#1 Make Sense of Problems and Persevere in Solving Them

When presented with a problem, I can make a plan, carry out my plan, and evaluate its success.

START

ANALYZE and translate the problem

- Have I solved a problem like this before?
- What is the concept?
- Plan your path
- Look for entry points

ORGANIZE ideas

- What is being asked?
- What do we know and need to find?
- What skills and procedures relate to the concept?
- What prior knowledge do I have to help me?
- What tools are needed to solve?

PERSEVERE in solving

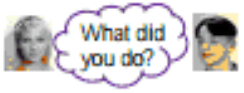
- Consider analogous problems
- Model problems in different ways
- Does this make sense?
- Change plan if it is not working

CHECK answers

- Differentiate approach to check solutions
- Is my answer correct?
  YES: proficient
  NO: revise your strategy and return to organize ideas

EVALUATE work

- What worked and didn't work?
- What other strategies could be used to solve the problem?
- Compare strategies and work with other classmates



END

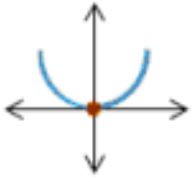
#2 Reason Abstractly and Quantitatively

I can use reasoning habits to help me contextualize and decontextualize problems.

CONTEXTUALIZE: given an equation or graph, I can write a real-world application problem.

Problem 1:

$y = x^2$



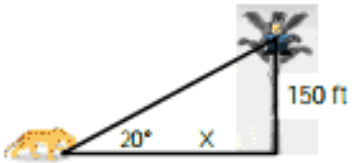
➡

Location of the transponder is at the vertex

Problem 2:

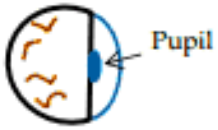
$\text{Tan } 20 = \frac{150}{x}$ ➡

Distance from the base of the tree to the tiger



DECONTEXTUALIZE: given a real-world application problem, I can write and solve an equation.

Problem 1:



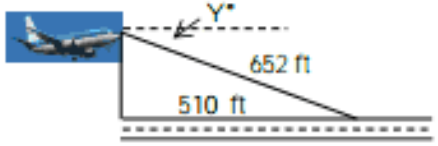
Pupil is located at the focus of the parabola

➡

Major axis: vertical

Equation: $(y - k)^2 = 4p(x - h)$

Problem 2:



Angle of depression from the plane to the runway

➡

$\text{Cos } Y = \frac{510}{652}$

$Y = \cos^{-1}\left(\frac{510}{652}\right)$

$Y = 38.5°$

Reasoning habits include:

- flexibility in thinking
- interpret meaning in context
- attention to units and correct labeling of a diagram
- understand / connect mathematical terminology

#3 Construct Viable Arguments and Critique the Reasoning of Others

I can make conjectures and critique the mathematical thinking of others.

MAKE CONJECTURES:

- Inductive reasoning
- Logical reasoning

ANALYZE:

- Recognize and use counter examples
- Ask useful questions while engaged in active

UNDERSTAND:

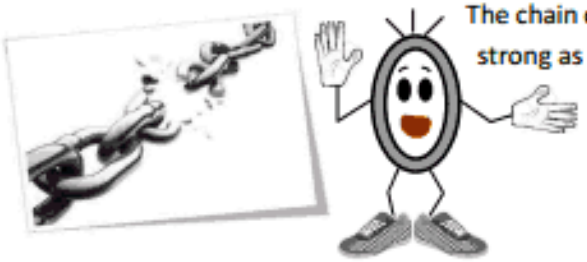
- Definitions
- Previous knowledge
- Logical progressions
- Drawings and diagrams

CONSTRUCT ARGUMENTS AND CRITIQUE OTHERS

DEFEND:

- Use examples and counterexamples
- Recognize mistakes and correct flawed logic
- Use precise vocabulary
- Justify conclusions

Sin
Opp
Hyp
Cos
Adj
Hyp
Tan
Opp
Adj



$\sqrt[4]{x}$
x^3
$|x|$
$f(x)$
$y =$
$x =$

#4 Model with Mathematics

I can recognize math in the real world and use math to solve life's problems.

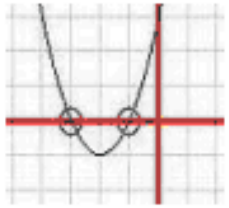
REAL WORLD MATHEMATICS

Generate EQUATIONS from data

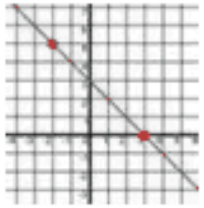
1. How long will it take to drive to Georgia? $d = rt$
2. How tall will my child be in 3 years? $y = mx + b$
3. How much coke is in my soda can? $\mathbf{V = \pi r^2 h}$

ESTIMATE to make problems simpler

Estimate the zeros



Estimate the slope



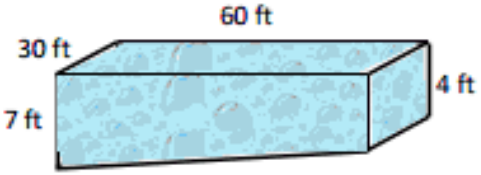
Connect math to REAL LIFE

DOW

TEACHER PAY

Use PICTURES to help with complex problems

Volume of a swimming pool



Use appropriate SYMBOLS

$\pm \quad \neq \quad \sim \quad \infty \quad \approx \quad \cap$

$\sqrt{x} \quad |x| \quad \leq \quad \geq \quad \$ \quad \%$

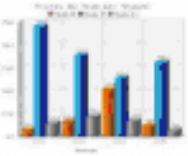
$+ \quad - \quad ( ) \quad ! \quad \bullet \quad \int$

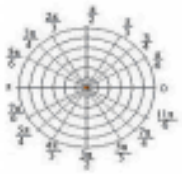
#5 Use Appropriate Tools Strategically

I know when to use certain tools to help me explore and deepen my math understanding.

Math Toolbox and Resources

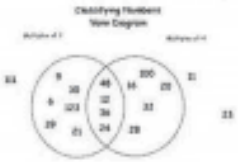
- I know **WHEN** to use math tools and external resources.



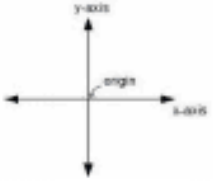


- I know **HOW** to use math tools and external resources.



- I know **WHAT** the limitations of my tools are and the resources available.

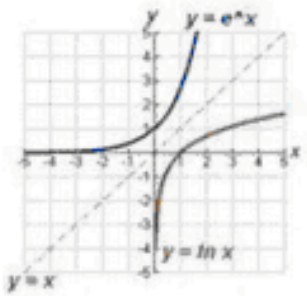




#6 Attend to Precision

I can use precision when solving problems and communicating my ideas.

Problem Solving

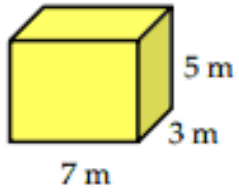
- Use symbols, units, and measurements correctly
- Label graphs & charts accurately
- Calculate the exact answer
- Check answers to see if they are reasonable and accurate



Using the **horizontal line test**, the **equation** $y = e^x$ is **one-to-one** therefore it has an **inverse** which is $y = \ln x$.

Communicating

- Use clear definitions
- Speak and write using accurate mathematical vocabulary
- Listen and read mathematically



$V = Bh$ or lwh
$V = (7 \bullet 3)(5)$
$V = 105\ m^3$

The **volume** of the **rectangular prism** is 105 **cubic meters**.

#7 Look for and Make Use of Structure

I can see and understand how rules and patterns are used when identifying parts and wholes of problems.

1. Communicate in mathematical language
2. Discover and analyze patterns
3. Apply appropriate rules and break them down in to simpler parts
4. Step back for an overview and shift perspective, when needed

RULE: Do the opposite

$3(x - 4) = -4x + 9$

$\underset{+4x}{3x} - 12 = \underset{+4x}{-4x} + 9$ I do the opposite of negative 4x which is a positive 4x.

$7x \underset{+12}{-12} = \underset{+12}{9}$ Look for operation sign so I see subtraction, I do addition.

$\frac{7x}{7} = \frac{21}{7}$ Again, I see multiplication so I do division.

$x = 3$

PATTERN: Pascal's Triangle

$(x+1)^0$ 1

$(x+1)^1$ 1 1

$(x+1)^2$ 1 2 1

$(x+1)^3$ 1 3 3 1

$(x+1)^4$ 1 4 6 4 1

$(x+1)^2 = 1x^2 + 2x + 1$

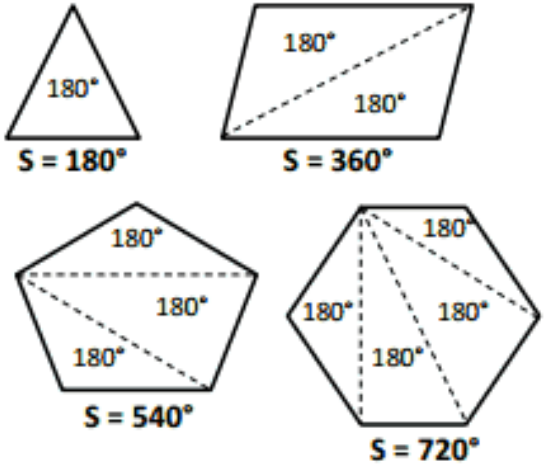
$(x+1)^3 = 1x^3 + 3x^2 + 3x + 1$

$(x+1)^4 = 1x^4 + 4x^3 + 6x^2 + 4x + 1$

#8 Look for and Express Regularity in Repeated Reasoning

I can notice when patterns and calculations are repeated and find more efficient methods and short cuts.

PATTERNS



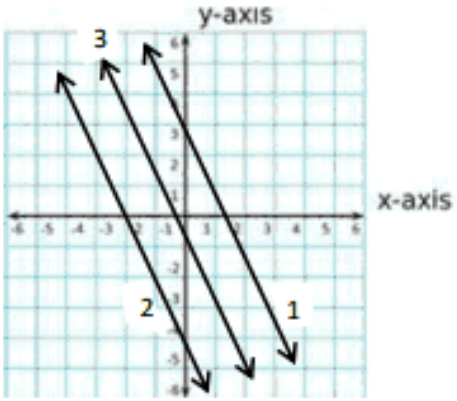
S = 180° S = 360° S = 540° S = 720°

– The number of triangles formed within a polygon is the number of sides minus 2. **(n – 2)**

– The sum of the degrees in a polygon is **S = 180(n – 2).**

1. $y = -2x + 3$
2. $y = -2x - 4$
3. $y = -2x - \frac{1}{2}$

These lines have the same slope. They are parallel.



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

$(x^2 - 5)(x^2 + 5)$
$x^4 + 5x^2 - 5x^2 - 25$
$x^4 - 25$

$(3x^2 - \sqrt{2})(3x^2 + \sqrt{2})$
$9x^4 + 3x^2\sqrt{2} - 3x^2\sqrt{2} - \sqrt{4}$
$9x^4 - 2$

Wow, when multiplying the sum and difference of the same binomial, the middle terms always cancel out.

$(3x - 1)(3x + 1)$
$9x^2 - 1$

$(x^3 + 6)(x^3 - 6)$
$x^6 - 36$