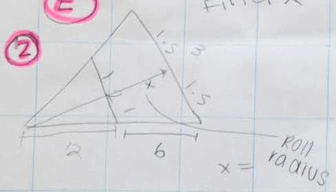
Modeling Rolling cups Ideas

Ⓔ ②



Find x

$$\begin{array}{r} 6 \\ \times 1.5 \\ \hline 9 \end{array}$$

9+9=18

d = 2

Ⓑ ②

$$\begin{array}{r} 3.5 \\ \times 1.5 \\ \hline 5.25 \end{array}$$

525 + 5.25

10½

equation:

wide diameter = w   slant height = h   Narrow diameter = d

r = roll radius

① $(wh)2$ = roll radius AC

② $(\frac{1}{2}wh)2$ = roll radius EB

ex:

Ⓐ ①   d = 3

$((3\frac{1}{2})3\frac{3}{4})2 = r$

$((1.75)3\frac{3}{4})2 = r$

$(13.125)2 = 26.75$

Ⓒ ①   d = 2

$(2.5(5.75))2 = r$

$= 28.75$

Ⓖ ② $(\frac{1}{2}(3.75)3.75)^2$

① $(3.75(3.75)^2$

none worked

E^2 ② incorrect   d = 2

$(3(6))^2 = r$

Side splitter therom

w e

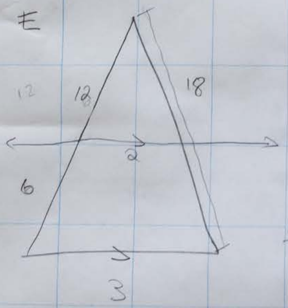
A = 3½ = 1

B = 3 = 2

C = 2½ = 1

E = 3 = 2

G = 3½ = 0



If a line is parallel to a side of a triangle and intersects the other two sides, then the line divides those two sides proportionally

$\frac{18}{3} = \frac{12}{2}$

$6 = 6$

equation: $\frac{r}{w} = \frac{r-h}{d}$

Ex: G

$$\frac{r}{3.75} = \frac{r-3.75}{3}$$

$3r = 3.75(r-3.75)$

$3r = 3.75r - 14.0625$

$-3r \quad -3r$

$0 = .75r - 14.0625$

$\frac{14.0625}{.75} = \frac{.75r}{.75}$

$\boxed{r = 18.75}$

Ex #2:

$$\frac{r}{3.5} = \frac{r-3.75}{2}$$

$2r = 3.5r - 13.125$

$-2r \quad -2r$

$0 = 1.5r - 13.125$

$\frac{13.125}{1.5} = \frac{1.5r}{1.5}$

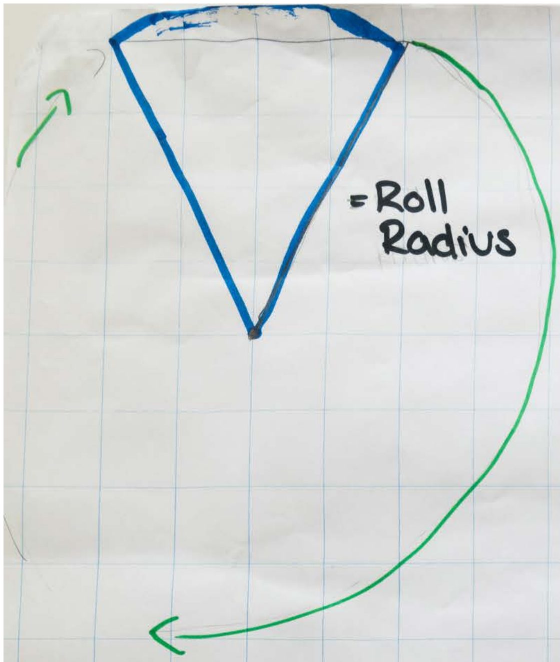
$\boxed{r = 8.75}$

Modeling Rolling Cups

* The larger the slant length, the larger the roll radius.
* The closer together the wide diameter and narrow diameter, the larger the roll radius.
* If the narrow diameter is equal to the wide diameter, the roll radius is infinite.
* If the narrow diameter is 0, the slant length and roll radius are equal.

We got this from Heather's solution:

$$\text{Roll radius} = \frac{? \times \text{slant height}}{\text{wide diameter} - \text{narrow diameter}}$$



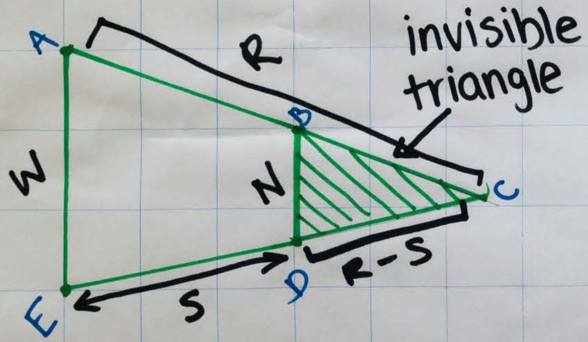
The smaller the slant degree, and the taller slant height = larger roll radius.

Extra Data Points:

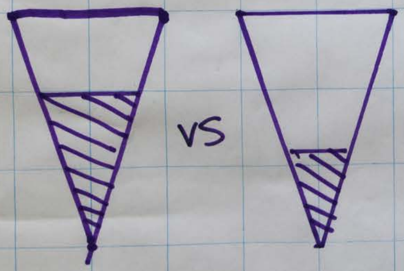
$w = 100$
$n = 99.9$
$s = 1$
$r = 1{,}000$

$w = 100$
$n = 99$
$s = 1$
$r = 100$

The narrow ~~radius~~ diameter compared to the wide diameter has a significant effect on the roll radius (smaller difference = larger roll radius)



$\Delta ACE \sim \Delta BCD$



Rolling Cups Problem

Wide Diameter	Narrow Diameter	Slant length	Roll Radius
3	2	5	15
3	2	6	18
3	1	4	6
3	3	4	Infinite
3	1.5	4	8
3	2	4	12
4	2	4	8
6	2	4	6

$\left(\frac{NW}{2}\right) S = R$

$\left(\frac{1 \cdot 3}{2}\right) \cdot 1 = 1.5$

$\left(\frac{1.5}{2}\right) \cdot 4 = 3$

$\frac{5\frac{1}{2}}{8\frac{1}{2}} \times \frac{2\frac{1}{4}}{3\frac{1}{2}}$

$19.25 = 19.125$

$\frac{2\frac{1}{4}}{5\frac{1}{2}} = \frac{3\frac{1}{2}}{8\frac{1}{2}}$

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

$\frac{15}{3} = \frac{15-5}{2}$

$5 = 5$

$RN = WR - S$

$15 \cdot 2 = 3(15-5)$

$30 = 45 - 15$

$30 = 15$

$\frac{R}{3} = \frac{R-5}{2}$

$2R = 3R - 15$
$-2R$

$0 = R - 15$

$15 = R$

$RN = \sout{WR - S)}$
R

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

$\frac{R}{3} = \frac{R-5}{2}$

$2R = 3R - 15$

$\boxed{R = 15}$

$\frac{R}{3} = \frac{R-4}{3}$

$3R = 3(R-4)$

$3R = 3R - 12$

no radius
(inf)

$\frac{R}{3} = \frac{R-4}{1}$

$R = 3(R-4)$

$R = 3R - 12$

$12 = 2R$

$\boxed{R = 6}$

$\frac{R}{W}$

Key

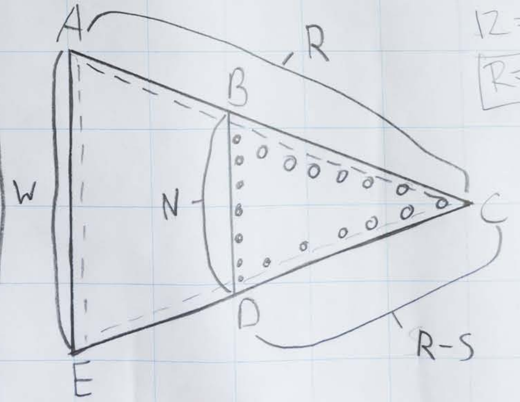
W = Wide Diameter

N = Narrow Diameter

S = Slant Length

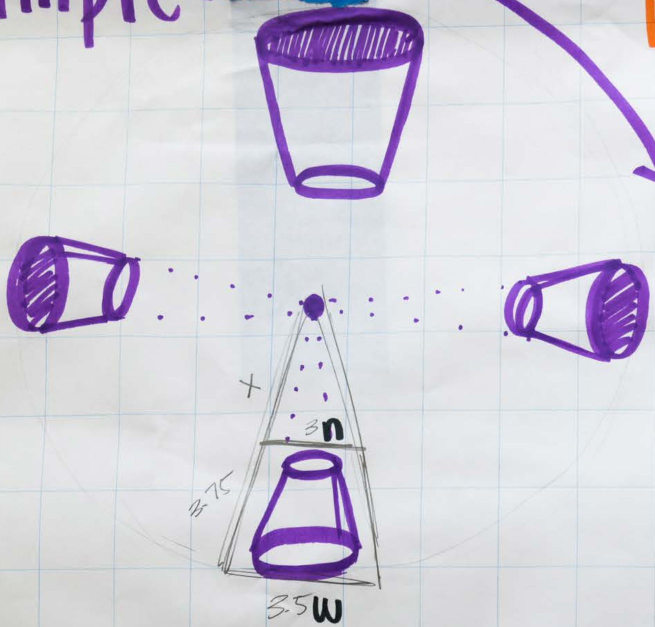
R = Roll Radius

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



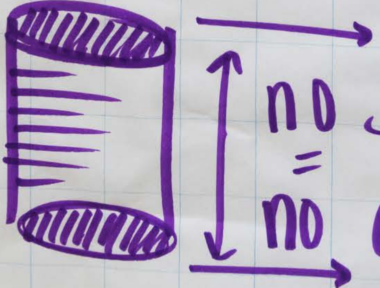
Rolling Cups

example:



$$\frac{x}{n} = \frac{R}{w}$$

In return, a slight difference between the top & bottom diameter creates a larger roll radius.

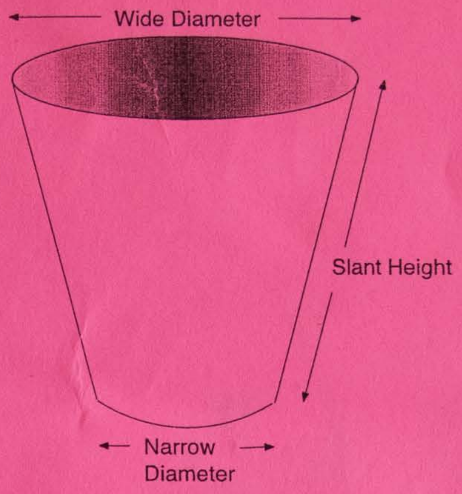


no slant
=
no circle

$$\boxed{\frac{R-S}{n} = \frac{R}{w}}$$

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	4¼	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.

The slant length has the largest affect on the roll radius, and the smaller the ratio between the wide diameter and narrow diameter, the larger the roll radius.

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 : Narrow Diameter

A $3\frac{1}{2} : 3 = 1.185$

B $3 : 2 = 1.5$ $\quad 1.5\overline{)10.5}$

C $2\frac{1}{2} : 2 = 1.25 \rightarrow$ $\quad \overset{23}{1\overline{)28.75}}$ 350 375

$\overset{1.18}{3\overline{)3.5}}$

You're on the right track!

Keep going and include the slant height.

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Modeling Rolling Cups

(slant length)(wide diameter) ≈ 2(roll radius)

a proportion is a good start.

$\frac{3.75}{0.5} = \frac{7.5 \times 2}{1 \times 2}$

$\frac{23}{2} > \frac{15}{2} =$

C A

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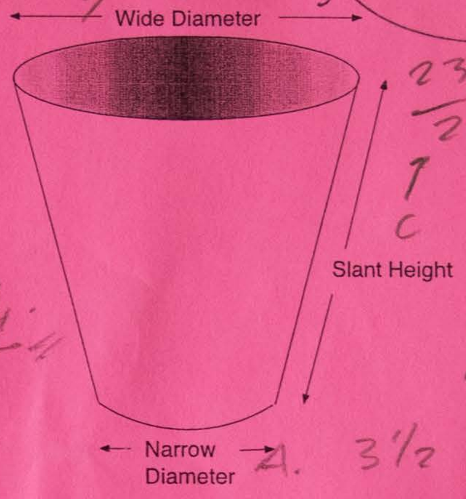
D	3	3	4¼	Infinite!
E	3	2	6	18
F	3½	2	3¾	8¾
G	3¾	3	3¾	18¾
H	3½	0	3¾	3¾

2.

$\frac{26\frac{1}{4}}{x}$



c has greater roll radius

A. 3½ − 3 = ½

C. 2½ − 2 = ½

11.5 $\frac{23}{2}$

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1.

the greater the difference between wide and Narrow diameters respectively compared to the slant length, the greater the roll radius.

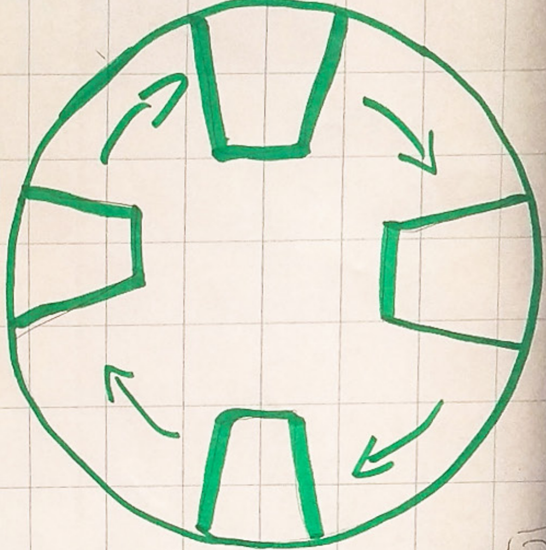
Great! Try adjusting just one measure?

2).

Our Process of Thought

We looked at Heathers Equation

$$\boxed{R = \frac{? \times S}{W-N}}$$



We imput the dimensions of several cups and solved for $\boxed{?}$

$$3.75 = \frac{(x \cdot 3.75)}{(3.75 - 0)}$$

$$3.75 = \frac{(3.75 x)}{(3.75)}$$

$$3.75 = 3.75$$

Our final equation

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

Heather Formula: $R=\frac{?\times S}{W-N}$ What is "?"

key

W= wide diameter
R= roll radius
S= slant height
N= narrow diameter

trials: * $18=\frac{?\times 6}{1}$ $?=3$ (which is the wide diameter)

* $10\frac{1}{2}=\frac{?\times 3.5}{1}$ $?=3$ (is the W.D)

* $8\frac{3}{4}=\frac{?\times 3.75}{1\frac{1}{2}}$ $?=3.5$ (is the W.D)

So.... $R=\frac{W\times S}{W-N}$