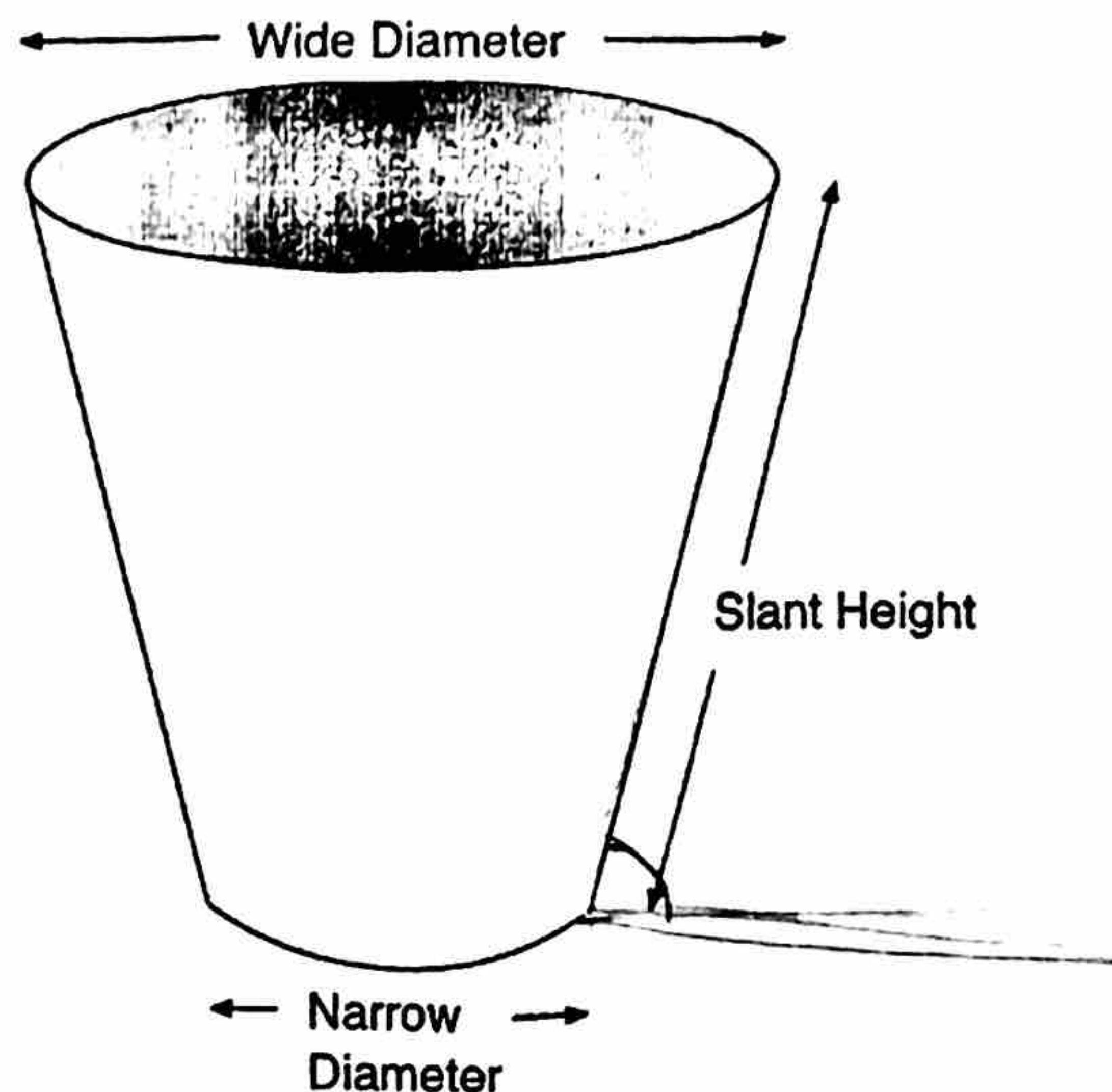


Modeling Rolling Cups

Cup	Dimensions in inches			
	Wide diameter	Narrow diameter	Slant length	Roll radius
A	3½	3	3¾	26¼
B	3	2	3½	10½
C	2½	2	5¾	28¾
D	3	3	4¾	Infinite!
E	3	2	6	18
F	3½	2	3¾	8¾
G	3¾	3	3¾	18¾
H	3½	0	3¾	3¾



Here is a reminder of the data you saw in the video with a few extra cups added.

- Describe how each of the three lengths on the picture affect the roll radius. Show how you used the data to explain your ideas.

The larger the slant length was the wider the circle was. The smaller the ratio was between the

- Show how you can use math to predict the radius of the circle rolled by any size of cup. Show all your reasoning, including any diagrams and calculations.

The closer the cup is to a perfect cylindrical formation the larger the circle will be.

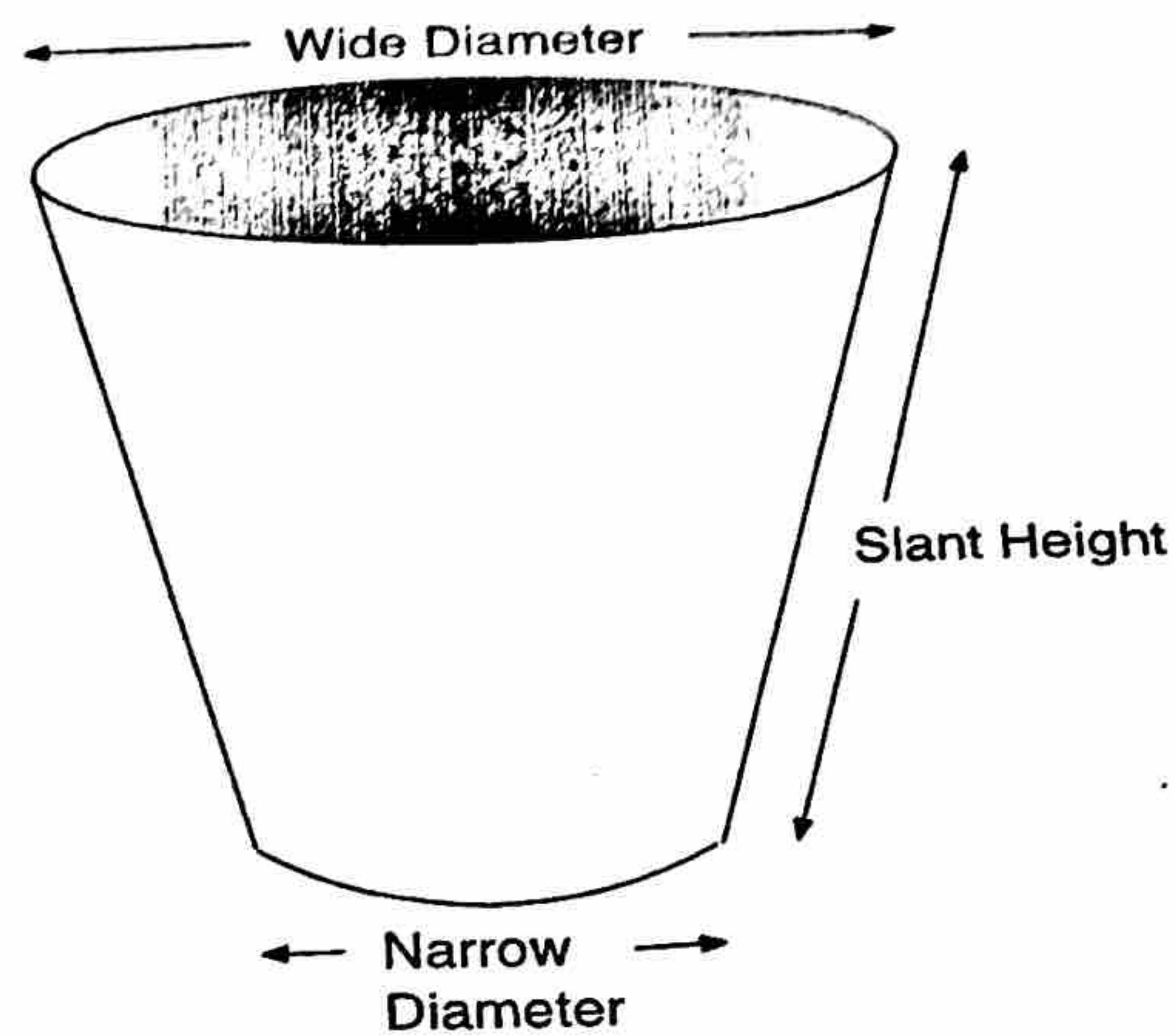
The closer this angle is to 90°, the larger the circle will be.

$$2.5 \div 2 = 1.25$$

This image is great! Think about if you just adjusted one measure?

Modeling Rolling Cups

Cup	Dimensions in inches			
	Wide diameter	Narrow diameter	Slant length	Roll radius
A	3½	3	3¾	26¼
B	3	2	3½	10½
C	2½	2	5¾	28¾
D	3	3	4¾	Infinite!
E	3	2	6	18
F	3½	2	3¾	8¾
G	3¾	3	3¾	18¾
H	3½	0	3¾	3¾



Here is a reminder of the data you saw in the video with a few extra cups added.

1. Describe how each of the three lengths on the picture affect the roll radius. Show how you used the data to explain your ideas.

2. Show how you can use math to predict the radius of the circle rolled by any size of cup. Show all your reasoning, including any diagrams and calculations.



Wide diameter \times Slant length \div Difference between wide diam and narrow diameter

$$\frac{w \times s}{w - n}$$

$$R = \frac{wR - s}{n}$$

$$r = \frac{ws}{w - n}$$

What values for the narrow diameter and wide diameter do you think Heather should choose next?

Justify your answer.

I believe that Heather has in fact done all of the necessary tests to achieving the correct equation. She has completed a cylinder test and a simple ratio test. Perhaps the only test she has not done is a test where the narrow diameter is larger than the wide diameter, but you do not need to conduct this test to achieve the correct equation. Heather has described some patterns in the data.

Find and describe a new pattern in the data.

The larger the difference is between the narrow diameter and the wide diameter, the smaller the radius will be

What are the strengths of Heather's solution?

Lots of data to support answer, good observations that may eventually lead to a conclusion,

What would you do to improve Heather's solution?

Explain your answer.

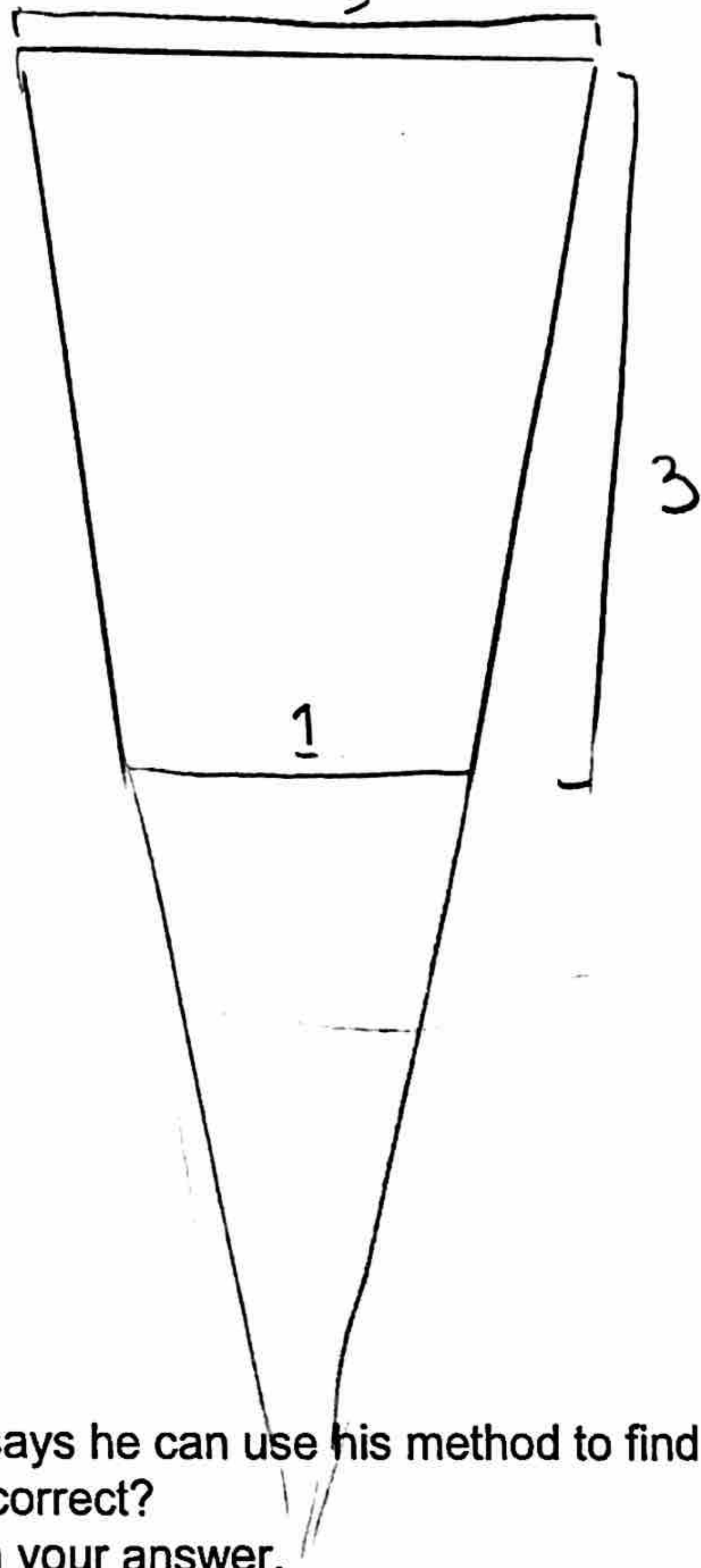
Heather could make the explanation of the equation more clear to allow for better understanding of her work.

Use Gerry's method to find the roll radius of this cup:

Wide diameter = 3"

Narrow diameter = 1"

Slant length = 3"



Gerry says he can use his method to find the roll radius of any cup.

Is this correct?

Explain your answer.

No, because there are some cups that cannot be drawn exactly to scale and Gerry's solution relies on measurement, not math.

What are the strengths of Gerry's approach?

He draws a very visual solution to display his result

What could Gerry do to improve his solution?

Gerry could add a mathematical solution to his problem

Judi says Triangle ACE and Triangle BCD are similar.

Is Judi correct?

Explain your answer.

Triangle ACE and BCD are similar because they are both isosceles triangles with the same angle measurement at the top.

Judi draws a triangle diagram.

Explain how this represents a cup.

A cup can form a triangular shape if its slant sides are extended and flattened.

Judi has made a mistake in her formula.

Find and correct the mistake.

Judi does not isolate R in her formula, and therefore her formula does not answer the prompt. Subsequently, if you do solve her formula, she put the radius over the narrow circle.

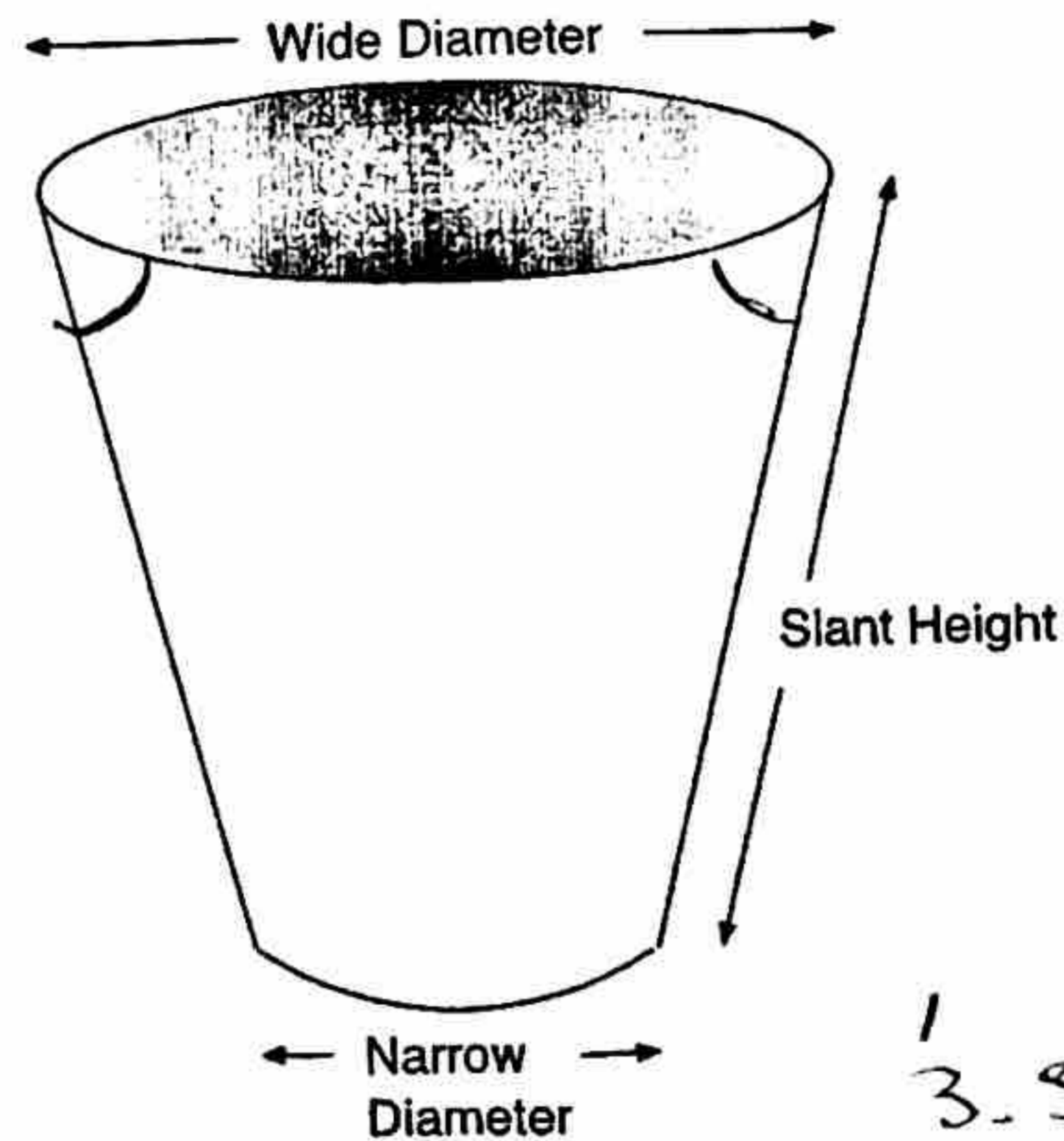
Now find a formula for R, the roll radius.

$$r = \frac{ws}{w-a}$$

Modeling Rolling Cups

Modeling Rolling Cups

Cup	Dimensions in inches			
	Wide diameter	Narrow diameter	Slant length	Roll radius
A	3½	3	3¾	26¼
B	3	2	3½	10½
C	2½	2	5¾	28¾
D	3	3	4¾	Infinitel
E	3	2	6	18
F	3½	2	3¾	8¾
G	3¾	3	3¾	18¾
H	3½	0	3¾	3¾



Here is a reminder of the data you saw in the video with a few extra cups added.

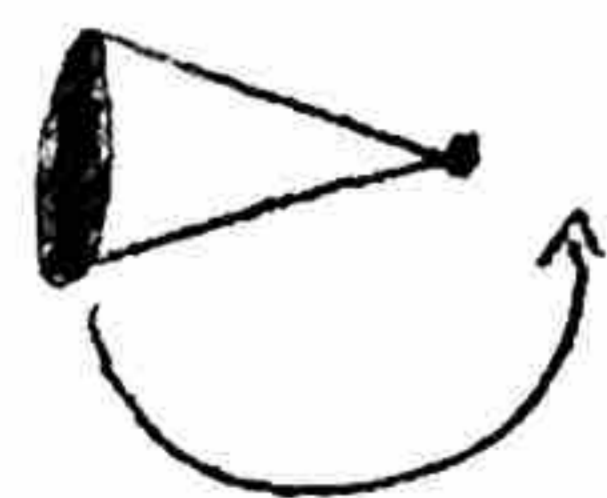
1. Describe how each of the three lengths on the picture affect the roll radius. Show how you used the data to explain your ideas.

2. Show how you can use math to predict the radius of the circle rolled by any size of cup. Show all your reasoning, including any diagrams and calculations.

$$\begin{array}{r}
 1 \\
 3.5 \\
 \times 3 \\
 \hline
 10.5 \\
 10.5 \\
 \times 3.78 \\
 \hline
 1525 \\
 7350 \\
 +31500 \\
 \hline
 39375
 \end{array}$$

I noticed that the ratio between the wide diameter and the narrow diameter is directly correlated with the roll radius. The larger the discrepancy between them, the smaller the circle (also the smaller the base angle).

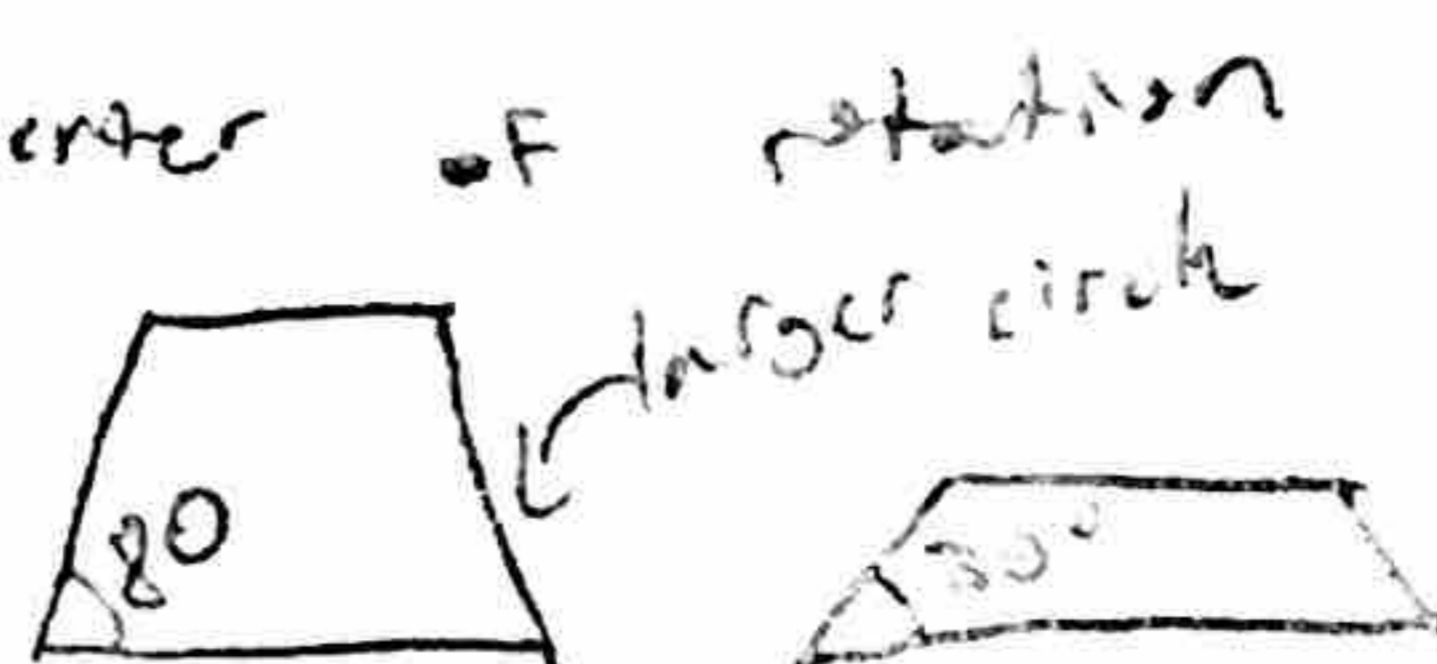
- If you roll a cone it will roll around its top vertex.



You can think of each of the cups as sections of a cone.



Therefore, the shallower the base angle, the smaller the cone, and the smaller the wide diameter the circle.



You're on the right track !!

Keep going with this

$\frac{4}{2}$
 3.75
 $\times 6.50$
 $\hline 18750$
 225000
 $\hline 243750$

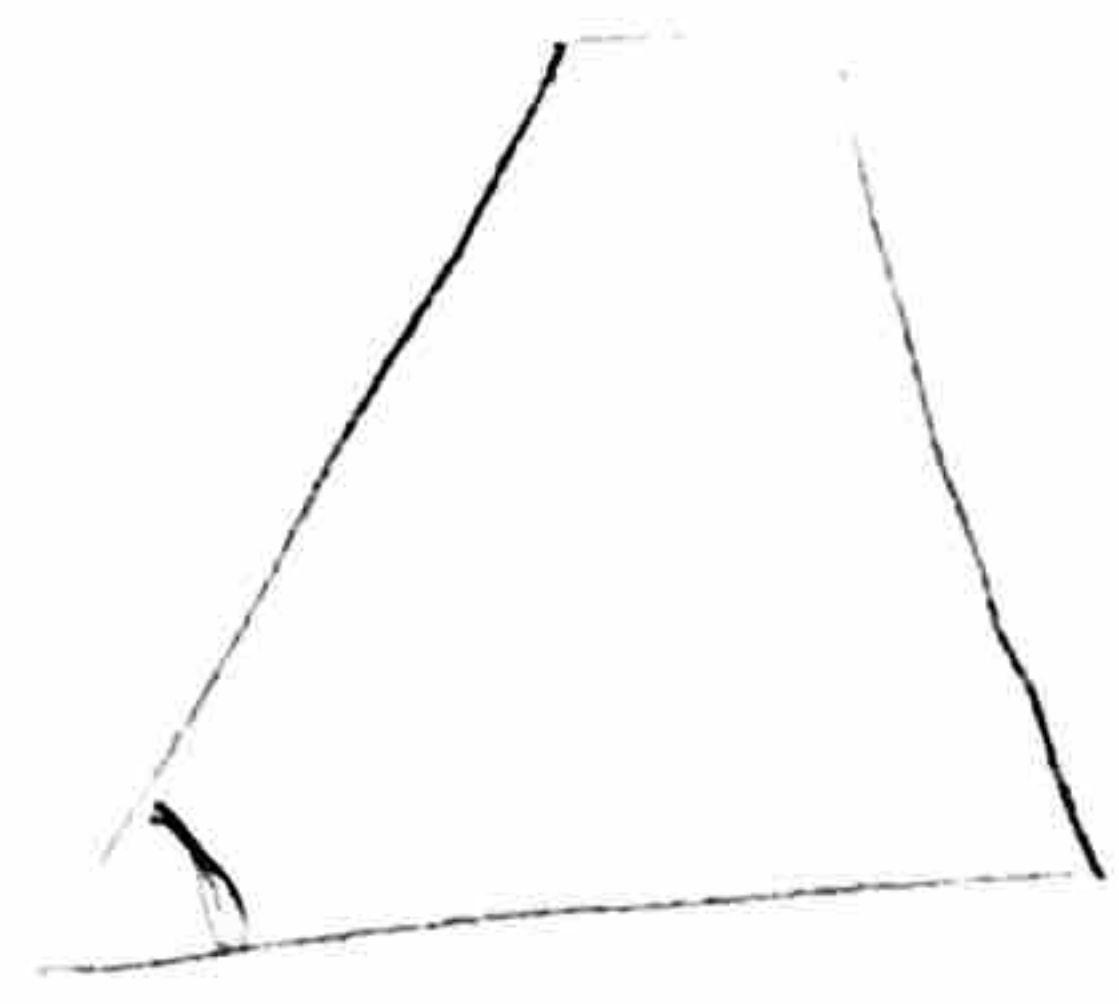
• extending the slant length while keeping the diameters the same, that increases the base angle causing a larger circle

$$\frac{2}{3} = \frac{x}{10.5}$$

$$\frac{21}{3} = \frac{3x}{3}$$

$$x = 7$$

$$11\frac{1}{2} = 10\frac{1}{2}$$



$$\frac{5}{3.5} = \frac{x}{26.25}$$

$$\frac{78.75}{3.5} = \frac{3.5x}{3.5}$$

$$22.5 = x$$

26.25
 $\frac{312}{26.25}$
 $\frac{x}{3.5}$
 $\hline 131250$

$$\frac{10.5}{3} = \frac{x}{31.5}$$

$$\frac{2}{3} = \frac{10.5}{x}$$

$$\frac{31.5}{2} = \frac{2x}{2}$$

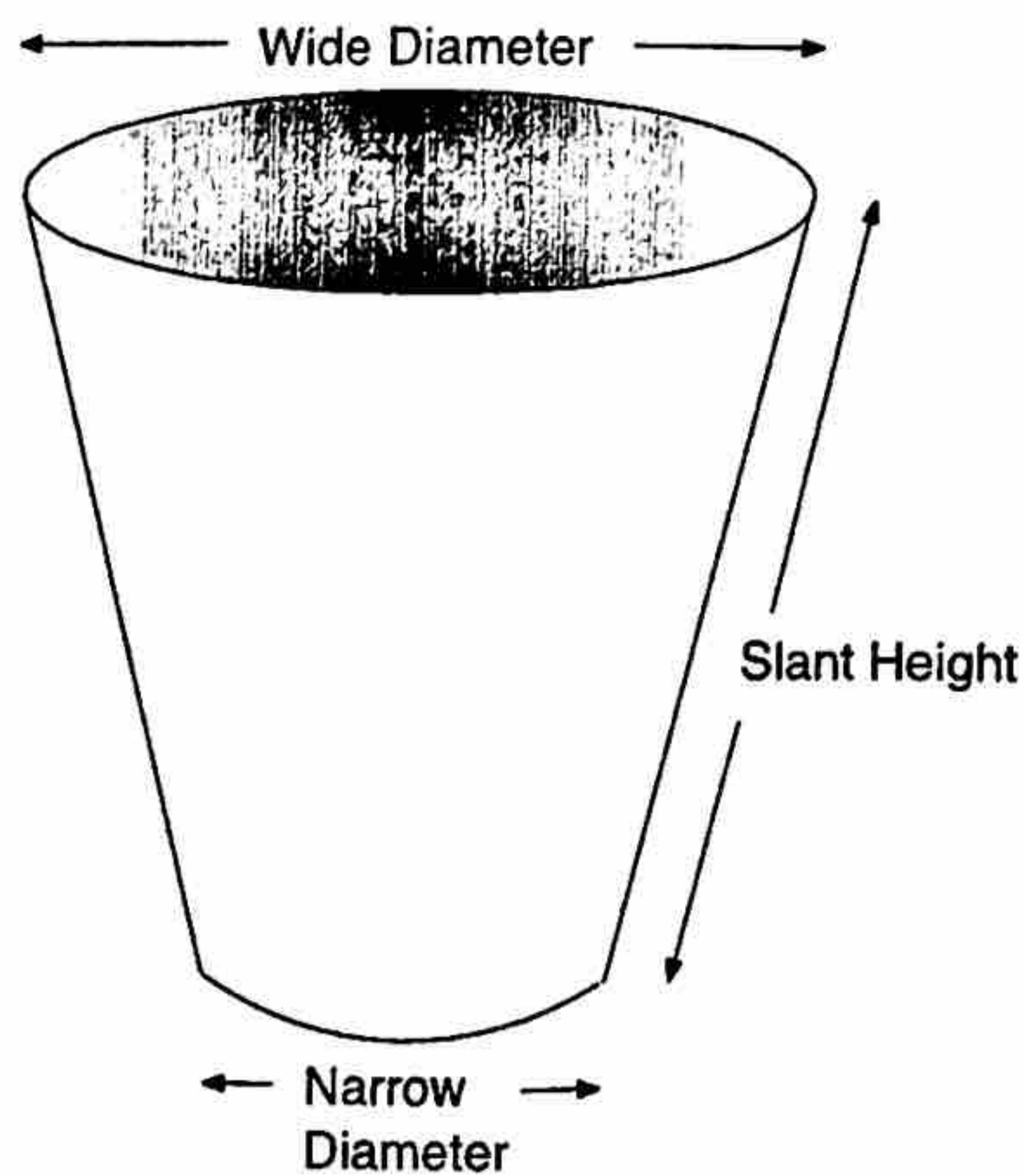
$$15.75 = x$$

$\frac{15.75}{2}$
 $\frac{31.5}{2}$
 $\hline 15.75$
 $\frac{24}{1}$
 $\hline 15$
 $\frac{14}{1}$
 $\hline 1$

Modeling Rolling Cups

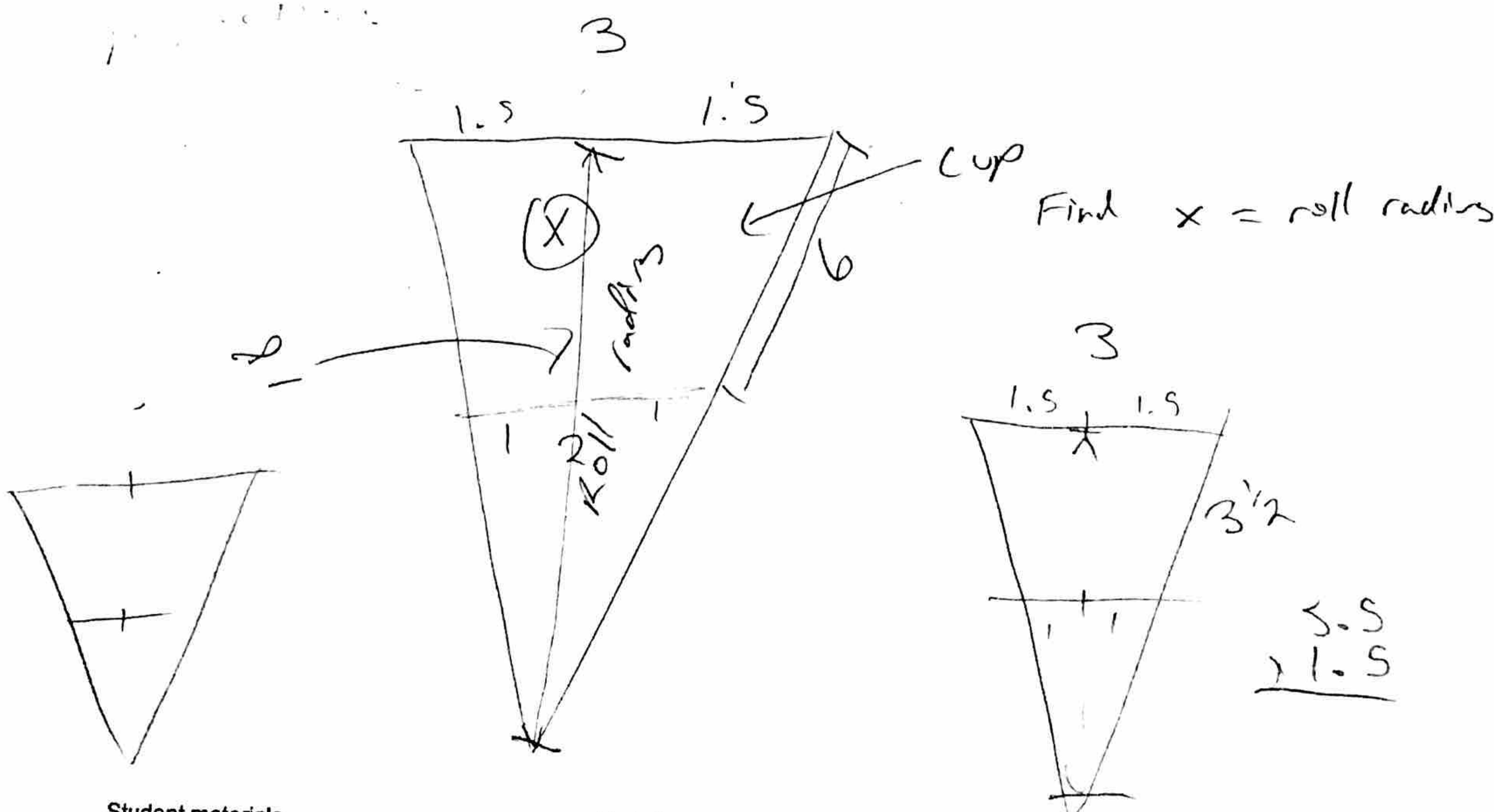
Cup	Dimensions in inches			
	Wide diameter	Narrow diameter	Slant length	Roll radius
A	$3\frac{1}{2}$	3	$3\frac{3}{4}$	$26\frac{1}{4}$
B	3	2	$3\frac{1}{2}$	$10\frac{1}{2}$
C	$2\frac{1}{2}$	2	$5\frac{3}{4}$	$28\frac{3}{4}$
D	3	3	$4\frac{1}{4}$	Infinite!
E	3	2	6	18
F	$3\frac{1}{2}$	2	$3\frac{3}{4}$	$8\frac{3}{4}$
G	$3\frac{3}{4}$	3	$3\frac{3}{4}$	$18\frac{3}{4}$
H	$3\frac{1}{2}$	0	$3\frac{3}{4}$	$3\frac{3}{4}$

Core →

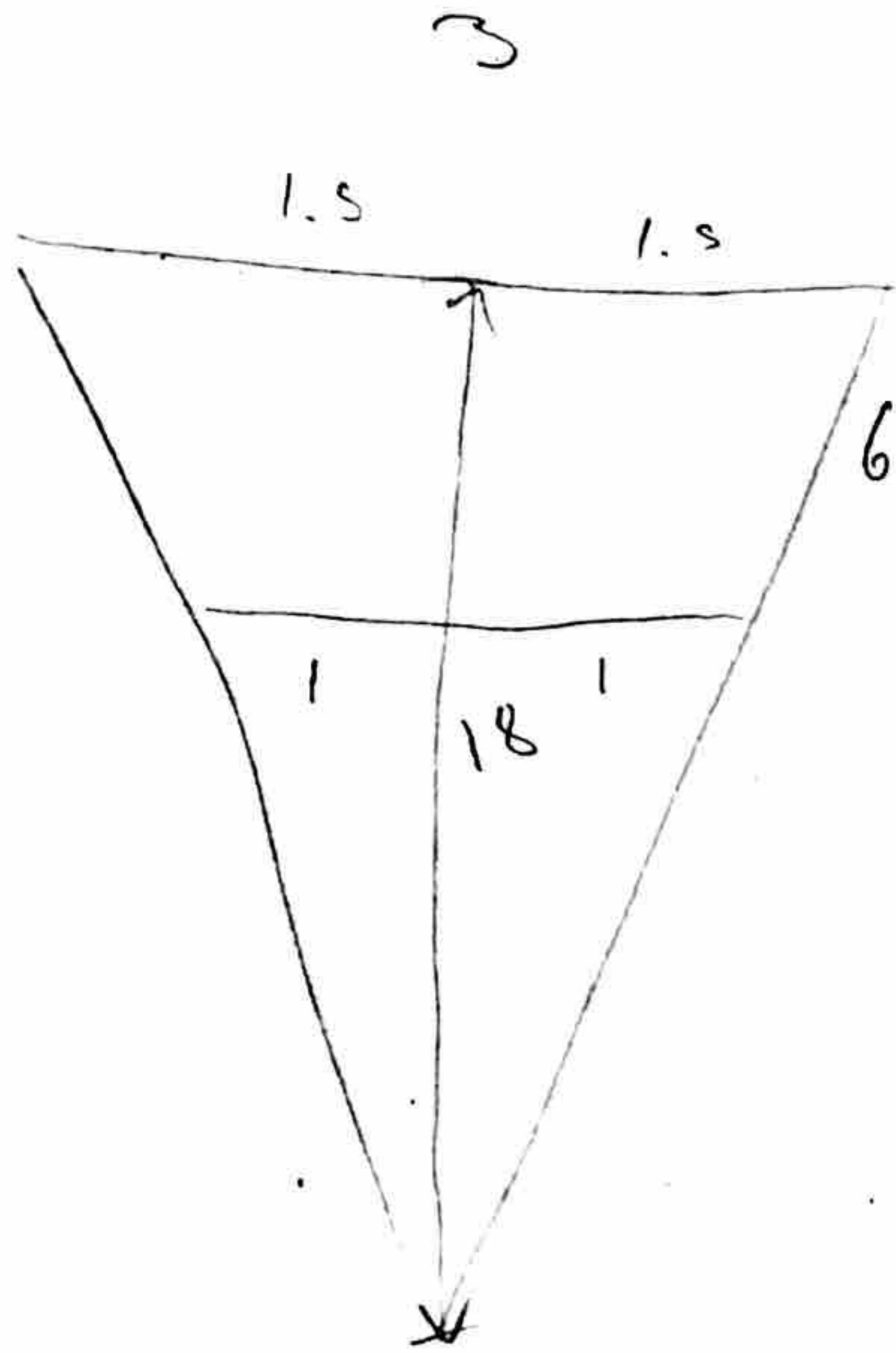


Here is a reminder of the data you saw in the video with a few extra cups added.

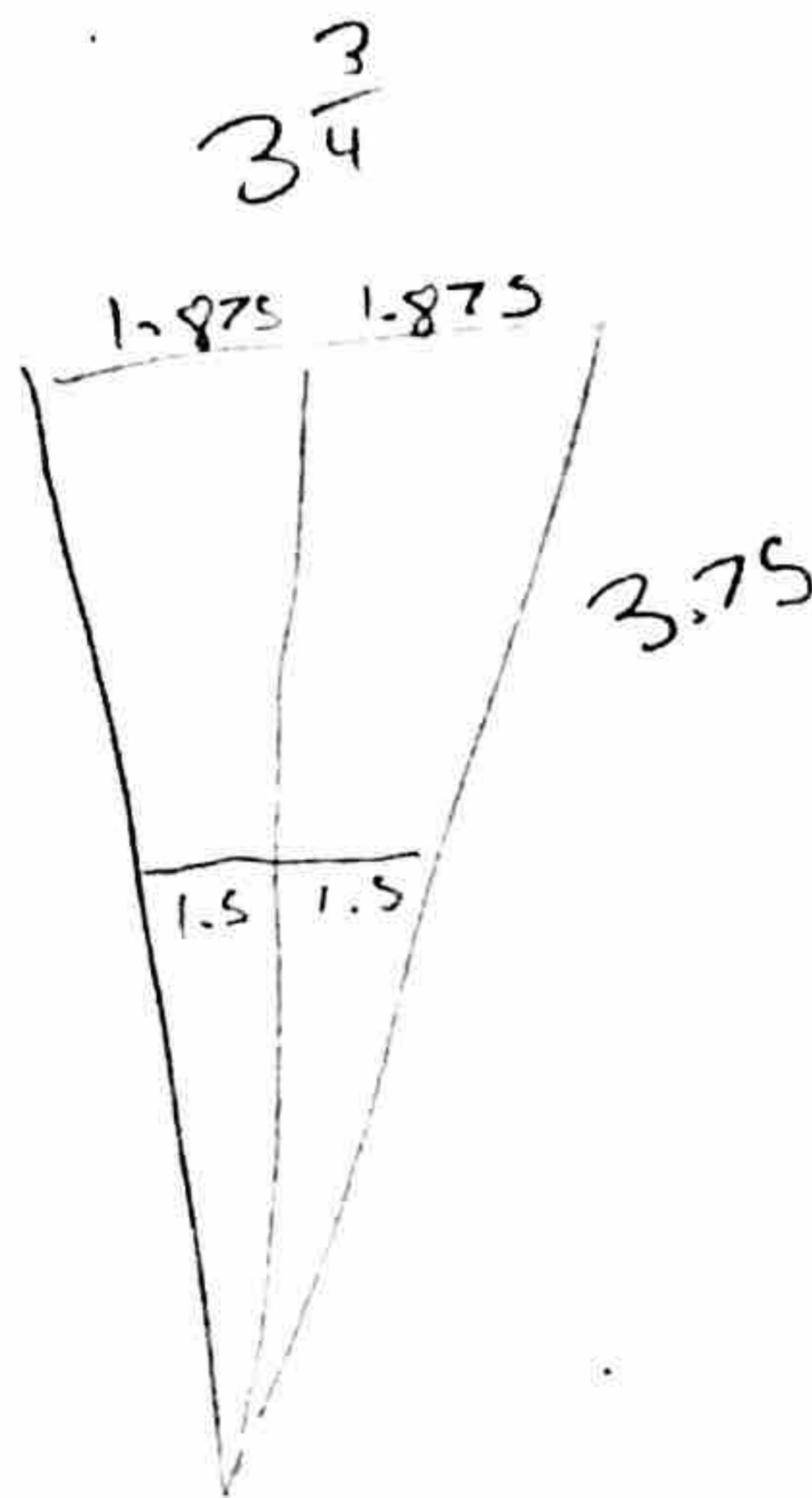
- Describe how each of the three lengths on the picture affect the roll radius. Show how you used the data to explain your ideas.
- Show how you can use math to predict the radius of the circle rolled by **any** size of cup. Show all your reasoning, including any diagrams and calculations.



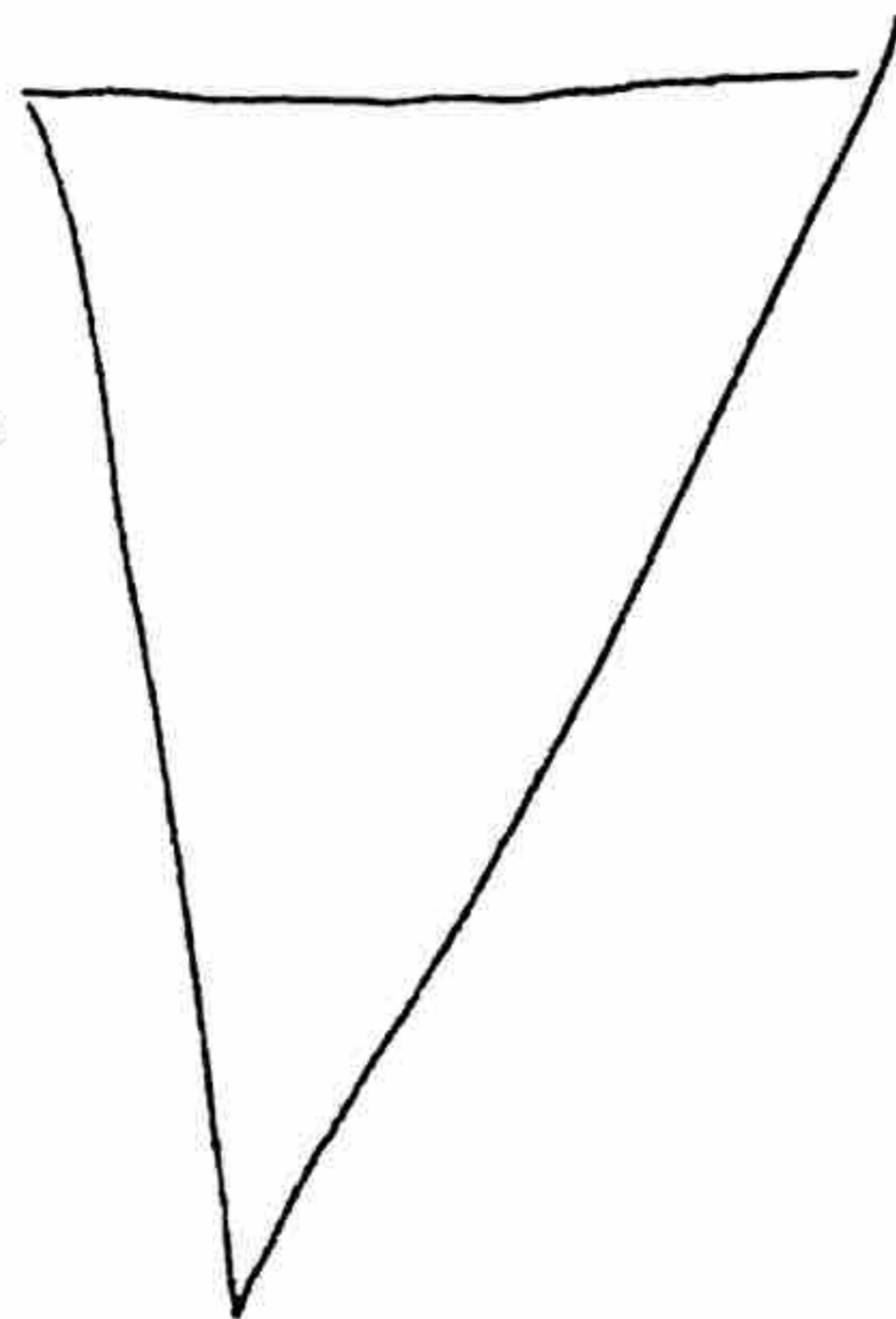
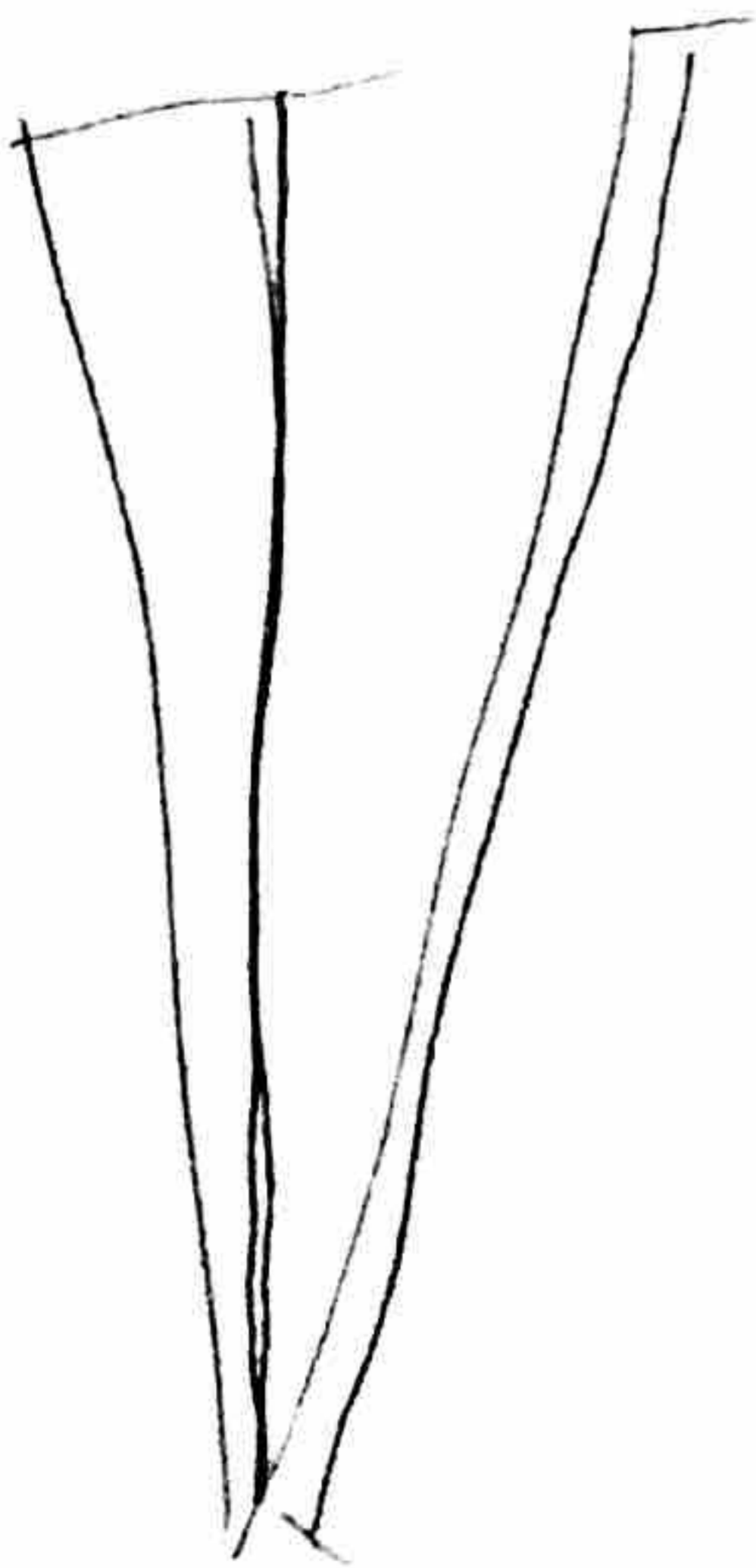
Student materials



$$6 \times 1.5 = 9 + 9 = 18$$



$$3.75 \times 1.875 = \cancel{7.03125}$$



What values for the narrow diameter and wide diameter do you think Heather should choose next?

Justify your answer.

She should try one where the "narrow diameter" is larger than the "wide diameter."

Heather has described some patterns in the data.

Find and describe a new pattern in the data.

When w is $2 \times N$, the roll radius is twice the slant length.

What are the strengths of Heather's solution?

She tried using different values to make sure her solution worked.

What would you do to improve Heather's solution?

Explain your answer.

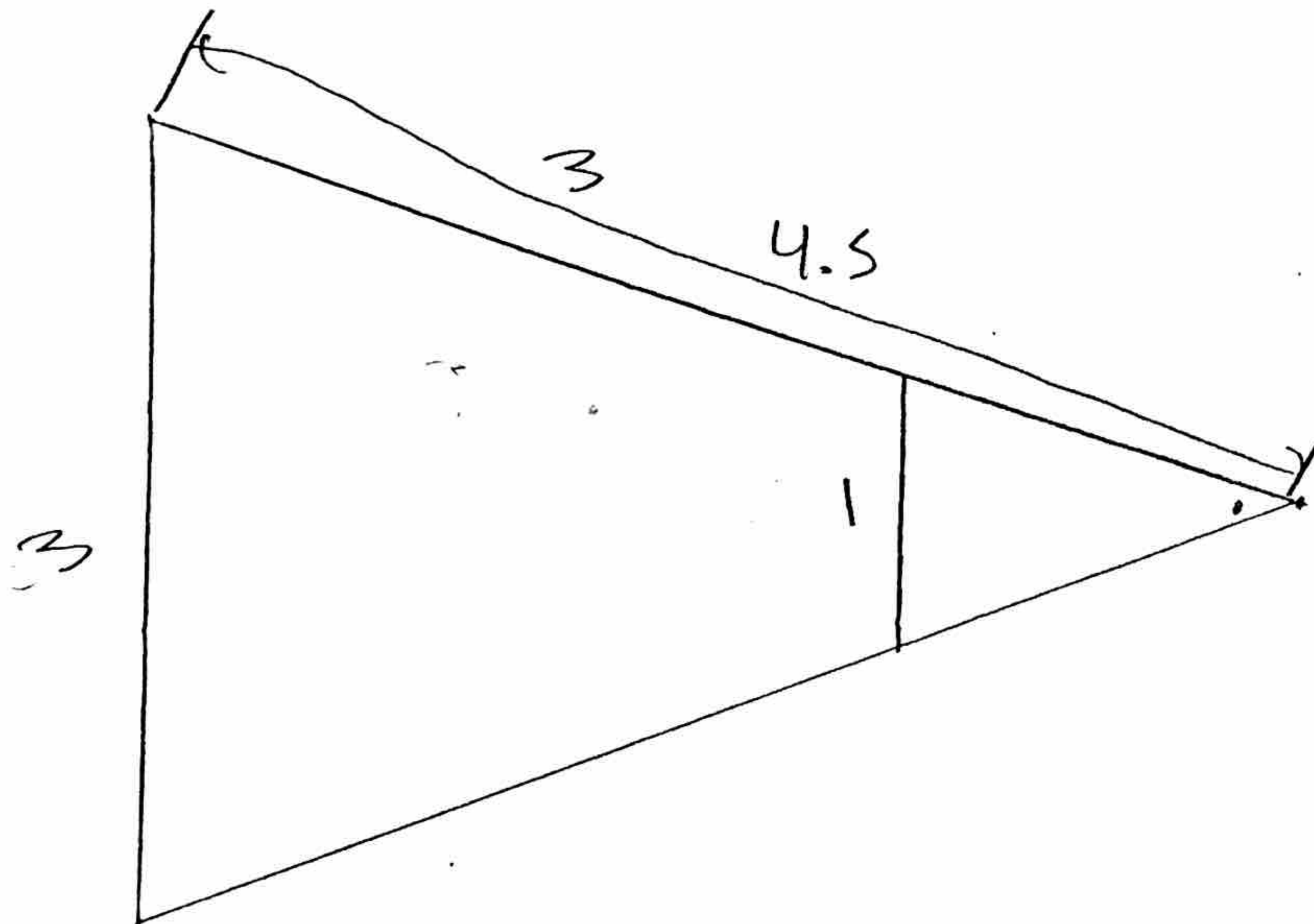
I would find out what the question mark represents in the equation.

Use Gerry's method to find the roll radius of this cup:

Wide diameter = 3"

Narrow diameter = 1"

Slant length = 3"



Gerry says he can use his method to find the roll radius of any cup.

Is this correct?

Explain your answer.

Yes this is true because you just need
to know W , Ab and S

What are the strengths of Gerry's approach?

It is visual and simple.

What could Gerry do to improve his solution?

He could write an equation based
off of his idea

Judi says Triangle ACE and Triangle BCD are similar.

Is Judi correct?

Explain your answer.

Yes because BD and AE are parallel and they are similar based on the side splitter theorem.

Judi draws a triangle diagram.

Explain how this represents a cup.

It represents extending the start lengths until the two lines intersect and $N=0$

Judi has made a mistake in her formula.

Find and correct the mistake.

She did not place parentheses around $R-S$ in the second equation

Now find a formula for R , the roll radius.

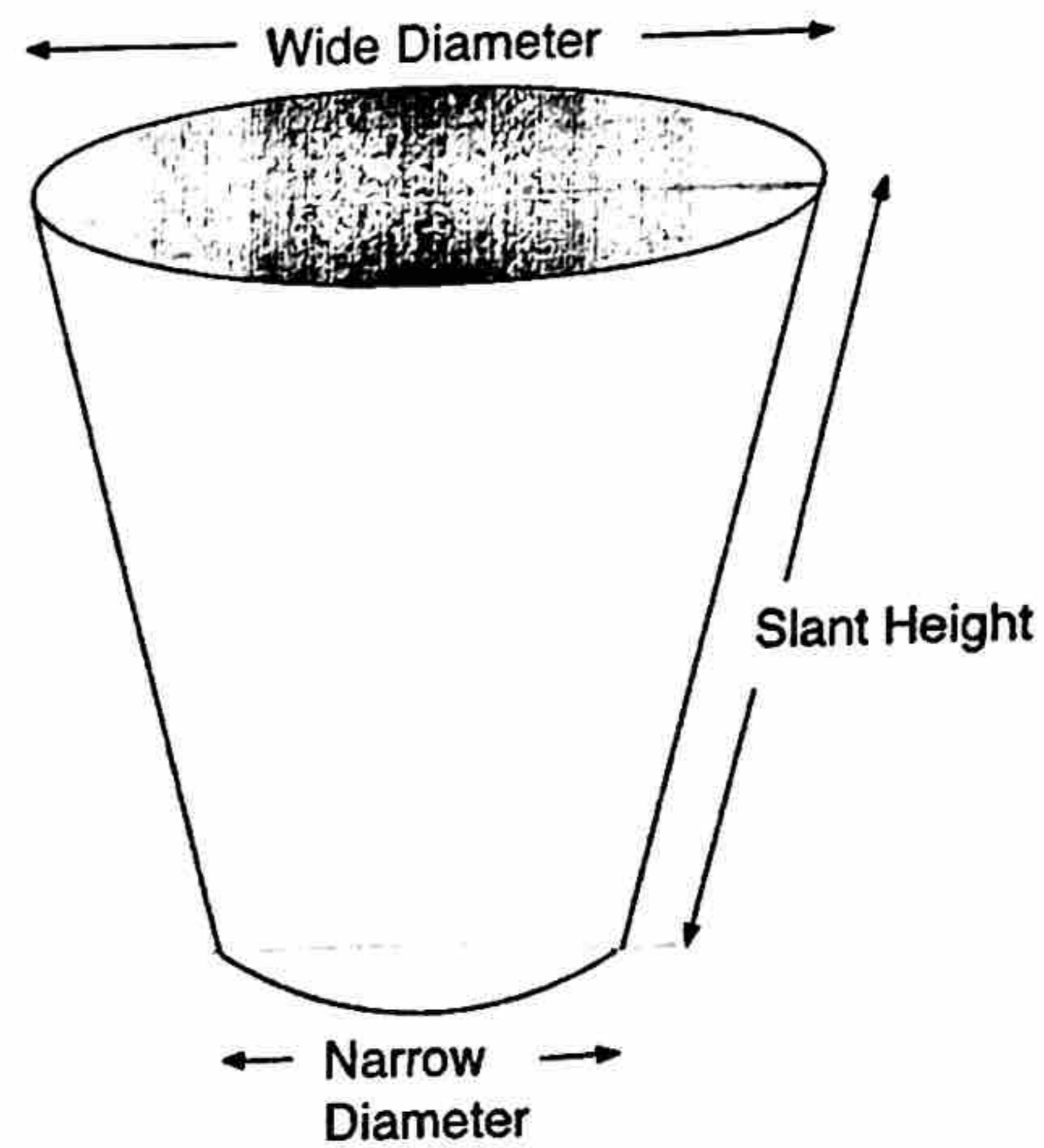
$$R = \frac{R-S}{N} \cdot W$$

Modeling Rolling Cups

Cup	Dimensions in inches			
	Wide diameter	Narrow diameter	Slant length	Roll radius
A	3½	3	3¾	26¼
B	3	2	3½	10½
C	2½	2	5¾	28¾
D	3	3	4¾	Infinite!
E	3	2	6	18
F	3½	2	3¾	8¾
G	3¾	3	3¾	18¾
H	3½	0	3¾	3¾

= closest ratios

2
5
1
8
4
6
3
7



Here is a reminder of the data you saw in the video with a few extra cups added.

- Describe how each of the three lengths on the picture affect the roll radius. Show how you used the data to explain your ideas.

- Show how you can use math to predict the radius of the circle rolled by any size of cup. Show all your reasoning, including any diagrams and calculations.

largest circle → smallest wide diameter · narrow diameter · slant length

not equal

Smallest · largest

ratio must be > 1:1

you compare that ratio to the slant height, the larger the slant height the larger the circle

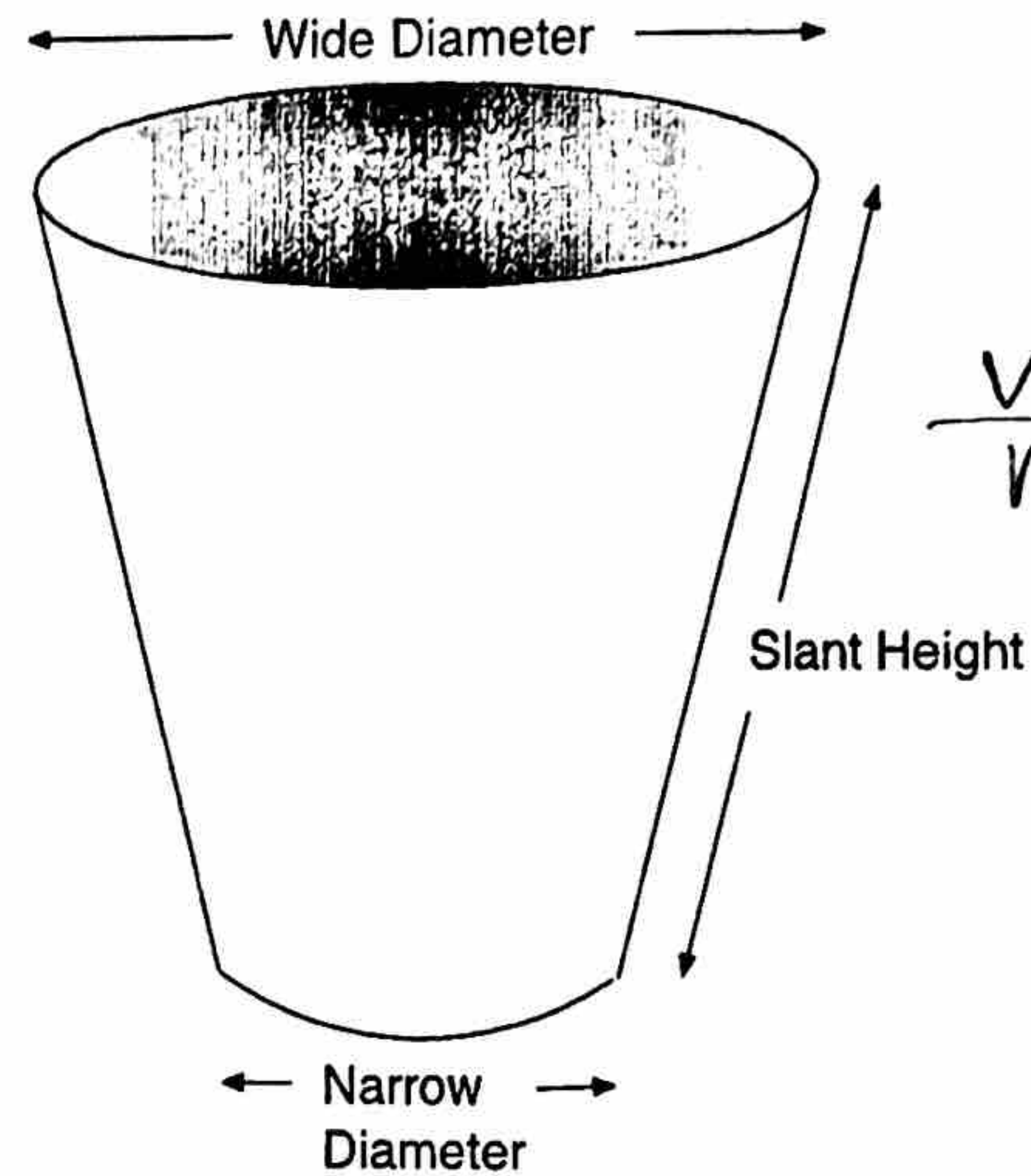
$$\frac{\text{slant height}}{2} \times \text{wide diameter} \times \text{narrow diameter} ?$$

Great start!
keep going with this idea

Modeling Rolling Cups

$$\frac{\text{wide}}{\text{narrow}} \times \text{slant}$$

Cup	Dimensions in inches			
	Wide diameter	Narrow diameter	Slant length	Roll radius
A	3½	3	3¾	26¼
B	3	2	3½	10½
C	2½	2	5¾	28¾
D	3	3	4¼	Infinite!
E	3	2	6	18
F	3½	2	3¾	8¾
G	3¾	3	3¾	18¾
H	3½	0	3¾	3¾



$$\frac{W}{n} \times S = r$$

Here is a reminder of the data you saw in the video with a few extra cups added.

- Describe how each of the three lengths on the picture affect the roll radius. Show how you used the data to explain your ideas.

the ratio of the wide diameter to the narrow diameter determines the size of the circle the smaller the ratio, the larger the circle

- Show how you can use math to predict the radius of the circle rolled by any size of cup. Show all your reasoning, including any diagrams and calculations.

largest circle = $\frac{\text{smallest wide diameter}}{\text{smallest narrow diameter}} \cdot \text{largest slant length}$ then compare that ratio to the slant height, the larger the slant height the larger the circle

if the narrow diameter is zero, the radius of the circle is = to the slant length

if wide diameter and narrow diameter are equal, the radius = infinity

$$\frac{W}{n} \times S = r ?$$

$$r = \frac{W - S}{W \times n}$$

What values for the narrow diameter and wide diameter do you think Heather should choose next?

Justify your answer.

Heather should use decimals next. She should use numbers like $3\frac{3}{4}$ and $2\frac{1}{2}$, because we found they changed the way the equation worked.

Heather has described some patterns in the data.

Find and describe a new pattern in the data.

For the table fix $N=2$ and $W=3$, the radius is wide diameter \times slant height

What are the strengths of Heather's solution?

she notices the outlines which helps create the bottom part of the equation, started an equation

What would you do to improve Heather's solution?

Explain your answer.

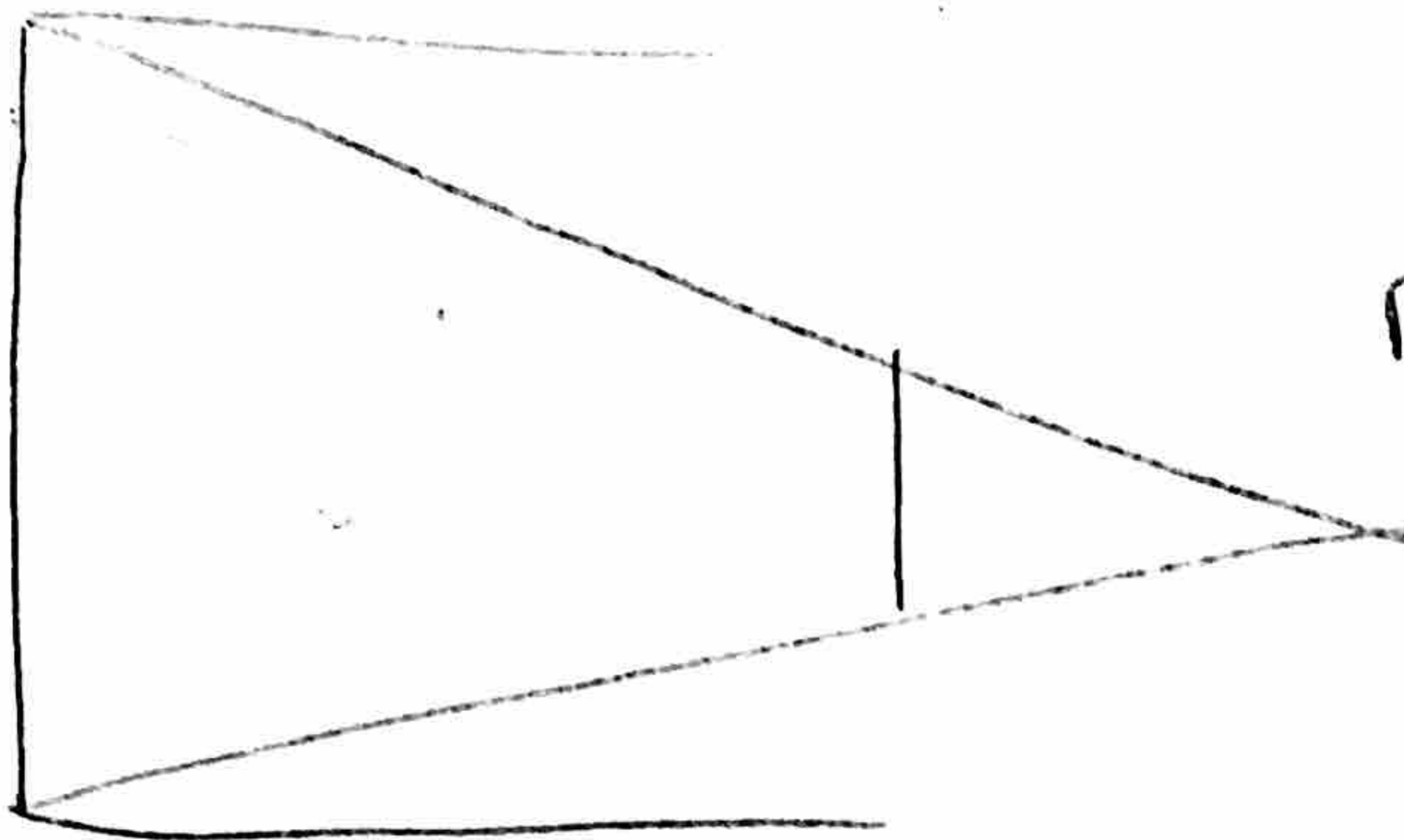
a diagram is easier to visualize, try more decimals

Use Gerry's method to find the roll radius of this cup:

Wide diameter = 3"

Narrow diameter = 1"

Slant length = 3"



radius = $4\frac{1}{2}$

Gerry says he can use his method to find the roll radius of any cup.

Is this correct?

Explain your answer.

it will work but you need to write too since
you need to measure and draw straight lines

What are the strengths of Gerry's approach?

he uses images to make his point, its not complicated

What could Gerry do to improve his solution?

you have to have the roll radius to create it, make an
equation

Judi says Triangle ACE and Triangle BCD are similar.

Is Judi correct?

Explain your answer.

The triangles are similar by side angle side similarity conjecture

Judi draws a triangle diagram.

Explain how this represents a cup.

the bottom of the triangle, the trapezoid is the cup and the top point of the triangle is the center of the circle and the connecting lines are the roll radii

Judi has made a mistake in her formula.

Find and correct the mistake.

she cross multiplied wrong

$$\frac{R}{W} = \frac{R \cdot S}{W} \text{ and } R \cdot W = W \cdot R - \boxed{W \cdot S}$$

↑
she forgot

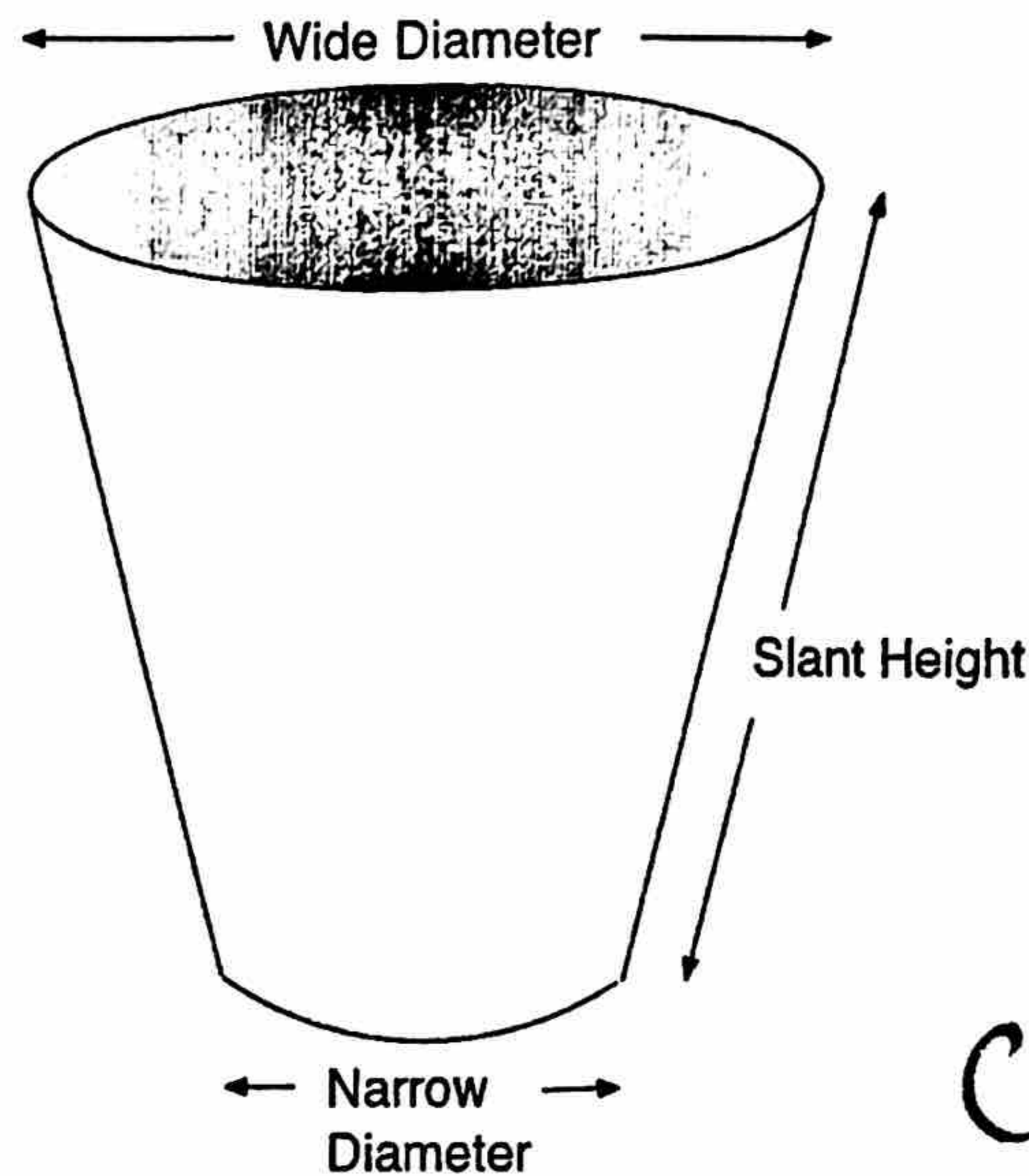
Now find a formula for R , the roll radius.

$$R = \frac{W \cdot S}{W - W}$$

Modeling Rolling Cups

Cup	Dimensions in inches			
	Wide diameter	Narrow diameter	Slant length	Roll radius
A	3½	3	3¾	26¼
B	3	2	3½	10½
C	2½	2	5¾	28¾
D	3	3	4½	Infinite!
E	3	2	6	18
F	3½	2	3¾	8¾
G	3¾	3	3¾	18¾
H	3½	0	3¾	3¾

Shorter cups taller cups soap cans



How do these relate?

$$C = \pi d$$

$$C = 3\pi$$

$$2\pi$$

Here is a reminder of the data you saw in the video with a few extra cups added.

- Describe how each of the three lengths on the picture affect the roll radius. Show how you used the data to explain your ideas.
- Show how you can use math to predict the radius of the circle rolled by any size of cup. Show all your reasoning, including any diagrams and calculations.

#1.

- difference between narrow and wide diameter determines roll radius

- slant heights affects if cup is taller and circle is measured from the rim of the cup

longer slant height? what would the figure be if the slant height increased?

#2. for the soap can the equation has to equal as if the W diameter + N diameter are equal.

- R is infinite

$$C = \pi d$$

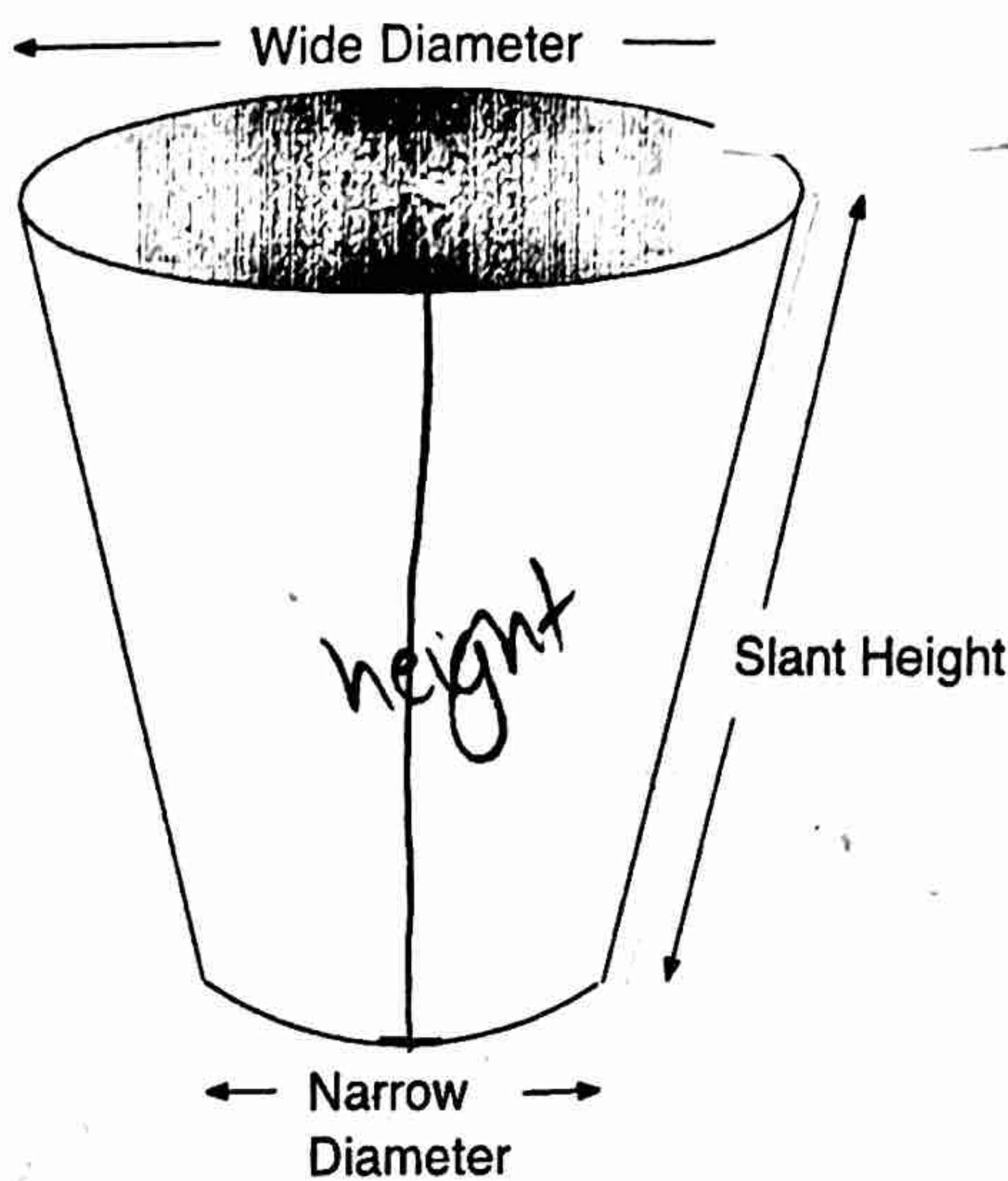
roll radius = some combo of
 W. diameter
 N. diameter
 Slant length

test formulas



Modeling Rolling Cups

Cup	Dimensions in inches			
	Wide diameter	Narrow diameter	Slant length	Roll radius
A	3½	3	3¾	26¼
B	3	2	3½	10½
C	2½	2	5¾	28¾
D	3	3	4¾	Infinite!
E	3	2	6	18
F	3½	2	3¾	8¾
G	3¾	3	3¾	18¾
H	3½	0	3¾	3¾



Comparative wd and nd that creates circle

I 100 99.9 10 10000

J 100 99.9 1 1000 ← 99.9 → 1000 but 99 → 100

Here is a reminder of the data you saw in the video with a few extra cups added.

K 200 199 1 200

L 100 99 1 100 ← both 200

- Describe how each of the three lengths on the picture affect the roll radius. Show how you used the data to explain your ideas.

M 100 99.5 1 200

- Show how you can use math to predict the radius of the circle rolled by any size of cup. Show all your reasoning, including any diagrams and calculations.

needs division

taller slant height



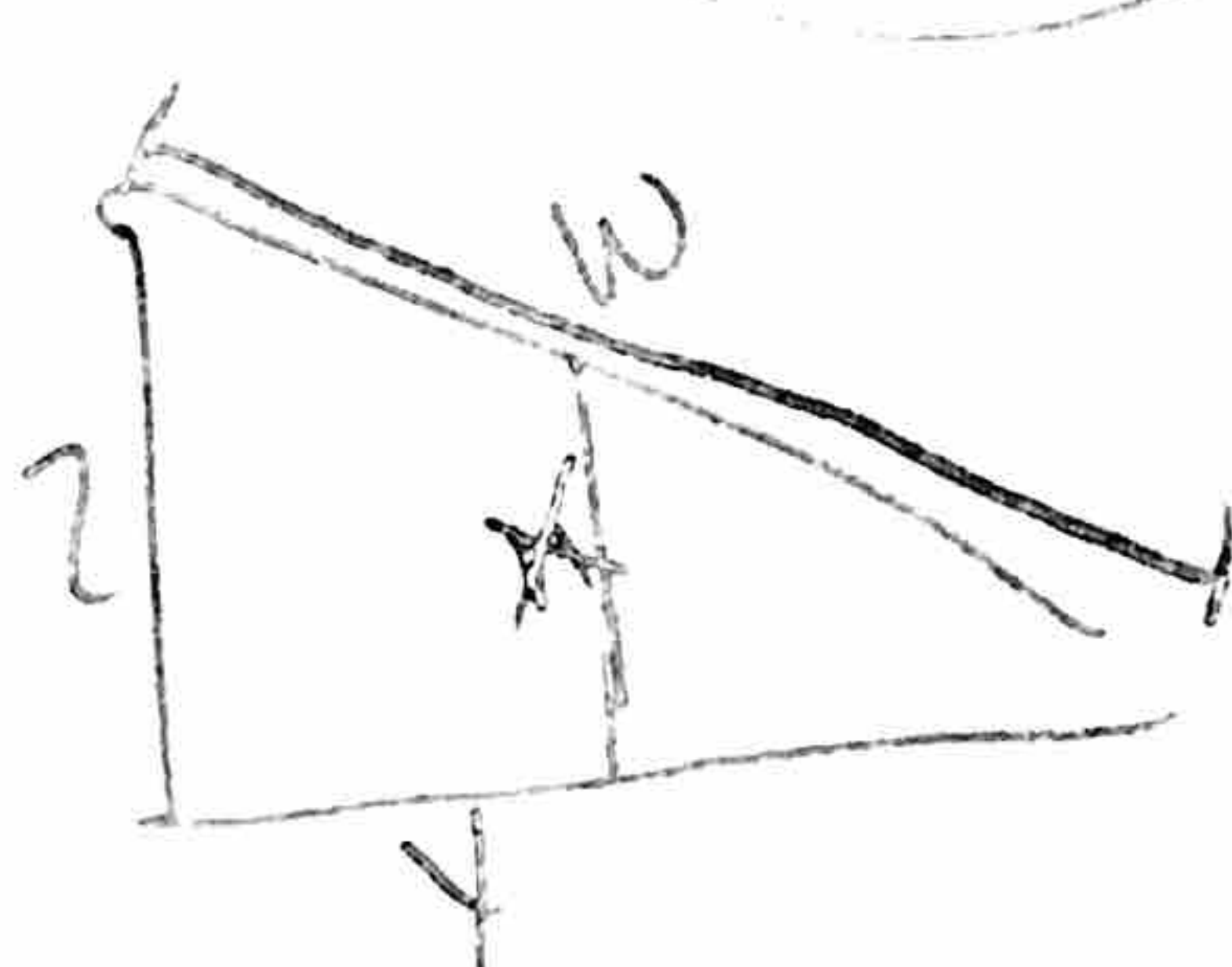
is it proportional?

smallest slant and height = larger roll radius

RR = sl when nd = 0

Can you create an equation w/o Roll radius?

$$\frac{w}{RR} = \frac{h}{st}$$



relationship of volume bowl versus pin or narrow diameter

$$3 \leftarrow 1/2 = \frac{y^2}{3.1/4} \leftarrow 2 \text{ times}$$

$$3.75 \sqrt{2.00}$$

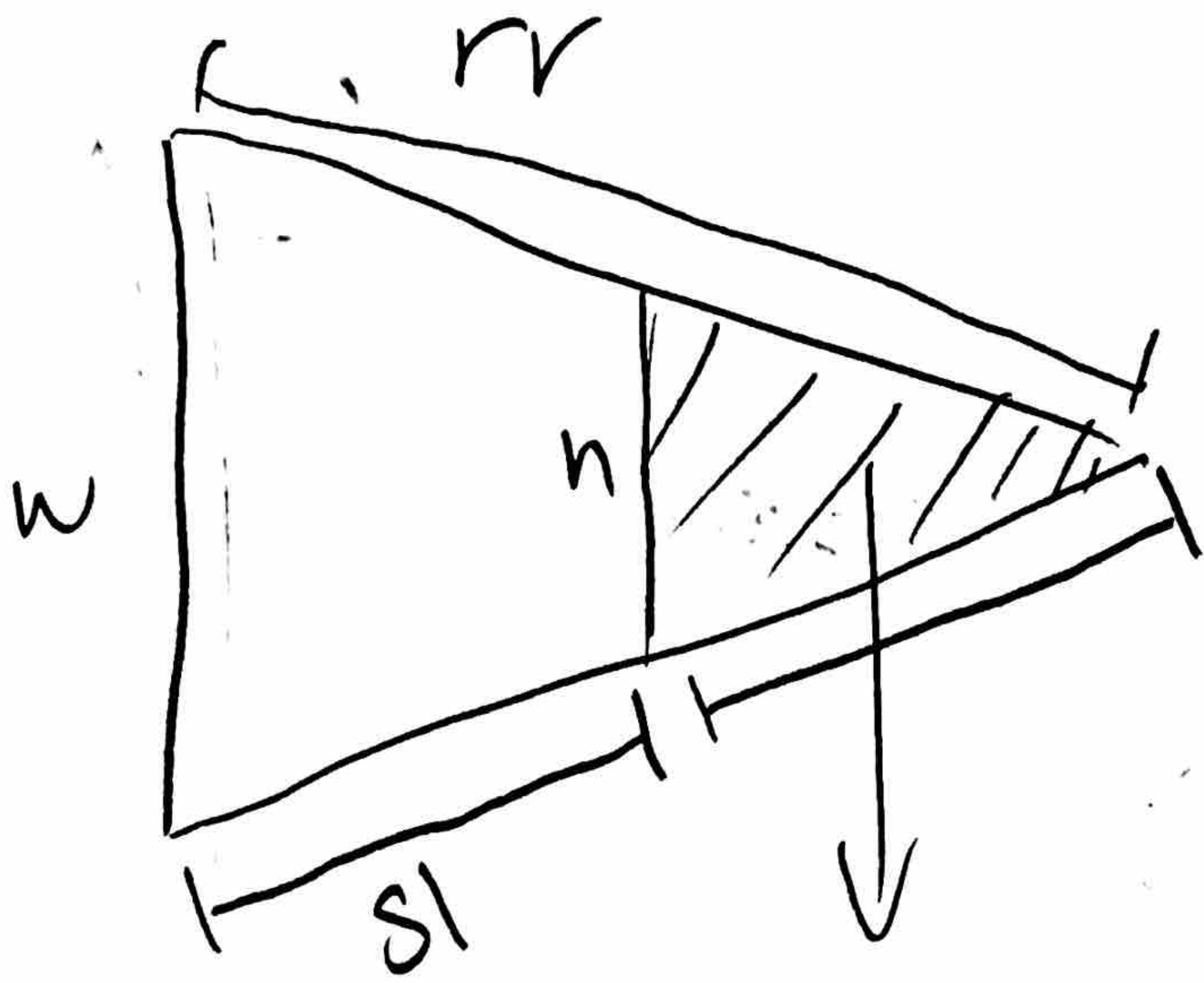
100

= big circle

10

999

18



$$\frac{w}{n} = \frac{s1}{rr}$$

$$\frac{w}{rr}$$

n unknown

If this is longer the roll radius is greater

- N - 2
- w - 3
- S - 6
- R - 18

$$\frac{S+X}{w-n} = \frac{RR}{(w-n)}$$

$$\frac{6+X}{w-n} = \frac{18}{1}$$

$$\frac{3\frac{1}{2}+X}{3-2} = \frac{10\frac{1}{2}}{1}$$

$$\frac{6+12}{w-n} = \frac{18}{1}$$

RR

~~$$\frac{S+X}{2(w-n)} = A$$~~

$$S+X = RR$$

What values for the narrow diameter and wide diameter do you think Heather should choose

Justify your answer.

Heather should try the values of $N=3$ and $w/N=3$, $w=4,5,6$. She should use these values to compare + further her data and try to see patterns w/ compared $w=1$ or 2.

Heather has described some patterns in the data.

Find and describe a new pattern in the data.

When $N=2$ the proportion of n to w is the same as s to r . As goes for all others except when $N=w$.

What are the strengths of Heather's solution?

She has found specific comparisons of N to w to find a partial answers, and begin and equation. Her method is through.

What would you do to improve Heather's solution?

Explain your answer.

Continue data collection to find missing value

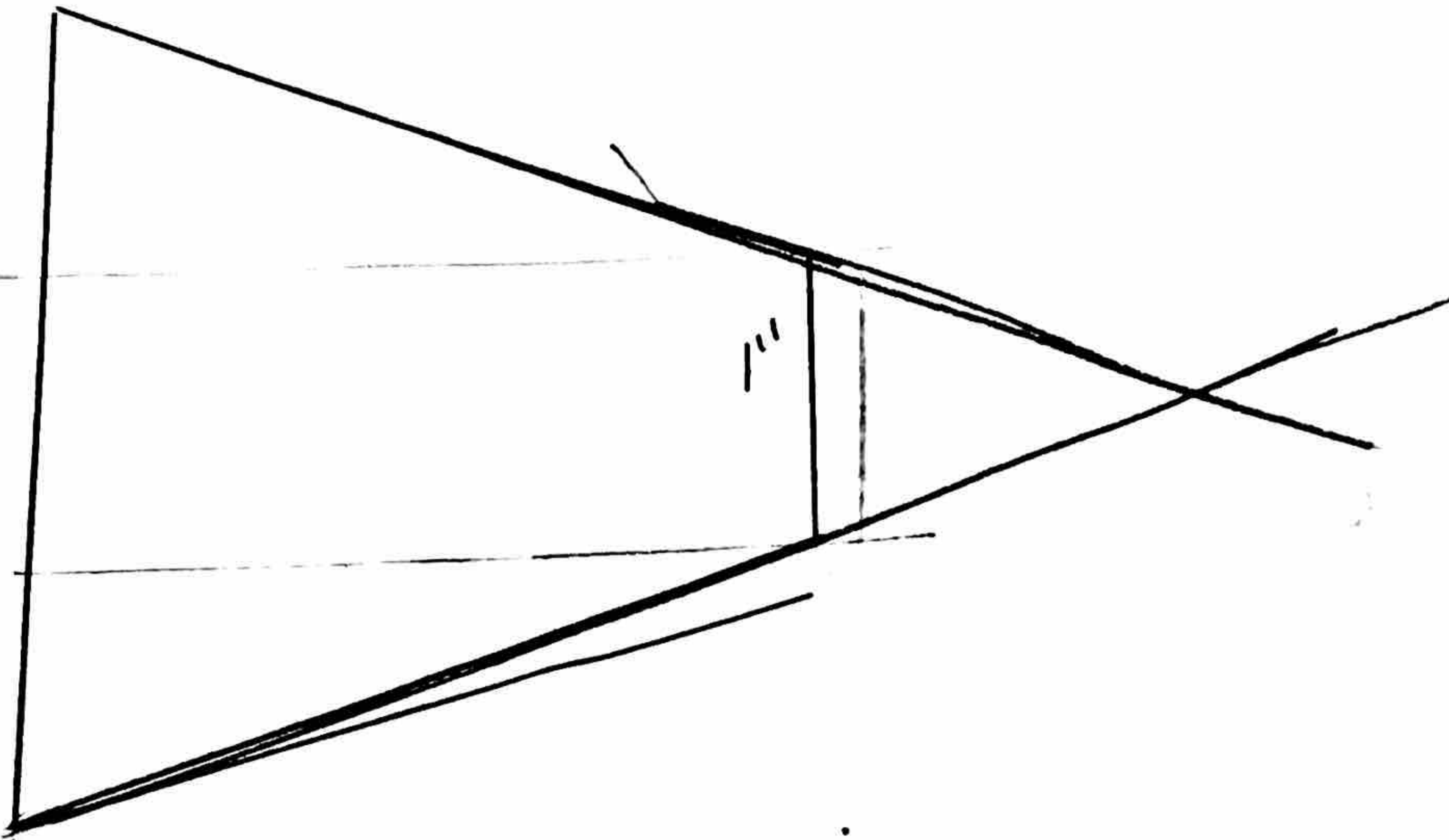
Use Gerry's method to find the roll radius of this cup:

Wide diameter = 3"

Narrow diameter = 1"

Slant length = 3"

4.5"



Gerry says he can use his method to find the roll radius of any cup.

Is this correct?

Explain your answer.

HIS method works, but requires drawing every value

What are the strengths of Gerry's approach?

Without user error will always be correct

What could Gerry do to improve his solution?

He could come up with an equation instead of always drawing

Judi says Triangle ACE and Triangle BCD are similar.

Is Judi correct?

Explain your answer.

Yes, because the proportions of each are congruent. $\frac{m}{R-S} = \frac{w}{R}$

Judi draws a triangle diagram.

Explain how this represents a cup.

The trapezoid EABD is like the cup, and ABCD is the portion of circle not created by the cup.

Judi has made a mistake in her formula.

Find and correct the mistake.

She didn't distribute the w

$$\frac{R}{w} = \frac{R-S}{N} = R \cdot w \left(\frac{R-S}{N} \right)$$

Now find a formula for R , the roll radius.

$$R = WR - WS \quad R = (WR - WS)N$$