from number 3. Then I solved for n using the quadratic formula. Doing this I found the height of the tower to be 100 cubes.

Good Strategy

+5

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

$4(15 \cdot 2 + 10) + 5$

$4(40) + 5$

$\boxed{165}$

+2

Each side of the tower would have 40 square faces that need to be painted. Only the top cube of the center stack would need to be painted so five faces need to be added. ✓

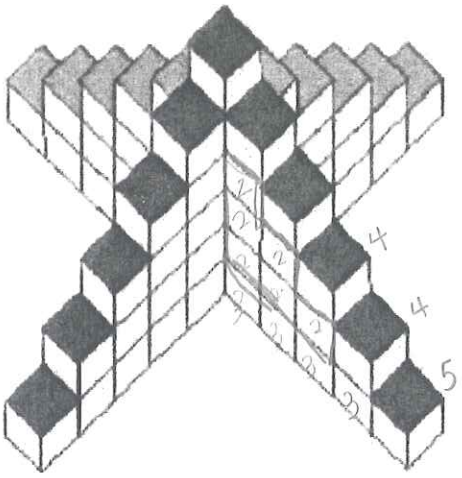
Building Towers (Yellow Worksheet)
10 points possible

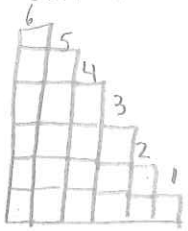
10.5/10

Name: Ana Bayer
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**

Prob. #3 Work





Column height decreases by 1.
6+1=7 n+(n+7) = (n+2)+(n+6) etc.
5+2=7
3+4=7
Find # of cubes of this pattern by equation $\frac{n}{2}(n+1)$

4 corners = multiply by 4, but the center column only occurs once, so you subtract the result by 3n.
This results in equation $4\left[\frac{n}{2}(n+1)\right] - 3n =$
$2n(n+1) - 3n =$
$2n^2 - n$

Great Work for #3

1) **(1 point)** Describe what you notice about the structure of the tower above.

+1 As you move further from the center column, the columns decline in height by one cube.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1 $6+5(4)+4(4)+3(4)+2(4)+1(4) =$ total
$6+20+16+12+8+4 = 66$

Great job using your explanation.

There are columns moving outwards from the center column in 4 directions. Since each column is one less, I multiply one less of each column after by 4, and then add it to the 6 cubes in the center column to get the total.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1 No, because if it was used for a larger cube tower it would be too arduous and time consuming.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$2n^2-n$ = # of cubes.
$2(6)^2-6 = 66$

~~Show how you got~~

+2 I see your work at the top.

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

① $2n^2 - n = 19,900$

② $2n^2 - n - 19,900 = 0$

$$n = \frac{1 \pm \sqrt{1 - 4(2)(-19,900)}}{2(2)}$$

$$n = \frac{1 \pm \sqrt{159,201}}{4}$$

$$n = \frac{1 + 399}{4}$$

$$h = \frac{400}{4} = 100$$

Answer: The height of the tower is 100 units.

① Since I have an equation to find the number of cubes based on the height, I can use that same one for the reverse situation

② The equation is not factorable, so I must use the Quadratic Formula.

+5

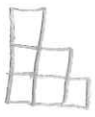
Good job! Using your tools/resources.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

$5(5) + 4 \cdot 4(6-2) + [2(3) + 2(2) + 2(1)] =$

+0.5

- $5(5)$: faces painted; top + 4 end cubes
- $4 \cdot 4$: faces painted; branches
- $(6-2)$: top cubes of each column minus very top + very side
- $[2(3) + 2(2) + 2(1)]$: painted; small section left to paint.



$25 + 64 + 6 + 4 + 2 = 101 \text{ units}^2$

Good Attempt! But I believe you went wrong looking at your relation of cubes with # of faces to "paint"

Method: Figure out the surface area of each section and add them together.

I applied the method I used to solve the question to form an equation for all heights.

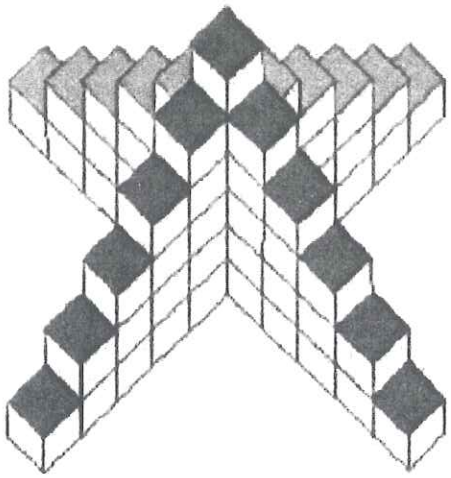
equation: $28n - 31 + \frac{n-3}{2}(n-2)$

Building Towers (Yellow Worksheet)
10 points possible

3/10

Name: ZACH MEYERS
Date: 3-5-14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

+1 THE NUMBER OF BLOCKS HAS A PATTERN OF 1, 5, 9, 13, 17, 21. BEGINNING AT THE TOP. THIS IS AN ARITHMETIC SEQUENCE, REPRESENTED BY THE LINEAR EQUATION $y=4x-3$ WHERE x IS THE BLOCK HEIGHT AND y IS THE NUMBER OF BLOCKS IN JUST THAT ROW.

Good Observation!

2) Reference the diagram shown above:

a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1 I ADDED THE FORMULA ABOVE 6 TIMES FOR A TOTAL OF 66 CUBES

b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1 NO, BECAUSE MY STRATEGY ONLY FINDS ONE LAYER AT A TIME Good Observation.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$4(n^2-15)-3n$ = NUMBER OF CUBES

+0 Only works for $n=6$. If $n=1$, this equation wouldn't work. Generalized formulas should work for all n's. Check with $n=1, n=2, n=3$...

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$4 = 4(n^2 - 15) - 3n - 19900$

4 IS HEIGHT, PLUG INTO CALC AND FIND THE ZEROES.

+0

Correct strategy, but your equation from #3 is wrong. You should use the quadratic equation instead of your calculator.

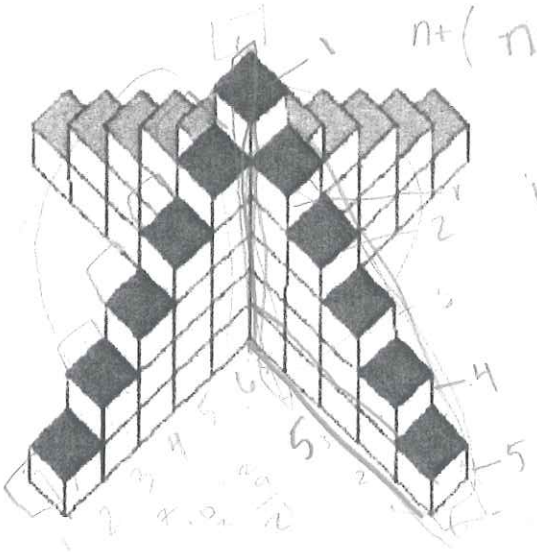
5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

Building Towers (Yellow Worksheet)
10 points possible

4/10

Name: Virginia Layfield
Date: 3/5/14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

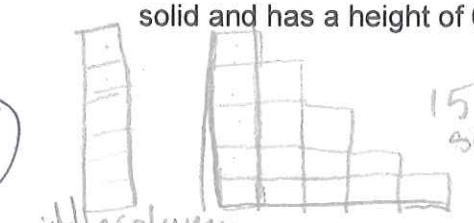
+1

Four equal protrusions of cubes descending from the middle structure at a height of six; height decreases by 1 cube as you move down from that point on all four sides forms an X if seen from above. ↑ column of 6 cubes

2) Reference the diagram shown above:

a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1



15 cubes on each side
4 sides from which the cubes come out of

15 · 4 = 60 cubes
+ 6 cubes
66 cubes

I counted the cubes in one section of the structure multiplied it by how many sections were exactly like it + added the remaining column

b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

+1

Probably not because yes it would work but it would take a lot of time to find the number of cubes. Good Observation

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

+0

$4(5n-15)+n$

Works only for $n=6$

Generalized formulas should work for all n's. Next time test n=1, n=2, n=3.... That's a good test to see if your formula works.

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19900 = n + 4(5n-10)$

$19900 = n + 20n - 40$

$19900 = 21n$

$n = 950.47$ cubes

Can't have .47 of a cube. (Formula is wrong)

+1 You recognized here that your formula was incorrect, but you should have gone back to #3 and correct the formula there.

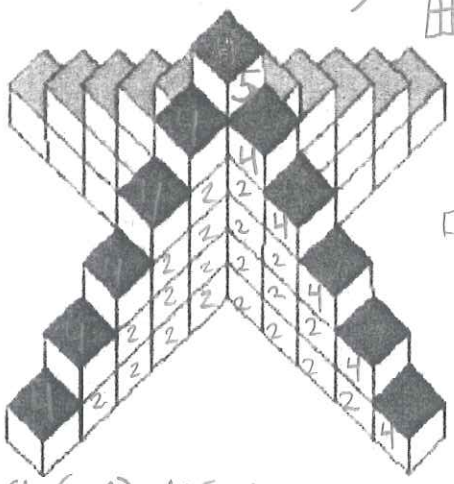
5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

Building Towers (Yellow Worksheet)
10 points possible

5/10

Name: Jay Pullyblank
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



3.)

1	2	3	4	5	6	7	8	9	10
1	6	15	28	45	66	91	120	153	190
1×1	2×3	3×5	4×7	5×9	6×11	7×13	8×15	9×17	10×19
nan	n×(n+1)								

1 + 0
5 + 1
9 + 6
13 + 15 +4 each step down
17 + 26
21 + 45
25 + 66
29 + 91
33 + 124
37 +
41 +
45 +
49 +

1	- 1	n^2
6	- 2	$n(n+1)$
15	- 3	$n(n+2)$
28	- 4	$n(n+3)$
45	- 5	$n(n+4)$
66		$n(n+5)$
91		$n(n+6)$
120...		$n(n+7)$

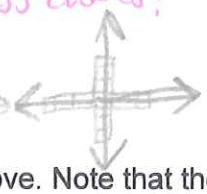
$SA = (n-1) + 4(n-1) +$

$f(x) = n(n+(n-1)) = 2n^2 - n$

1) **(1 point)** Describe what you notice about the structure of the tower above.

+1

- made of 66 cubes
- consists of less cubes as it rises vertically ← what consists of less cubes?
- it's 3 dimentional
- it's symetrical across a line that travels completely through the tower →



2) Reference the diagram shown above:

a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

+1

Counting the blocks in the picture, I found the number of cubes to be 66. To solve this mathematically I found the number of blocks in one of the four sides (), multiplied it by four and added it to the number of blocks in the center column (the height) and got 66 cubes

b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not? My strategy from (a) wouldn't work easily to find the number of cubes in a tower with a large height because it involves mostly counting and it would take a long time to add $4(299+298+297+296+295\ldots)+300$

+1

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

+2

$f(n) = 2n^2 - n$

$f(6) = 2(6^2) - 6$

$f(6) = 72 - 6$

$f(6) = 66$ ✓

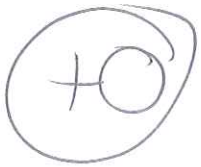
Since the height was the variable that was changing, I decided to view the structure from a vertical standpoint rather than a horizontal one. Doing this, I found the number of cubes that were added on each step of the height as it increased. I then found the relationship between these numbers and the height in order to derive a formula that can find the total number of cubes in the structure when only given the height.

← Great Explanation!

$f(n) = n(n+(n-1))$ simplified to $f(n) = 2n^2 - n$

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19900 = 2n^2 - n$



You started out the problem correctly. You should still go back and solve this to practice skills of problem solving a quadratic equation.

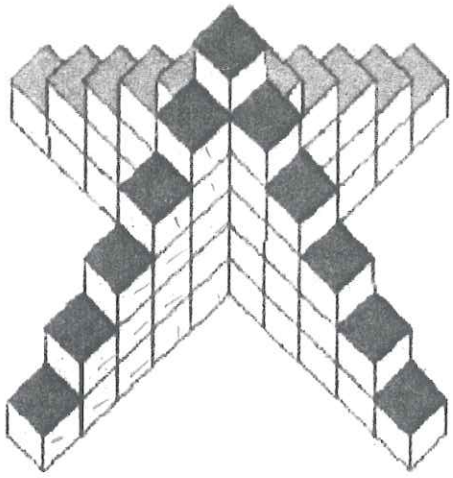
5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

12/10

Building Towers (Yellow Worksheet)
10 points possible

Name: Ben Pawlowicz
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

Tower of 6 cubes with 4 "staircases" descending by one cube each step on each side, down to one cube

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

$6+5(4)+4(4)+3(4)+2(4)+1(4)=66$

My strategy was to add the height of the tower, 6, by the height of each stair multiplies by the number of staircases.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

My initial strategy would not work to easily find the number cubes for a tower with a height of 300 as it would take a long time to add up all of those numbers

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$2n^2-n$

How did you come up with this?

$2(6)^2-6$
$=2(36)-6$ good
$=72-6$
$=66$ ✓

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$2n^2 - n = 19,900$

$2n^2 - n - 19,900 = 0$

$n = \frac{1 \pm \sqrt{1 - 4(2)(-19,900}}{4}$

$n = \frac{1 \pm 399}{4}$

$n = \frac{400}{4}$

$n = 100$

I used the equation I came up with in problem 3 and put in 19,900 as the solution. I turned that equation and turned it into a quadratic and solved for n using the quadratic formula. I ignored the 1-399 as n cannot be negative. good!

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

$15 \times 8 = 120$

$10 \times 4 = 40$

$5 \times 1 = 5$

$SA = 165$

not including the bottom of the tower

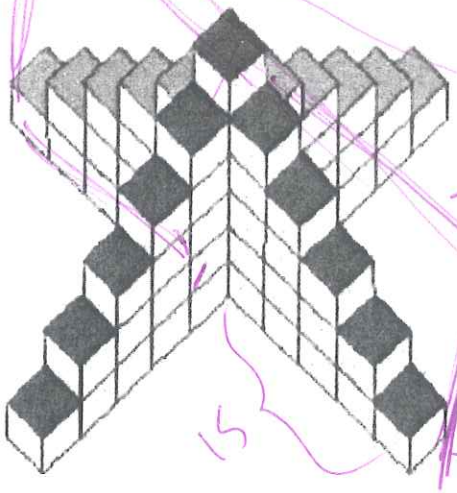
I counted the cubes on the side of one "staircase" and multiplied it by the number of sides of staircases, 8. Then counted the front and tops of each stair and multiplied it by the number of staircases, 4. The counted the number of sides on the top cube, 5. I then added these together.

Do you think that you find an equation for surface area?

Building Towers (Yellow Worksheet) +8.75/10
10 points possible

Name: [illegible]
Date: March 6, 2019

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

The tower begins with a maximum weight that decreases into four sections removing one block each time.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

I added the first n to each (n-1) progression ← multiplied by four

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

no - I would have to manually add each weight of blocks (300 + (300-1)4 + (300-2)4 etc)

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

C = # of cubes
n = weight

$C = [n+(n-1)]n$

Addition factorial (not multiplication)

How did you find this?

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

OK

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

-5

② [illegible] by adding [illegible] (straight) to each number lower than 6 (definition factorial) and multiplying each of these numbers by 9.

Alexandria

① The tower begins with a maximum height (n) that branches out into sections of four with each height decreasing by 1 each time.

② 66 → I added the first n (height) to each
a) (n-1), (n-2), (n-3), (n-4), (n-5) and multiplying each of those by 4.

b) no - I would have to manually add each number of blocks as the height decreases by one. I would have to add 300 numbers.

③ If you move the blocks to create a perfect rectangle, you get height n and width n + (n-1). To get the formula you multiply the height and width together.

$$C = [n + (n-1)]\,n$$

④ $19{,}900 = (n + (n-1))\,n$

$19{,}900 = (2n-1)n$

$19{,}900 = 2n^2 - n$

$0 = 2n^2 - n - 19{,}900$

-.25 good! but why did you set the equation equal to 19900? explain :)

quadratic formula → $\frac{1 \pm \sqrt{1 - 4(2)(-19{,}900)}}{2(2)} = n$

$\frac{1 \pm \sqrt{159{,}201}}{4} = n$

$\frac{1 \pm 399}{4} = n$

$n = 100$

is there another solution?

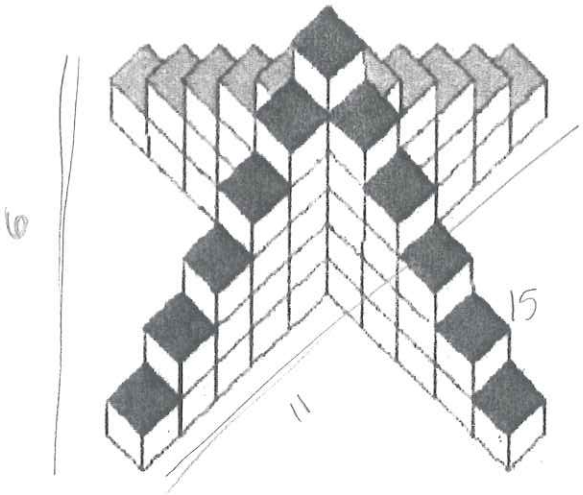
the height would be 100 cubes tall.

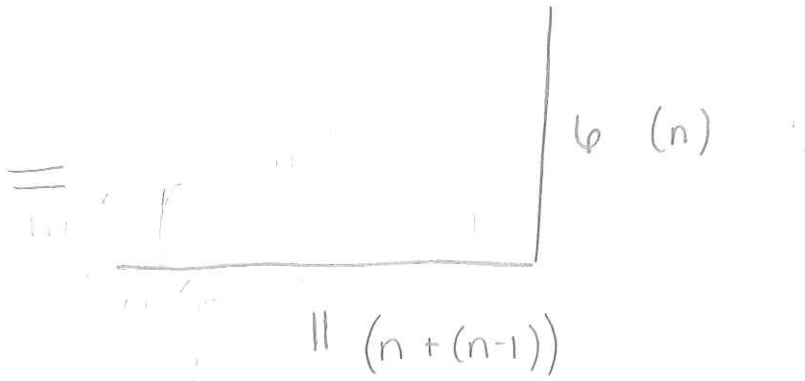
+9.75/10

Building Towers (Yellow Worksheet)
10 points possible

Name: Aisha Fichtner
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**





1) **(1 point)** Describe what you notice about the structure of the tower above.

It increases upward by increments of 1. From top to bottom and across it's 6x6. 15 blocks on each side. 6 going down the middle. 66 blocks total. 1+2+3+4+5+6. For one side plus the middle. If you put one side on top the other side on both sides it makes a rectangle.

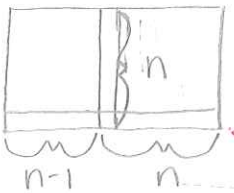
2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

66 blocks. Each of the 4 sides has 15 blocks. 15x4 = 60 then I added the 6 blocks in the middle.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

No, I would have to count all the blocks on one side and then multiply by 4 and add the 300 in the middle.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.



$[n + (n-1)]n$

Could you explain this further?

$[6 + (6-1)]6$

66 ✓

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

-2S

why set it equal?

$$19,900 = \left[n + (n-1)\right] n$$

$$19,900 = n^2 + n(n-1)$$

$$19,900 = 2n^2 - n$$

$$0 = 2n^2 - n - 19,900$$

quadratic formula

what are the solutions?

$$\frac{-b \pm \sqrt{(b)^2 - 4AC}}{a^2} = \frac{1 \pm \sqrt{1 - 4(2)(19,900)}}{4} = \frac{1 \pm \sqrt{159201}}{4} = \frac{1 \pm 399}{4} =$$

The height would be 100

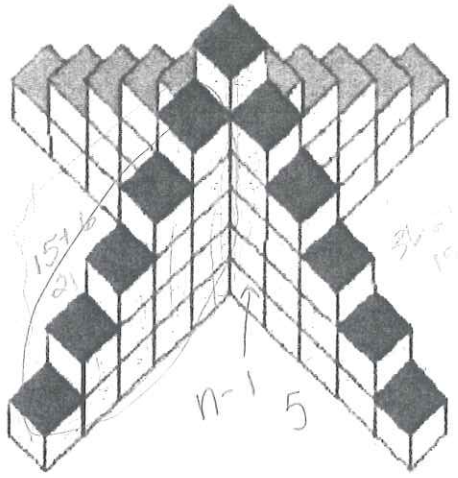
5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

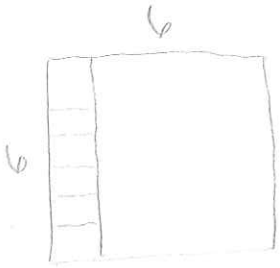
+12/10

Building Towers (Yellow Worksheet)
10 points possible

Name: Lindsey shaffner
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**





6·6 6·5

1) **(1 point)** Describe what you notice about the structure of the tower above.
Each side of the tower is symmetrical.
m

What does symmetrical mean in this case?

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

(6+5+4+3+2+1) (5+4+3+2+1)
21 15 · 3
45
21+45 =
66

*There is only one time you have to count the height of 6 cubes

good!

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?
No because I added up each section which would take awhile to do with a height of 300.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$n \cdot n + n \cdot (n-1)$

$\boxed{n^2 + n(n-1)}$ ✓

$n^2 + n^2 - n$

$2n^2 - n$

Where did this come from?

$6^2 + 6(6-1)$

$36 + 30$

$\boxed{66}$

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19,900 = n^2 + n(n-1)$

$19,900 = n^2 + n^2 - n$

$19900 = 2n^2 - n$

$0 = 2n^2 - n - 19900$

$\frac{1 \pm \sqrt{1^2 - 4(2)(-19900)}}{4}$

$\frac{1 \pm \sqrt{1 + 159201}}{4}$

$\frac{1 \pm \sqrt{159201}}{4}$

$\frac{1 \pm 399}{4}$

$\frac{400}{4} = 100$

HOW did you plug it in? Did you plug it in for n or for another term?

The height is 100.

why is this incorrect?

$-\frac{398}{4}$

I plugged in 19,900 into the answer to the formula. Then used the quadratic formula to find n.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

5

6.

$40 + 40 + 40 + 40$

$160 + 5$

$\boxed{165}$

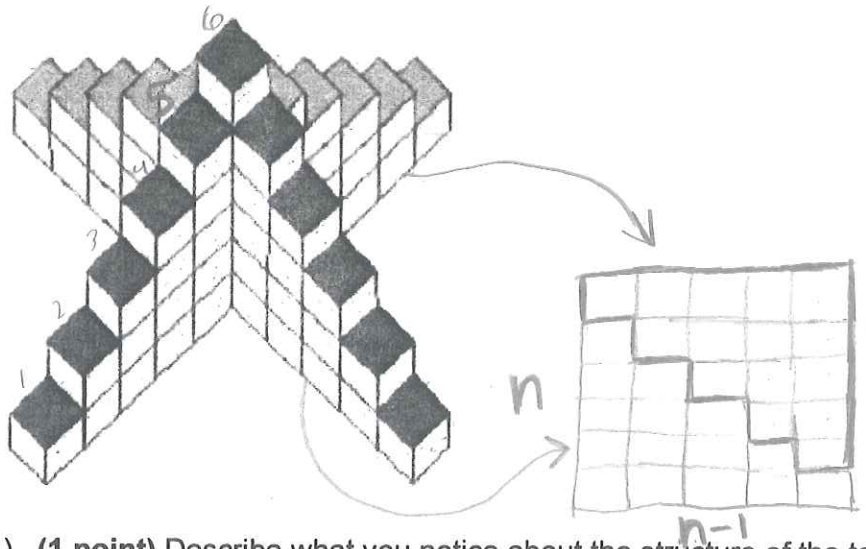
I counted up how many would be showing which was 40. There are 4 that are equal to 40. 4. The the only thing showing on the highest is 5.

+12/10

Building Towers (Yellow Worksheet)
10 points possible

Name: Lauren Cannatell
Date: march 6, 2014

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



$2n(n-1)+n$

Love this drawing!

1) **(1 point)** Describe what you notice about the structure of the tower above.

The structure of the tower above is symmetrical and seems to be rotated around the center, tallest point.

interesting!

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

Find the number of cubes for one "arm" of the tower and then multiply by 4. Add to the number of cubes needed to make the tallest point (its height).

$15 \times 4 = 60 + 6 =$ 66 cubes needed to build the tower

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

NO, because there are many more cubes, it would be difficult to count all of the cubes as I did in part a, so my strategy would not work easily.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$2n(n-1)+n$ or $2n^2-n$

good! but could you explain further? how did you get this formula?

$2(6)(5)+6 = 66$ ✓

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$2n(n-1)+n$

$19{,}900 = 2n^2 - n$

$0 = 2n^2 - n - 19{,}900$

$n = \frac{1 \pm \sqrt{1^2 - 4(2)(-19{,}900)}}{4}$

$n = \frac{1 \pm 399}{4}$

$n = \frac{400}{4} = 100$ ~~$-399 = n$~~

The height of a tower with 19,900 cubes is 100 cubes. We set our equation equal to the total number of cubes and used the quadratic formula to solve for X. This resulted in two solutions, but only the positive solution would work. So, the height is 100 cubes.

good!

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

There are 15 square faces on one side of an "arm", So 30 square faces on the sides of an "arm". We have to add the number of faces going up the "steps" of one of the arms which is 10, so 40 square faces on each arm. $40 \times 4 = 160$ and now we have to add the tallest block on the top of the tower which has 5 square faces, so $SA = 165$ units^2

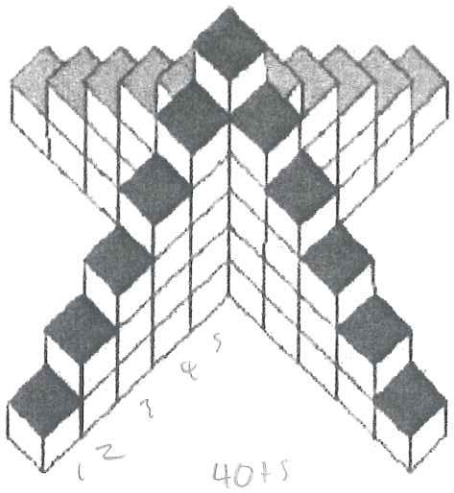
Would it be easy to find an equation for surface area?

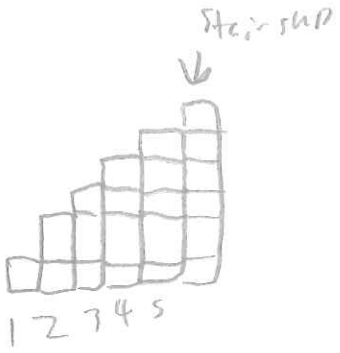
+12/10

Building Towers (Yellow Worksheet)
10 points possible

Name: Connor Cunningham
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**





1) **(1 point)** Describe what you notice about the structure of the tower above.

show this through a drawing?

It is 6 blocks high at its highest point, and its width and length are both 11 blocks long. Each "stair step" increases in height by one block each step.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

5 +4 9 +3 12 +2 14 +1 15

15 blocks total

x4 = 60 blocks + 6 blocks = 66 blocks are needed.

Each stair step, without center tower, has 15 blocks. There are 4 of them, so 15x4=60. 60 + the highest tower is 66 blocks.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not? No, because having to add all the numbers 1 to 299 would take a long time. It would not be easy at all to do that.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

Thinking

x=1 x=6 x=15 28

1, 6, 15, 28, 45, 66

5 9 13 17

height

1, 6, 15, 28, 45, 66

5 9 13 17 21 25

4 4 4 4 4

n = greatest height x = total # of cubes

$n(n+(n-1)) = x$

$2(2+1)$

$3(3+2)$

$4(4+3)$

n^2+n^2-n

$2n^2-n=x$

$2(36)-6=x$

$72-6=x$

$66=x$

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$2n^2-n=x$

$2n^2-n=19900$

$2n^2-n-19900=0$

$(2n+199)(n-100)$

$n=\frac{-199}{2}, 100$

$n\neq\frac{-199}{2}$

$n=100$

X would equall 19,900 in this equation

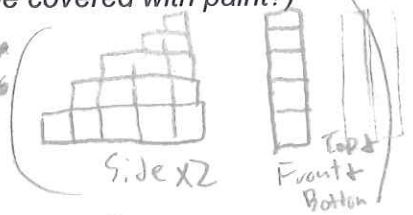
So factoring allows us to get $\frac{-199}{2}$ and 100,

good! This can't be $\frac{-199}{2}$ because the height can't be negative, the height must be 100.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

Visible Stairstep:



x4

$((15x2)+(5x3))x4=$

$(30+15)x4=$

$(45)4=$

180 units² for stairstep

Love your drawings!

The only sides being painted for each stairstep are the Top, front, bottom, and both sides. The back of each are not being painted.

*each block is 1x1x1 the units used are "units"

Visible Tower: (Top + Bottom + Sides x4)

$(1+1+4)$

(6)

6 units² for tower

The only visible parts of the tower is the bottom square, top square, and 4 sides. This means only 6 units² are painted.

180 units² + 6 units² = 186 units² total

186 square units total would be painted.

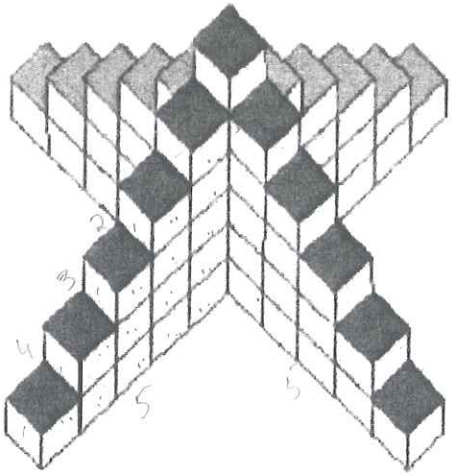
*I included the bottom in the total

+12/10

Building Towers (Yellow Worksheet)
10 points possible

Name: Luke Johnston
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



n=2=21
q n=3
11 n=4
4n°
196
40

1) **(1 point)** Describe what you notice about the structure of the tower above.

It is in the shape of an X and has stairs or pyramid steps.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

5+4+3+2+1=15(4)=60+6=66

Each set of stairs has 15 cubes so I multiplied that by 4 for the 4 sets of stairs. Then added 6 for the center column.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

No because my first strategy involved counting and not just multiplying

And counting is not easy? ☺

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$2(n^2)-n$ = number cubes

$2(6^2)-6=$

How did you get this?

$2(36)-6=66$ ✓

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19,900 = 2(n^2) - n$

$2n^2 - n - 19,900 = 0$

$(2n + 199)(n - 100)$

$2n + 199 = 0$ $\quad n - 100 = 0$

$2n = 199$ $\quad n = 100$

$n = 99.5$

$n = 100$

The height would be 100 because I plugged it into my formula then factored.

What is it?

Be more specific!

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

$40 \times 4 = 160 + 5 = 165 + 21 = 186$

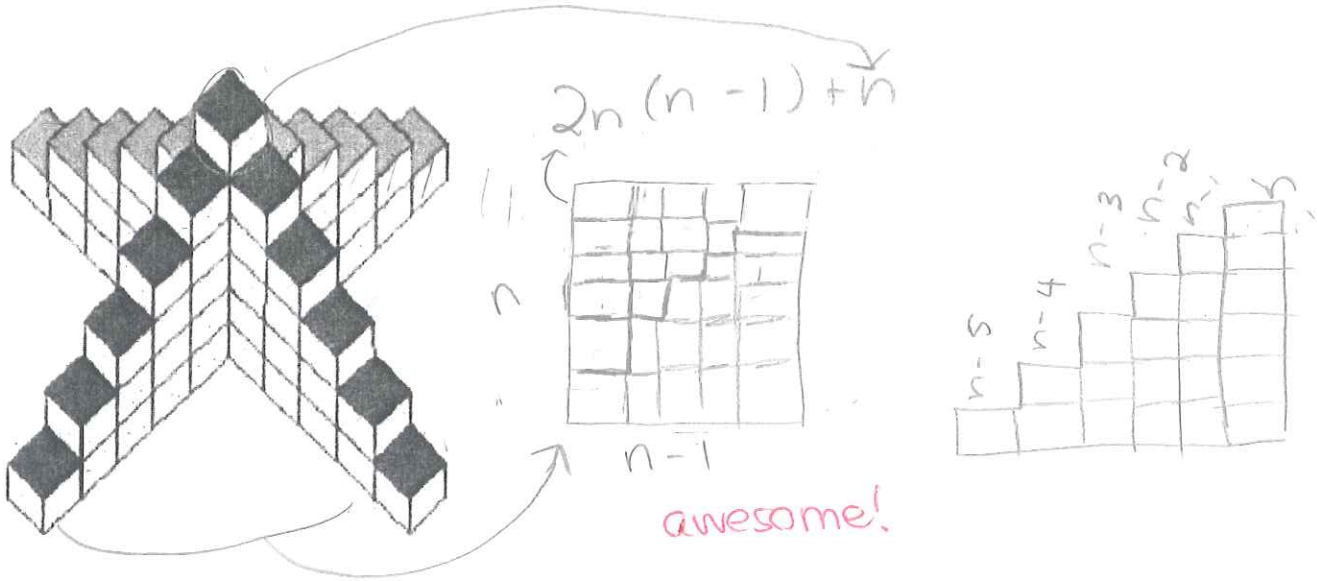
I counted on each of the sides and top. Then times that by 4 to get all the sets and add 5 for the top one. Then add 21 for the bottom.

+11/10

Building Towers (Yellow Worksheet)
10 points possible

Name: Molly Hoffenberg
Date: 3/6/14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

The Structin is symmetric on all four sides. The number of blocks increases by one for each "step" of the stair

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

$4(5+4+3+2+1)$
$60+6(\text{height})$
66 cubes

All four sides are equal, so you take the number of cubes on each side and multiply it by four. Then is only one stack with a height of 6, so you just add it

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

no, there would be too many numbers to add, you could make an equation to make it easier

3) **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$2n(n-1)+n$

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$2n(n-1) + n = 19900$

$0 = 2n^2 - n - 19900$

$0 = (2n \quad)(n \quad)$

$\frac{1 \pm \sqrt{(1)^2 - 4(2)(-19900)}}{4}$

$\frac{400}{4}$

$n = 100$

The height of the tower is 100. In order to solve the equation, you plug in 19900 where? in for n? to the equation and use the quadratic formula to solve.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

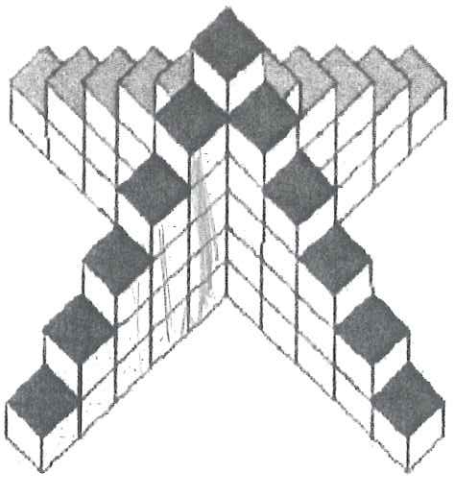
165 I reasoned that the highest cube has 5 sides showing. The other sides could not show any more than 5 sides. So, I added the number of cubes with 4 sides and 2 sides showing and added all the surfaces together to get 165.

+11.75/10

Building Towers (Yellow Worksheet)
10 points possible

Name: Taylor H
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



6-15
5-10 +4
4-6 +3
3-3 +2
2-1

1) **(1 point)** Describe what you notice about the structure of the tower above.

central column
4 sticking out parts are the same
↳ 4? OK

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

$4(5+4+3+2+1)$ $+6$ $4(15)+6$
(sides sticking out) (cubes in staircase column) (central column)
$60+6$
66 cubes

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

NO. there are too many numbers to add.

3) **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

does it work for n=6?

$[2(n-1)+1]\,n$

-1

$(2n-2+1)n$

$2n^2-2n+n$ ✓

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

-.25

one side

bottom length of tower

center column cube

center column

$$n\left(2(n-1)+1\right)=19900$$

$$n(2n-2+1)$$

$$2n^2-n-19900=0$$

$$n=\frac{1\pm\sqrt{1-(4)(2)(-19900)}}{4}$$

$$n=\frac{1}{4}\pm\frac{\sqrt{159201}}{4}$$

$$n=\frac{1}{4}\pm\frac{399}{4}$$

$$n=100$$

Explain your method more!!

Why did you do what you do?

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+1

$(15)(2)(4)=120+4+21+20+121=186$

Explain!

5 faces → 5

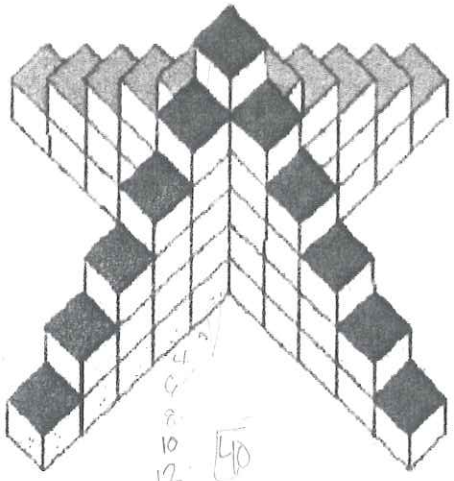
4 faces →

+11.75/10

Building Towers (Yellow Worksheet)
10 points possible

Name: Megan Quinn
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

It is 3D, there are six blocks on the bottom, and the highest is six tall, and then it goes down by one, there are four sections.

2) Reference the diagram shown above:

a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

$(15 \times 4) + 6$

$60 + 6 =$ 66 blocks

each section has 15 blocks, there are 4 sections (15×4) and then there are the six in the middle that all the sections share/connect to, so you have to add 6.

b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

no, because you had to count the blocks, and counting 300 blocks would take awhile. It would not be efficient.

nice word (1)

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

b = base
h = height

✓ $(b)(h-1) \cdot 2 + h$

$6 \cdot (6-1) \cdot 2 + 6$

$6 \cdot 5 \cdot 2 + 6$

$30 \cdot 2 + 6$ $60 + 6 = 66$

$2n^2 - 2n + n$

$n \cdot (n-1) \cdot 2 + n$

$6 \cdot (6-1) \cdot 2 + 6$

$6 \cdot 5 \cdot 2 + 6$

$30 \cdot 2 + 6$

$60 + 6 =$ 66 blocks

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

-.25

plug the number of cubes into the formula and solve.

$n \cdot (n-1) \cdot 2 + n = 19900$

explain more plug it in where? why?

$n^2 - n \cdot 2) + n$

$2n^2 - 2n + n = 19900$

$n(2n^2 - n = 19900$

$n(2n-1) = 19900$

$2n^2 - n - 19900 = 0$

b^2

$1^2 - 4159201$

4

$n = 399$

4

$\frac{400}{4}$ = 100

$n = 399$ - doesn't work because can't have negative block

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

165

$40 \times 4 + 5$

$160 + 5$

165

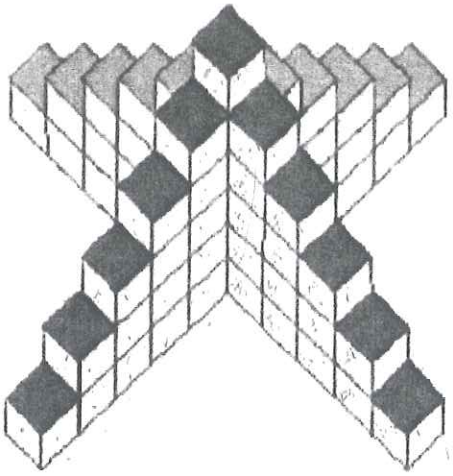
40 surface area of 1 section of block + 5

so multiply by 4 to get all sections add 5 because it is the top block

Building Towers (Yellow Worksheet) +12/10
10 points possible

Name: Nick Engle
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



$\frac{n^2}{2} + \frac{n}{2}$

$\frac{n^2+n}{2}$

n^2-n

$A = \frac{h \cdot (h-1)}{2}$

$A = A_1$

1) **(1 point)** Describe what you notice about the structure of the tower above.

It is 6 blocks high in the center, and it climbs down 1 less block in each of the four directions from 6, 5, 4, 3, 2, 1.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

$6 + 4(5) + 4(3) + 4(2) + 4 = 66$ cubes I added the center 6 cubes to all the cubes on 5 tall stacks, then 4, etc.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

No, because it would be a lot of work to total up all the layers.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$2n^2 - n$

way to show your work for your formula!

$4\left(\frac{n(n-1)}{2}\right) + n$

$2(n^2-n)+n$

$2n^2-2n+n$ $2n^2-n$

$2(6^2)-6$

$2(36)-6$

$72-6$ (66) ✓

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$2n^2 - n = 19,900$ I set up an equation

$4\left(n^2 - \frac{1}{2}n + \left(\frac{1}{4}\right)^2\right) = 9950 + \frac{1}{16}$

$\left(n - \frac{1}{4}\right)^2 = \frac{159,201}{16}$

$n - \frac{1}{4} = \pm\frac{\sqrt{159,201}}{4}$

$n = \pm\frac{399}{4} + \frac{1}{4}$

$n = 100, -99.5$ ← why not?

Solve for n

100 blocks tall

Using n as the hight of the tower, I solved for the area of the side parts with $4\left(\frac{n(n-1)}{2}\right)$, and add that to the middle section of the tower with value n. Simplifying this gives $2n^2 - n = T$ T = total blocks, I can then plug 19,900 for T to get the answer.

+2 5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

n = 6

$15(8) + 5(2)(4)\ \ 5(4) + 5 + 1 = 186$

Area of Side | Stair sides | bottom faces | middle top | middle bottom

Bonus #2: $8\left(\frac{n^2 - n}{2}\right) + 8(n-1) + 4(n-1) + 5 + 1 = SA$

$4n^2 - 4n + 8n - 8 + 4n - 4 + 5 + 1$

$4n^2 + 8n - 6 = SA$

$SA = 4n^2 + 8n - 6$

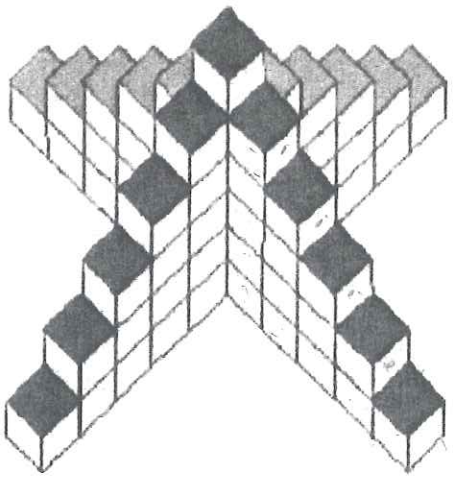
I counted the bottom of the tower as part of the Surface Area.

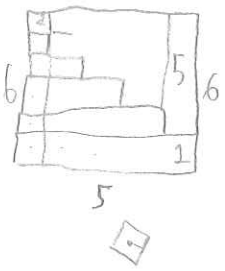
10/10

Building Towers (Yellow Worksheet)
10 points possible

Name: Michael S.
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



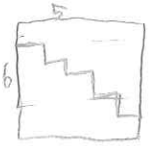


1) **(1 point)** Describe what you notice about the structure of the tower above.
The structure is made of congruent cubes, if you rotate the structure to form a shape with a circular base with a radius of 5½ blocks. The structure has a tower of 6 Blocks in the center with a 5 row of blocks coming out from the base block, then a row on top of that, then 3 then 2 then 1

what?

interesting!

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.
My strategy would be to find area of blocks in a rectangle
6×5=30 this would be the blocks for two arms so
30×2=60 Then add the 6 from the tower in the middle
60+6=66 blocks



6 blocks by 5 blocks with is two arms put on top of each other

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not? Yes, because the rectangle length would be equal to the towers height (h) and the width would be 1 less than the height of the tower (h-1), then add the center tower.
$A=2h(h-1)+h$ $A=2h^2-2h+h$ $A=2h^2-h$ $A=h(2h-1)$ $A=300(2(300)-1)$ $A=300(599)$ $A=179700$ wow!

edit this isn't the strategy you used in b)

OK

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units. The number of cubes need would be $A=n(2n-1)$

where A= # of blocks

$A=6(2(6)-1)$
$A=6(11)$
$A=66$

yes this works

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work. The height of the tower would be how many cubes high the center tower would have.

Plugging the numbers into the formula I found gives.

$A = n(2n-1)$ where A is # of cubes, and n is the height of the tower.

ok

$19,900 = n(2n-1)$

$19,900 = 2n^2 - n$

$-2n^2 - n - 19900 = 0$ found this polynomial

plugged into quadratic formula good terminology

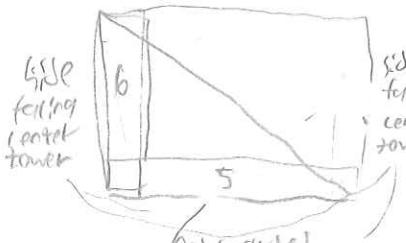
$n = \frac{-(-1) \pm \sqrt{(-1)^2 - 4(-19900)(2)}}{2(2)}$ $n = \frac{1 \pm \sqrt{1 + 159200}}{4}$

$n = \frac{1 \pm 399}{4}$ $n = 100$ or $-\frac{399}{4}$ n can't be negative

The height of the tower would be 100 cubes

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

with the same rectangle in 2D



9 faces on the diagonal for both arms

counting bottom as surface area

1 3 5 7 9 ← included on prism faces

combined

$2(5\times6) + 2(1\times5) + 18 = SA$

so add 18 of arms so multiple by 4

two faces shown

the bottoms of both arms

$2(2(2n) + 10 + 18) =$

$2(6n + 10 + 18) =$

$2(84) =$

$176 = SA$ of arms

Then add the one remaining side on the center tower with has 5 faces showing

$176 + 5 = 181$ cubes of surface area

$2(2(n-1 \cdot n) + 2(n-1) + (n-1+n-2) + 5 =$

$2(2(n^2-n) + n + (2n-3)) + 5 = SA$

$2(2n^2 - 2n + n + 2n - 3) + 5 = SA$

$2(2n^2 + n - 3) + 5 = SA$

$4n^2 + 2n - 6 + 5 = SA$

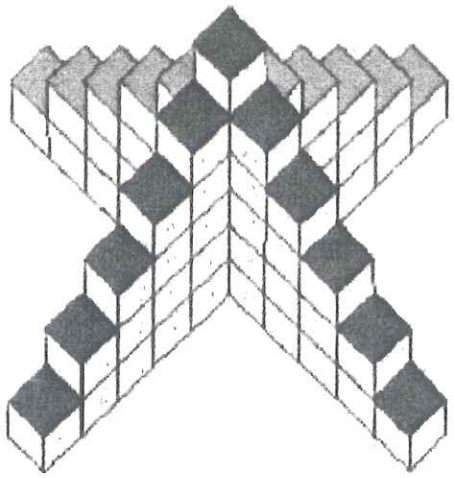
$4n^2 + 2n - 1 = SA$

+10
10

Building Towers (Yellow Worksheet)
10 points possible

Name: Amanda Drago
Date: 3/6/14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

how did you get this?

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$n^2 + (n-1)n = 19900$

$n^2 + n^2 - n = 19900$

$2n^2 - n = 19900$

$n(2n-1) = 19900$

$2n^2 - n - 19900 = 0$

$(2n + 199)(n - 100) = 0$

$n = 100$

$2n = -199$

$n = -99.5$

$n^2 + (n-1)n = 19900$ cubes

The height is 100.

I used factoring of my equation after setting it $= 19900$ to find it.

Where did you plug 19900?

Why not?

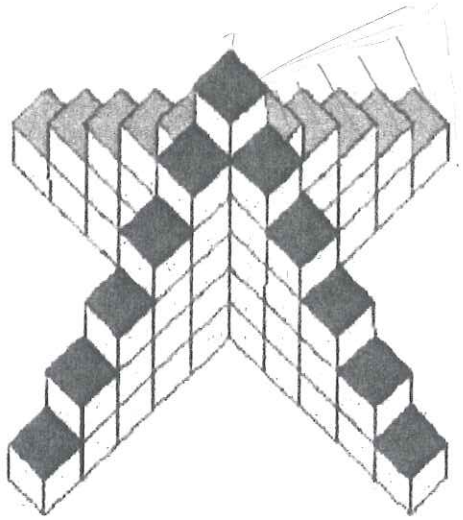
5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+10
10

Building Towers (Yellow Worksheet)
10 points possible

Name: Niki Moftakhar
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



b·h

l·w·h
·6·6

h·(2(n)+1

1) **(1 point)** Describe what you notice about the structure of the tower above.

The base has the most cubes and as you go up the number of cubes on each level gets smaller and smaller. Similar to a cube tower but is missing parts.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

6 + 4(5 + 4 + 3 + 2 + 1)
6 + 4(15) = 6 + 60
666 cubes

I found the sum of each edge and then multiplied that by the 4 edges of the cube and added it to the 6 that makes up the foundation

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

I believe that it would work, maybe not as easily since the number is bigger and my method included counting down numbers from 6 and 300 is much larger

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

-2

height = 2(n-1) + 1

↑ check with n=6

2(6-1) + 1 = 11 ×

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19,900 = 2(n+1), +1$ ∴

$6 \cdot 2(n-1) + 1$

$6 \cdot (2n-1) + 1$?

When you flip the sides of the cube it just makes it a rectangular prism and that way you can do l. w. h.

$n = 100$

$19,900 = n(2(n-1)+1$ ~ part of center cubes column

center column
one side
bottom
length of rod

Where did you get this formula?

$n(2n^2-2+1)$

$2n^2 - n - 19900$

$n = \frac{1 \pm \sqrt{1 - 4(2)(-19900)}}{4}$ $\frac{1 + \sqrt{399}}{4} = \frac{400}{4} = 100$

height is 100 units

Is there another answer?

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

$(15)(2)(4) = 120 + 4 + 21 + 20 + 21 = 186$

top edge
top faces
sides
bottom
OK

# of squares / 2 sides / number of edges

186 units^2

n = number of cubes

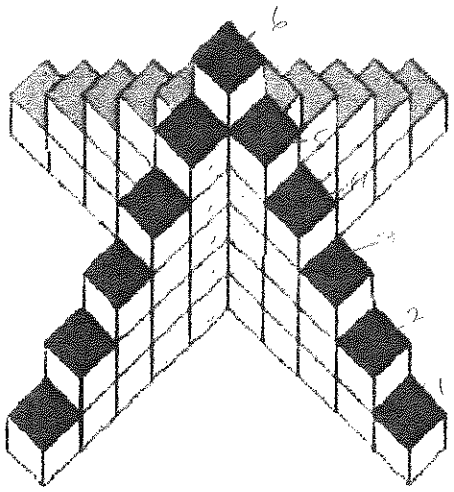
$n(2)(4) +$

6.5/10

Building Towers (Yellow Worksheet)
10 points possible

Name: _____
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1 + 2 + 3 + 4 + 5 + 6

1) **(1 point)** Describe what you notice about the structure of the tower above.
   - The structure of the tower above has [illegible]
   - It is made of eight triangles
   -

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

The total number of cubes needed to build the tower above is 66,
If you find the height of the center tower and add the height of each descending tower and multiply that by 4 (because the corner towers) then you get the total of 66 cubes.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

would that give you the # of cubes in each?
how?
Yes because, It is the same concept, due to its symmetrical features, one can find the height of each surrounding tower on one side and multiply it by four and add the center tower, you will get the right answer. would that be "easy"?

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

would this formula work for a tower of any height?

$n + 4(n-1) + 4(n-2) + 4(n-3) + 4(n-4) + 4(n-5)$

$6 + 4(5) + 4(4) + 4(3) + 4(2) + 4(1)$

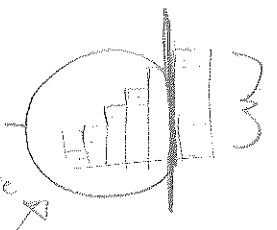
66 cubes

-1

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

2/5

1) I found the Percentage of one side of Cubes Surround the tower. → 22.7% of Structure



2) Next, I found the amount of cubes in that Percentage

3) Next, I found the total amount of cubes minus the Center tower

4) finally, I subtracted the given total from the "total minus the center".

19900
x 22.7%
4522.+2 ★ one side of tower
x 4
18090.9 ★ 11 cubes minus the Center tower

19900
-18090.9
1809 = height
cubes

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+.5

★ If you were to Paint the bottom of the tower, that would include 21 more faces, thus making the new surface area 669 units²

Answer

165
x 36 - area of one face
5940 units² Surface area of tower

36 / 6

Vertical faces - not showing
- Side faces

1/6 of cube
5 faces

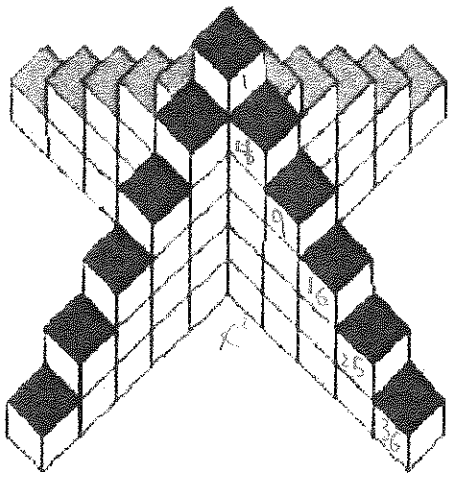
2(5+4+3+2+1)
30 - ■
+10 - ■
40★ faces Showing
x4 on one Surrounding tower
160 Surrounding faces showing
+5
165 faces showing

1) first, I made a diagram depicting the faces that are showing on one side
2) Next, I found the amount of faces showing
3) I multiplied that number by 4 (amount of surrounding towers)
4) I added the faces showing on the top cube.
5) I took the total and multiplied it by the area of one face (36).

Building Towers (Yellow Worksheet) 2.5/10
10 points possible

Name: Sean Kelley
Date: 3/5/14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



~~f(x) = f(x-1)~~

$f(x) = |x + 2(x-1) + 2(x-2)|$ $x \in [1, \infty)$

$f(x) = |5x - 6|$

1) **(1 point)** Describe what you notice about the structure of the tower above.

The tower has 1 block at the top, the second upper level has 4 blocks sprouting from the southwest and east sides. The third level shows 9 blocks sprouting from the north side.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

-1

I noticed the cubes from the south side and the heights follow a parabolic function, where the northside blocks follow a different parabolic function. I [illegible] not? and found 56 [illegible]

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

No it wouldn't, too much [illegible] a little [illegible] agreed!

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

-2

$C(n) = 2n^2 - 3n + 2$ $C = |5n - 6|$

$C(6) = 2(6^2) - 3(6) + 2$

$72 - 18 + 2 = 56$

would this work for all cases? where's the formula you are using?

$C(n) = n^2 + n - n^2 - (n-1)$

$C(4) = 1 + 0 - 0$ $C(3) = 1 + 4 - 2$

$n^2 + n - (n^2 - n + 1)$

$2n^2 - 3n + 2$ $C(2) = 4 + 1 - 1$

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

5/5

I take my equation from #3 and solve for n

$19,900 = 2n^2 - 3n + 2$

$-2 \quad -2$

$19,898$

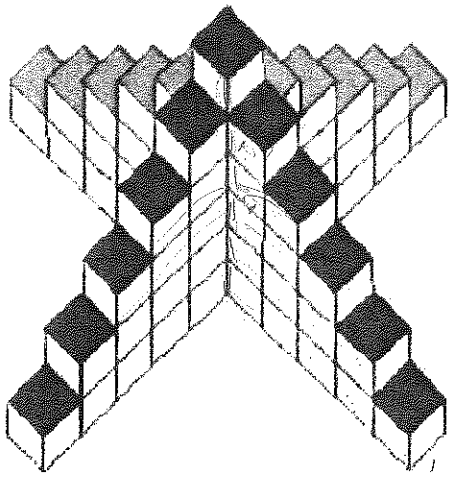
5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

Building Towers (Yellow Worksheet)
10 points possible

3.5/10

Name: Tommy Jun
Date:

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



$6 + 4(5+4+3+2+1)$

$5+4+3+2+1$

$5-1$

$5-2$ $20-16$

$5-3$

$5-4$

1) **(1 point)** Describe what you notice about the structure of the tower above.

it is 6 blocks tall the base contains the most blocks has 4 sides each making a staircase shape

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

$6 + 4(5+4+3+2+1) = 66$ I took the height of the center of the tower and added the resulting rows until it got to 1 then multiplied by 4.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

yes you would do $300 + 4(300+299(\ldots))$ however there could be an easier way

How would you easily compute this?

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

-2

$n + 4($

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

would this formula work for any height?

-5
5

$19,900 = n + 4(n-1)$

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

10

5 = top block

$(1 \cdot (2) + 5)\,4 + 5 = 145$ blocks

$(30 + 5)\,4$

35
4
140 + 5

$6 + 15(4)$

$n + 4((n+1)($

$6 + 4((6-1)$

$7 + 4(7 + 6$

$8 + 4(7 + 6$

$7 + 4(8 + 7 + 6 + 5 + 4(3 + 2 + 1)$

$11 + 4(10 + 9$

$\frac{66}{4}$ 16.5

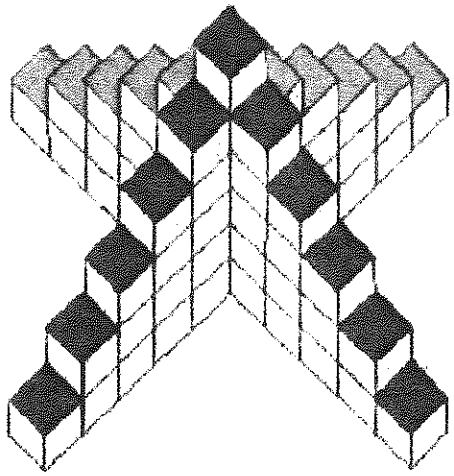
$66 - n$

Building Towers (Yellow Worksheet)
10 points possible

5/10

Name: _____
Date: 3/5/14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

-2

Try analyzing how you found the # of cubes in the provided figure

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

-5

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

$5 + 4(20) + 2(40)$

$5 + 80 + 80$

165 SA

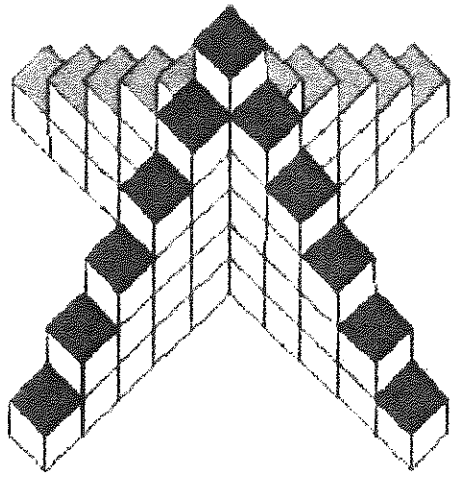
Great!

Building Towers (Yellow Worksheet)
10 points possible

12/10

Name: Nick Anderson
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

the tower has 4 sides all with equal number of cubes. The center has the largest height but in this case also the fewest cubes.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

$1+2+3+4+5=15$
$15 \cdot 4 = 60$
$60+6=66$ cubes

the tower has 66 cubes. Each side has 15 cubes in it and there are four sides. Added with the middle six there are 66.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

NO, I would have to add numbers 1 through 299. then multiplying it by four, this would just require a lot of time.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$4\left(\frac{n}{2}(n)\right)-n$

Great!

$4\left(\frac{6}{2}(6)\right)-6$
$4(18)-6$
66 cubes

I noticed a relationship between the side blocks and the height, then multiplied by 4 for the sides. However I was always 6 off so I just subtracted it.

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

x 5

$\frac{19,900}{4} = \frac{4(\frac{1}{2}(n))}{4} - n$

$2(4975) = (\frac{n^2}{2} - n)2$

$9950 = n^2 - 2n$

$0 = n^2 - 2n - 9950$

$a=1 \quad b=-2 \quad c=-9950$

$-b \pm \sqrt{b^2 - 4ac}$ / $2(a)$

$\frac{2 \pm \sqrt{4 - 4(1)(-9950)}}{2}$

$x = 100$ or ~~-9876~~

the tower is 100 cubes high. I took the formula I got in 3, then used the answer as the x. I knew if I got the equation into a quadratic I could get the answer using the quadratic formula. I threw out the negative answer and got 100.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

5+5+1
4+4+1
3+3+1
2+2+1
1+1+1
35+5
40.4
160+5
165

165 units.

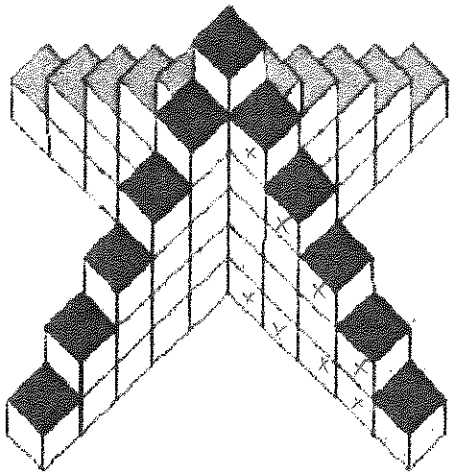
I found how much was on one side multiplied it by 4 and added 5 for the top.

Building Towers (Yellow Worksheet)
10 points possible

9.5/10

Name: Robert Skoog
Date:

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

a central stack of cubes with four stacks coming of each side of the central stack. each stack coming off the previous stack decreases by one. after the first stack only one stack comes off that one.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

$6 + (5\times4) + (4\times4) + (3\times4) + (2\times4) + (1\times4) = 66$ cubes
6 20 16 12 8 4

finding the amount each individual step down had and add them up

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

no because you would need to write out $n\times4$ for all 300 steps of the tower except center and add them up

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$2n^2 - n$

-1

how did you get this?
does it work for a height of 6 units?

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

x5

using the formula from the last problem 19,900 was plugged in for the answer and solved for n or the height of the tower.

$2n^2 - n = 19{,}900$

$2n^2 - n - 19{,}900 = 0$

$(2n + 199)(n - 100) = 0$

$2n + 199 = 0$ $\quad n - 100 = 0$

$n = -\frac{199}{2}$ $\quad n = 100$

GOOD!

the height of the tower is 100 cubes

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+.5

$1 + (20 \times 2) + (12 \times 3) + (12 \times 4) + (5 \times 5)$

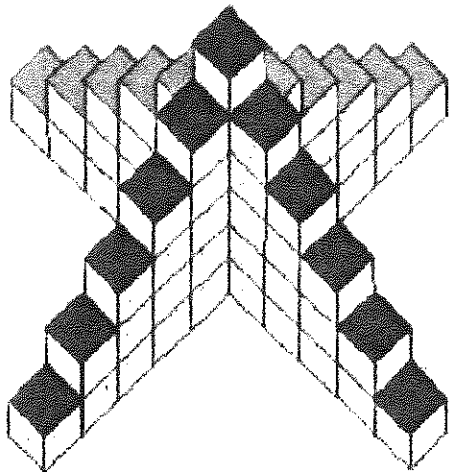
~~150~~ units^2

Building Towers (Yellow Worksheet)
10 points possible

10.5/10

Name: Greg LeMay
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

4 legs, the steps go up by 1 block, the maximum number of blocks in the middle is 6, there are 6 levels. one leg is 15 blocks excluding the middle

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

$4(5+4+3+2+1)+6$
$4(15)+6$
$60+6$
66

You multiply one leg by 4 to get the 4 legs, then you add the middle to find the total # of blocks it takes.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

No, because it would be very tedious to find the final answer, $4(299+298+297\ldots+1)+300$ this would take a very long time to complete, a very inefficient way to solve the problem

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$n^2+(n^2-n)$

The total number of cubes is equal to $n^2+(n^2-n)$

-1

Does it work?

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

+5

$n^2 + n^2 - n = 19900$

$2n^2 - n = 19900$

$2n^2 - n - 19900 = 0$

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

$n = \frac{1 \pm \sqrt{(-1)^2 + 4(2)(19900)}}{2(2)}$

NICE!

$n = \frac{1 \pm \sqrt{159200}}{4}$

$n \approx 100$

The height of the tower is 100 cubes. I took the formula I found in part 3 and I set it equal to the max number of cubes, then I set the equation equal to 0 by getting everything on the left side of the equation and got a quadratic. At first I attempted to factor then I realized I could just use the quadratic formula and I plugged the numbers in and got $n = 100$. I then plugged 100 into my original equation and got 19900 blocks

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+1.5

Total Number of cubs: 66

$4(21) + 2(40) + 0(5)$

$84 + 80 + 0$

164 165

I look down for the tower from a birds eye. View and found there are 20 blocks on the top, and now including the tip, there are 21 blocks All the top blocks have 4 sides exposed, so 4(21) then I found the amount of blocks in the middle that would have no paint on them so 0(5). The rest of the blocks only have 2 sides showing, so 2(40) all the numbers in the parentheses add up to the total number of blocks in the tower.

$4(n-1) + 1 + 2(2(n-1)) + 0(n-1)$

$4(n-1) + 1 + 2(8(n-1)) + 0(n-1)$

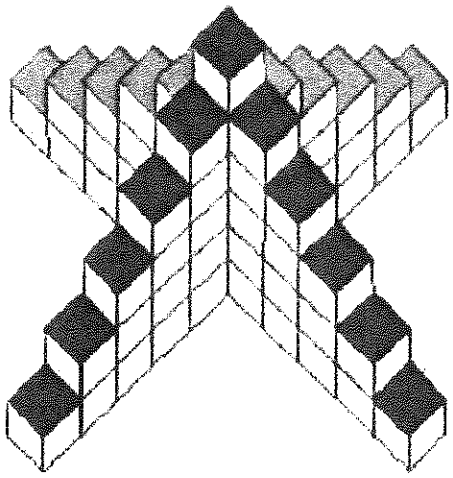
$4(n-1) + 1 + 16(n-1) + 0(n-1)$

Building Towers (Yellow Worksheet)
10 points possible

9.5/10

Name: Jenna Eagle
Date: 3/5/14 :)

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.
* it looks like 2 planes, each with an absolute value graph ← interesting!
* to be more basic, it looks like 4 identical staircases leading to one point.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.
   4(1+2+3+4+5)+6 = 166 cubes
   each of 4 sides has a column consisting of 1, 2, 3, 4, and 5 cubes
   the center consists of 6 cubes

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not? no, it would be easier to write n as the total height and use factorial numbers, with a calculator, to solve
   4((n-1)!)+n = # of cubes needed
   because writing out each number 1-299 would be tedious.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.
   Yeah, I just did that in 2b. I'm always jumping the gun :(:) that's ok!
   n: 6 4((6-1)!)+6 = 166 yay it works.
   ↑ I later found out I did that wrong. see #4 :)

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

2.5/5

if # of cubes = $4((n-1)!)+n$ and $n = 19{,}900$, then use a calculator to find that # of cubes = a number that is too big for my calculator to handle maybe $5! = 5\cdot4\cdot3\cdot2\cdot1$, not $5+4+3+2+1$. oops. time for a new solution.

6 tower: 6=6, 1+5=6, 2+4=6, 3=½(6) → $4(2.5)6+6$

7 tower: 7=7, 1+6=7, 2+5=7, 3+4=7 → $4(3)7+7$

8 tower: 8=8, 1+7=8, 2+6=8, 3+5=8, 4=½8 → $4(3.5)8+8$

9 tower: 9=9, 1+8=9, 2+7=9, 3+6=9, 4+5=9 → $4(4)9+9$

# of cubes = $4n(\frac{1}{2}n-\frac{1}{2})+n$ ✓

NOW I will solve that problem.

= 4(19,900)(.5·19,900 − .5) + 19,900

= 79,600 · 9,949.5 + 19,900

= 791,980,200 + 19,900

= 15,760,405,980,000 cubes

$19{,}900 = 4n(\frac{1}{2}n-\frac{1}{2})+n$

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)* I'm not including the bottom of the tower.

+2

most of the side faces would be $2\cdot 4n(\frac{1}{2}n-\frac{1}{2})$ ×8

all of the top faces would be $4(n-1)+1$

the rest of the side faces would be $4n$ ×4

$8n(\frac{1}{2}n-\frac{1}{2})+4(n-1)+1+4n$

$8\cdot6(\frac{1}{2}\cdot6-\frac{1}{2})+4(6-1)+1+4\cdot6$

$48(2\frac{1}{2}) + 4(5) + 1 + 24$

$120 + 20 + 25$

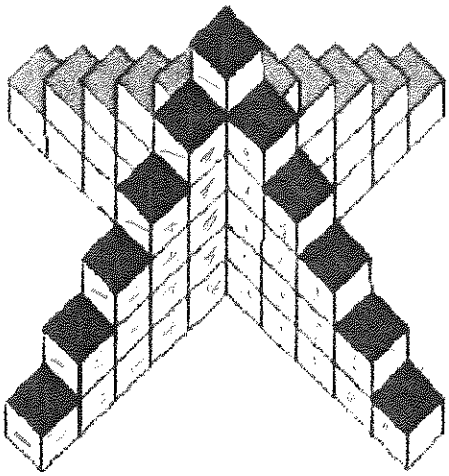
165 faces

Building Towers (Yellow Worksheet)
10 points possible

12/10

Name: Jenna Singer
Date: _____

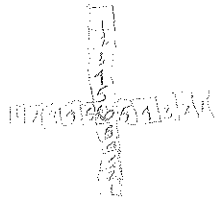
Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

The structure is symetric, increasing by 1 block each time as you work from the outside in.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.



$6+5(1)+4(1)+3(1)+2(1)+1(1)$
$6+20+16+12+8+4$
$=66$ cubes

I looked at it from the top view, also noting aside from the middle column of 6, the other 4 legs are the same.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

No, because it requires drawing a diagram and writing out each row. A formula would be easier - yes!

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

Y = # of cubes

$y = n + 2[(n)(n-1)]$

$y = 6 + 2(6(5))$
$= 6 + 2(30)$
$= 66$ ✓

*Two legs together make a height of "n" and length of "n-1"

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

+5

a) $y = n + 2[(n)(n-1)]$

$19,900 - n + 2((n)(n-1))$

$= n + 2(n^2 - n)$

$= n + 2n^2 - 2n$

$19,900 = 2n^2 - n$

$0 = 2n^2 - n - 19,900$

$(2n + 199)(n - 100)$

$2n + 199 = 0$ $\quad n - 100 = 0$

$2n = -199$ $\quad \boxed{n = 100}$

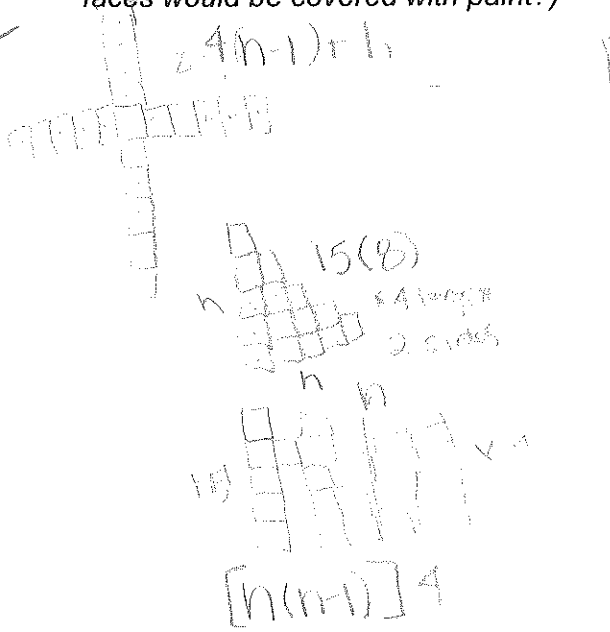
$n = -99.5$

Great!

I plugged 19,900 into the formula for y, then set the equation equal to zero. Since I received two answers, I knew the height couldn't be a negative number, but 100 would [illegible] the equation.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2



$\boxed{SA = 165}$

To solve this, I looked at the tower from all sides, drew a 2-D diagram, and created an equation/formula for each, then put in the height of 6.

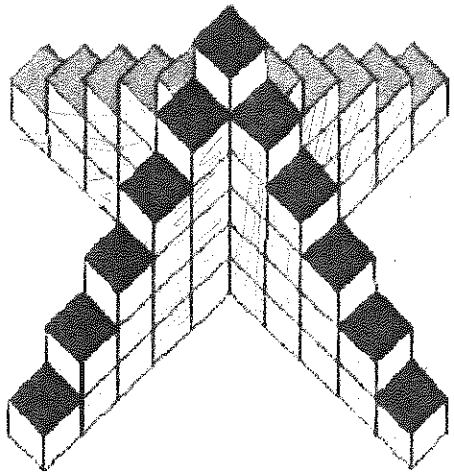
100

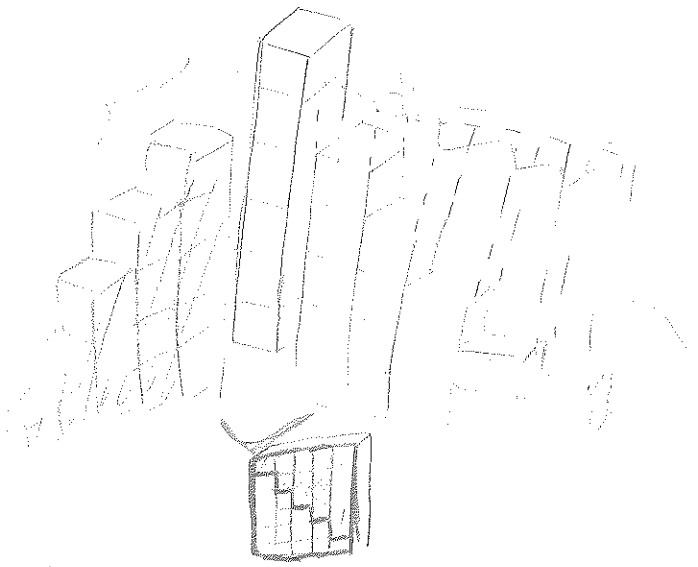
Building Towers (Yellow Worksheet)
10 points possible

9.5/10

Name: Jennifer Song
Date:

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**





1) **(1 point)** Describe what you notice about the structure of the tower above.

There is a stack of 7 cubes in the center of the tower with 6 cubes on four sides, forming a stair-like pattern with descending steps on each side.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

height of central stack + 4(5+4+3+2+1) — cubes necessary for each of the descending structures on each side

6 + 4(15) = 6 + 60 = 66

66 cubes are needed

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

No, the equation used would be 300 + 4(299+298+297+296...) it would be tedious & take too long to just set it up.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

Great!

$x = n + 2(n(n-1))$

$x = n + 2(n^2 - n)$

$x = n + 2(n^2 - n)$

$6 + 2(36 - 6)$

$6 + 2(30)$

$6 + 60 = 66$ ✓

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

3/5

You can use the equation from question 3 and solve for n with 19,900 as x, since the height(n) is needed, and the number of cubes(x) is provided.

$x = n + 2(n^2 - n)$

$19{,}900 = n + 2n^2 - 2n$

$19{,}900 = 2n^2 - n$ ✓ quadratic formula?

$19{,}900 = n(2n^2 - 1)$

$2n^2 - 1 = 19{,}900$

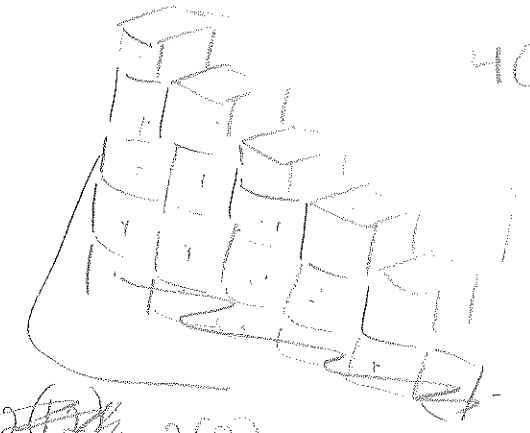
$9{,}950.5$

$9{,}950.5 = n$

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+.5

SA=149



4(5)

2(3)

236

$5 + 4(2 \cdot 8 + 4 \cdot 5)$

$5 + 4(16 + 20)$

$5 + 4(36)$

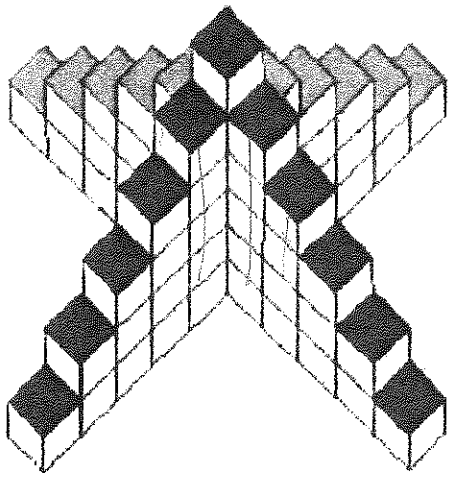
$5 + 144$

149

Building Towers (Yellow Worksheet) 2.5/10
10 points possible

Name: Sydney Richardson
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



$6+(n-1)4+(n-2)4+(n-3)4$
$6+(n-3)4$
$6+5(4)+4(4)+3(4)+2(4)+1(4)$
$n+($
$n+4(n-d)$
$n+4(n-1)$

1) **(1 point)** Describe what you notice about the structure of the tower above.

The structure resembles four staircases bonded together by a tower in the middle that is one cube higher than the next highest height of the first staircase.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

are four staircases, and added together to get the height of the staircase.

$6+5(4)+4(4)+3(4)+2(4)+1(4)=66$ cubes
Since the height of the tower is six cubes, that height has to be added on. Since the staircases descend by one each time, that number multiplied by four since there

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

-.5 It wouldn't easily

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

-2 $n+(n-1)4+(n-2)4+(n-3)$

Would this work for any height?

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

-5

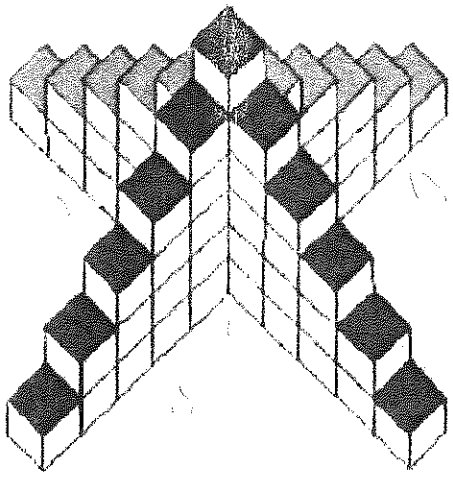
5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

Building Towers (Yellow Worksheet)
10 points possible

11.5/10

Name: Jordan Kline
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

rotational symmetry around a middle column
- height of 6 units volume of 66 cubic units

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

66. legs are 5 in height (one in the middle)
so two legs 5, 4, 3, 2, 1, and the other 4, 3, 2, 1, 5.
Four legs total to 15·4 = 60, plus 6 from each column
6+60 = 66

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

not especially easy, but easier than counting by hand. This is because any multiple only deals with one leg

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$V = n + 2(n-1)(n)$
$V = n + 2n^2 - 2n$
$V = 2n^2 - n$

$V = 2(36) - 6$
$V = 72 - 6$
$V = 66$ ✓

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

4.5/5

$19900 = 2n^2 - n$

$2n^2 - n - 19900 = 0$

plugged into my formula, then used quadratic equation.

Height is 100 cubes.

$\frac{1 \pm \sqrt{1 + 159200}}{4}$

$\frac{1 \pm 399}{4}$

$\frac{400}{4} = 100$

$n = 100$

$\frac{-B \pm \sqrt{B^2 - 4ac}}{2a}$

$\frac{1 \pm \sqrt{1^2 - (4)(2)(-19900)}}{2(2)}$

further explanation of process?

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

2 sides of each leg = 4 + 4 = 8

all four legs plus top = 6 + 6 + 6 + 6 + 24

(5) (1)

bottom = 5 · 4 = 20

top = 5 · 4 = 20

total surface area = 156 units²

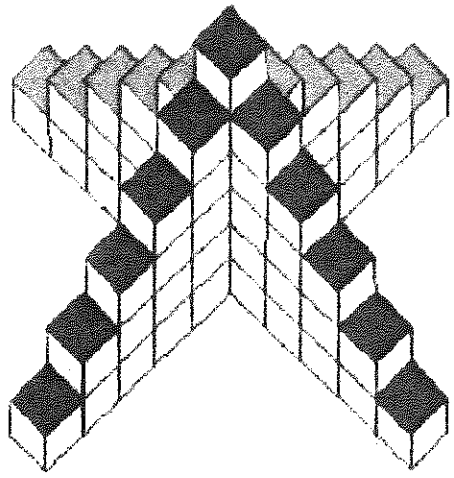
Great!

Building Towers (Yellow Worksheet)
10 points possible

10/10

Name: Bayley Costner
Date: 3/5/14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

the tower has columns of blocks that branch out from the center column, and decrease in height by 1 block each column

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

$4(5+4+3+2+1)+6=66$

multiply by 4 for each "branch" of the tower

the number of cubes in each "branch"

the number of blocks in the center column

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

no, because finding the number of cubes in each "branch" would take too long

exactly!

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$n + 4\left(\frac{n}{2} \cdot (n-1)\right) = C$

-1

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

4/5

$n + 4\left(\frac{n}{2}(n-1)\right) = 19{,}900$

$n + 4\left(\frac{n^2}{2} - \frac{n}{2}\right) = 19{,}900$

$n + 2n^2 - 2n = 19{,}900$

$2n^2 - n = 19{,}900$

$2n^2 - n - 19900 = 0$

$(2n + 199)(n - 100) = 0$

$2n = -199 \qquad n = 100$

$n = -99.5$

$n = 100$

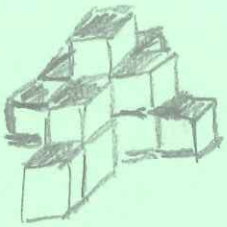
Explain your problem-solving method

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

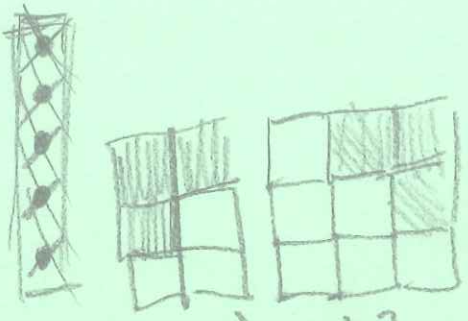
+2

$(5 \cdot 5) + (4 \cdot 16) + (3 \cdot 16) + (2 \cdot 24) + (1 \cdot 1) + (0 \cdot 4) = 186$ units²

- $(5 \cdot 5)$: number of blocks with 5 sides showing
- $(4 \cdot 16)$: # of blocks with 4 sides showing
- $(3 \cdot 16)$: # of blocks with 3 sides showing
- $(2 \cdot 24)$: # of blocks with 2 sides showing
- $(1 \cdot 1)$: # of blocks with 1 side showing
- $(0 \cdot 4)$: # of blocks with 0 sides showing



4 parts with a middle



$1+2+3+4+5+6 = 3(7)$

$4\left[\frac{3(7)}{2}\right] - 3(6) =$ ~~168~~ $84-18$

66 ✓

$4(1)+4(2)$

$4(1+2+3+4+5)+6$

$4(2.5)(6)+6 = 66$ ✓

yes!

$4\left(\frac{n}{2}\right)(n+1) - 3(n)$

$n + 4\left(\frac{n-1}{2}\right)(n)$

$2n^2+2n-3n = 2n^2-n$ ✓

$n + (2n-2)(n)$

$n + 2n^2 - 2n$

$2n^2 - n$ ✓

~~36+25~~

$n^2 + (\cancel{81})$

~~n^2+n^2+2n+1~~

~~$2n^2+2n+1$~~

$n^2 + n(n-1)$

$n^2 + n^2 - n$

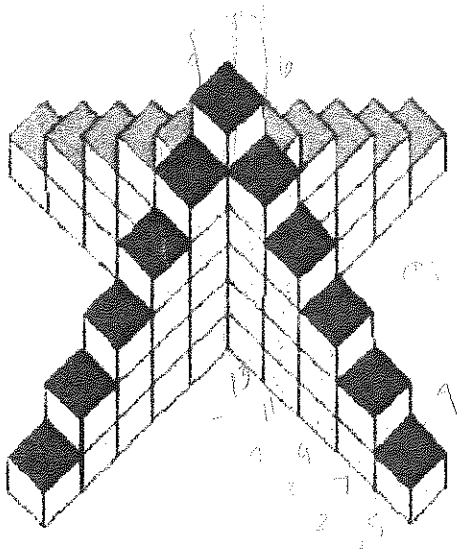
$2n^2 - n$

Building Towers (Yellow Worksheet)
10 points possible

10.5/10

Name: Kathryn Uhland
Date: 2/5/14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

As each column gets closer to the center, one more is added to it's top. There are 4 equally spaced "legs" each with the same amount of blocks.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

   4(3+4)+6=66 cubes. Each "leg" bar is blocks and the center column was 6. I multiplied the legs by the number of blocks and added the center column.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

   no, because it would take too long and would be inefficient. A formula would be better. Good!

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

y=number of cubes

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

4.5/5

$19,900 = 2(n)(n-1) + n$

$= 2(n^2 - n) + n$

$= 2n^2 - 2n + n$

$= 2n^2 - n - 19,900$

$1 \pm \sqrt{1 - 4(2)(-19,900)}$

4

$\frac{1}{4} + \frac{}{4}$

$\frac{1}{4} + \frac{}{4}$

$n = 100$

$19,900 = 2(100)(99) + 100$

$\checkmark = 19,900$

The height of this tower is 100 cubes. My method uses the formula to solve for n

further explanation?

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+1

$S_n = 185$ 186?

I counted the open faces, multiplied by 4 and added the top.

X	Y
1	2
2	7
3	9
4	11
5	13

$2n+3$

- can you also find a formula for the surface area of a tower of height n?

$n(n+1)5 + 5$

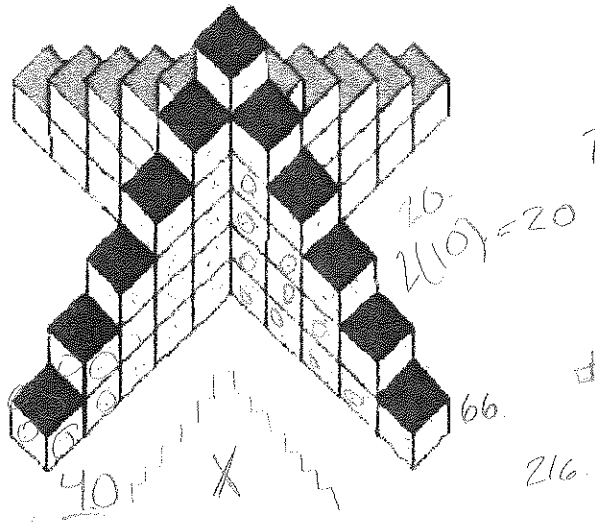
$6(5) - 5$

Building Towers (Yellow Worksheet)
10 points possible

12/10

Name: Sumreet Sidhu
Date: 3/6/14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



7: $21 \times 4 = 84 + 7 = 91$
$2(7^2) - 7 = 91$

$n - 1 =$

$5 \cdot 4 = 20$
$\times 4$
80
80

1) **(1 point)** Describe what you notice about the structure of the tower above.
The structure looks like a X is you look from the top view. Looking from one of the sides it looks like a triangle with steps. It's like a pyramid but its missing sides. going up the cubes increase by one.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.
For this tower you need 66 cubes. I added up the sides - first leaving the middle for later. one side had 15 and $15 \times 4 = 60$ and adding the middle is 66. one side - $1+2+3+4+5 = 15 \times 4 = 60 + 6 = 66$.
   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not? No it wouldn't work easily because counting the amount of cubes on one side would become a very tedious job. yes!

$2(n^2) - n =$

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units. To find this formula I played around trying to find out what 6 and 66 had in common. I noticed that $6^2 + 6^2 = 72$ is close to 66. The difference is of only 6. So I derived the formula $2(n^2) - n$.

91

NICE!

$2(6^2) - 6$
$2(36) - 6$
$72 - 6 = 66$ ✓

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19,900 = 2(n^2) - n$

$2n^2 - n - 19,900 = 0$

$(2n+199)(n-100) = 0$

$2n+199=0$ $\quad n-100=0$

$n=-99.5$ $\quad n=100$

Great!

The height would be 100 cubes.

I took the formula I had and made it equal to 19,900. then I solved for n. I got two different answers but I knew the height couldn't be negative so it had to be the positive answer 100.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

40 squares shown on one wing of the shape.

$40 \times 4 = 160$

$+ 5$ ← Blocks shown of the very top cube

165

20 = top 5 have 4 sides showing

+ 20 = Bottom 10 have 2 showing

× 4

160

The surface area without the bottom would be 165 sq. cubes.

b) Surface area formula:

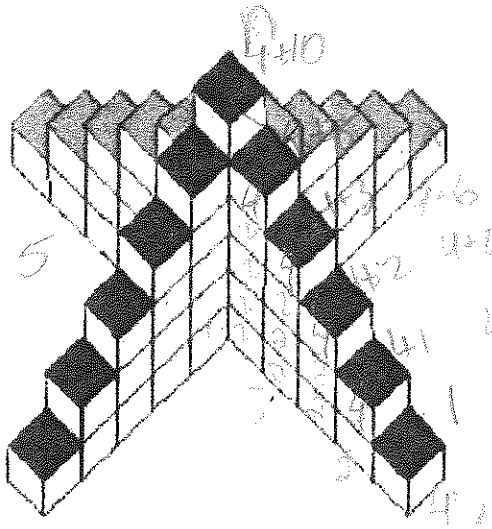
$4(4(n-1)) + 5 + 2$

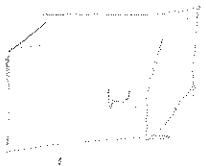
Building Towers (Yellow Worksheet)
10 points possible

11.5/10

Name: Valeria M.
Date: 2/6/14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**





1) **(1 point)** Describe what you notice about the structure of the tower above.

It's three-dimensional, there are 11 rows, 22 blocks all connected in the center the tower is 6 blocks high and 11 blocks long with a width of one block and the length is 5 blocks

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

The length one side is 5 blocks. I'd have to find how many blocks around two sides would multiply the height times one of the sides (6 × 5) = 30 blocks. And add it only half so 30(2) = 60 blocks. Also the center must be counted for, so add 6 more blocks.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

Yes because to find the height multiply the height times one number of blocks on one side to get the amount of blocks on one side. 300 × 300 = 90000 and then × 2 = 180000 then multiply by 2 and add the height once more to get

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$2n \times (n-1) + n$

$2n^2 - 2n + n$

$2n^2 - n$

$2(6)^2 - 6$

66

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

4.5/5

$2n^2 - n = 19900$ - used the formula

$2n^2 - n - 19900 = 0$ - all on one side

$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ - quadratic formula

$\frac{1 \pm \sqrt{1 - 4(2)(-19900)}}{4}$ - Solve

$\frac{1 \pm \sqrt{159201}}{4}$

$\frac{1 \pm 399}{4}$

$\frac{400}{4}$, ~~$-\frac{398}{4}$~~

Answer: 100 blocks

Further explanation of problem-solving method?

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

x2

$10 \times 4 = 40$ to surface area on one side with 2 sides showing

+

5 x 4 blocks with 4 sides are showing

1 block at top with 5 sides showing

one side of the tower has 40 sides showing + 2 the other side (not counting the bottoms) +

the top blocks on one row have 4 sides showing and there is 5 rows

add the blocks

$(40 \times 2) + (5 \times 4)(4) + 5 =$

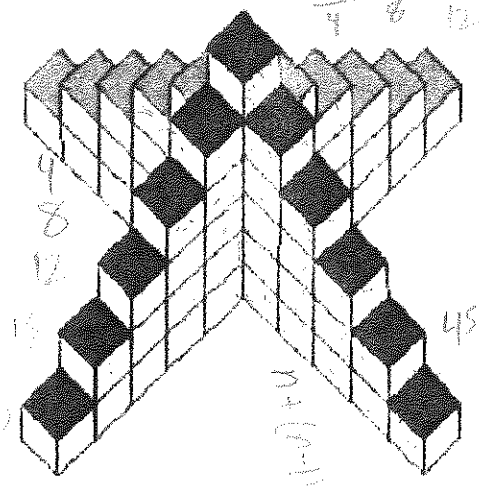
Surface Area: 165 square faces

5.5
10

Building Towers (Yellow Worksheet)
10 points possible

Name: Sean M Pearson
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

one block down the middle with four legs coming out of it, each layer has four more blocks than the one above it. at the top of each block is shaded.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

sum all of the cubes in one leg, multiply by 4, and add the center column. 66 cubes.

$n+4\left(\sum_{x=1}^{n}(n-1)\right)$

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

179700

yes, because it uses a formula which the height n can be plugged in to find the how "easy" would summing (n-1) from 1 to 300?

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

-2

$n+4\left(\sum_{x=1}^{n}(x-1)\right)$

How would you compute this?

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work. The Height is 100.

$19900 = n + 4\left(\sum (x-1)\right)$

+2.5

$100 = 4\left(\sum_{x=1}^{100} (x-1)\right)$

After I got my final formula, I didn't know how to solve it for n, I guess and checked and found that when I plugged 100 in, it came out to 19900

how?

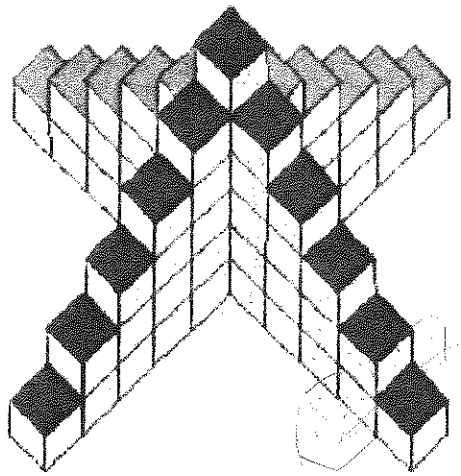
5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

Building Towers (Yellow Worksheet)
10 points possible

12/10

Name: Trent Hirsch
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

The tower is shaped like a cross, where each leg of the cross is 1 block wide. At the end of each leg, the tower is 1 block high. At the second block in, the tower is 2 blocks high, at the third, it is 3, and so on until the legs meet at the center, where it is 6 blocks high.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

$6 + 4(5+4+3+2+1)$
$6 + 4(15)$
$6 + 60$
66 cubes

Each leg consists of columns of 5, 4, 3, 2, and 1. So, I could add up how many cubes were in each leg, and since there are 4 legs, multiply by 4. Then I just had to add 6 for the middle column.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

No, I would not, because the height of 300, each leg would have 299 columns on it. So I would have to add 299+298+297... down until 1.

3. **(2 points)** How many cubes would be needed to construct a tower of height n? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

n: height

$1 \cdot 6 = 6$ $\quad 1 \cdot 2 \cdot 6 - 1$
$2 \cdot 5 = 45$ $\quad 9 \cdot 2 \cdot 5 - 1$
$4 \cdot 7 = 28$ $\quad 8 \cdot 2 \cdot 4 - 1$
$5 \cdot 3 = 15$ $\quad 5 \cdot 2 \cdot 3 - 1$
$3 \cdot 2 = 6$
$1 \cdot 1 = 1$

$\text{cubes} = n \cdot (2n-1)$
$\text{cubes} = 2n^2 - n$

$2 \cdot (6)^2 - 6$
$2 \cdot 36 - 6$
$72 - 6$
66

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

+5

$19,900 = 2n^2 - n$

$2n^2 - n - 19,900 = 0$

$(2n + 199)(n - 100) = 0$

$2n = -199$ $\quad n = 100$

$n = \frac{-199}{2}$

Great!

The height is 100 cubes

I used the formula I found in part 3 and set it equal to 19,900 since that is how many cubes are in the tower. Then, I solved for n to find the height. I got two answers, but since height must be positive, $-\frac{199}{2}$ can't work, so the answer is 100 cubes.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2 Including Bottom

$SA = (2n)^2 + 2(4n - 3)$

$= (2 \cdot 6)^2 + 2(4 \cdot 6 - 3)$

$(12)^2 + 2(24 - 3)$

$144 + 2 \cdot 21$

$144 + 42$

$SA = 186$

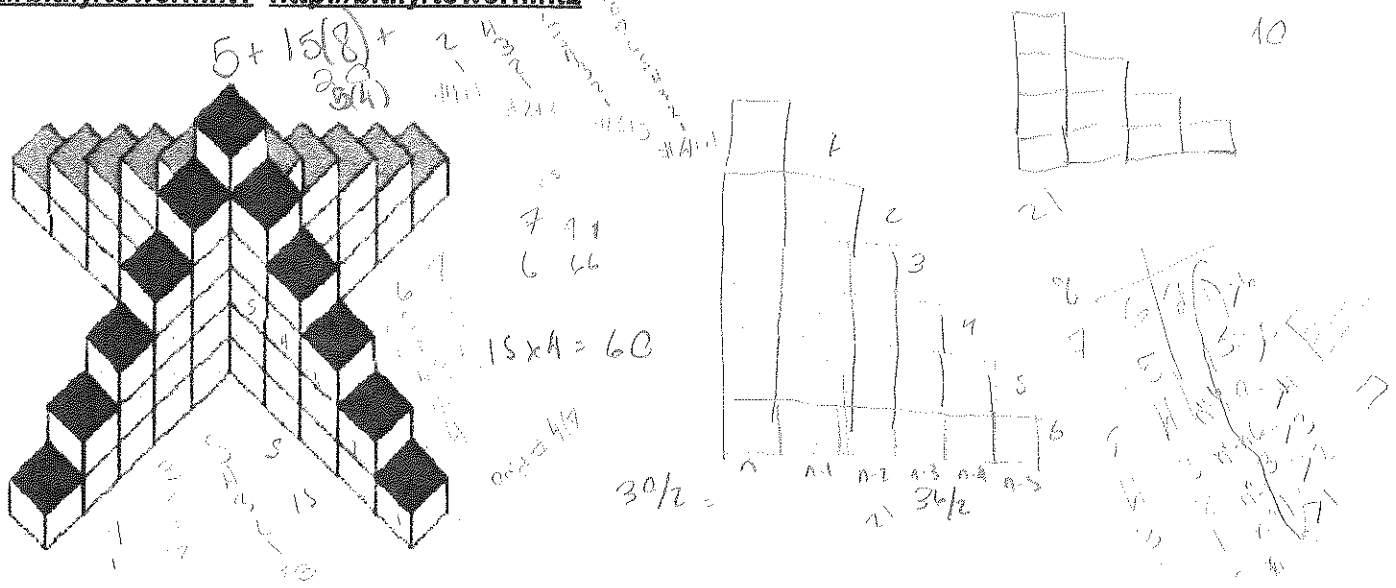
I found a formula that represents the surface area. I noticed that when counting up the surface area of the tower, that the surface area of the layer, not including the tops of the cubes or the bottom, was 144, or 12^2, or $(2 \cdot 6)^2$. I then noticed that the pattern was $(2n)^2$ and I wrote that down. Next, I noticed that from the top, the figure was a square when each layer, 6 long including the center. So, since the center is only included once, the bottom and the sides can be found with $4n - 3$, where n is the number of layers. The 3 takes the center into account. Then, adding these two patterns together, gives the formula $SA = (2n)^2 + 2(4n - 3)$, which I then plugged in 6 to get 186.

Building Towers (Yellow Worksheet)
10 points possible

10.25/10

Name: Caroline Carroll
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

Three Dimensional figure made with stacking cubes in a stair like fasion from each edge of the center Cube. Height is 6 cubes

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

The Cubes stack in an order of increasing by one cube. Therefore one side contains a row of 5, 4, 3, 2, 1 cubes which can be multiplied by 4 to get each side. Then an additional 6 cubes must be added for the Centeral Stacks of the tower, to get 66.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

Although possible, my strategy would not be an efficent tool to find the height of the tower, since that would reaure adding up the digits from 1-299, multiplying by 4 and then adding 300. It would

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$n + ((n-1)4)n/2$

$\text{Volume} = n + (n-1)4 + (n-2)4 + (n-3)4 + (n-3)5 \ldots$ Until $(n-\#) = 0$

↑ Works but not reasoning

$\text{Volume} = 2n^2 - n$

$h = 2(6)^2 - 6 = 66$ ✓

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

+4.75

$V = 2n^2 - n$

$19,900 = 2n^2 - n$

$2n^2 - n - 19,900 = 0$

$2(n - 100)(n + 99.5) = 0$

$n = 100, -99.5$

Plugged into Volume equation

Quadratic formula

↑ more detail about process

The height is 100 Cubes

$V = 2(100)^2 - 100$

$V = 19,900$

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+.5

$n = \# - 1$

$SA = n + 3n(8) + n(4) + n(4) + 1$

$= 5 + 15(8) + 20 + 20 + 1$

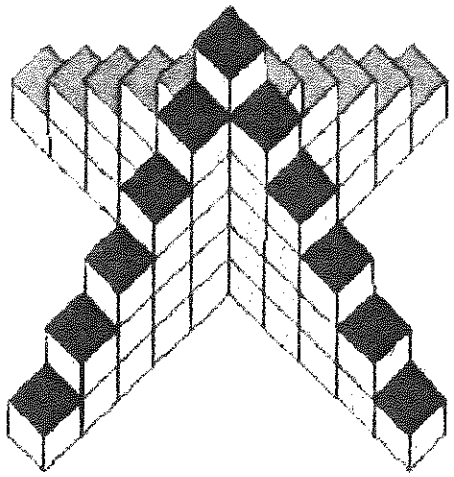
$= 166$ units^2

Building Towers (Yellow Worksheet)
10 points possible

12/10

Name: Braden Palmore
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

It has 4 equal staircases, counting 1 to 2 to 3 to 4 to 5 blocks high leading into a third [illegible] at right angles from two other staircases.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

$(1+2+3+4+5)(4)+6=$ Total number of cubes

$15(4)+6=$ Total

66 = Total number of cubes

I took the total number of cubes in a staircase by [illegible] by 4 to account for all 4 staircases.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

No, my strategy would [illegible] for a tower [illegible] because that would require adding [illegible] all the way to 300 which is very difficult.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

T = # of cubes needed

$T=2n^2-n$

$T=2(6^2)-6$

$T=(2\cdot36)-6$

$T=72-6$

$T=66$

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

19900 = total # of cubes

+5

$19900 = 2n^2 - n$

$0 = 2n^2 - n - 19900$

A B C

$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $\frac{-(-1) \pm \sqrt{(-1)^2 - 4(2)(-19900)}}{2(2)}$

Great!

$\frac{1 + 399}{4}$ $\frac{1 - 399}{4}$ can't have negative n

$\frac{400}{4} = 100 = n$

After writing 19900 equal to the $2n^2 - n$, the use of the quadratic formula was needed to determine the [illegible]. Once the number [illegible] it, it came to be $\frac{1 \pm 399}{4}$ or $\frac{1 - 399}{4}$. Since $\frac{1 - 399}{4}$ resulted in a negative value, [illegible] only solution satisfying to a height of 100 cubes.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

10·4 blocks with 4 non-visible faces

5·4 blocks with 4 non-visible faces

1 block with 5 non-visible faces

$(40 \cdot 2 \text{ non-vis}) + (20 \cdot 1 \text{ non-vis}) + (1 \cdot 5 \text{ non-vis})$

$80 + 20 + 5 = 105$

165 square = surface area

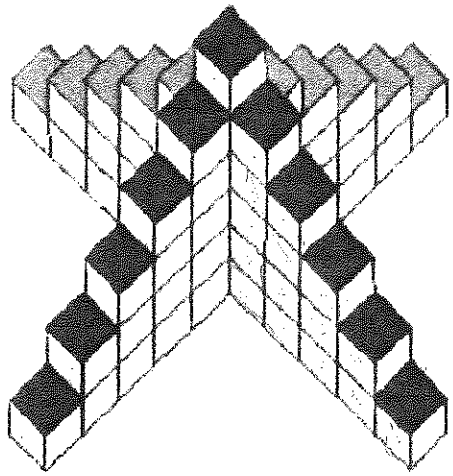
The block [illegible] top of a stack [illegible] have two non-visible faces and [illegible] of them on the [illegible] the block on top [illegible] the very top block, [illegible] showing, and [illegible] with no visible faces. [illegible] number of blocks by the number of non-visible faces [illegible] $(40 \cdot 2) + (20 \cdot 1) + 5$, [illegible] the block [illegible]

Building Towers (Yellow Worksheet)
10 points possible

11/10

Name: Alyssa Troxel
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.
It looks like a pyramid with the corners taken out also the tower gets 1 cube shorter everytime it goes another row away from the center

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

-.5

$6+4(5)+4(4)+4(3)+4(2)+4(1)$
$6+20+16+12+8+4$
66 cubes

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?
not easily because
My strategy would work but the numbers would get very large and maybe hard to work with without a calculator.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

n = height
# = total number of cubes

n=1, #=1 | n=2, #=6 | n=3, #=15 | n=4, #=28

$n(2n-1)$ → n=6

$6(2(6)-1)$
$6(12-1)$
$6(11)$
66 cubes

$n(2n-1)=C$
C = total cubes

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work. $C = 19900$

+5

$n(2n-1) = 19900$

$2n^2 - n - 19900 = 0$

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

Great!

$\frac{1 \pm \sqrt{1-4(2)(-19900)}}{2(2)} = n$

$\frac{1 \pm \sqrt{1+159200}}{4} = n$

$\frac{1 \pm \sqrt{159201}}{4} = n$

$\frac{1 \pm 399}{4} = n$

$\frac{400}{4} = n$

$100 = n$

I plugged in 19900 into my equation and solved to get a height of 100 cubes

+1.5

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

S = surface area

$C = n(2n-1)$

$n=1$ $C=1$ $S=6$

$n=2$ $C=6$ $S=25$

$n=3$ $C=15$ $S=$

$n=4$ $C=28$ $S=$

$15 \cdot 2 = 30$ - each side of inner corners

$30 \cdot 4 = 120$ - all 4 inner corners

$11 \cdot 4 = 44$ - all 4 sides going up

$120 + 44 + 1 + 21 = 186$

top cube

all bottoms

Bonus

+6 - for top cube

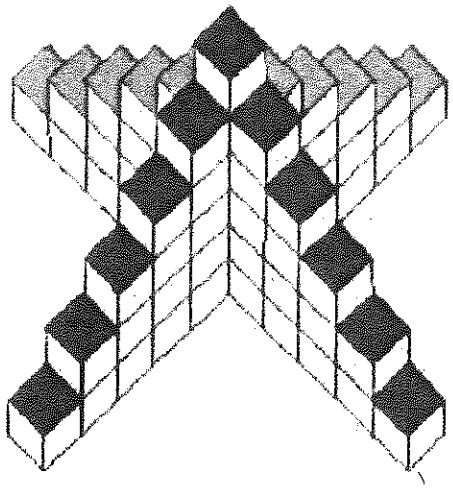
186 cubes^2 to paint the tower including the bottom

Building Towers (Yellow Worksheet)
10 points possible

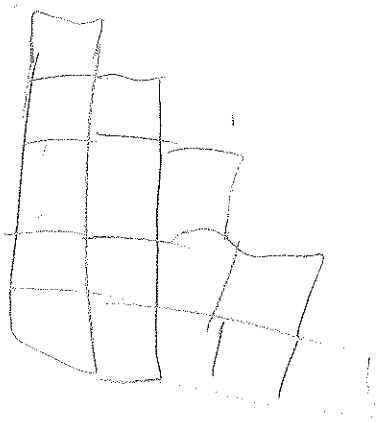
10.5/10

Name: Matthew Lantz
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



0 n: 1 → 0 → 1
4 n: 2 → 1 → 6
12 n: 3 → 3 → 15
24 n: 4 → 6 → 28
40 n: 5 → 10 → 45
60 n: 6 → 15 → 66



1) **(1 point)** Describe what you notice about the structure of the tower above.

It is 6 blocks high. There are 4 branches that come from the single tower. As you get further from the base, The branches get smaller at a 1:1 ratio.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

$6 + 4(5+4+3+2+1)$
$6 + 4(15)$
$6 + 60$
66 cubes

I found the number of cubes in center tower then I added that to the number of cubes in each branch, I multiplied that number by 4 because there is 4 branches.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

No, You would have to add up the numbers 1-300 and that would not be to easy.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

cubes = $2n^2(n-1) + n$ (2 sides, height)

cubes = $2n^2 - 2n + n$

cubes = $2n^2 - n$

$n(2n-1)$

cubes = $2n^2 - n$

does your formula work?

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

+5

$\text{Cubes} = 2n^2 - n$

$19900 = 2n^2 - n$

$2n^2 - n - 19900 = 0$

$\frac{-b \pm \sqrt{b^2 - 4ac}}{2A} = n$

$\frac{1 \pm \sqrt{1 + 159200}}{4}$

$\frac{1 \pm 399}{4} = n$

$\frac{400}{4} = n$

$n = 100$

height = 100

I plugged in 19900 into the equation and used the quadratic equation to find n since n is height.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+1.5

sides bottom/top middle column

$15(2)(4) + 5(3)(4) + 6$

$120 + 60 + 6$

186 squares

Includes bottom

$\left(\frac{2n(n-1)}{2}\right)(8) + (n-1)(3)(4) + 6$

$4n(n-1) + (n-1)(12) + 6$

$4n^2 - 4n + 12n - 12 + 6$

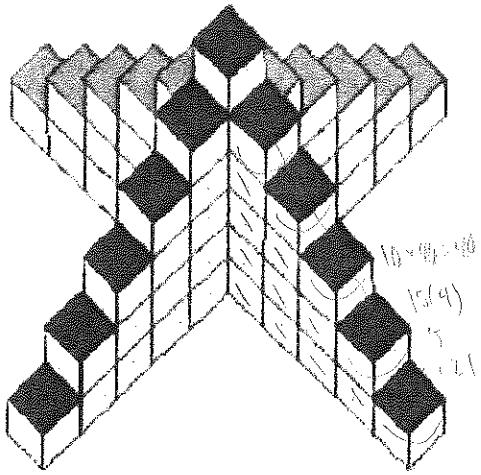
$4n^2 + 8n - 6$

Building Towers (Yellow Worksheet)
10 points possible

12/10

Name: Aubrey Hoppe
Date: 3/6/14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

The tower has four stacks jutting from the middle, and each side is 5 blocks long. They also add one block when they move over, making the heights 1, 2, 3, 4, and 5 until reaching the middle of a height of 6.

2) Reference the diagram shown above:

   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

one side $1+2+3+4+5=15$

all sides $15(4)=60$

add middle $60+6=66$

It will take 166 cubes. I found this by calculating that 15 blocks make a side, so all all 4 would take 60. They I added the height to get 166 blocks

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

No, it would not, because my method takes adding the numbers of blocks on one side, and so adding from 1 until 299 would be very tedious, and time consuming

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$4\left(\frac{n(n-1)}{2}\right)+n = \#$ of cubes

$2n(n-1)+n$

$2(6)(5)+6$

$60+6$

166 cubes.

$2n(n-1)+n = \#$ of cubes

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

+5

cubes $= 2n(n-1)+n$

$19,900 = 2n(n-1)+n$

$19,900 = 2n^2-2n+n$

$19,900 = 2n^2-n$

$0 = 2n^2-n-19900$

Great. $0=(2n+199)(n-100)$

$0=2n+199$

$0=100+n$

$n=100$

$n=-99.5$ cannot be possible

The height is 100 blocks. I found this by first plugging in the 19,900 as the answer for the equation, and after factoring, the answers were 100 and -99.5, and since there cannot be a negative height, the height must be 100 blocks.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

1 with 5 sides

20 with 4 sides

40 with 2 showing or bottom

$5+20(4)+40(2)$

$5+80+80$

165 faces + 21

186

186 faces. I found this because the top block shows 5 faces, and all the blocks on the top of the towers show 4, and there are 20. And the rest (40) only show 2. So, $5+80+80=165$ faces, but you must add the 21 on the bottom to get 186.

additional bonus:

$5(n-(n-1))+4(n-1(4))+2(n+4(4))$

$5(1)+4(4n-4)+2(4n+16)+4(n-1)+1$

$5+16n-16+8n+32+4n-4+1$

$5+28n+13$

$SA=18+28n$

$2+78(6)=SA$

$165=SA$

$18+28(6)$

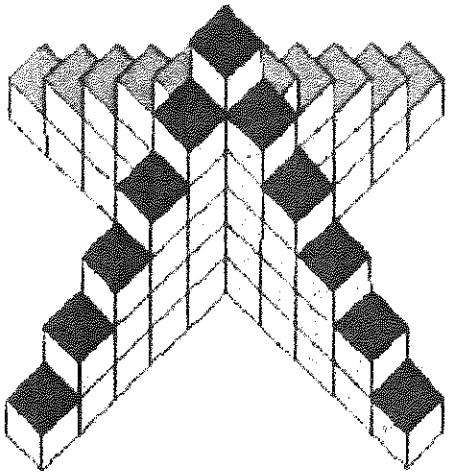
$186=SA$

Building Towers (Yellow Worksheet)
10 points possible

12/10

Name: Rishabh Choudhary
Date: 3-6-14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

The cubes form part of a structure of a square pyramid.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

Number of cubes = 6 + 4(5+4+3+2+1)
= 66 cubes

Each column had a descending order of cubes than the previous when going out from the middle. I added starting from the 5 level to 1 and multiplied by 4 since there were 4 faces. Then I added 6 because there was only one six level column.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

It would not work easily because the number of cubes in each column would have to be added starting from 299. Yes!

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

Number of cubes = $n(n-1) \times 2 + n$
$= (n^2 - n) \times 2 + n$
$= 2n^2 - 2n + n$
Number of cubes $= 2n^2 - n$

x = # of cubes
$x = 2(6)^2 - 6$
$x = 66$

×5 4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19900 = 2n^2 - n$

$2n^2 - n - 19900 = 0$

$n = \frac{-(-1) \pm \sqrt{(-1)^2 - 4(2)(-19900)}}{2(2)}$

$n = \frac{1 \pm \sqrt{159201}}{4}$

$n = \frac{1 + 399}{4}$ ghat!

$n = \frac{398}{4}$ $n = \frac{400}{4}$

$n = 100$

The height of this tower is 100 cubes. I used 19900 in the formula: number of cubes = $2n^2 - n$ to get $19900 = 2n^2 - n$. Then I used the quadratic formula and got the height to be either $-\frac{398}{4}$ cubes or 100 cubes. Since the height would have to be possitive, the height is 100 cubes.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

×2

Surface area = $5(4)(4) + 10(9)(2) + 5$

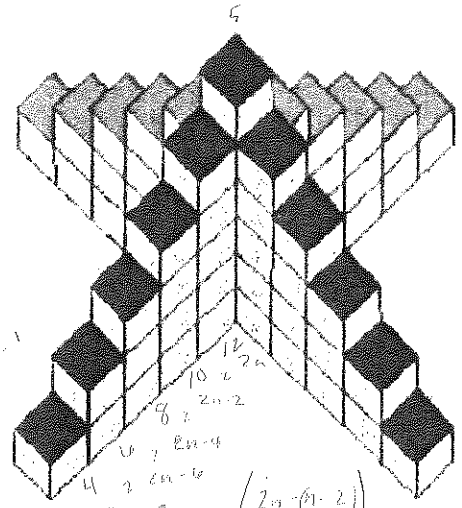
$= 165 \text{ cubes}^2$

I noticed the top layer for each wall had 5 cubes that showed 4 sides, so I multiplied those and then multiplied that by 4 because there are 4 walls. Next, I had 10 cubes that showed 2 sides on 4 walls. Finally, the 10 and two were added to 5 for the number of sides that the top cube showed.

Building Towers (Yellow Worksheet) 12/10
10 points possible

Name: Mehar Chawla
Date: 3/6/2014

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

It consists of four right triangles with the same height and the all have the same area and base length. The base length is equal to the height for each triangle.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

Total Number of cubes = center triangle's area of triangle + 4 × (1/2)(6-1)(6) + 6 (center six cubes)

$T = 6 + 4(\frac{1}{2})(5)(6)$
$= 6 + 60$
$= 66$

I found the area of one triangle multiplied it by four and then added six for the center.

66 cubes

$T = h + (2)(h-1)(n)$
$= h(1 + 2h - 2) = h(2h-1)$

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

Yes, because the values "plugged" in for the base and height can be changed easily.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$T = n(2n-1)$
$T = 6(2(6)-1)$
$T = 6(12-1)$
$T = 6(11)$
$T = 66$

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

+5

Great!

Total Number of Cubes = $h(2h-1)$

$19{,}900 = h(2h-1)$

$19{,}900 = 2h^2 - h$

$2h^2 - h - 19{,}900 = 0$

$h = \frac{-(-1) \pm \sqrt{(-1)^2 - 4(2)(-19900)}}{(2)(2)}$

$h = \frac{1 \pm \sqrt{159201}}{4}$

$h = \frac{1 \pm 399}{4}$

$h = 100$ $\quad h = \cancel{-}\ 99.5$ ↑ negative

The height is 100 cubes.

h = height

Using the formula from question 3, I substituted the 19,900 cubes in for the total amount of cubes. Then, I solved for h, the height, by using the quadratic formula. The final answer has to be positive, since we're finding the height of the tower, so 100 cubes is the height of the tower.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2 TOP ↓ 5

$(n-1)(n-2)$ 4 triangles

- find a formula for the surface area of a tower of height n

$S.A = 5 + 4(n-1)(n+2)$

$= 5 + 4(6-1)(6+2)$

$= 5 + 4(5)(8)$

$= 5 + 160$

$S.A = 165\ u^2$

This surface area doesn't include the bottom of the tower.

There are n-1 steps for each triangle and the amount of cube faces is 2n and decreases by n-2 each step down.

So, $2n - (n-2)$

$= 2n - n + 2$

$= n + 2$ is the number of cube faces for each step. Since there are n-1 steps, I multiplied n+2 and n-1 together to get the amount of cube faces for one triangle. I multiplied that quantity by 4 because there are 4 similar triangles. I then added 5 because the top cube will always have 5 faces.

Surface Area = $5 + 4(n+2)(n-1)$

OR

$= 5 + 4(n^2 + n - 2)$

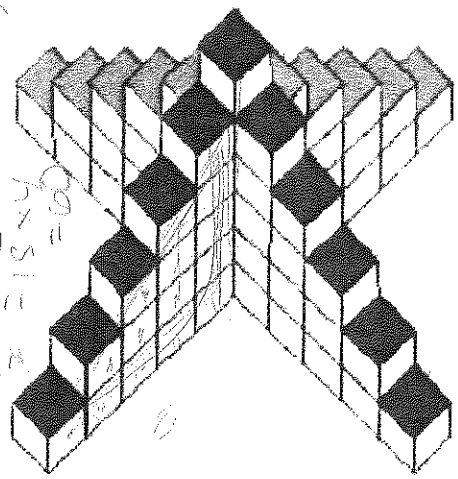
$= 4n^2 + 4n - 3$

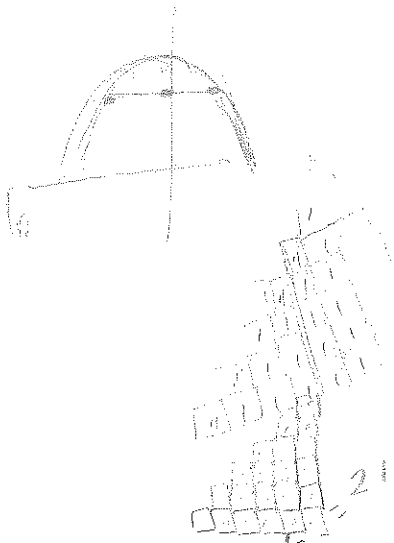
5.25
10

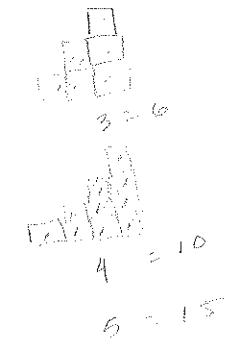
Building Towers (Yellow Worksheet)
10 points possible

Name: Romulo
Date: 1st hour

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**







1) **(1 point)** Describe what you notice about the structure of the tower above.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

3) **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$h + \left\{ \frac{h-1}{2} \left[2(h-1) + (h-2)(-1) \right] \right\} \times 4$

$= 19900 + \left(\frac{19900-1}{2} \cdot 19900 \right) 4$

$= 792,000,100$ cubes

$h + \left(\frac{h-1}{2} \cdot h \right) 4$

You found the number of cubes in a tower of height 19,900.

$\frac{2.25}{5}$

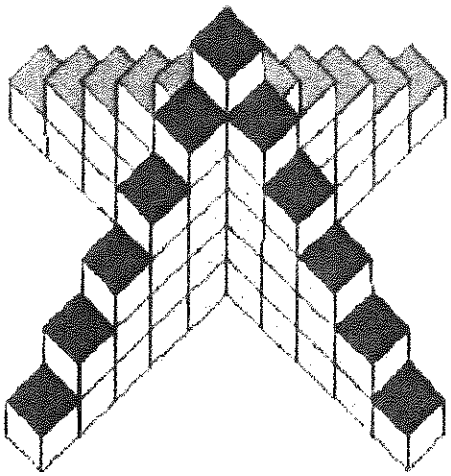
5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

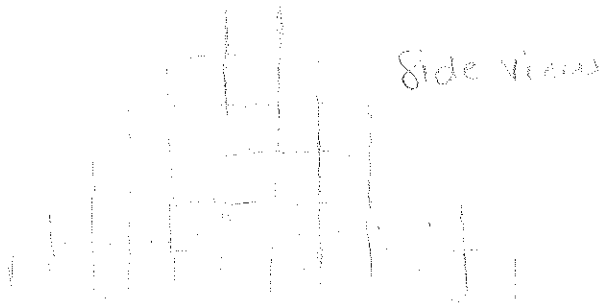
Building Towers (Yellow Worksheet)
10 points possible

10/10

Name: Amanda Stetler
Date: 3/6/2018

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**





1) **(1 point)** Describe what you notice about the structure of the tower above.

the tower is made up of cubes and almost has a pyramidal shape. the towers have legs coming out from the center small sides of the middle is part of the tower

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

1 2 3 4
5 6 4
x 9
10

15 60
x4 +16
60 60

I found how many cubes it take to the legs, multiplied by 4 to include all the legs and added the middle cubes to get the total

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

No, because it would take too much time to count the cubes how many are in each of the 4 legs and the middle.

Yes!

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

length + width
2n+1

= n(2n-1)

60 = 6(2(6)-1)
60 = 6(12-1)
60 = 6(11)
60 = 60 ✓

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

x 5

$19900 = n(2n-1)$

$19900 = 2n^2 - n$

$2n^2 - n - 19900 = 0$

Great!

$\frac{1 \pm \sqrt{1 - 4(2)(-19900)}}{4}$

$\frac{1 \pm \sqrt{1 + 159200}}{4}$

$\frac{1 \pm \sqrt{159201}}{4}$

$\frac{1 \pm (399)}{4}$ $n = \frac{400}{4}$ / $\frac{-398}{4}$

$n = 99.5, 100$

$n(2n-1)$

I plugged in 19900 as the number of cubes & created a quadratic equation. It was unfactorable, so I used the quadratic formula & got two values for n and eliminated the one I didn't check out

$99.5(2(99.5)-1)$

$99.5(199-1)$

$99.5(198)$

~~19701~~

$100(2(100)-1)$

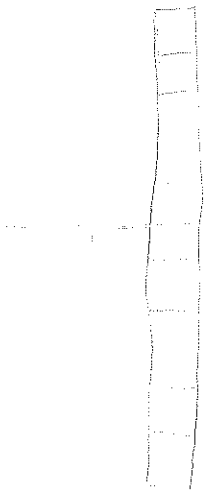
$100(200-1)$

$100(199)$

19900 ✓

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

top view & bottom view



21 square faces

15 x 8 = 120 + 21 = 141 + 4 = 145 + 4

149 square faces would be covered in paint.

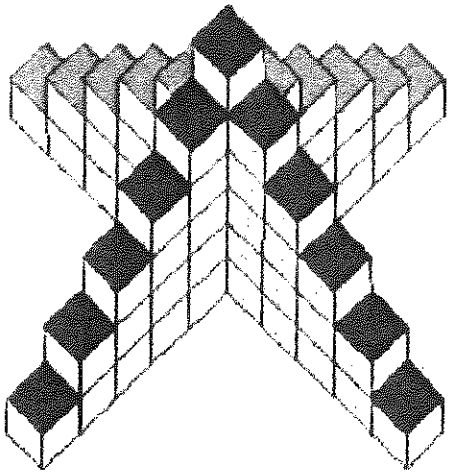
I multiplied 15 by 8 because the legs have two sides, each with 5 square faces. I then added 21 because the tops of [illegible] can be seen [illegible] 21 sq. ft. Then I added 4 to include the remaining legs. The top row After that I added 4 to get the [illegible] side of [illegible] faces on the legs of the [illegible]

Building Towers (Yellow Worksheet)
10 points possible

12/10

Name: Andrew Huser
Date: 9/6/14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

There are 4 congruent pieces that are all perpendicular to each other. In the middle there is a lone column that is one block higher than the perpendicular pieces' highest column.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

15(4) + 6
total #: 606

I counted the number of cubes in one of the four pieces. I multiplied it by 4 and then added 6 to account for the middle column

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

NO. Because you would have to do a lot of counting to find the number of cubes

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$(2n-1)n$

$(1(6)-1)6$
$(5)6$
30

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19,900 = (2n-1)n$

$19,900 = 2n^2 - n$

$\times 5$ $\quad 2n^2 - n - 19900 = 0$

$(2n+199)(n-100) = 0$

Great!

$2n = -199 \qquad n = 100$

$n = -99.5$

Height = 100 cubes

To solve this, I plugged in 19900 for the number of total cubes in the equation I found and solved for n. I had to factor in order to find n and one of the numbers was negative so I knew it could not be that, the other was positive and it works when I plug it in.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

$\times 2$ $\quad 40(4) + 5$

$160 + 5$

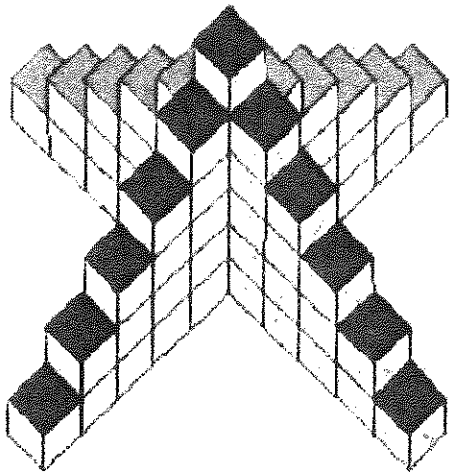
165 square faces

Since I knew there were 15 blocks in each piece, I multiplied that by 10 to get 10 of each side of one piece. I also accounted for the 5 added to 10 to account for the faces that were showing, but not included in the [illegible] I multiplied it by [illegible] to find out the [illegible] that were showing.

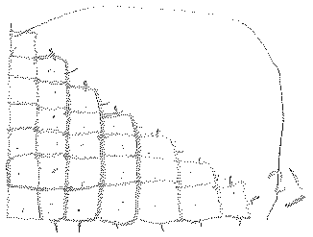
Building Towers (Yellow Worksheet) 12/10
10 points possible

Name: Chase Kaiser
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



5·2



$\frac{7 \cdot 7 - 7}{2}$ 6·2

1) **(1 point)** Describe what you notice about the structure of the tower above.

One center tower, 6 blocks high
4 branches that are decreasing one block height every block they go away from the center 4 branches are the same.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

1 side
5+4+3+2+1
15

$15 \cdot 4 = 60$
$+ 6$
66

found how many cubes is needed for one branch multiplied that by 4 because there's 4 of them. Then added 6 for the middle piece.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

Would not work well. Having to add 299+298+297, etc. would take a very long time. Yes!

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$\frac{n \cdot n}{2} - n$ $\frac{6 \cdot 6 - 6}{2}$ $\frac{30}{2} = 15$

$n + 4\left(\frac{n^2 - n}{2}\right)$

$6 + 4\left(\frac{6^2 - 6}{2}\right)$ $6 + 4(15)$
66 ✓

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

+5

$19{,}900 = n + 4\left(\frac{n^2-n}{2}\right)$

$19{,}900 = n + 2n^2 - 2n$

$2n^2 - n - 19{,}900 = 0$

$\frac{1 \pm \sqrt{1^2 - 4(2)(-19900)}}{2(2)}$

CHECK!

$\frac{1 \pm 399}{4}$ $\quad \frac{400}{4} = 100$

$\frac{398}{4} = 99.5$

$100 + 4\left(\frac{100^2 - 100}{2}\right) = 19900$

made 19,900 equal to my equation. simplified to $2n^2 - n - 19{,}900 = 0$. Used quadratic formula and got 2 possible solutions 100 and 99.5. Plugged those into my equation and found 100 to be the correct answer.

$99.5 + 4\left(\frac{99.5^2 - 99.5}{2}\right) = 19901$ ~~19901~~

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

x2

bottom included

$(15 \cdot 2 + 10 + 5) \cdot 4 + 6$

$45) \cdot 4 + 6$

$45 \cdot 4 + 6$

186

15 on one side of a branch x2 for both sides plus 10 on the top and sides leading out, + 5 for the bottom. add all those to get 45 surface area for one branch multiply by 4 for all of the branches. cube on top has 5 sides showing and left on the bottom so add 6 to get 186

$\left(2\left(\frac{n^2-n}{2}\right) + 2(n-1) + (n-1)4 + 6\right)$ ← Bonus #2

$2\left(\frac{n^2-n}{2}\right)$ finds the 2 sides

$2(n-1)$ finds the top and sides leading out.

$(n-1)$ finds the bottom.

x4 for the 4 branches.

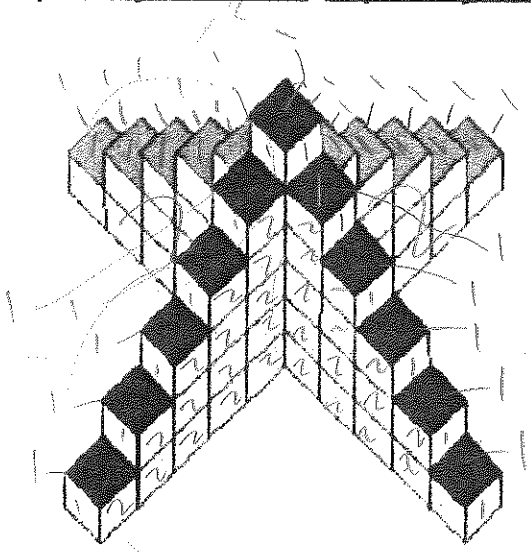
+ n for the 5 on top and 1 on bottom remaining.

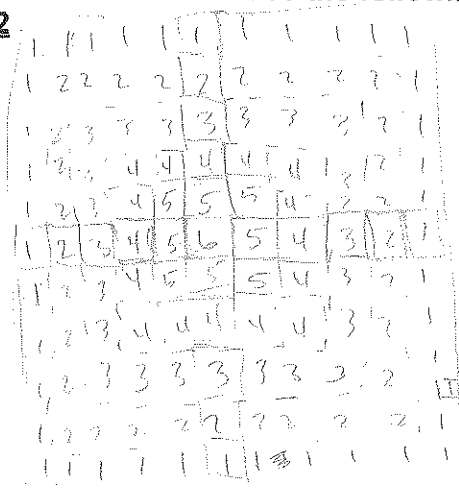
Building Towers (Yellow Worksheet)
10 points possible

12/10

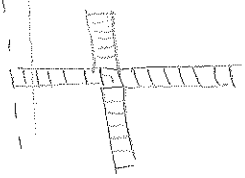
Name: Ian Wagner
Date: _____

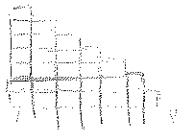
Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**





layer 1 121
2 81
3 49
4 25
5 9
6 1
total 286
66





1) **(1 point)** Describe what you notice about the structure of the tower above.

Tower, but only with perpindicular legs.
Interesting!

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

60+6 66 cubes Count the cubes of the legs +6
for centers cubes.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

NO, because you would have to [illegible]
[illegible]

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

Largest Height = n
Area
# of cubes = C

$C = 2n(n-1)+n$

$66 = 2(6)(6-1)+6$
$66 = 12(6-1)+6$
$66 = 72-12+6$
$66 = 66$

$C = 2n(n-1)$

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

+5

Great!

$19900 = 2n(n-1)+n$

$19900 = 2n^2 - 2n + n$

$19900 = 2n^2 - n$

$2n^2 - n - 19900 = 0$

$\frac{1 \pm \sqrt{1 - 4(2)(-19900)}}{2(2)} = n$

$n = \frac{1 \pm \sqrt{159201}}{4}$

$n = 100, n = -99.5$

combining

Use Quadratic equation

First, you plug in 19900 into the equation ($C = 2n(n-1)+n$)

Then you combine to get

then you can either factor or use the Quadratic formula

you will get two answers but one is negative so you may or may not use it since there cannot be negatives

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

$4(2n-1)$

$3(n-1)^2 + 4(n-1)$ = $4((n-1)^2 + (n-1))$

$4(n-1)+1$

bottom faces of blocks

$4(2n-1)$ finds surface area of all block faces labeled # 1 on front.

$4((n-1)^2 + (n-1))$ Finds area for sides of the legs labled 2

$4(2n-1) + 4((n-1)^2 + (n-1)) + 4(n-1)+1$

$8n - 4 + 4(n^2 - 2n + 1 + n - 1) + 4n - 4 + 1 + 1$

$8n - 4 + 4n^2 - 4n + 4n - 4 + 2$

$8n - 6 + 4n^2$

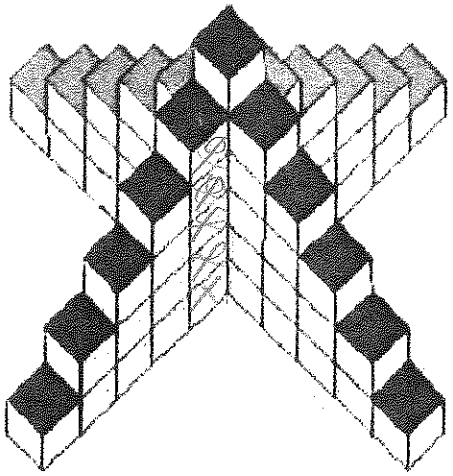
$4(6)^2 - 6 + 8(6) = 186$

Building Towers (Yellow Worksheet)
10 points possible

12/10

Name: Rashmeet Kaur
Date: 3/6/14

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

The structure shown is made up of 4 sections with each part leading to the center. There are 6 cubes in the center and from each face of the cube in the center, a column of cubes is built, each one less than the one before.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

There are 606 cubes needed to build the tower above. The strategy I used to find this number is I added one side of columns by adding (5+4+3+2+1) and the answer was 15 which I then multiplied by 4 = 60 and added the height of 6 to get 606.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

This strategy would not easily find the number of cubes for a tower that has a height of 300 in that it would be difficult to count the number of cubes on one side (300+299+298...) and also multiplying and then further adding would take much longer

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$t = 2n^2 - n$

$t = 606$ ✓

$t = 2(6)^2 - 6$

$t = 2(36) - 6$

$t = 72 - 6$

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

+5

$2n^2 - n = 19,900$

$2n^2 - n - 19,900 = 0$

Quadratic Formula

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

Great!

$$\frac{-(-1) \pm \sqrt{(-1)^2 - 4(2)(19,900)}}{2(2)}$$

$$\frac{1 \pm \sqrt{1 + 159200}}{4}$$

$$\frac{1 \pm \sqrt{159201}}{4}$$

$\frac{1 \pm 399}{4} = \frac{-398}{4}, \frac{400}{4} = 100$

The height of the tower that is made up of 19,900 cubes is 100 cubes.

I used my formula and set it equal to the number of cubes in the tower. I then solved for n using the Quadratic Formula and got 2 answers. Because the height of the cube cannot be negative, only one answer remained of 100 cubes.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

There are 40 squares shown on one side of the tower. Therefore the surface area of the tower is 165 sq. units.

$(5)(4)(4) + 10(4)(2) + 5 =$ 165 cubes.

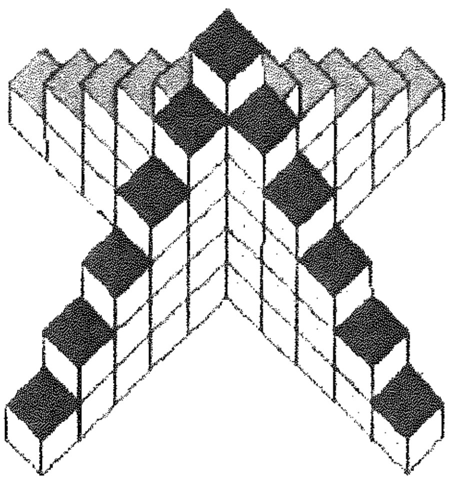
↑ Blocks shown

5.5/10

Building Towers (Yellow Worksheet)
10 points possible

Name: Morgan [illegible]
Date: ____________

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:**
http://bit.ly/towerhint1 http://bit.ly/towerhint2



1) **(1 point)** Describe what you notice about the structure of the tower above.

4 sides going out 5 blocks from the center block
the center is 6 blocks high

2) Reference the diagram shown above:

a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

$6 + 4(15) = 66$ [illegible]

$6 + 4(5) + 4(4) + 4(3) + 4(2) + 4(1)$ 66 [illegible] in each column

b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

No. Because it would be difficult to [illegible] blocks [illegible] or to multiply 4 by [illegible] number [illegible]

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

.5/2

$n + 4(n-1) + 4(n-2) + 4(n-3) + 4(n-4) + 4(n-5)$

$n + 4(n-1 + n-2 + n-3 + n-4 + n-5)$

$n + 4(5n - 15)$ [illegible]

$n + 4[(n-1)n - ?]$

$n + 4(n^2 - n - (\frac{n-1}{2})(2n+1) + (n-2)(n-1))$

$\frac{n-1}{2}(2(n-1) + (n-1-1)(1))$

$n + 4(n \cdot [illegible])$

$n + 4(6n - 21)$

[illegible]

would this work for any height

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19,900 = n + 4(n^2 - n - 4(\frac{n-1}{2}(2(n-1) + (n-2)(-1))$

$= n + 4(n^2 - n - 4(\frac{n-1}{2}(2n-2 - n + 2))$

$= n + 4(n^2 - n - 4(\frac{n-1}{2}(n))$

$= n + 4(n^2 - n - 2(n^2 - n))$

$= n + 4(n^2 - n - 2n^2 + 2n)$

$= n + 4(-n^2 \cdot$

2/5

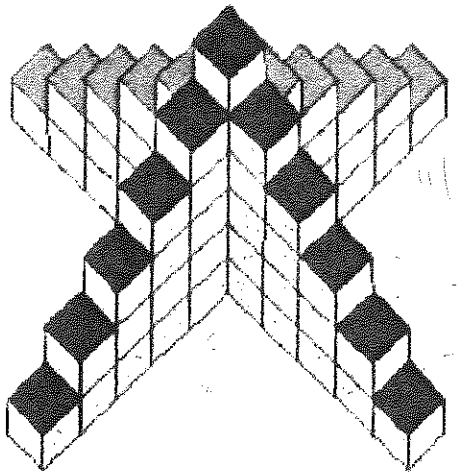
5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

7.75
10

Building Towers (Yellow Worksheet)
10 points possible

Name: Abby Leasure
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**



1) **(1 point)** Describe what you notice about the structure of the tower above.

The highest point is in the middle and there are 4 sections coming off the highest point. These sections decrease in height by one block until reaching zero. Made of cubes.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

$6+4(5)+4(4)+4(3)+4(2)+4(1)=66$ cubes

Since you know there are 4 towers with 5 cubes, you multiply 4 by 5 to get the amount of blocks used in that tower. Continue decreasing 5 and multiplying it by 4, then add the amount of blocks used in the middle (the height).

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

No my strategy wouldn't easily work because you would have to do 299 times 4 all the way until the 299 gets to zero and then you would have to add all those numbers together

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$n+4\left(\sum_{1}^{n}(n-1)\right)$

how would you compute this?

-2

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

19,900 = total # of cubes including center column

3.25/5 $\frac{19900}{4}$ = 4,975 cubes in each section

My method would be to set the formula for finding the amount of cubes equal to 19,900 then solving for n.

The tower has a height of 100 cubes. Because if you plug n into my equation, you get the answer of 19,900

$100 + 4\left(\frac{100}{2}(x-1)\right) = 19{,}900$

how did you compute this?

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

$6 + 4(5) + 4(7) + 4(9) + 4(11) + 4(13) = 185$ 186?

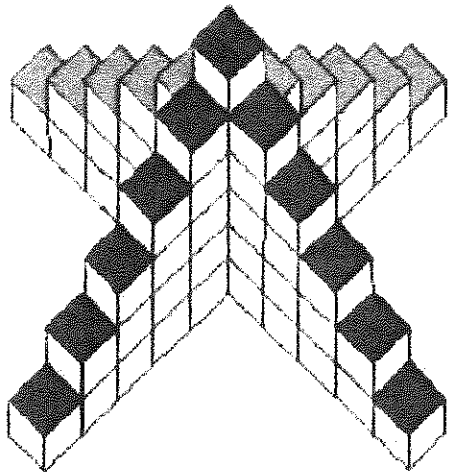
+1.5/2 To find the surface area of the tower, I counted how many sides were visible on the outside of each tower, then I multiplied that number by 4 since there were 4 sections (except the height) of each tower. I added those together then added how many sides were on the surface of the height to get my answer. (Bottom included)

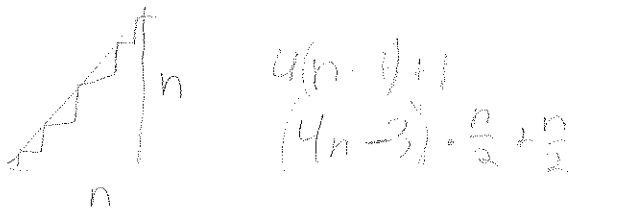
10/10

Building Towers (Yellow Worksheet)
10 points possible

Name: _____
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**





1) **(1 point)** Describe what you notice about the structure of the tower above.

It has a pyramid shape.
Each row has 4 more cubes than the last one.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

Assuming there is 6 cubes vertically in the center,
It would take 66 cubes to build the tower.
I found the cubes per level on the first level (6 each side *4) +1 ... then added (n-4) until I reached 1.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

No because it would be a lot of adding
but you could use an arithmetic sequence if it was that large.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$(4n-3)\cdot\frac{n}{2}+\frac{n}{2}$ $2n^2-\frac{3n}{2}+\frac{n}{2}$ $2n^2-n$

$2n^2-\frac{2n}{2}$

DOES your formula work?

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

+5

$2n^2 - n = A$

$2n^2 - n = 19{,}900$

$2n^2 - n - 19{,}900 = 0$

I took the formula I had for area vs. height and plugged in 19,900 for area. I then used the quadratic formula to solve for the height.

$$\frac{1 \pm \sqrt{1^2 - 4(2)(-19{,}900)}}{2(2)}$$

$$\frac{1 + 399}{4}$$

$\frac{400}{4} = 100$

100 cubes

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+1

Solving not including any bottoms only sides showing.

height of 6

~~205~~ square faces

each side $= 4 + (2 \cdot 4)$

$= 12$

I used n-2 because each row is 2 less and n-1 because the top is not touching so has a different equation which is factored by the 5.

$\frac{12}{4}$

48 bottom squares

each row higher $\rightarrow$ n-2 until last top square always 5

12, 10, 8, 6, 4, 5

50

Equation for the bottom row surface area is always $2n$ plus the top square always 5.

$5 + 4(n+2)(n-1) + 4(n-2)$

$4(n^2 + n - 2)$

$4n^2 + 4n - 8 - 8n - 8 + 5$

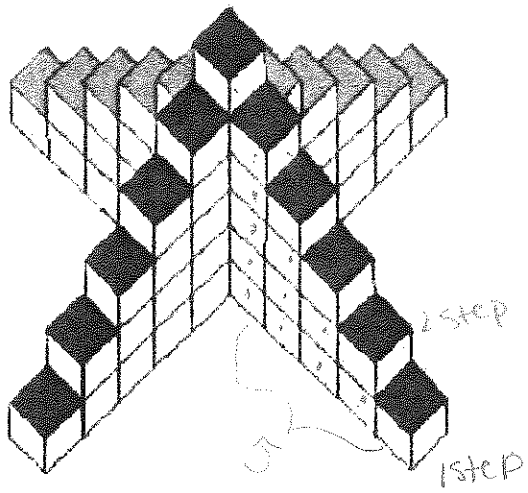
$4n^2 - 4n - 15$

Building Towers (Yellow Worksheet)
10 points possible

12/10

Name: Taylor Vohland
Date: March 5th

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



for a tower with n rows
$(n-1)^2$ → for a full square
height to height 5
15/25 10/16
$\frac{3(n-2)}{2}(n-1)$ $\frac{(n-1)^2}{2}$
$(n-1)(n-\frac{3}{2})$ $n-3\left(n-\frac{n-1}{2}\right)$
$(n-1)($ $(2)(5)=10$

1) **(1 point)** Describe what you notice about the structure of the tower above.

I notice that when looking at the tower from a birds-eye view, the tower is in the shape of an X. Also, the tower is built like a pyramid, in the (out that towards) the bottom there are more cubes, and the number decreases

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

$(1)4+2(4)+3(4)+4(4)+5(4)+6$
$4+8+12+16+20+6$
106

The total number of cubes needed is 106. Since there are four sections to the X, I multiplied each step of cubes by 4 (4 sides) and added in the middle layers because the

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

My strategy for finding the number of cubes would not be easy to find if the height is 300 because I would have to know how many cubes are in each layer. I would have to multiple large numbers together to find the total

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$(n-1)^{n-1}$

$t_{cubes} = 2h^2 - h$ ← work shown above

h: height

$t = 6+4(5)+4(4)+4(3)+4(2)+4(1)+4(0) = 106$ ✓
$t = 2(6)^2 - 6 = 106$ ✓

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

+5

$t = 19,900$ cubes

Great! $19,900 = 2h^2 - h$

$0 = 2h^2 - h - 19,900$

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

$h = \frac{1 \pm \sqrt{1 - 4(2)(-19,900)}}{4}$

$h = \frac{1 \pm \sqrt{159201}}{4}$

$h = 100, -99.5$

The height of the tower is 100 units (cubes). I used the formula that was derived from problem three, and plugged in the value of 19,900 cubes, and then used the quadratic formula to find the value of h.

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

First, I am going to find at how many cubes have four faces visible (the top layer of each step). $5 \times 4 \times 4 = 80$
(cubes · sections · faces)

Next, I am going to add in the number of cubes below the top cube that only have two faces visible. $(4+3+2+1 = 10)$ ~ per section
$10 \times 4 \times 2 = 80$
(cubes · sections · faces)

Finally, I am going to add in the top cube that has 5 visible faces.

ex 1 sa 1 5 : 165 unit 2

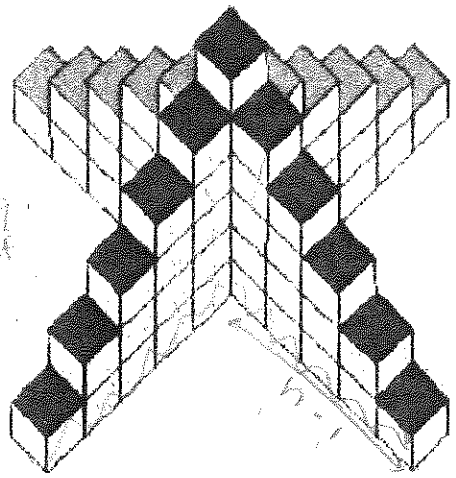
Formula: $SA = 5 + (n-1)16 + (\quad)8$

Building Towers (Yellow Worksheet)
10 points possible

10.5
10

Name: Abby Vrla
Date: _____

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help:** **http://bit.ly/towerhint1** **http://bit.ly/towerhint2**



I saw the tower as 1 pole with 4 wings, each of the wings being a part of a possible square (n-1)(n-1) the ratio of the square filled to the total square was $\frac{(n-1)(n)}{(n-1)^2}$

if the "wings" were full squares how much is missing from them

6	5	4
15/25	10/16	6/9

of a square

$\left(n\left(\frac{n}{2}\right)-\frac{n}{2}\right)(n-1)$

1) **(1 point)** Describe what you notice about the structure of the tower above.

As the tower gets taller, it uses 4 blocks per level. There are 4 stabilizing extensions at the base, with a 1x1 tower in the middle

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.

21 blocks @ the base

since each level is 4 more than the last by 1, adding onto a base of 21, you add 4 more than the current level

21+17+13+9+5+1 = 66

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not?

NO, to find the number of cubes for a tower of 300, a equation would be necessary

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

-1

$4\left(n\left(\frac{n}{2}\right)-\frac{n}{2}\right)(n-1)^2$ = all of cubes

percentage of n-wings square that there is

$4\left(\frac{\frac{n}{2}(n-1)}{n-1}\right)(n-1)^2+n$

$\left(\frac{2n}{n-1}\right)(n-1)^2+n$

$2n^2-n$

$2n(n-1)+n$

$4\left(\frac{(n-1)\left(\frac{n}{2}\right)}{(n-1)^2}\right)$ $2n^2 - n \pm$

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

4.5/5

$2n^2 - n = 19{,}900$

$2n^2 - n - 19{,}900 = 0$

plug into quadratic formula

more explanation of process?

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

$\frac{1 \pm \sqrt{1-4(2)(-19{,}900)}}{2(2)}$

$\frac{1 \pm 399}{4}$ $\frac{400}{4} = 100$

100 cubes ✓

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

+2

11 square on top with 5 visible sides

20 sq w/ 4 sides visible

40 sq w/ 2 sides visible

(5 blocks w/ 4 sides visible) 4 wings

10 blocks with 2 sides visible 4 wings

165 units²

$16(n-1) + (n-1)16 + 5$

$32(n-1) + 5$

Period 2

Building Towers (Yellow Worksheet) 12/10
10 points possible

Name: Nanditha Kaurkandam
Date: 3/16/19

Directions: *Consider the cube tower illustrated below, then answer each of the 5 tasks that follow. For each task explain your thinking in words and/or with mathematics work.* **See the following links for extra help: http://bit.ly/towerhint1 http://bit.ly/towerhint2**

$4(2n-1)+1$

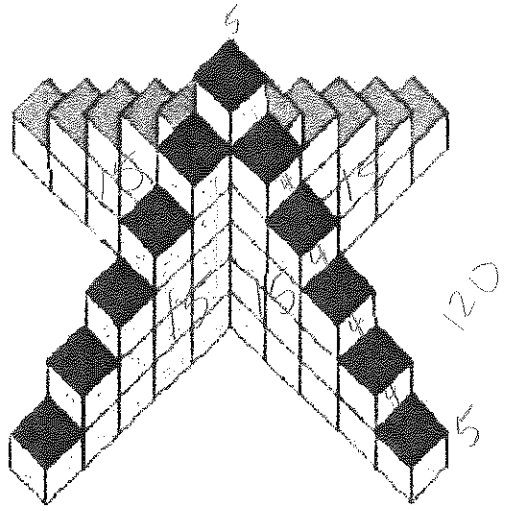
$8\left(\frac{(n-1)^2+n}{2}\right)$

$(n-1)4+1$

15×8

120

180



1) **(1 point)** Describe what you notice about the structure of the tower above.
The tower is essentially a square pyramid with a diagonal base length of 11 units. It is symmetric! It has four equal protruding sides with a center column that is one cube taller than the rest of the structure.

2) Reference the diagram shown above:
   a) **(1 point)** Find the total number of cubes needed to build the tower above. Note that the tower is solid and has a height of 6 cubes. Explain your strategy and show your work.
   Each side is composed of $(5+4+3+2+1=15)$ cubes. If this number is multiplied by 4 (for each side), $15\times 4=60$ cubes is the total so far. Then 6 cubes (height of the sides in the middle plus the cube on top can be added to 60 for a total of 66 cubes needed to build the tower.

   b) **(1 point)** Would your strategy from (a) work to *easily* find the number of cubes for a tower that has a height of 300? Why or why not? It would not work to find the number of cubes easily for a height of 300 because my strategy required that I knew the base length of the individual sides from the diagram. For a tower with a height of 300, the strategy would only be easy if one could see the length. Otherwise, it would have to be calculated.

3. **(2 points)** How many cubes would be needed to construct a tower of height *n*? (In other words, provide a formula that allows you predict the number of cubes used for a tower of any height). Check your formula using a tower of height 6 units.

$((n-1)2)n$

$2n(n-1)+n$

$2n(n-1)+n$

If $n=6 \rightarrow 2(6)(6-1)+6$

$12(5)+6$

$60+6$

66 ✓

+5 Great!

4. **(5 points - see rubric)** Consider a tower that is made up of 19,900 cubes. What is the **height** of this tower? Explain your method and show your work.

$19{,}900 = 2n(n-1)+n$, where n = height of tower

$19{,}900 = 2n^2 - 2n + n$

$19{,}900 = 2n^2 - n$

$2n^2 - n - 19{,}900 = 0$

$n = \frac{1 \pm \sqrt{(1)^2 - 4(2)(-19{,}900)}}{2(2)}$

$n = \frac{1 \pm \sqrt{159201}}{4}$

$n = \frac{1 \pm 399}{4}$

$n = \frac{400}{4}$ or $\frac{-398}{4}$

$n = 100$ or ~~-99.5~~ (can't be a negative height)

Height = 100 cubes

The formula from part 3 can be used because it determines the number of cubes needed to construct a tower of height n. Given the number of blocks needed, n can be solved for, using the quadratic formula. This yields two answers of which only one (100) is logical because the other is a negative value.

+12

5. **(Bonus - up to 2 points).** Find the **surface area** of a tower with a height of 6. Explain your problem solving process and show your work. *(In other words, if I paint the original tower, how many square faces would be covered with paint?)*

Individual area expressions:

Edges (excluding top block) → $4(2n-1)$

top side of top block → $+1$

total area of 4 sides → $4\left(\frac{(n-1)^2+(n-1)}{2}\right) = 4\left((n-1)^2+n\right)$

bottom → $4(n-1)^2+1$

Edges: not including sides on top of top block of tower

Combined surface area:

$4(2n-1) + 4\left((n-1)^2+(n-1)\right) + 4(n-1) + 1 + 1$

$8n - 4 + 4(n^2 - 2n + 1 + n - 1) + 4n - 4 + 2$

$8n - 4 + 4n^2 - 8n + 4 + 4n - 4 + 2$

$4n^2 + 8n - 6$

Formula: $SA = 4n^2 + 8n - 6$ (where n = height)

$4(6^2) + 8(6) - 6$

$144 + 48 - 6$

= **186 units²** (for a tower of 6)

I found an expression for individual components of the structures and then added them together for a final expression. I plugged in 6 for n in the formula to find surface area of 186 units² for a tower of height 6 (including the surface area of the bottom of the structure).