Student Mathematical Practices (SMP)
High School

Make Sense of the Problems and Persevere in Solving Them
Student Mathematical Practice 1

- How would you describe the problem in your own words?
- What are you trying to find?
- What information is given to you in the problem? Can you describe the relationships between the quantities?
- Describe the strategies you have already tried. What change might you make to reach a solution?
- What steps in the process are you most confident about? What are some other strategies you might try?
- What prior knowledge can you use from previous problems?
- How else might you organize, represent, or show the task?
- Is the solution reasonable and does it make sense? Be persistent, and do not give up!

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**What are two numbers which have a sum of 4 and a product of 5?**

Reason Abstractly and Quantitatively
Student Mathematical Practice 2

- How can you make sense of the quantities and their relationships within the problem situation?
- How might the units and numbers be considered in creating a solution?
- How might you explain the meaning of quantities you have computed?
- What properties might you use to find a solution?

Jane, Carol, and Mary all walked from the railroad station. Jane walked at a steady pace, Carol speeded up as she walked, and Mary slowed down. *Choose which graph identifies each girl's walk. Explain your reasoning.*
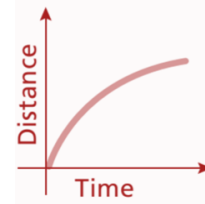
Relationships between quantities and rate of change

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- What mathematical evidence would support your solution? How would you justify and defend your conjectures?
- Will it still work if the quantities/process you used changed?
- Why did you decide to try that strategy?
- How did you test whether your approach worked?
- How did you decide what the problem was asking you to find? (What was unknown?)
- Did you try a method that did not work? Why didn't it work? Would it ever work? Why or why not?
- What is the same and what is different about the strategies used by you and others? How could you demonstrate a counter-example?

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Jack and Sara's class must find the length of $\widehat{DE}$ using the diagram below. A classmate submits the solution shown below. What is the error?

Length of $\widehat{DE} = \dfrac{m\widehat{DE}}{360} \cdot 2\pi r$

$= \dfrac{110}{360} \cdot 2\pi(6)$

$= \dfrac{11}{3} \pi \ m$
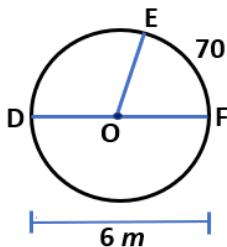
Model With Mathematics
Student Mathematical Practice 4

- What number model could you construct to represent the problem?
- What are some ways to represent the quantities? What are the relationships between the quantities?
- What is an equation or expression that matches the diagrams, graphs, coordinate grids, calculators, tables, …?
- How will you represent quantities in the task in your equation or expression?
- What math do you know that you could use to represent this situation?
- What assumptions do you have to make to solve the problem?
- What formula might apply in this situation?

Maria wants to buy oranges and peaches from the store to add to her party's fruit display. She must buy at least 5 oranges, and the number of oranges must be less than twice the number of peaches. An orange weighs 150 grams and a peach weighs 100 grams. Maria can not carry more than 3.6 kilograms of fruits home. If oranges cost $0.70 each and peaches cost $0.90 each, what is the maximum amount Maria can spend buying the fruits?

https://www.onlinemathlearning.com/linear-programming-example.html

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Use Appropriate Tools Strategically
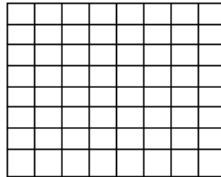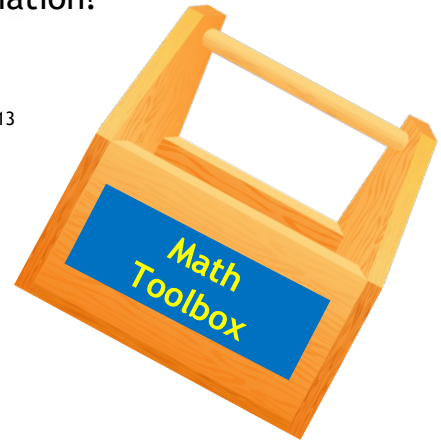# Student Mathematical Practice 5

- How could a mathematical tool help you understand/interpret/solve this problem?
- What mathematical tools could you use to visualize and represent the situation?
- What approach are you considering trying first?
- What tools do you have available? Which tool will best provide the needed information?
- How can using a tool show something different?
- In what situations might it be more informative or helpful to use tools?

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Make some predictions about how the graph of $f(x) = D + A \sin B(x - C)$ changes when:

a) only A changes
b) only B changes
c) only C changes
d) only D changes

How can you test your predictions?

Math Toolbox

National Council of Teachers of Mathematics (NTCM).*Implementing the CCSS through Mathematical Problem Solving: High School*. Reston, Va: NCTM, 2012: 31

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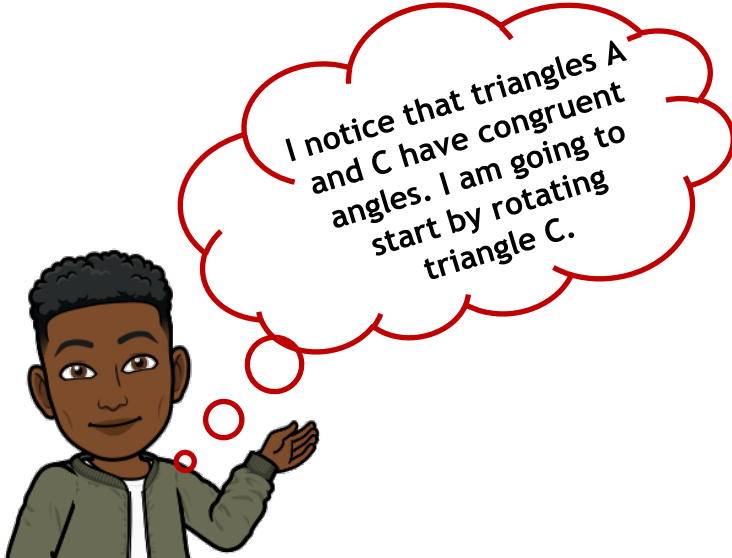Alabama Math, Science, and Technology Initiative

Attend to Precision
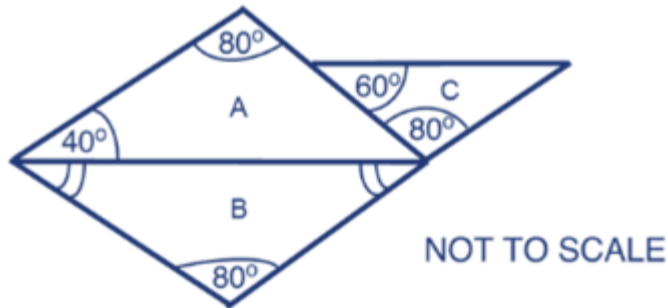# Student Mathematical Practice 6

- What mathematical terms apply in this situation? How did you know your solution was reasonable?
- Explain how your solution answers the problem.
- Is there a more efficient strategy?
- How are you showing the meaning of the quantities?
- What symbols or mathematical notations are important in this problem?
- What mathematical language, vocabulary/definitions, and properties can you use to explain this problem?
- How could you test your solution to see if it answers the problem?

Are any of the triangles A, B, and C mathematically similar? Explain your reasoning.

I notice that triangles A and C have congruent angles. I am going to start by rotating triangle C.

80°
A
60° C
40° 80°
B
80°

NOT TO SCALE

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- What observations can you make about the problem?
- What parts of the problem might you eliminate or simplify?
- What patterns do you see in problem? Describe the patterns.
- What ideas or prior knowledge will be useful in solving this problem?
- What are some other problems which you have worked that are similar to this one?
- In what ways does this problem connect to other mathematical concepts?

Express each in simplest form using exponents.

a) $x^3 \cdot x^3$

b) $x^2 \cdot x^2$

c) $x \cdot x$

d) $x^{\frac{1}{2}} \cdot x^{\frac{1}{2}}$

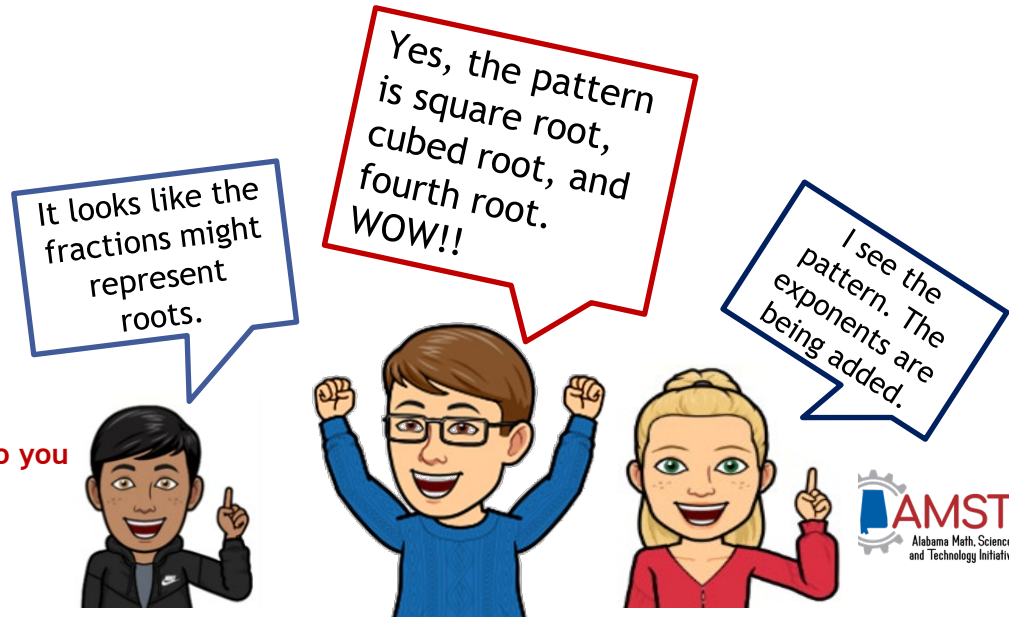e) $x^{\frac{1}{3}} \cdot x^{\frac{1}{3}} \cdot x^{\frac{1}{3}}$

f) $x^{\frac{1}{4}} \cdot x^{\frac{1}{4}} \cdot x^{\frac{1}{4}} \cdot x^{\frac{1}{4}}$

In part (d) you should have gotten an answer of x.

What quantity when multiplied by itself gives you x.

Based on your answer, what do you think $x^{\frac{1}{2}}$ means? What do you think $x^{\frac{1}{3}}$ means? Why? What do you think $x^{\frac{1}{4}}$ means? Why?

It looks like the fractions might represent roots.

Yes, the pattern is square root, cubed root, and fourth root. WOW!!

I see the pattern. The exponents are being added.

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Look For and Express Regularity in Repeated Reasoning Student Mathematical Practice 8

- Is there a pattern?
- Can you generalize the pattern to a rule or method?
- What process is being used? How does each part relate?
- How can you use the relationships and patterns to evaluate your results and build a general method?

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Your grandparents want to help you begin a savings account for college. They will give you $20 to open the account and then increase the amount by 2% each month. How much money will she have after 1 month? 2 months? 10 months? X months?

So... I think that x months is $20(1.02)^x$.

Month	Amount in Account
0	$20
1	20(1.02)
2	20(1.02)(1.02)
3	20(1.02)(1.02)(1.02)
4	20(1.02)(1.02)(1.02)(1.02)
5	20(1.02)(1.02)(1.02)(1.02)(1.02)
10	$20(1.02)^{10}$
x	$20(1.02)^x$

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