

SHARING INSPIRATION 2019

THE POWER OF REALIZATION



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Promoting Productive Struggle That Leads To Understanding



Who's in the Room?

- ❑ The usual (name, location, course(s))
- ❑ How are you feeling, really?
- ❑ One outcome you hope for



Norms



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Teachers Teaching with Technology™
Professional Development from Texas Instruments

The principle of productive struggle [is] that students who confront and fail a challenging problem and are then provided further clarifying instruction outperform traditionally taught students.



Hattie, J. (2017). *Visible learning for mathematics, grades K-12: what works best to optimize student learning*. Thousand Oaks, CA: Corwin, a SAGE Company.



Nothing good comes easy

Catering to a child's learning style has been popular for decades, but the popular belief that people are auditory, visual or tactile learners simply isn't supported by research.

In fact, making things too easy may hinder their progress. Research is finding that children are more engaged when they experience some frustration. Struggling to find a solution forces kids to grasp the structure of problems (rather than only working for the correct answer), which fosters a way of problem solving that's more applicable to the real world.

How fresh approaches can foster smarter students - by Lee Marshall

The Globe and Mail, Monday, Aug. 18 2014

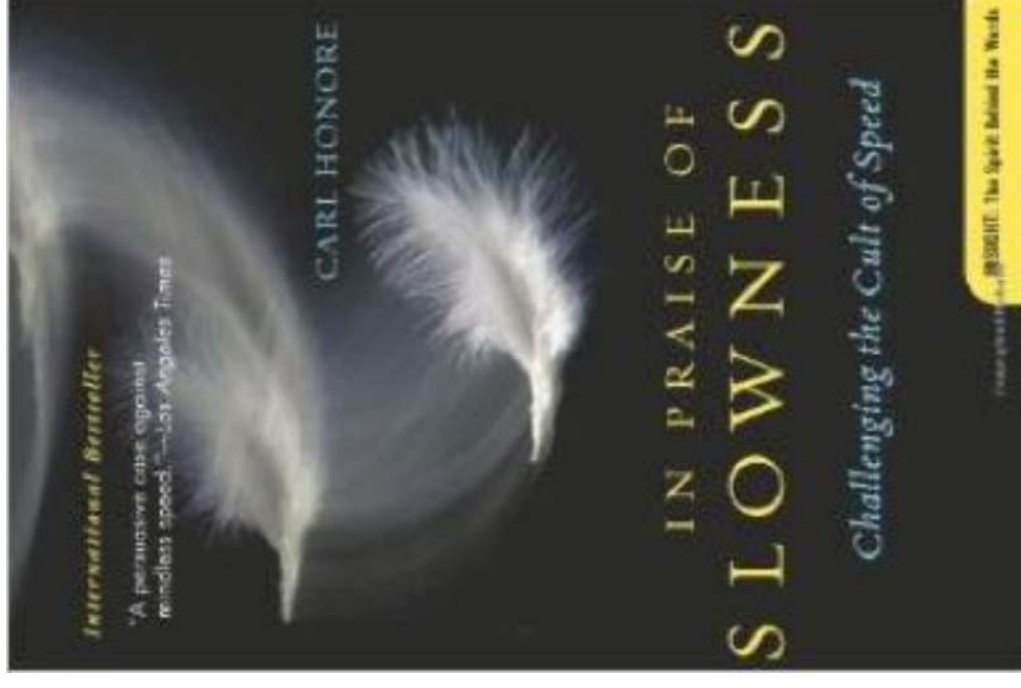


Learning Intentions

- I can recognize the difference between productive struggle and destructive struggle.
- I can recognize #AskDontTell opportunities to "unstuck" students.
- I can select tasks that will provide students the opportunity to engage in #SlowMath productive struggle.
- I can anticipate how students will solve tasks and expect use of multiple representations to deepen mathematics understanding.

It is a cultural revolution against the notion that faster is always better. The Slow philosophy is not about doing everything at a snail's pace. It's about seeking to do everything at the right speed. **Savoring** the hours and minutes rather than just counting them. Doing everything as well as possible, instead of as fast as possible. It's about quality over quantity in everything from work to food to parenting.

In Praise of Slowness, Carl Honoré



Productive Struggle

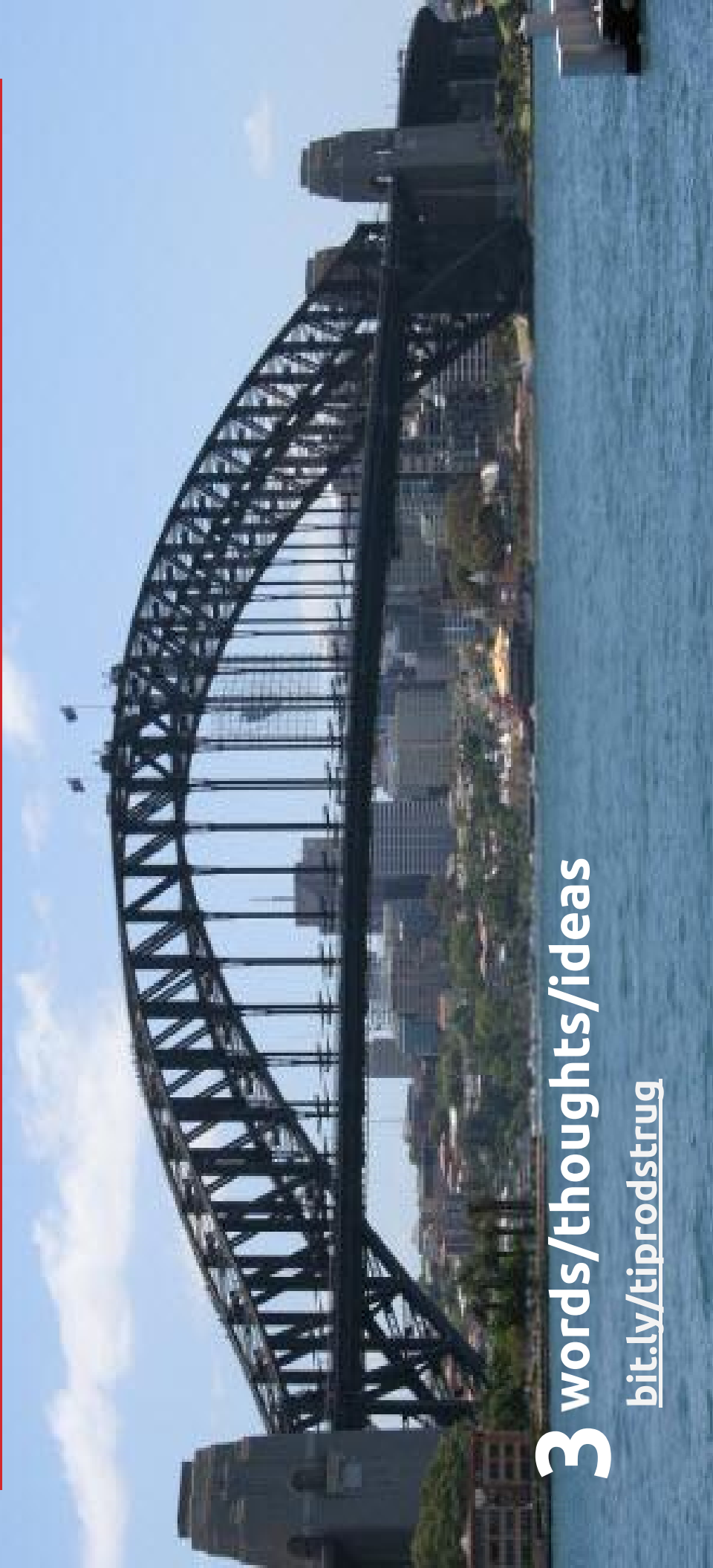
3-2-1 Bridge



3 words/thoughts/ideas

Productive Struggle

3-2-1 Bridge

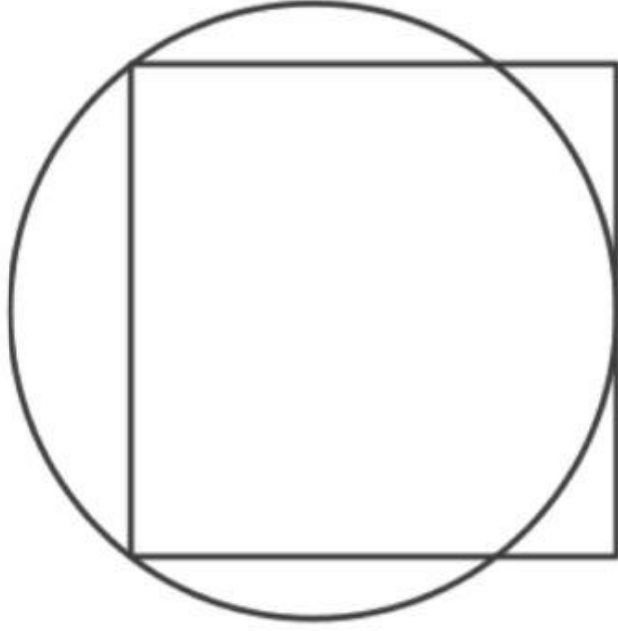


3 words/thoughts/ideas

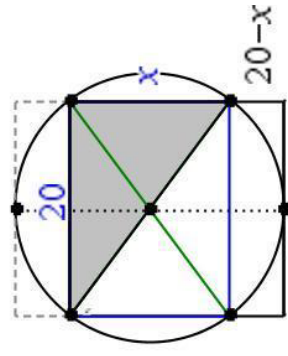
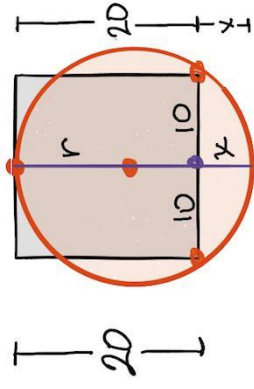
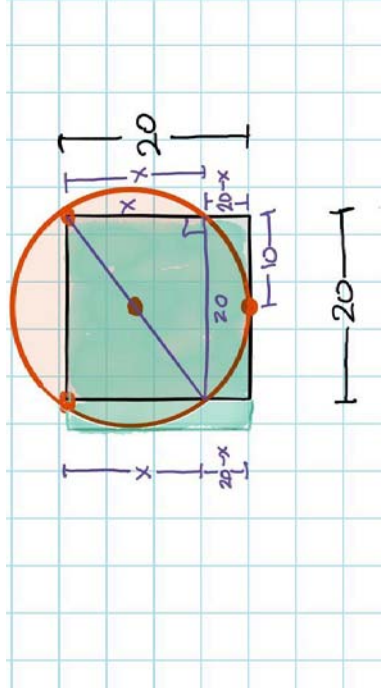
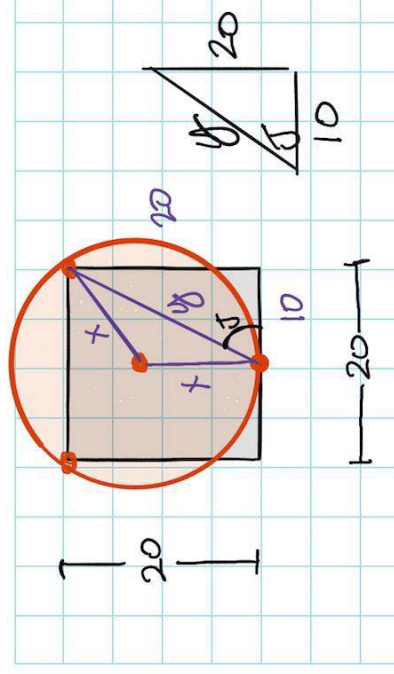
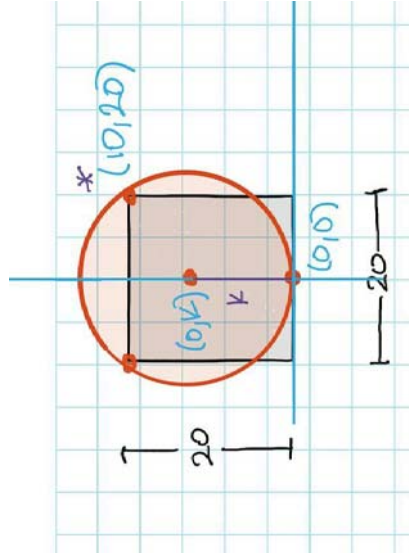
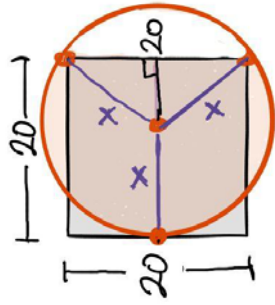
bit.ly/tiprodstrug

Let's Do Some Math

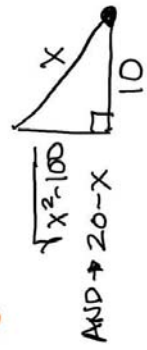
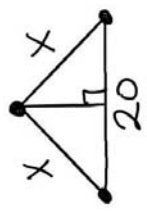
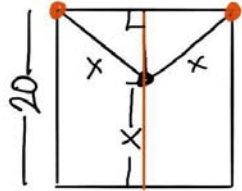
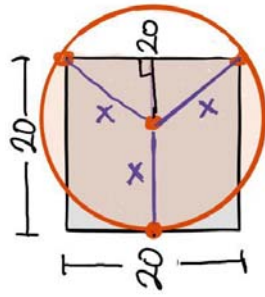
The sides of the square are 20.
What is the diameter of the circle?



Let's Do Some Math



Let's Do Some Math



$$\sqrt{x^2 - 100} = 20 - x$$

$$x^2 = \frac{25}{2} = 12.5$$

x IS A
RADIUS

DIAMETER IS 25.



Let's Do Some Math

$y = \sqrt{500}$
 $\tan J = \frac{20}{10}$
 $J = \tan^{-1}(2)$
 $J \approx 63.43^\circ$
 $\Rightarrow A = 26.57^\circ$

$\cos A = \frac{\frac{1}{2}\sqrt{500}}{x}$
 $x = \frac{\frac{1}{2}\sqrt{500}}{\cos A}$
 $x = 12.5$

DIAMETER IS $2x = 25$

Let's Do Some Math

$a \cdot b = c \cdot d$
 $10 \cdot 10 = 20 \cdot x$
 $100 = 20x$
 $x = 5$

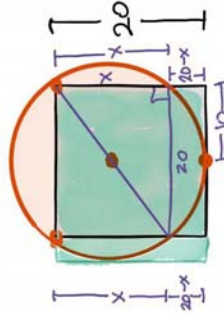
THE DIAMETER IS 25.

$\frac{a}{c} = \frac{d}{b}$
 $a \cdot b = c \cdot d$

CHORD SEGMENT

Let's Do Some Math

$$\text{tangent}^2 = \text{ext sec} \cdot \text{sec}$$



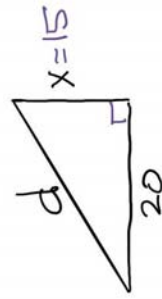
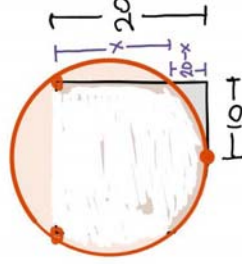
$$10 - x$$

$$10^2 = (20-x)(20)$$

$$100 = 400 - 20x$$

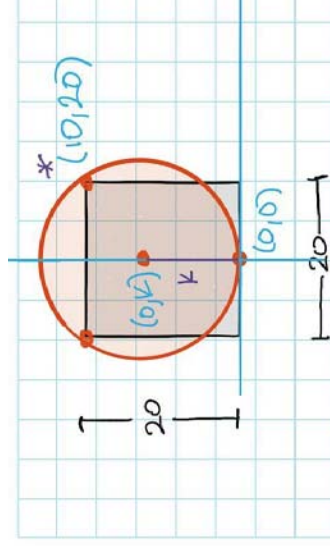
$$20x = 300$$

$$x = 15$$



$$r = 25$$

Let's Do Some Math



$$\text{Eq: } (x-h)^2 + (y-k)^2 = r^2$$

$$h=0, k=r$$

$$x^2 + (y-k)^2 = k^2$$

$$100 + (20-k)^2 = k^2$$

$$100 + 400 - 40k + k^2 = k^2$$

$$500 - 40k = 0$$

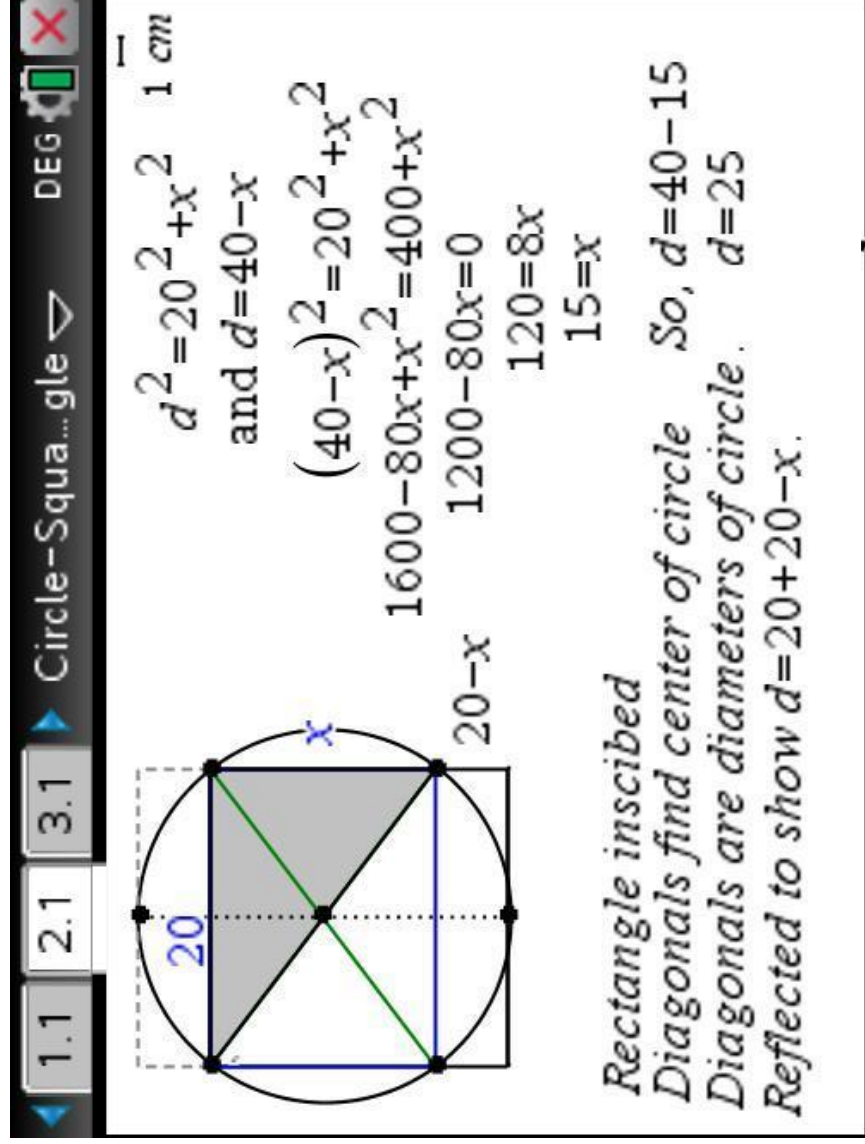
$$500 = 40k$$

$$k = \frac{500}{40} = 12.5$$

$$k=r \text{ and } d=2r$$

$$d=25$$

Let's Do Some Math



$d^2 = 20^2 + x^2$
and $d = 40 - x$

$(40 - x)^2 = 20^2 + x^2$
 $1600 - 80x + x^2 = 400 + x^2$
 $1200 - 80x = 0$
 $120 = 8x$
 $15 = x$

Rectangle inscribed
Diagonals find center of circle So, $d = 40 - 15$
Diagonals are diameters of circle. $d = 25$
Reflected to show $d = 20 + 20 - x$.

Planning a Task that Supports Productive Struggle

- ❑ State the task.
- ❑ Anticipate ways students will work on the task.
- ❑ Anticipate multiple representations and find their connections.
- ❑ Anticipate how technology may play a role in student struggle.
- ❑ Anticipate ask/moves can you suggest to “unstuck” students.
- ❑ Select a content standard and a practice standard with which this task aligns.
- ❑ Prepare an organizer to help you select, sequence, and connect student learning.





CHECKPOINT SUMMARY

Destructive Struggle	Productive Struggle
Leads to frustration	Leads to understanding
Makes learning goals feel hazy and out of reach and further effort seem pointless	Makes learning goals feel attainable and effort seem worthwhile
Feels fruitless	Yields results
Leaves students feeling abandoned and on their own	Leads students to feelings of empowerment and efficacy
Creates a sense of inadequacy	Creates a sense of hope

Jackson, Robyn R. (2010-07-27). [How to Support Struggling Students \(Mastering the Principles of Great Teaching series\)](#) (Pages 18-19). Association for Supervision & Curriculum Development. Kindle Edition.



Let's Do Some STEM

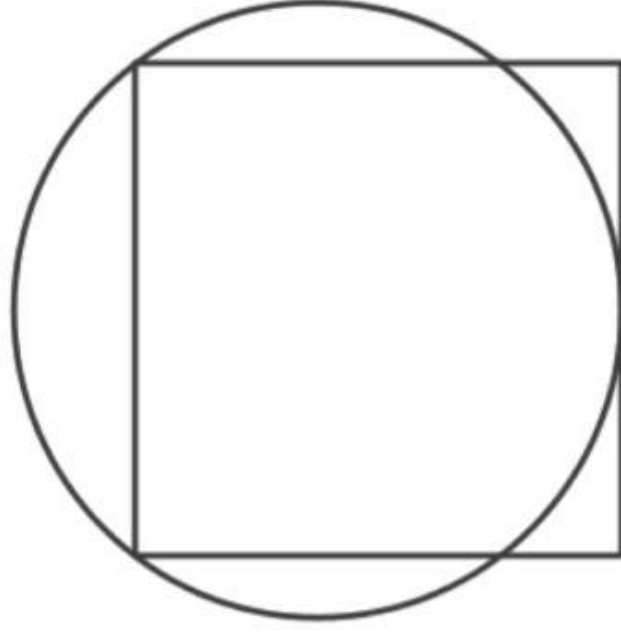
Task:

Write the code to have Rover re-create the circle/square diagram.

Note:

Sides of square are 20 cm

Diameter of circle is 25 cm



Documents and Info:

Access to Documents: <http://bit.ly/SI19PS>

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