# Depth of Knowledge

8.F.4 *Use functions to model relationships between quantities. Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values*

DOK 1

Use the graph below to find the slope of the line.
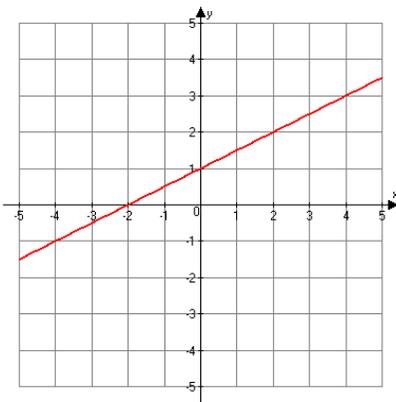
**Rationale for DOK 1:**
•Apply/Compute a well-known algorithm.
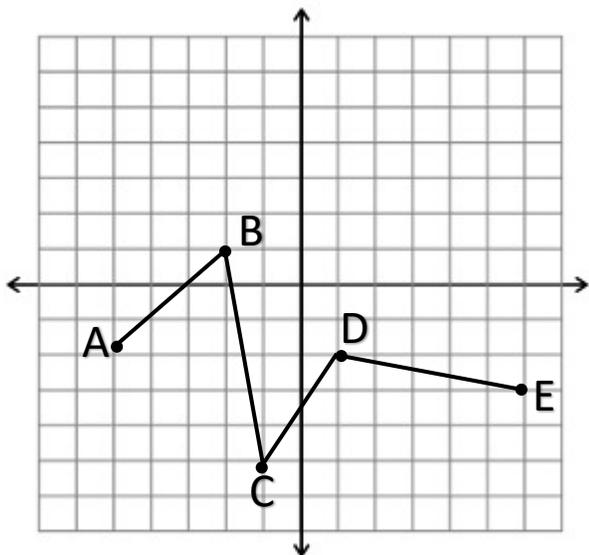
Rationale for DOK 2:
•Compare/Contrast Concepts

Which line segment has the greatest positive rate of change?

    A. $\overline{AB}$
    B. $\overline{BC}$
    C. $\overline{CD}$
    D. $\overline{DE}$
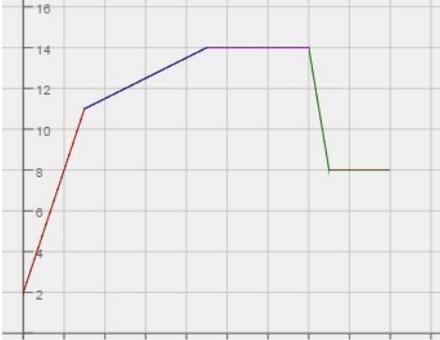
Rationale for DOK 3:
- Interpret data from complex graph
- Formulate an original problem given a situation
- Explain thinking when more than one response/solution is possible.

Note: Y-axis should not labeled or have scale.

A. Choose a scenario that could fit this graph.
   a. Relating money to time
   b. Relating distance to time
   c. Relating speed to time
   d. Temperature to time

B. Using your chosen scenario provide a label and a scale for each of the axes.

C. Using your chosen scenario, labels, and scale write a story problem describing the graph.

8.EE.7.b *Analyze and solve linear equations and pairs of simultaneous linear equations.* *Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.*

DOK 1

Solve for *x*.

$$4x - \frac{3}{4}(2x - 4) = \frac{1}{2}x + 1$$

    a. -1

    b. $5\frac{1}{5}$

    c. 2

    d. $\frac{2}{5}$

> **Rationale for DOK 1:**
> - Evaluate an expression with opportunity to substitute numbers into the equation.

DOK 2

> **Rationale for DOK 2:**
> - Solve routine problem applying multiple concepts or decision points.

Solve for *x.*

$$4x - \frac{3}{4}(2x - 4) = \frac{1}{2}x + 1$$

DOK 3

Jaylen, Anna, Will, Maria, and Max solved the following equation: $4x - \frac{3}{4}(2x - 4) = \frac{1}{2}x + 1$. Each student got a different equation after the first step. Which student(s) is correct?

    Jaylen: $16x - 3(8x - 16) = 2x + 4$

    Anna: $16x - 3(2x - 4) = 2x + 4$

    Will: $4x - \frac{6}{4}x - 3 = \frac{1}{2}x + 1$

    Maria: $-\frac{3}{4}(2x - 4) = 4\frac{1}{2}x + 1$

    Max: $4x - \frac{6}{4}x + 3 = \frac{1}{2}x + 1$

> **Rationale for DOK 3:**
> - Describe, compare, and contrast solution methods.

7.G.6 *Solve real-life and mathematical problems involving angle measure, area, surface area, and volume. Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.*

DOK 1

Find the area of the park shaped like a trapezoid.

109.6 ft

212 ft

324.4 ft
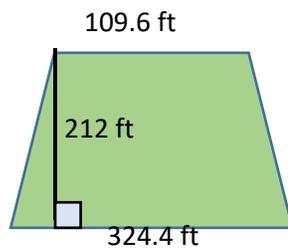
Rationale for DOK 1:
• Apply algorithm or formula

DOK 2

A park shaped like a trapezoid needs to be seeded with grass. There is a circular fountain inside the park. The fountain will not be seeded. Find the area of the park that needs to be seeded with grass.

109.6 ft

212 ft   3 ft

324.4 ft
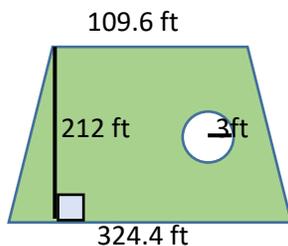
Rationale for DOK 2:
• Solve a routine problem applying multiple concepts or decisions points.

DOK 3

You are contracted to design a fountain to be placed in a trapezoidal park. The park will have 45,975.74ft^2 square feet of grass. The rest of the park is the space for the area of the fountain. Design a possible shape for your fountain. Determine the dimensions. Justify your solution.
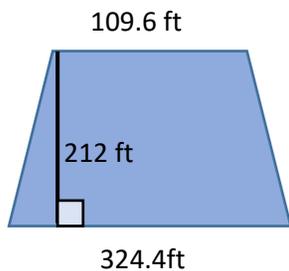
109.6 ft

212 ft

324.4ft

> **Rationale for DOK 3:**
> •Use concepts to solve non-routine problems
> •Explain thinking when more than one response/solution is possible

6.G.2 Solve real-world and mathematical problems involving area, surface area, and volume.

Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas V = l w h and V = b h to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.

DOK 1

Find the volume of the box.

7.25ft

5ft

12.75ft
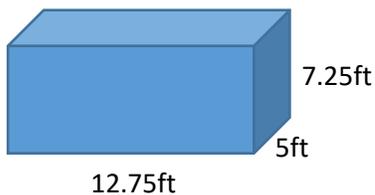
Rationale for DOK 1:
• Apply algorithm or formula

DOK 2

How many times larger is the volume of a box that measures 2.5ft by 2.5 ft by 4ft compared to a box that is 7ft by 12.5ft by 14ft?

Rationale for DOK 2:
• Compare/Contrast figures
• Solve a routine problem applying multiple concepts or decision points

DOK 3

A truck needs to haul boxes in the shape of a rectangular prism where the edges of the box measure 2.5ft by 2.5ft by 4ft, and the cargo-hold of the truck measures 5ft by 7.25ft by 12.75ft. What is the greatest number of boxes that the truck can carry? Show your work or provide an explanation.

Rationale for DOK 3:

• Use concepts to solve non-routine problem

• Use and show reasoning, planning, evidence

2.5ft
2.5ft
4ft

7.25ft
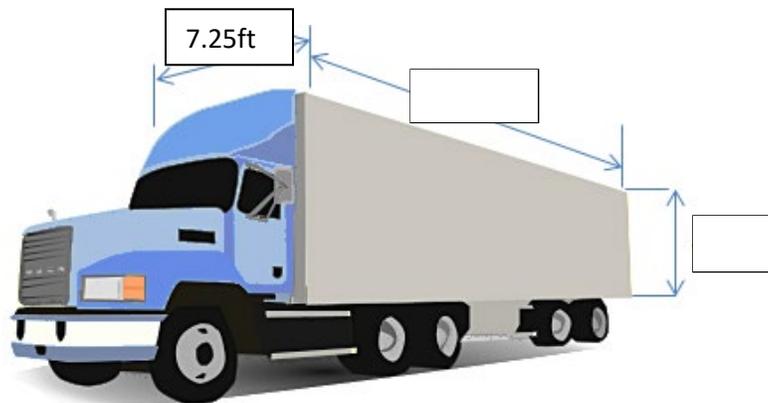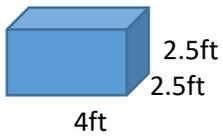
6.NS.3 Compute fluently with multi-digit numbers and find common factors and multiples.

Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.

DOK 1

Solve. $38.01 \div 4.2$

DOK 2

Which of the following expression(s) will have the same quotient as $38.01 \div 4.2$?

A. $3.801 \div 0.42$
B. $9.05 \div 4.2$
C. $3801 \div 42$
D. $3801 \div 420$
E. $380.1 \div 42$
F. $3.801 \div 42$
G. $90.5 \div 42$

DOK 3

Mrs. Hernandez wrote the following problem on the board for students to solve: $38.01 \div 4.2$. Three students chose different ways to solve the problem. Michelle didn't like decimals, so she rewrote the problem as $3801 \div 42$. Sean doesn't like decimals either, so he rewrote it as $3801 \div 420$. Laura doesn't mind a few decimals, so she rewrote it as $380.1 \div 42$.

a. Is each student's thinking mathematically correct? Justify your answer.

5.NF.4.a *Apply and extend previous understandings of multiplication and division to multiply and divide fractions. Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction. a. Interpret the product (a/b) × q as a parts of a partition of q into b equal parts; equivalently, as the result of a sequence of operations a × q ÷ b. For example, use a visual fraction model to show (2/3) × 4 = 8/3, and create a story context for this equation. Do the same with (2/3) × (4/5) = 8/15. (In general, (a/b) × (c/d) = ac/bd.)*

DOK 1

What is $\frac{3}{4}$ of $\frac{2}{3}$ of the cake?
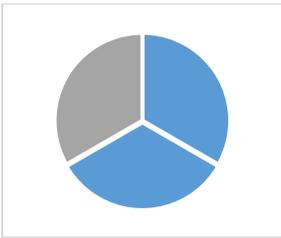
Rationale for DOK 1:
• Evaluate an expression
• Apply algorithm or formula

DOK 2

Which situation(s) describe $\frac{3}{4} \times \frac{2}{3}$?

   a.   Molly ate $\frac{3}{4}$ of $\frac{2}{3}$ of a cake.

   b.   Jasmine had $\frac{3}{4}$ of a cup of flour and needed $\frac{2}{3}$ more to finish the recipe.

   c.   A container of juice held 2/3 of a liter. If Abby drank ¾ of the juice in the container, how many liters did she drink?

   d.   Julian had $\frac{3}{4}$ yds of material. If a shirt took $\frac{2}{3}$ yd of fabric. How many shirts can he make?

Rationale for DOK 2:
• Solve a routine problem applying multiple concepts or decision points
• Translate between tables, graphs, words, and symbolic notation

DOK 3

Three friends worked together to mow a lawn. Jack mowed $\frac{1}{3}$ of the lawn before lunch. After lunch Mike mowed $\frac{1}{4}$ of what was left. The next day Deja mowed the rest. Represent the problem in a visual fraction model. What fractional part of the lawn did Deja mow? How do you know you are correct?

Rationale for DOK 3:
• Use concepts to solve non-routine problems.
• Verify reasonableness of results
• Use and show reasoning, planning, and evidence.

4.MD.3 Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit. *Apply the area and perimeter formulas for rectangles in real world and mathematical problems. For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor.*

DOK 1

What is the area of the rectangular floor?

$21 ft$

$10\frac{1}{2} ft$
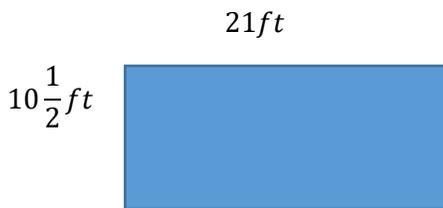
Rationale for DOK 1:
- Apply algorithm or formula

DOK 2

The Jones family has $880 budgeted to purchase tile for their rectangular floor. If the tile they prefer costs $4.00 per square foot, do they have enough budgeted? Explain your reasoning.

$21 ft$

$10\frac{1}{2} ft$
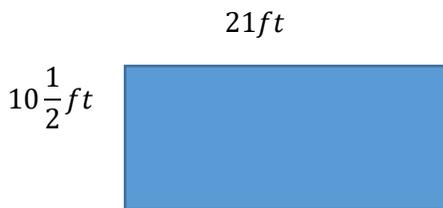
Rationale for DOK 2:
- Solve routine problem applying multiple concepts and decision points
- Make basic inferences or logical predictions form data
- Make and explain estimates
- Retrieve information from a table, graph, or figure and use it to solve a problem requiring multiple steps

DOK 3

Fencing is bought in $3\frac{1}{2} ft$ panels. If 18 panels are used to fence a garden, what is a possible area of the garden?

Rationale for DOK 3:
- Use concepts to solve non-routine problems
- Explain thinking when more than on response/solution is possible
- Use and show reasoning, planning, and evidence

3.0A.5 *Understand properties of multiplication and the relationship between multiplication and division.* *Apply properties of operations as strategies to multiply and divide.2 Examples: If 6 × 4 = 24 is known, then 4 × 6 = 24 is also known. (Commutative property of multiplication.) 3 × 5 × 2 can be found by 3 × 5 = 15, then 15 × 2 = 30, or by 5 × 2 = 10, then 3 × 10 = 30. (Associative property of multiplication.) Knowing that 8 × 5 = 40 and 8 × 2 = 16, one can find 8 × 7 as 8 × (5 + 2) = (8 × 5) + (8 × 2) = 40 + 16 = 56. (Distributive property.)*

Commutative Property:

DOK 1

Fill in the blank.

$4 \times 3 = 3 \times \boxed{}$

Rationale for DOK 1:
- Solve a one-step problem.
- Recall, observe & recognize facts, principles, properties

Select the three pictures that represent 2 x 6.

A.
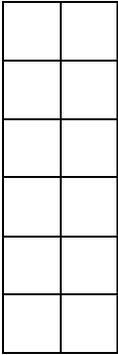
B.
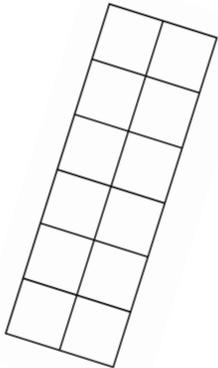
C.
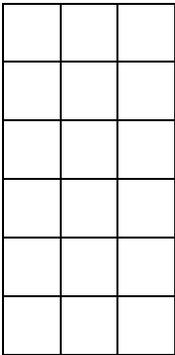
D.
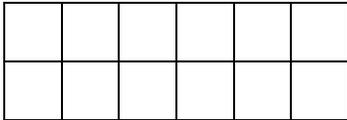
E.
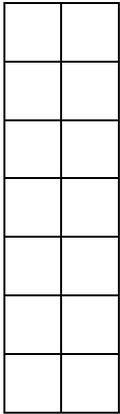
Monica notices that Diagram A and Diagram B have the same area. She wonders if that works for all rectangles, so she draws a 4×5 rectangle and a 5×4 rectangle. She then tries several other rectangles such as a 2 x 3 rectangle and a 3 x 2 rectangle. Write a rule that would work for all rectangles.

Rationale for DOK 3:
- Make and/or justify a conjecture
- Write a rule

3

6

6

3
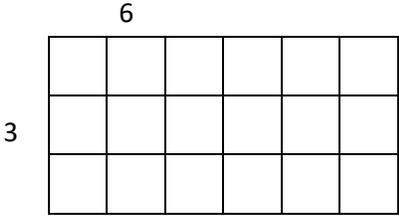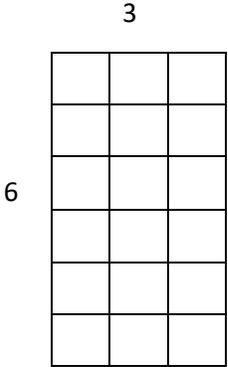
Distributive Property:

Finish the picture and fill in the blank.

$7 \times 8 \quad = \quad 7 \times 5 \quad + \quad 7 \times \boxed{}$
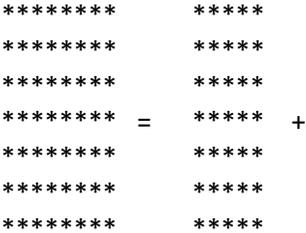
```
*******       *****
*******       *****
*******       *****
******* =     *****   +
*******       *****
*******       *****
*******       *****
```

Rationale for DOK 1:
- Solve a one-step problem.
- Recall, observe & recognize facts, principles, properties

DOK 2

$7 \times 8 \quad = \ 7 \times \boxed{} \quad + \ 7 \times \boxed{}$

Enter a number in each box that make the equation true.

Rationale for DOK 2:
•Solve a routine problem applying multiple concepts or decision points

DOK 3

Mrs. Wood had her students solve the problem 7×8, and each student got the same answer, but did it differently.
- Monica turned the 8 to a 10, multiplied by 10 x 7 and then subtracted 14.
- Tyler multiplied 7 x 2 to get 14 and then added 14 four times.
- John multiplied 5 x 8 and then added it to 2 x 8.

Rationale for DOK 3:
•Describe, compare, and contrast solution methods
•Make and justify conjectures
•Explain thinking when more than one response/solution is possible

a. Identify the answer.
b. Explain how each student was able to get the same answer even though they solved it differently.

2.NBT.4 *Understand place value. Compare two three-digit numbers based on meanings of the hundreds, tens, and ones digits, using >, =, and < symbols to record the results of comparisons.*

DOK 1

Fill in the blanks by writing the numbers represented by models. Then circle the symbol >, <, or = to correctly compare the numbers.

Rationale for DOK 1:
- Solve a one-step problem.
- Recall, observe & recognize facts, principles, properties
- Represent math relationships in words, picture, or symbols

_____ > _____

<

=
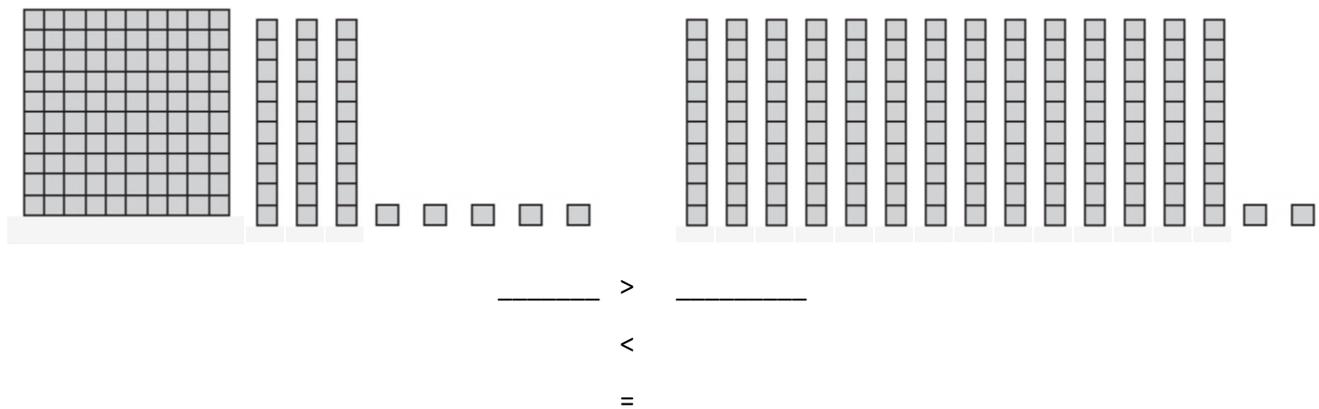
DOK 2

Use base-ten blocks to compare 135 and 142. Use they symbols <, >, or = to write a comparison statement.

Rationale for DOK 2:
- Use models
- Construct models given criteria
- Solve routine problems applying multiple concepts or decision points
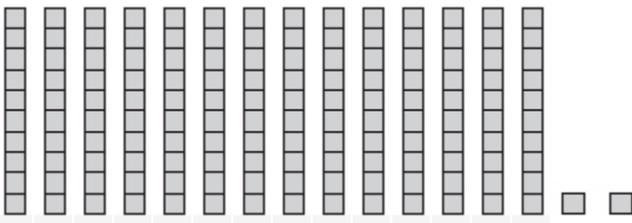
Rationale for DOK 3:

•Analyze and draw conclusions form data, citing evidence

a. Write the number that is shown in the model.
b. Replace the number in the tens place with a 0, and model the new number with base-ten blocks.
c. Write a comparison statement using <, >, or = to compare the original number with the new number.

_____<_____
          >
          =

d. Based on what you learned in part **a.,** how does 237 compare to 207?

1.G.1 *Reason with shapes and their attributes.* *Distinguish between defining attributes (e.g., triangles are closed and three sided) versus non-defining attributes (e.g., color, orientation, overall size); build and draw shapes to possess defining attributes.*

DOK 1

Identify which are triangles.

A.

B.
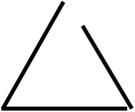
C.

D.

E.

F.

G.
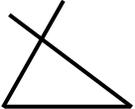
Rationale for DOK 1:
•Identify figures
•Recall, observe & recognize facts, principles, and properties

DOK 2

Label each example triangle or not a triangle, and explain why.

A.

B.
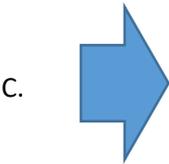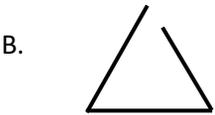
> **Rationale for DOK 2:**
> •Specify and explain relationship (e.g., non-example/examples, cause-effect)
> •Compare/Contrast figures or data

C.

D.

DOK 3

Jaylen and Maria both drew shapes. Both said they were triangles. Who is correct? Explain your answer.

Jaylen
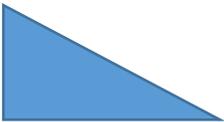
Maria

> **Rationale for DOK 3:**
> •Describe, compare, and contrast solution methods

K.NBT.1 Work with numbers 11-19 to gain a foundation for place value. Compose and decompose numbers from 11-19 into a group of ten ones and some further ones by using objects, and when appropriate, drawings or equations; understand that these two numbers are composed of a group of ten ones and one, two, three, four, five six, seven, eight, or nine ones.

DOK 1

Show me the number 14 with counters.

Rationale for DOK 1:
•Represent math relationships in words, pictures, or symbols.
•Recall, observe, & recognize facts among facts, principles, and properties.
•Solve a one-step problem.

DOK 2

How many more counters do I need to have 14?

Rationale for DOK 2:
•Solve a routine problem applying multiple concepts.
•Construct models given criteria.

You have 2 ten-frames that have counters on them. One is full and one is not.

- What is the largest number you could make? How do you know?
- What is the smallest number you could make? How do you know?

N-RN.2 *Extend the properties of exponents to rational exponents.* *Rewrite expressions involving radicals and rational exponents using the properties of exponents.*

DOK 1

Find *x*.

$$\sqrt[6]{3^{30}} = 3^x$$

Rationale for DOK 1:
- Solve a one-step problem
- Follow simple procedures
- Represent math relationships in words, pictures, or symbols

DOK 2

Find *x*.

$$\sqrt[3]{27^2} \cdot 9^{\frac{3}{2}} = 3^x$$

Rationale for DOK 2:
- Solve a routine problem applying multiple concepts or decision points

DOK 3

Three students, Luis, Mateo, and Camila, solved the equation:
$\sqrt[3]{27^2} \cdot 9^{\frac{3}{2}} = 3^x$ using three different methods. Which student's method is correct? Select the step where the other two students made mistake. Justify your selection using mathematics.

Rationale for DOK 3:
• Describe, compare, and contrast solution methods
• Analyze similarities/differences between research procedures or solutions
• Justify thinking

Luis

a. $\sqrt[3]{27^2} \cdot 9^{\frac{3}{2}} = 3^x$

b. $\sqrt[3]{27^2} \cdot \sqrt{9^3} = 3^x$

c. $\sqrt[5]{27^2 \cdot 9^3} = 3^x$

d. $\sqrt[5]{(27 \cdot 9)^5} = 3^x$

e. $\sqrt[5]{(3^3 \cdot 3^2)^5} = 3^x$

f. $\sqrt[5]{(3^5)^5} = 3^x$

g. $3^5 = 3^x$

h. $x = 5$

Camila

a. $\sqrt[3]{27^2} \cdot 9^{\frac{3}{2}} = 3^x$

b. $\sqrt[3]{27^2} \cdot \sqrt{9^3} = 3^x$

c. $27^{\frac{2}{3}} \cdot 9^{\frac{3}{2}} = 3^x$

d. $(27 \cdot 9)^{\frac{2}{3}+\frac{3}{2}} = 3^x$

e. $(3^3 \cdot 3^2)^{\frac{13}{6}} = 3^x$

f. $(3^6)^{\frac{13}{6}} = 3^x$

g. $3^{13} = 3^x$

h. $x = 13$

Mateo

a. $\sqrt[3]{27^2} \cdot 9^{\frac{3}{2}} = 3^x$

b. $\sqrt[3]{27^2} \cdot \sqrt{9^3} = 3^x$

c. $\sqrt[6]{27^4 \cdot 9^9} = 3^x$

d. $\sqrt[6]{(3^3)^4 \cdot (3^2)^9} = 3^x$

e. $\sqrt[6]{3^{12} \cdot 3^{18}} = 3^x$

f. $\sqrt[6]{3^{30}} = 3^x$

g. $3^{\frac{30}{6}} = 3^x$

h. $x = 5$

F-IF.4 *Interpret functions that arise in applications in terms of the context. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.**

DOK 1

Identify the zeros of $f(t) = -16t^2 + 24t + 16$

DOK 2

The function $f(t) = -16t^2 + 24t + 16$ represents the height of a ball above ground being thrown from a ladder, where t represents time in seconds and *f(t)* represents height in meters.

- What is the initial distance of the ball above the ground?
- What is the maximum distance above the ground?
- How long was the ball in the air?
- What is the distance of the ball from the ground after 1 second?

Rationale for DOK 1:
- Identify whether specific information is contained in graphic representations
- Retrieve information from a table or graph to answer a question

Rationale for DOK 2:
- Solve a routine problem applying multiple concepts or decision points
- Retrieve information from a table, graph, or figure and use it to solve a problem requiring multiple steps
- Select a procedure according to criteria and perform it
- Construct models given criteria
- Select appropriate graph and data display

The function $f(t) = -16t^2 + 24t + 16$ represents a height, in meters, of a red ball above the ground after t seconds being thrown from a ladder. The function $g(t) = -16t^2 + 32t + 16$ represents a height, in meters, of a green ball above the ground after t seconds being thrown from the same ladder in the same direction.

a. What is the distance between the two balls once they land?

b. If both balls are thrown from the same height, use mathematics to explain why they land in different places?

Rationale for DOK 3:
- Use concepts to explain non-routine problems
- Explain phenomena in terms of concepts
- Interpret data from complex graph
- Make and justify conjectures
- Explain, generalize, or connect ideas using supportive evidence
- Explain thinking when more than one response/solution is possible

A-CED-2 *Create equations that describe numbers or relationships.* *Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.*

DOK 1

Terrance uses the investment plan that doubles the amount money in his account each day. If Terrance's initial investment was $5, write an equation representing this situation, where *f(t)* is the amount of money Terrance has and *t* is the time in days. Fill in the blanks.

$$f(t) = 5\left(\boxed{}^{\boxed{}}\right)$$

Rationale for DOK 1:
•Solve a one-step problem
•Represent math relationships in words, pictures, or symbols

DOK 2

Terrance uses the investment plan that doubles the amount money in his account each day. If Terrance's initial investment was $5, write an equation representing this situation. Use the graph to illustrate it. Make sure to define your variables.
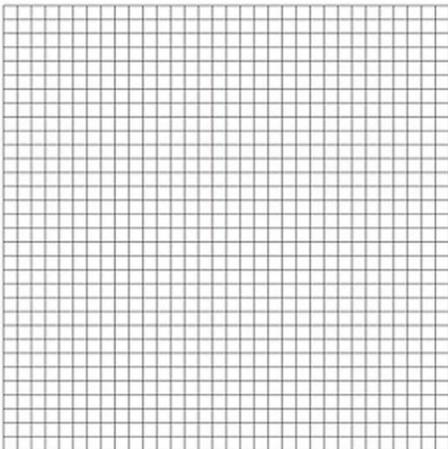
Rationale for DOK 2:
•Translate between tables, graphs, words, and symbolic notations
•Select appropriate graph and organize & display data

DOK 3

Terrance had two investment options. The first option would require Terrance to invest $5 and the amount of money would double every day. The second option would require him to invest $500 but it will double his money every other day. What factors should Terrance consider before he makes a decision?

a. Write an equation to model each situation.
b. Explain which opportunity would be the most profitable?

Rationale for DOK 3:
•Use concepts to solve non-routine problems
•Make and justify conjectures
•Explain thinking when more than one response/solution is possible
•Compare information within data sets or texts or across related data sets

G-SRT.6 *Define trigonometric ratios and solve problems involving right triangles.*

Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles

DOK 1

Given a right triangle ABC. What is the tangent of angle A?

A°

3

5

4
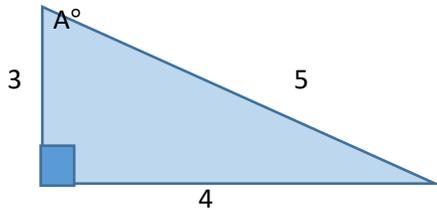
Rationale for DOK 1:
- Follow simple procedures
- Represent math relationships in words, pictures, or symbols
- Apply and algorithm or formula

DOK 2

Given a right triangle ABC. What is the length of *d*?
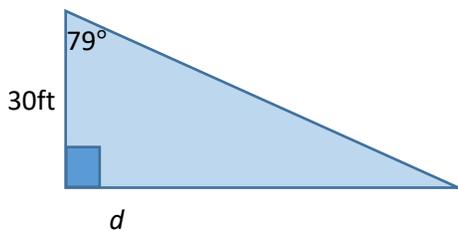
79°

30ft

d

Rationale for DOK 2:
- Solve routine problem applying multiple concepts or decision points
- Retrieve information from a table, graph, or figure and use it to solve problems requiring multiple steps

DOK 2

From his balcony Reginald's line of sight is 30ft above High Street where he sees two of his friends. Jose is in front of the coffee shop directly east of him. Reginald's line of sight to Jose makes an 11° angle of depression. Directly west of him, Kiara is in front of the bookstore. Reginald's line of sight to Kiara makes a 15° angle of depression. How far away from each other are the two friends?

Rationale for DOK 2:
- Solve routine problem applying multiple concepts or decision points
- Construct models given criteria

DOK 3

Explain why the cosine of A is the same regardless of which triangle is used to find it in the figure.
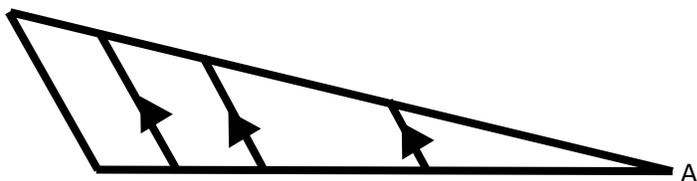
From http://www.schools.utah.gov/CURR/mathsec/Core/Secondary-II/II5GSRT6.aspx

Represent data with plots on the real number line (dot plots, histograms, and box plots).

DOK 1

Rationale for DOK 1:
• Represent math relationships in words, pictures, or symbols
• Recall formula

What percent of the data shown in the box-and-whisker plot is located between 30 and 70?

A. 30

B. 70

C. 50

D. 25
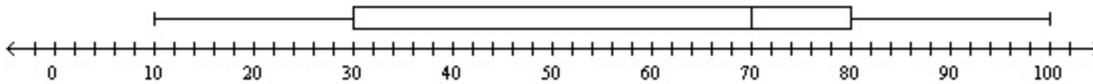
The male and female teacher at Mountainview School recorded the number of years they have been teaching at the school. The box-and whiskers plots summarize the data.

Female Teachers
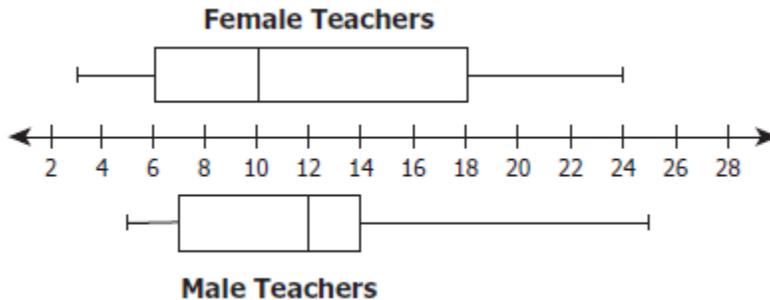
Male Teachers

Identify which statements are false. Select all that apply.

A. The range in the years teaching is greater for male teachers than for female teachers.
B. The difference in the maximum number of years teaching for male and female teachers is 1.
C. The median number of years teaching for female teachers is 2 less than the median for male teachers.
D. More than half of all the teachers have taught at the school for more than 10 years.
E. 25% of the teachers have taught 7 years or less.

Rationale for DOK 2:
- Specify and explain relationships
- Summarize results or concepts
- Make basic inferences or logical predictions from data/observation
- Compare/Contrast figures or data

http://www.doe.virginia.gov/testing/sol/released_tests/2009/test09_eoc_algebra1_reduced.pdf

Katie recorded the number of miles she drove for each of the 9 days. She drove a different number of miles each day. This box-and-whisker plot summarized her information.

Miles Driven
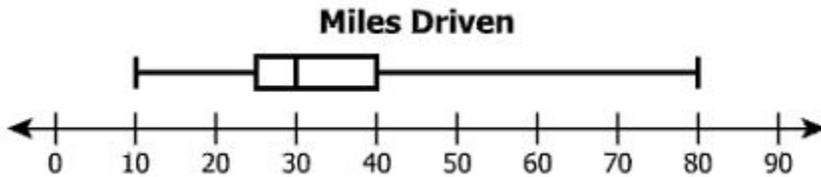
Katie drove 30 miles on each of the two additional days. She redrew the box-and-whisker plot to include this data. Which statement must be true?

A. The value of the range decreased.
B. The value of the mean remained the same.
C. The value of the median remained the same.
D. The value of the interquartile range increased.

Rationale for DOK 3:
• Use concepts to solve non-routine problems.
•Analyze and draw conclusions from data, citing evidence.

From: http://www.doe.virginia.gov/testing/sol/released_tests/2013/algebra_1_released_in_spring_2014.pdf

OR

The number of quiz grades in 2 different Algebra classes is shown below.
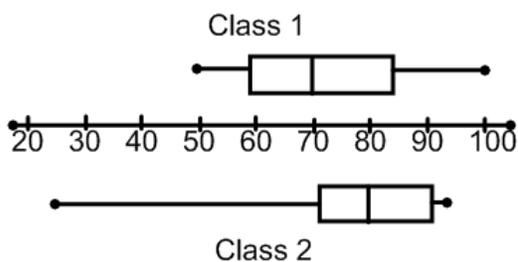
- Class 1 had 11 quizzes.
- Class 2 had 10 quizzes.

What is the total number of quizzes that earned a 70% or higher?

If class 1 had 10 quizzes and class 2 had 11 quizzes, could you find the answer?   Explain.