

Grade 7  
Mathematics MCA-III  
Item Sampler Teacher Guide

# Grade 7 Mathematics MCA Item Sampler Parent/Teacher Guide



The purpose of the Item Samplers is to familiarize students with the online MCA test format. The Item Samplers contain multiple choice items (MC) and technology enhanced items (TE).

This guide includes:

- A snapshot of each item
- Benchmark and examples from the Minnesota Academic Standards for Mathematics
- Item specifications (Content limits contained in the item specifications are intended for use by item developers. They should not be construed as instructional limits.)
- Vocabulary
- Depth of Knowledge (DOK) - see more detail below
- Calculator designation (CL = calculator allowed; NC = no calculator)
- Correct answer
- Table of rationales (explanations for why a student might choose each incorrect answer option, e.g., mixed up addition and subtraction, used incorrect place value, etc.)
- Notes on grade expectations for some items

## Cognitive Complexity/Depth of Knowledge (DOK)

Cognitive complexity refers to the cognitive demand associated with an item. The level of cognitive demand focuses on the type and level of thinking and reasoning required of the student on a particular item. Levels of cognitive complexity for MCA-III are based on Norman L. Webb's Depth of Knowledge<sup>1</sup> levels.

**Level 1 (recall) items** require the recall of information such as a fact, definition, term or simple procedure, as well as performing a simple algorithm or applying a formula. A well-defined and straight algorithmic procedure is considered to be at this level. A Level 1 item specifies the operation or method of solution and the student is required to carry it out.

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<sup>1</sup> Webb, N. L. *Alignment of science and mathematics standards and assessments in four states* (Research Monograph No. 18). Madison: University of Wisconsin – Madison, National Institute for Science Education, 1999.

**Level 2 (skill/concept) items** call for the engagement of some mental processing beyond a habitual response, with students required to make some decisions as to how to approach a problem or activity. Interpreting information from a simple graph and requiring reading information from the graph is a Level 2. An item that requires students to choose the operation or method of solution and then solve the problem is a Level 2. Level 2 items are often similar to examples used in textbooks.

**Level 3 (strategic thinking) items** require students to reason, plan or use evidence to solve the problem. In most instances, requiring students to explain their thinking is a Level 3. A Level 3 item may be solved using routine skills but the student is not cued or prompted as to which skills to use.

**Level 4 (extended thinking) items** require complex reasoning, planning, developing and thinking, most likely over an extended period of time. Level 4 items are best assessed in the classroom, where the constraints of standardized testing are not a factor.

### **Technology Enhanced Items**

There are several types of technology enhanced items. To respond to these questions, students may be required to type a number into a blank, select their answer choice(s), or select and drag. When typing an answer into a blank, the test engine allows students to type in numbers, the division bar (/), decimal points, and negative signs (in certain grades only). The test engine does not allow students to type in other characters, symbols, or letters of the alphabet.

Grade 7 Mathematics MCA Item Sampler  
Answer Key

Item #	Correct Answer	Item Type	Benchmark	Calculator
1	D	MC	7.1.1.3	CL
2	C	MC	7.1.1.4	CL
3	B	MC	7.1.2.5	CL
4	C	MC	7.2.2.4	CL
5	N/A	TE	7.2.3.2	CL
6	A	MC	7.2.4.1	CL
7	B	MC	7.3.1.1	CL
8	B	MC	7.3.2.3	CL
9	N/A	TE	7.4.1.2	CL
10	B	MC	7.4.3.3	CL
11	N/A	TE	7.1.1.1	NC
12	N/A	TE	7.1.2.1	NC
13	B	MC	7.1.2.2	NC
14	D	MC	7.1.2.6	NC
15	D	MC	7.2.1.1	NC
16	A	MC	7.2.1.2	NC
17	N/A	TE	7.2.2.1	NC
18	B	MC	7.3.2.1	NC
19	D	MC	7.4.2.1	NC
20	C	MC	7.1.1.2	CL
21	A	MC	7.1.1.5	CL
22	A	MC	7.1.2.4	CL
23	A	MC	7.2.2.2	CL
24	C	MC	7.2.3.1	CL
25	A	MC	7.2.4.2	CL
26	B	MC	7.3.1.2	CL
27	D	MC	7.3.2.4	CL
28	D	MC	7.4.1.1	CL
29	D	MC	7.4.3.2	CL
30	N/A	TE	7.4.3.2	CL
31	N/A	TE	7.2.3.1	CL
32	N/A	TE	7.2.1.2	CL
33	N/A	TE	7.3.2.4	CL

### Question Number 1

Four points are graphed on a line.



Which point is located at the opposite of  $-2$ ?

- A. Point *J*
- B. Point *K*
- C. Point *L*
- D. Point *M*

### Benchmark: 7.1.1.3

Locate positive and negative rational numbers on a number line, understand the concept of opposites, and plot pairs of positive and negative rational numbers on a coordinate grid.

#### Item Specifications

- Vocabulary allowed in items: opposite, coordinate, origin, and vocabulary given at previous grades

DOK: 1

Calculator: CL

Answer: D

A	Moved 2 spaces to the left of $-2$ .
B	Used $-2$ from the question.
C	Moved 2 spaces to the right of $-2$ .
D	Correct. The opposite of $-2$ is 2.

## Question Number 2

Which statement is true?

- A.  $0.75 < 0.75^2$
- B.  $-\frac{3}{8} < -0.38$
- C.  $\frac{46}{25} > 1\frac{5}{6}$
- D.  $-2\frac{3}{5} > 1.5$

### Benchmark: 7.1.1.4

Compare positive and negative rational numbers expressed in various forms using the symbols  $<$ ,  $>$ ,  $=$ ,  $\leq$ ,  $\geq$ .

For example:  $-\frac{1}{2} < -0.36$ .

### Item Specifications

- Vocabulary allowed in items: vocabulary given at previous grades

DOK: 1

Calculator: CL

Answer: C

A	0.75 is not less than 0.5625.
B	-0.375 is not less than -0.38.
C	Correct. 1.84 is greater than 1.833333...
D	-2.6 is not greater than 1.5.

### Question Number 3

Jeremy can plant 10 trees in 4 hours. How many trees can he plant in 10 hours?

- A. 16
- B. 25
- C. 40
- D. 100

#### Benchmark: 7.1.2.5

Use proportional reasoning to solve problems involving ratios in various contexts.

*For example:* A recipe calls for milk, flour and sugar in a ratio of 4:6:3 (this is how recipes are often given in large institutions, such as hospitals). How much flour and milk would be needed with 1 cup of sugar?

#### Item Specifications

- Vocabulary allowed in items: proportion and vocabulary given at previous grades

DOK: 2

Calculator: CL

Answer: B

A	Used 4 trees per hour and 4 hours; $4 \times 4 = 16$ .
B	Correct. $(10/4)10 = 25$
C	Used rate of 4 trees per hour instead of $10/4$ trees per hour; $4 \times 10 = 40$ .
D	Used rate of 10 trees per hour instead of $10/4$ trees per hour; $10 \times 10 = 100$ .

#### Question Number 4

On Mondays, Jayda runs between 2 and 5 miles. On Tuesdays, she runs 3 times as far as she runs on the previous Monday. Which inequality can be used to find  $x$ , the distance Jayda could run on a Tuesday?

- A.  $2 < 3x < 5$
- B.  $2 < 3x > 5$
- C.  $2 < \frac{x}{3} < 5$
- D.  $2 < \frac{x}{3} > 5$

#### Benchmark: 7.2.2.4

Represent real-world or mathematical situations using equations and inequalities involving variables and positive and negative rational numbers.

*For example:* "Four-fifths is three greater than the opposite of a number" can be represented as  $\frac{4}{5} = -n + 3$ , and "height no bigger than half the radius" can be represented as  $h \leq \frac{r}{2}$ .

*Another example:* "x is at least -3 and less than 5" can be represented as  $-3 \leq x < 5$ , and also on a number line.

#### Item Specifications

- Vocabulary allowed in items: vocabulary given at previous grades

DOK: 2

Calculator: CL

Answer: C

A	Showed Jayda running $\frac{1}{3}$ of the mileage instead of 3 times.
B	Mixed up second inequality sign and showed $\frac{1}{3}$ the mileage instead of 3 times.
C	Correct.
D	Mixed up second inequality sign.



### Question Number 5

What is the value of  $4t^2 + 6r - tr$  when  $t = -3$  and  $r = 5$ ?

Enter your answer in the box.

#### Benchmark: 7.2.3.2

Evaluate algebraic expressions containing rational numbers and whole number exponents at specified values of their variables.

For example: Evaluate the expression  $\frac{1}{3}(2x - 5)^2$  at  $x = 5$ .

#### Item Specifications

- Expressions contain no more than 3 variables
- Vocabulary allowed in items: evaluate, substitute, and vocabulary given at previous grades

DOK: 2

Calculator: CL

Answer:

This is a technology-enhanced item. The correct answer is shown. A student must type the correct answer in the box in order to receive 1 point.

What is the value of  $4t^2 + 6r - tr$  when  $t = -3$  and  $r = 5$ ?

Enter your answer in the box.

Notes on grade expectations: Student should know order of operations from previous grades.

Note: The allowable characters that can be entered in the answer box are digits 0-9, fraction bar (/), decimal point (.), and negative sign (-). Students cannot enter a comma in numbers with more than 3 digits. Familiarity with calculators will help the students with this concept.

### Question Number 6

The equation  $y = 12x + 60$  can be used to estimate  $y$ , the height of a tree in centimeters  $x$  months after it is planted. When a tree is 150 cm tall, how long ago was the tree planted?

- A. 7.5 months
- B. 10.8 months
- C. 17.5 months
- D. 78.0 months

#### Benchmark: 7.2.4.1

Represent relationships in various contexts with equations involving variables and positive and negative rational numbers. Use the properties of equality to solve for the value of a variable. Interpret the solution in the original context.

*For example:* Solve for  $w$  in the equation  $P = 2w + 2\ell$  when  $P = 3.5$  and  $\ell = 0.4$ .

*Another example:* To post an Internet website, Mary must pay \$300 for initial set up and a monthly fee of \$12. She has \$842 in savings, how long can she sustain her website?

#### Item Specifications

- Vocabulary allowed in items: vocabulary given at previous grades

DOK: 2

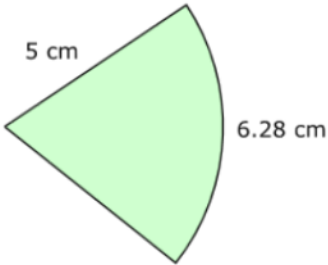
Calculator: CL

Answer: A

A	Correct. Solved $150 = 12x + 60$ .
B	$(150 - 60) = 90$ ; $90 \times 12/100 = 10.80$ .
C	$(150 + 60)/12 = 17.5$ .
D	$150 - 12 - 60 = 78$ .

### Question Number 7

A sector of a circle is shown.



What is the area of the sector? (Use 3.14 for  $\pi$ .)

- A. 12.5 cm<sup>2</sup>
- B. 15.7 cm<sup>2</sup>
- C. 31.4 cm<sup>2</sup>
- D. 78.5 cm<sup>2</sup>

#### Benchmark: 7.3.1.1

Demonstrate an understanding of the proportional relationship between the diameter and circumference of a circle and that the unit rate (constant of proportionality) is  $\pi$ . Calculate the circumference and area of circles and sectors of circles to solve problems in various contexts.

#### Item Specifications

- Allowable notation:  $\pi$  (written as a symbol, not as “pi”)
- Items may assess finding the area and arc length of a sector
- Items do not assess finding the perimeter of a sector
- Vocabulary allowed in items: radius, diameter, circumference, and vocabulary given at previous grades

DOK: 3

Calculator: CL

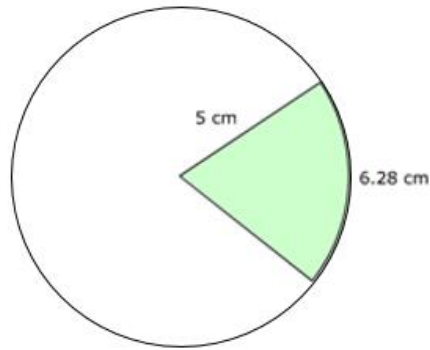
Answer: B

A	Divided area of circle by arc length; $78.5/6.28 = 12.5$ .
B	Correct. $(3.14 \cdot 5^2)(6.28)/(2 \cdot 3.14 \cdot 5) = 15.7$ .
C	Found circumference of circle; $2 \times 3.14 \times 5$ .
D	Found area of entire circle instead of just the area of the sector; $3.14(5^2)$ .

Notes on grade expectations: Student should know how to find area and circumference of a circle, and how to use proportional reasoning. A combination of skills is required to solve this item, though many different approaches exist, making this a DOK 3 item.

Student must conceptualize that a sector is a portion of a circle and use that idea to create a proportion to find the unknown. The problem is not scaffolded for the student.

Student may solve for the area of the sector using the fact that the ratio of the area of the sector to the area of the circle must equal the ratio of the arc length to the circumference.



$$\frac{\text{Area of sector}}{\pi \cdot 5^2} = \frac{6.28}{2\pi 5}$$

Or student may find the shaded fraction of the circle and multiply that by the area of the whole circle.

$$\text{Area of sector} = (\text{Arc length}/\text{circumference}) \times (\text{area of circle}); (6.28/31.4) \times (3.14 \cdot 5^2).$$

### Question Number 8

A map uses the scale  $1.5 \text{ cm} = 25 \text{ mi}$ . Two cities are 190 miles apart. How far apart are the cities on the map?

- A. 0.21 cm
- B. 11.4 cm
- C. 2,917 cm
- D. 6,563 cm

#### Benchmark: 7.3.2.3

Use proportions and ratios to solve problems involving scale drawings and conversions of measurement units.

*For example:* 1 square foot equals 144 square inches.

*Another example:* In a map where 1 inch represents 50 miles,  $\frac{1}{2}$  inch represents 25 miles.

#### Item Specifications

- Conversions are limited to no more than 2 per item
- Vocabulary allowed in items: similar, corresponding, scale drawing, conversion, and vocabulary given at previous grades

DOK: 2

Calculator: CL

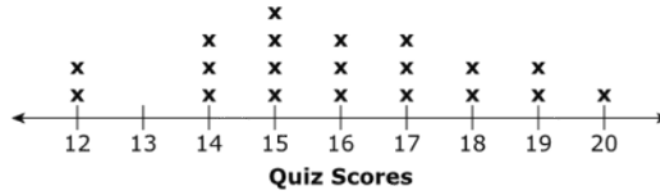
Answer: B

A	Miscalculated.
B	Correct. $1.5 \times 190/25 = 11.4$
C	Miscalculated.
D	Miscalculated.

### Question Number 9

A teacher made a line plot to show the scores of a quiz. After 2 more students took the quiz, the mean score was 16. Plot 2 possible scores on the line plot to make the mean 16.

Select a location above the line plot where you want to place each x.



### Benchmark: 7.4.1.2

Describe the impact that inserting or deleting a data point has on the mean and the median of a data set. Know how to create data displays using a spreadsheet to examine this impact.

*For example:* How does dropping the lowest test score affect a student's mean test score?

### Item Specifications

- Data sets are limited to no more than 10 data points
- Vocabulary allowed in items: outlier and vocabulary given at previous grades

DOK: 3

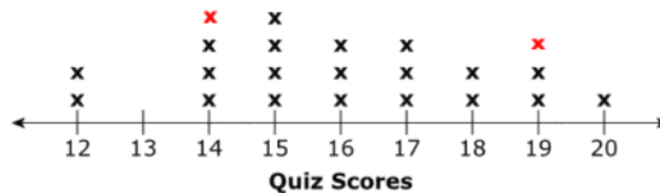
Calculator: CL

Answer:

This is a technology-enhanced item. A correct answer is shown. A student must complete the line plot correctly in order to receive 1 point.

A teacher made a line plot to show the scores of a quiz. After 2 more students took the quiz, the mean score was 16. Plot 2 possible scores on the line plot to make the mean 16.

Select a location above the line plot where you want to place each x.

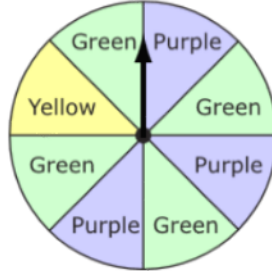


Notes on grade expectations: This item requires the ability to interpret a line plot and use the data to determine the mean. Student should be able to reverse the skills in this benchmark and find additional data points required to achieve a given mean. This item is DOK level 3 because the student must think of an approach for solving the problem, then carry out several steps. This scaffolding is not done for the student as is often done in DOK 2 items.

The sum of the 20 given data points is 319. If there are going to be 22 points with a new mean of 16, then the new sum is  $16 \times 22 = 352$ . The difference between 352 and 319 is 33, so that's the total value of the two new data points. Create any two points on the line plot that sum to 33. One example is shown.

### Question Number 10

A spinner is divided into 8 equal sections. Lara spins the spinner 120 times. It lands on purple 30 times.



How many more times does Lara need to spin the spinner and have it land on purple for the relative frequency to equal the theoretical probability?

- A. 15
- B. 24
- C. 45
- D. 54

#### Benchmark: 7.4.3.3

Use proportional reasoning to draw conclusions about and predict relative frequencies of outcomes based on probabilities.

*For example:* When rolling a number cube 600 times, one would predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.

#### Item Specifications

- Vocabulary allowed in items: vocabulary given at previous grades

DOK: 2

Calculator: CL

Answer: B

A	Added 15 to numerator, but not to denominator; $(30 + 15)/120 = 3/8$ .
B	Correct. Added 24 more spins $(30 + 24)/(120 + 24)$ which is $54/144$ or $3/8$ .
C	Found number of purple spins needed out of 120 to get $3/8$ .
D	Added 24 more spins ( $54/144 = 3/8$ ), but chose the sum of the numerators $(30 + 24)$ instead of just the 24 additional spins.

Notes on grade expectations: Student should be able to reverse the skills in this benchmark and find the number of additional successful spins required to achieve the equivalent of the theoretical probability. Theoretical probability is  $3/8$ . Solve for x:

$$\frac{(30 + x)}{(120 + x)} = \frac{3}{8}$$



### Question Number 11

Which numbers are rational?  
Select the numbers you want to choose.

2.0      $1\frac{7}{8}$       $\pi$       $\sqrt{5}$       $6.\overline{39}$

#### Benchmark: 7.1.1.1

Know that every rational number can be written as the ratio of two integers or as a terminating or repeating decimal. Recognize that  $\pi$  is not rational, but that it can be approximated by rational numbers such as  $\frac{22}{7}$  and 3.14.

#### Item Specifications

- Allowable notation: . . . . ,  $\pi$  (written as a symbol, not as “pi”)
- Vocabulary allowed in items: terminating, repeating, and vocabulary given at previous grades

DOK: 1

Calculator: NC

Answer:

This is a technology-enhanced item. The correct answer is shown. A student must select all three correct numbers in order to receive 1 point.

Which numbers are rational?  
Select the numbers you want to choose.

2.0      $1\frac{7}{8}$       $\pi$       $\sqrt{5}$       $6.\overline{39}$

Notes on grade expectations: Student should be able to determine if a number is rational or irrational using the definition.

## Question Number 12

Simplify.

$$3(2.25)^2$$

Enter your answer in the box.

### Benchmark: 7.1.2.1

Add, subtract, multiply and divide positive and negative rational numbers that are integers, fractions and terminating decimals; use efficient and generalizable procedures, including standard algorithms; raise positive rational numbers to whole-number exponents.

For example:  $3^4 \times \left(\frac{1}{2}\right)^2 = \frac{81}{4}$ .

#### Item Specifications

- Items must not have context
- Vocabulary allowed in items: vocabulary given at previous grades

DOK: 1

Calculator: NC

Answer:

This is a technology-enhanced item. The correct answer is shown. A student must type the correct answer in the box in order to receive 1 point.

Simplify.

$$3(2.25)^2$$

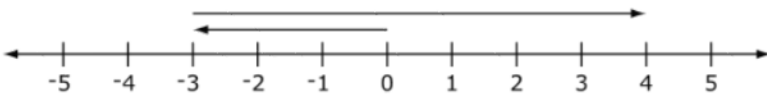
Enter your answer in the box.

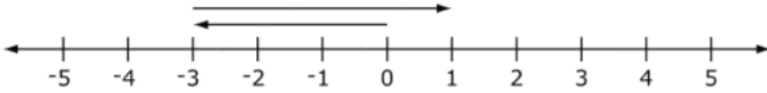
Notes on grade expectations: Student should know the order of operations from previous grades.

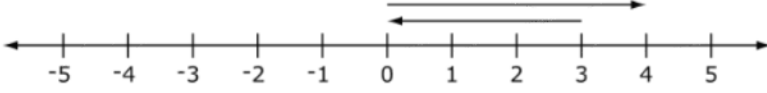
Note: The allowable characters that can be entered in the answer box are digits 0-9, fraction bar (/), decimal point (.), and negative sign (-). Students cannot enter a comma in numbers with more than 3 digits. Familiarity with calculators will help the students with this concept.

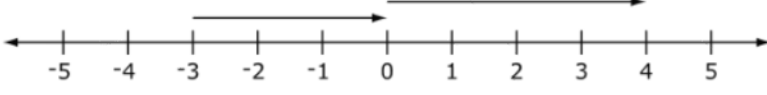
**Question Number 13**

Which shows a model of  $-3 + 4$ ?

A. 

B. 

C. 

D. 

**Benchmark: 7.1.2.2**

Use real-world contexts and the inverse relationship between addition and subtraction to explain why the procedures of arithmetic with negative rational numbers make sense. *For example:* Multiplying a distance by  $-1$  can be thought of as representing that same distance in the opposite direction. Multiplying by  $-1$  a second time reverses directions again, giving the distance in the original direction.

*Item Specifications*

- Vocabulary allowed in items: inverse and vocabulary given at previous grades

DOK: 2

Calculator: NC

Answer: B

A	Chose model showing $-3 + 7 = 4$ .
B	Correct.
C	Chose model showing $3 - 3 + 4$ .
D	Chose model showing $-3 + 3 + 4$ .

### Question Number 14

Which describes  $|k|$  on a number line?

- A. The opposite of  $k$
- B. The same value as  $k$
- C. A value between  $k$  and  $-k$
- D. A distance  $k$  units from 0

#### Benchmark: 7.1.2.6

Demonstrate an understanding of the relationship between the absolute value of a rational number and distance on a number line. Use the symbol for absolute value.

*For example:*  $|-3|$  represents the distance from -3 to 0 on a number line or 3 units; the distance between 3 and  $9/2$  on the number line is  $|3 - 9/2|$  or  $3/2$ .

#### Item Specifications

- Vocabulary allowed in items: absolute value and vocabulary given at previous grades

DOK: 1

Calculator: NC

Answer: D

A	Ignored the possibility of a negative value for $k$ ; distance cannot be negative.
B	Ignored the possibility of a negative value for $k$ ; distance cannot be negative.
C	Chose a value less than $k$ .
D	Correct.

### Question Number 15

Which represents a proportional relationship?

- A.  $np = 5$
- B.  $n = 2$
- C.  $n = \frac{4}{p}$
- D.  $\frac{n}{p} = 3$

#### Benchmark: 7.2.1.1

Understand that a relationship between two variables,  $x$  and  $y$ , is proportional if it can be expressed in the form  $y/x = k$  or  $y = kx$ . Distinguish proportional relationships from other relationships, including inversely proportional relationships ( $xy = k$  or  $y = k/x$ ).

*For example:* The radius and circumference of a circle are proportional, whereas the length  $x$  and the width  $y$  of a rectangle with area 12 are inversely proportional, since  $xy = 12$  or equivalently,  $y = 12/x$ .

#### Item Specifications

- Vocabulary allowed in items: proportional, inversely, and vocabulary given at previous grades

DOK: 1

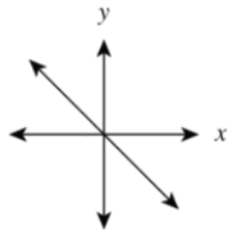
Calculator: NC

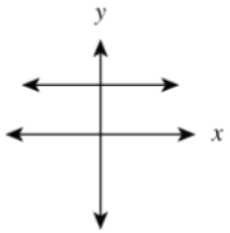
Answer: D

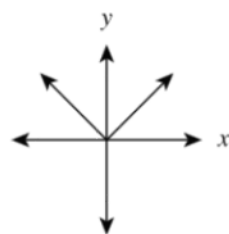
A	Chose an inversely proportional relationship.
B	Chose a horizontal line.
C	Chose an inversely proportional relationship.
D	Correct.

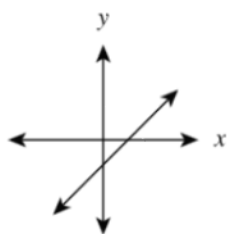
**Question Number 16**

Which represents a proportional relationship?

A. 

B. 

C. 

D. 

**Benchmark: 7.2.1.2**

Understand that the graph of a proportional relationship is a line through the origin whose slope is the unit rate (constant of proportionality). Know how to use graphing technology to examine what happens to a line when the unit rate is changed.

*Item Specifications*

- Vocabulary allowed in items: proportional, origin, slope, and vocabulary given at previous grades

DOK: 1

Calculator: NC

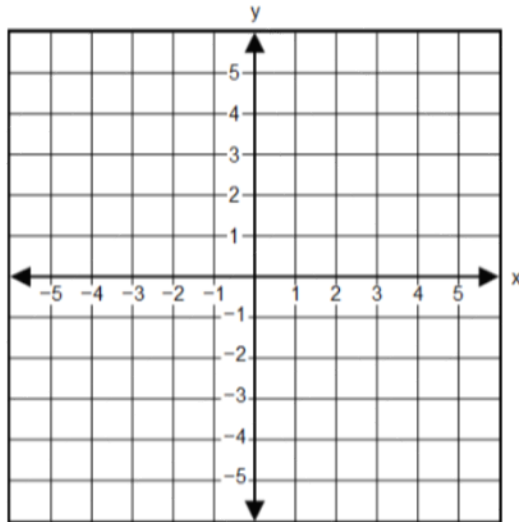
Answer: A

A	Correct. The graph of a proportional relationship is a straight line that goes through the origin; written as $y = kx$ where $k$ is the constant of proportionality.
B	Chose the straight line that does not go through the origin and has a slope of 0.
C	Chose the absolute value relationship, not the proportional relationship.
D	Chose a straight line that does not go through the origin.

**Question Number 17**

Graph the line of the equation  $y = 2x$ .

Select a location on the coordinate grid to plot each point. A line will connect the two points.



**Benchmark: 7.2.2.1**

Represent proportional relationships with tables, verbal descriptions, symbols, equations and graphs; translate from one representation to another. Determine the unit rate (constant of proportionality or slope) given any of these representations.

*For example:* Larry drives 114 miles and uses 5 gallons of gasoline. Sue drives 300 miles and uses 11.5 gallons of gasoline. Use equations and graphs to compare fuel efficiency and to determine the costs of various trips.

*Item Specifications*

- Vocabulary allowed in items: proportional, origin, slope, and vocabulary given at previous grades

DOK: 2

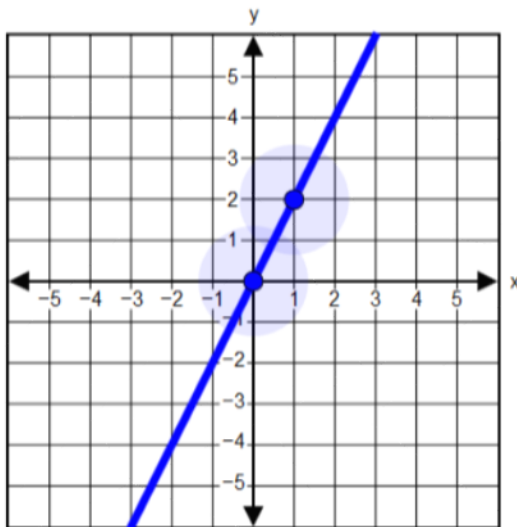
Calculator: NC

Answer:

This is a technology-enhanced item. The correct answer is shown. A student must select the correct points on the grid in order to receive 1 point. Any 2 points on the line  $y = 2x$  will score as correct.

Graph the line of the equation  $y = 2x$ .

Select a location on the coordinate grid to plot each point. A line will connect the two points.





**Question Number 18**

$\triangle EFG$  is similar to  $\triangle JKL$  and  $\triangle JKL$  is similar to  $\triangle QRS$ . Which statement must be true?

- A.  $\triangle EFG$  is congruent to  $\triangle QRS$ .
- B.  $\triangle EFG$  is similar to  $\triangle QRS$ .
- C.  $\triangle EFG$  is a reflection of  $\triangle QRS$ .
- D. There is no relationship between  $\triangle EFG$  and  $\triangle QRS$ .

**Benchmark: 7.3.2.1**

Describe the properties of similarity, compare geometric figures for similarity, and determine scale factors.

*For example:* Corresponding angles in similar geometric figures have the same measure.

*Item Specifications*

- Allowable notation:  $\sim$  (similar),  $\cong$  (congruent),  $\overline{FG}$  (segment FG),  $FG$  (length of segment FG)
- Vocabulary allowed in items: similar, corresponding, scale factor, and vocabulary given at previous grades

DOK: 2

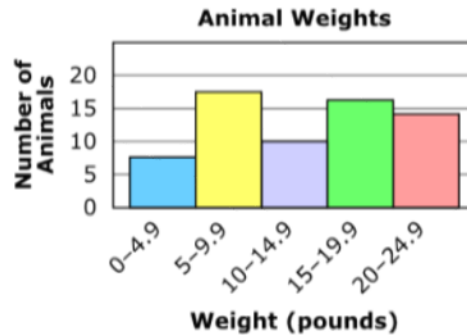
Calculator: NC

Answer: B

A	Mixed up the word “similar” with “congruent”.
B	Correct. Used the Transitive Property of Similarity.
C	Reflected figures are congruent; mixed up the word “similar” with “congruent”.
D	Did not realize that since both triangles are similar to $\triangle JKL$ , they must be similar to each other.

### Question Number 19

A veterinarian recorded the weights of animals in a histogram.



Which question can be answered using the information from the histogram?

- A. How many animals weigh 4.9 pounds?
- B. How many animals weigh between 5 and 10 pounds?
- C. How many animals weigh less than 8 pounds?
- D. How many animals weigh at least 15 pounds?

#### Benchmark: 7.4.2.1

Use reasoning with proportions to display and interpret data in circle graphs (pie charts) and histograms. Choose the appropriate data display and know how to create the display using a spreadsheet or other graphing technology.

#### Item Specifications

- Circle graphs have no more than 6 sectors
- Histograms have no more than 5 intervals
- Vocabulary allowed in items: circle graph, histogram, frequency table, and vocabulary given at previous grades

DOK: 2

Calculator: NC

Answer: D

A	Shows how many animals weigh between 0 and 4.9 pounds, not how many weigh exactly 4.9 pounds.
B	Shows how many animals weigh between 5 and 9.9 pounds, not how many weigh between 5 and 10 pounds.
C	Shows how many animals weigh less than 4.9 pounds or 9.9 pounds, not 8 pounds.
D	Correct. Question can be answered by summing the last two bar heights: $16 + 14 = 30$ .

### Question Number 20

An equation is shown.

$$n = 1 \div 17$$

Which describes  $n$ ?

- A. Integer
- B. Irrational
- C. Rational
- D. Whole

#### Benchmark: 7.1.1.2

Understand that division of two integers will always result in a rational number. Use this information to interpret the decimal result of a division problem when using a calculator. *For example:*  $125/30$  gives 4.16666667 on a calculator. This answer is not exact. The exact answer can be expressed as  $4\frac{1}{6}$ , which is the same as  $4.\overline{16}$ . The calculator expression does not guarantee that the 6 is repeated, but that possibility should be anticipated.

#### Item Specifications

- Vocabulary allowed in items: terminating, repeating, and vocabulary given at previous grades

DOK: 1

Calculator: CL

Answer: C

A	The number is a fraction, not a positive or negative whole number, so it is not an integer.
B	The number can be written as the ratio of 2 integers, so it is not irrational.
C	Correct. The number can be written as the ratio of 2 integers, so it is rational.
D	The number is a fraction, so it is not a whole number.

Notes on grade expectations: Student should know the definition of integer and rational from previous grades.

### Question Number 21

Which is equivalent to  $5\frac{2}{15}$ ?

- A.  $5.1\bar{3}$
- B.  $5.\bar{13}$
- C. 5.13
- D.  $5.\bar{3}$

#### Benchmark: 7.1.1.5

Recognize and generate equivalent representations of positive and negative rational numbers, including equivalent fractions.

For example:  $-\frac{40}{12} = -\frac{120}{36} = -\frac{10}{3} = -3.\bar{3}$ .

#### Item Specifications

- Vocabulary allowed in items: vocabulary given at previous grades

DOK: 1

Calculator: CL

Answer: A

A	Correct. The decimal is 5.133333333... so the bar is only over the 3.
B	The bar should only be over the repeating part of the decimal, which is 3, not 13.
C	The decimal does not terminate. The 3 repeats, so it should have a bar above it.
D	The 1 in the tenths place is missing.

### Question Number 22

Nora is running a race that is 26.2 miles. She is running at a speed of 8 miles per hour. She has completed  $\frac{3}{4}$  of the race. How much longer will it take Nora to finish the race?

- A. 0.82 hour
- B. 2.46 hours
- C. 3.28 hours
- D. 6.55 hours

#### Benchmark: 7.1.2.4

Solve problems in various contexts involving calculations with positive and negative rational numbers and positive integer exponents, including computing simple and compound interest.

#### Item Specifications

- Vocabulary allowed in items: simple interest, compound interest, and vocabulary given at previous grades

DOK: 2

Calculator: CL

Answer: A

A	Correct. $\frac{1}{4}$ of 26.2 is 6.55, and $6.55/8 \approx 0.82$ .
B	Calculated time to complete $\frac{3}{4}$ of the race instead of $\frac{1}{4}$ ; $\frac{3}{4}(26.2)/8 \approx 2.46$ .
C	Calculated time to complete entire race instead of $\frac{1}{4}$ of it; $26.2/8 \approx 3.28$ .
D	Calculated number of miles remaining; $\frac{1}{4}(26.2) = 6.55$ .

### Question Number 23

The table shows the cost of different numbers of boxes of cookies.

**Selling Cookies**

Boxes of Cookies	Cost (dollars)
5	11.25
7	15.75
11	24.75

What is the cost to buy 15 boxes of cookies?

- A. \$33.75
- B. \$36.00
- C. \$40.50
- D. \$51.75

#### **Benchmark: 7.2.2.2**

Solve multi-step problems involving proportional relationships in numerous contexts.

*For example:* Distance-time, percent increase or decrease, discounts, tips, unit pricing, lengths in similar geometric figures, and unit conversion when a conversion factor is given, including conversion between different measurement systems.

*Another example:* How many kilometers are there in 26.2 miles?

#### *Item Specifications*

- Contexts may include (but are not limited to) discounts, tax, and percent of change
- Vocabulary allowed in items: proportional and vocabulary given at previous grades

DOK: 2

Calculator: CL

Answer: A

A	Correct. Each box of cookies costs \$2.25. $15 \times 2.25 = 33.75$
B	Calculated 5 more boxes instead of 4 more boxes; $24.75 + 5 \times 2.25 = 36.00$ .
C	Added last two entries in cost column; $15.75 + 24.75 = 40.50$ .
D	Added all entries in cost column; $11.25 + 15.75 + 24.75 = 51.75$ .

### Question Number 24

Simplify.

$$8 - 2(n + 4)(-3)^2$$

- A.  $-2n - 9$
- B.  $-18n$
- C.  $-18n - 64$
- D.  $36n - 216$

#### Benchmark: 7.2.3.1

Use properties of algebra to generate equivalent numerical and algebraic expressions containing rational numbers, grouping symbols and whole number exponents. Properties of algebra include associative, commutative and distributive laws.

*For example:* Combine like terms (use the distributive law) to write  $3x - 7x + 1 = (3 - 7)x + 1 = -4x + 1$ .

#### Item Specifications

- Items must not have context
- Vocabulary allowed in items: simplify and vocabulary given at previous grades

DOK: 2

Calculator: CL

Answer: C

A	Subtracted $3^2$ instead of multiplying by $(-3)^2$ ; simplified $8 - 2(n + 4) - 3^2$ .
B	Distributed $(-3)^2$ to $n$ only, not to 4. Calculated $8 - 18n - 8$ .
C	Correct. $8 - 2(n + 4)(-3)^2 = 8 - 2(n + 4)(9) = 8 - 18(n + 4) = 8 - 18n - 72 = -18n - 64$
D	Made errors in applying order of operations; $((8 - 2) - n)(4)(-1)(3)^2 = (6 - n) \times (-36) = 36n - 216$ .

Notes on grade expectations: Student should know order of operations from previous grades.

### Question Number 25

The equation  $3c = 4s$  gives the relationship between  $c$ , the weight of clay, and  $s$ , the weight of sand in a mixture. There are 6.25 pounds of clay in the mixture. What is the weight of the sand?

- A. 4.69 pounds
- B. 8.88 pounds
- C. 18.75 pounds
- D. 75.00 pounds

#### Benchmark: 7.2.4.2

Solve equations resulting from proportional relationships in various contexts.

*For example:* Given the side lengths of one triangle and one side length of a second triangle that is similar to the first, find the remaining side lengths of the second triangle.

*Another example:* Determine the price of 12 yards of ribbon if 5 yards of ribbon cost \$1.85.

#### Item Specifications

- Vocabulary allowed in items: vocabulary given at previous grades

DOK: 2

Calculator: CL

Answer: A

A	Correct. $(3 \times 6.25)/4 = s$
B	Miscalculated.
C	Did not divide by 4; $3 \times 6.25 = 18.75$ .
D	Multiplied by 4 instead of dividing by 4; $3 \times 6.25 \times 4 = 75.00$ .



**Question Number 26**

A cylinder has a height of  $x$  inches. The diameter of the base is also  $x$  inches. Which gives the volume of the cylinder?

- A.  $2\pi x^2$
- B.  $\frac{1}{4} \pi x^3$
- C.  $\frac{1}{2} \pi x^3$
- D.  $\pi x^3$

**Benchmark: 7.3.1.2**

Calculate the volume and surface area of cylinders and justify the formulas used.

*For example:* Justify the formula for the surface area of a cylinder by decomposing the surface into two circles and a rectangle.

*Item Specifications*

- Units must be consistent throughout an item; conversions are not allowed
- Vocabulary allowed in items: radius, diameter, circumference, cylinder, lateral area, and vocabulary given at previous grades

DOK: 2

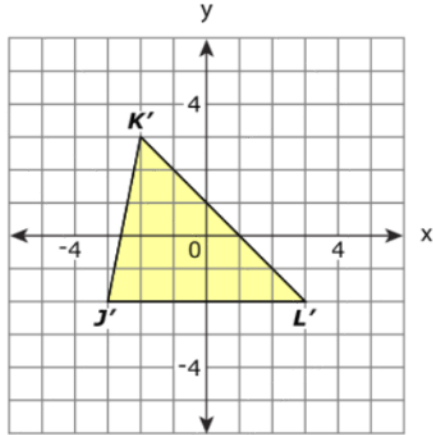
Calculator: CL

Answer: B

A	Used formula for lateral area instead of volume and used diameter instead of radius; $2\pi x(x)$ .
B	Correct. Radius is $x/2$ or $1/2 x$ , so volume = $\pi(1/2 x)2x$ .
C	Did not square $1/2$ when squaring radius.
D	Used diameter instead of radius; $\pi(x)2x$ .

**Question Number 27**

The translation  $(x, y) \rightarrow (x - 4, y + 5)$  was used to move  $\triangle JKL$  to  $\triangle J'K'L'$ .  $\triangle J'K'L'$  is shown on the grid.



What are the coordinates of point  $K$ ?

- A.  $(-6, 8)$
- B.  $(-4, 5)$
- C.  $(-2, 3)$
- D.  $(2, -2)$

**Benchmark: 7.3.2.4**

Graph and describe translations and reflections of figures on a coordinate grid and determine the coordinates of the vertices of the figure after the transformation.

*For example:* The point  $(1, 2)$  moves to  $(-1, 2)$  after reflection about the  $y$ -axis.

*Item Specifications*

- Allowable notation:  $J$  and  $J'$  (labels for points before and after transformation)
- Allowable translation notation:  $(x, y) \rightarrow (x + 3, y - 2)$
- Images may be reflected over vertical lines, horizontal lines and the lines  $y=x$  and  $y=-x$
- Vocabulary allowed in items: vocabulary given at previous grades

DOK: 2

Calculator: CL

Answer: D

A	Subtracted 4 from $x$ -value and added 5 to $y$ -value; thought $K'$ was $K$ .
B	Used $-4$ and $5$ from translation $(x - 4, y + 5)$ .
C	Used location of $K'$ $(-2, 3)$ .
D	Correct. $K'$ is $(-2, 3)$ , add 4 to $x$ -value and subtract 5 from $y$ -value to get $K(2, -2)$ .

Notes on grade expectations: Student should be able to perform the transformation in reverse and find the pre-image given the image.

### Question Number 28

The number of students of each age on a bus is shown in the table.

**Ages of Students**

Age (years)	Number of Students
13	2
14	10
15	5
16	18
17	24

What is the median age of the students?

- A. 10 years
- B. 14 years
- C. 15 years
- D. 16 years

#### **Benchmark: 7.4.1.1**

Design simple experiments and collect data. Determine mean, median and range for quantitative data and from data represented in a display. Use these quantities to draw conclusions about the data, compare different data sets, and make predictions.

*For example:* By looking at data from the past, Sandy calculated that the mean gas mileage for her car was 28 miles per gallon. She expects to travel 400 miles during the next week. Predict the approximate number of gallons that she will use.

#### *Item Specifications*

- Data displays are limited to no more than 10 categories
- Data displays from previous grades may be used
- Vocabulary allowed in items: stem-and-leaf plot, and vocabulary given at previous grades

DOK: 2

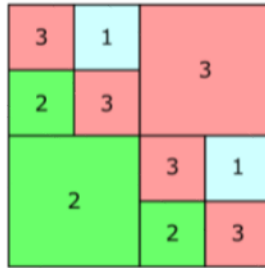
Calculator: CL

Answer: D

A	Used the frequency as the data set; chose median of 2, 5, 10, 18, 24.
B	Found median of all 10 numbers in table, then rounded down.
C	Chose middle number in age column; or found mean and rounded down.
D	Correct. The median is the 30 <sup>th</sup> piece of data, 16.

### Question Number 29

Leon uses squares to make a board. He randomly throws a stone onto the board.



What is the probability the stone lands on a space marked 3?

- A.  $\frac{1}{10}$
- B.  $\frac{1}{4}$
- C.  $\frac{1}{3}$
- D.  $\frac{1}{2}$

#### Benchmark: 7.4.3.2

Calculate probability as a fraction of sample space or as a fraction of area. Express probabilities as percents, decimals and fractions.

*For example:* Determine probabilities for different outcomes in game spinners by finding fractions of the area of the spinner.

#### Item Specifications

- Vocabulary allowed in items: vocabulary given at previous grades

DOK: 2

Calculator: CL

Answer: D

A	Counted 10 squares in all; gave probability for 1 of 10 squares.
B	Only counted large red section which is $\frac{1}{4}$ of the whole.
C	Used the 3 from the question.
D	Correct. The amount of the board with the number 3 is equivalent to 8 of the smallest squares out of 16.

Notes on grade expectations: Student should know that parts of the whole must be equal-sized, so they would use 16 as the denominator for this problem. Or the five squares marked 3 could be rearranged visually to determine that half of the figure is covered.

### Question Number 30


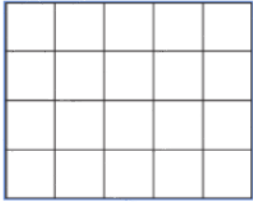
A floor has red, blue and yellow square tiles that are the same size. The probability that a randomly dropped coin lands on a red tile is 0.5. The probability that the coin lands on a blue tile is 0.2. How many tiles of each color does the floor have?

Drag the colored tiles into the box.

**Tiles**

- Red
- Blue
- Yellow

**Floor**



#### Benchmark: 7.4.3.2

Calculate probability as a fraction of sample space or as a fraction of area. Express probabilities as percents, decimals and fractions.

*For example:* Determine probabilities for different outcomes in game spinners by finding fractions of the area of the spinner.

#### Item Specifications

- Vocabulary allowed in items: vocabulary given at previous grades

DOK: 2

Calculator: CL

Answer:

This is a technology-enhanced item. A correct answer is shown. Student must color any arrangement of 10 red, 4 blue, and 6 yellow tiles in order to receive 1 point.



A floor has red, blue and yellow square tiles that are the same size. The probability that a randomly dropped coin lands on a red tile is 0.5. The probability that the coin lands on a blue tile is 0.2. How many tiles of each color does the floor have?

Drag the colored tiles into the box.

**Tiles**

- Red
- Blue
- Yellow

**Floor**



Notes on grade expectations: Student should be able to determine that if red and blue tiles cover 0.7 of the whole, then yellow tiles cover 0.3 of the floor. Calculate  $0.5 \times 20 = 10$  red tiles,  $0.2 \times 20 = 4$  blue tiles, and  $0.3 \times 20 = 6$  yellow tiles.

### Question Number 31

Which expressions are equivalent to  $3(x + 2) - (x - 4)$ ?

Select the expressions you want to choose.

- A.  $2x + 2$
- B.  $4x + 2$
- C.  $2(x - 1)$
- D.  $2(x + 5)$
- E.  $2x + 10$
- F.  $\frac{1}{2}(4x + 20)$

#### **Benchmark: 7.2.3.1**

Use properties of algebra to generate equivalent numerical and algebraic expressions containing rational numbers, grouping symbols and whole number exponents. Properties of algebra include associative, commutative and distributive laws.

*For example:* Combine like terms (use the distributive law) to write  $3x - 7x + 1 = (3 - 7)x + 1 = -4x + 1$ .

#### *Item Specifications*

- Items must not have context
- Vocabulary allowed in items: simplify and vocabulary given at previous grades

DOK: 2

Calculator: CL

Answer:

This is a technology-enhanced item. The correct answer is shown. Student must check all three boxes in order to receive 1 point.



Which expressions are equivalent to  $3(x + 2) - (x - 4)$ ?

Select the expressions you want to choose.

- A.  $2x + 2$
- B.  $4x + 2$
- C.  $2(x - 1)$
- D.  $2(x + 5)$
- E.  $2x + 10$
- F.  $\frac{1}{2}(4x + 20)$

Notes on grade expectations: Students should be familiar with the order of operations, and the Associative, Distributive, and Commutative properties from previous grades.

**Question Number 32**

Four graphs are shown.

Which graph represents a proportional relationship?

Select a number and phrases.

Graph  represents a proportional relationship because the graph  and .

**Benchmark: 7.2.1.2**

Understand that the graph of a proportional relationship is a line through the origin whose slope is the unit rate (constant of proportionality). Know how to use graphing technology to examine what happens to a line when the unit rate is changed.

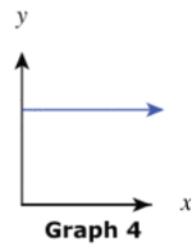
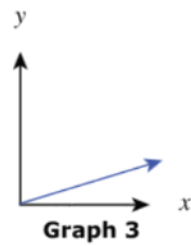
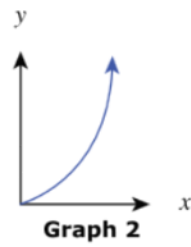
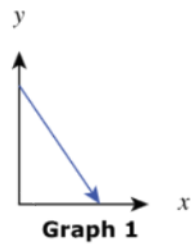
*Item Specifications*

- Vocabulary allowed in items: proportional, origin, slope, and vocabulary given at previous grades

DOK: 2  
Calculator: CL  
Answer:

This is a technology-enhanced item. The correct answer is shown. Student must select all three correct responses in order to receive 1 point.

Four graphs are shown.



Which graph represents a proportional relationship?

Select a number and phrases.

Graph  represents a proportional relationship because the graph  
 and .

Drop-down menu answer options:

Choose...

- 1
- 2
- 3**
- 4

Choose...  
**contains the origin**  
has a positive y-intercept

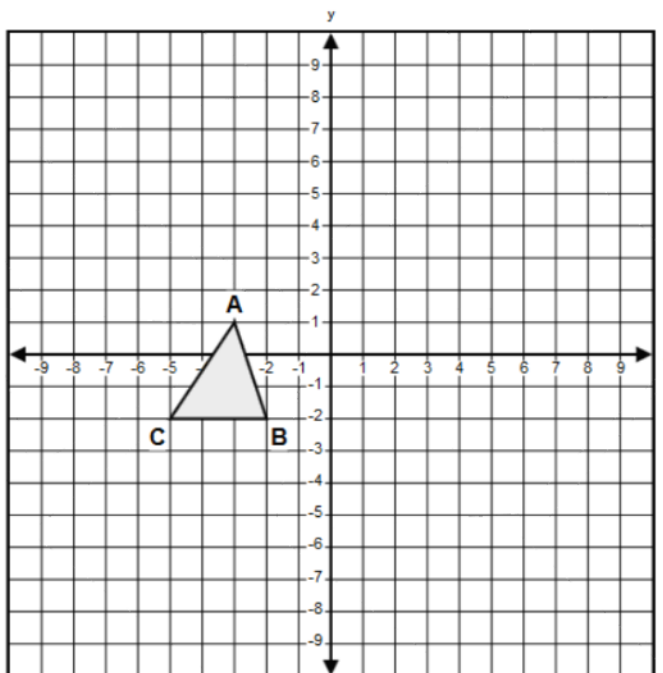
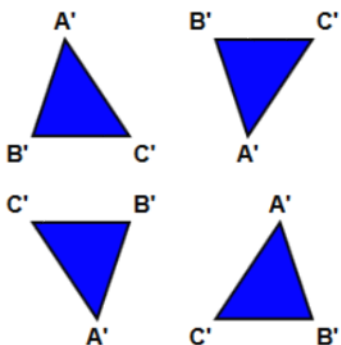
Choose...  
is increasing  
touches both axes  
**has a constant slope**  
has positive y-values

Notes on grade expectations: In seventh grade, students must be able to distinguish between linear and non-linear graphs. They should understand that a proportional relationship is linear and that its graph passes through the origin  $(0, 0)$ .

### Question Number 33

Translate  $\triangle ABC$  using the rule  $(x, y) \rightarrow (x - 4, y + 3)$ .

Drag the correct transformation to the correct position on the coordinate plane.



#### Benchmark: 7.3.2.4

Graph and describe translations and reflections of figures on a coordinate grid and determine the coordinates of the vertices of the figure after the transformation.

For example: The point  $(1, 2)$  moves to  $(-1, 2)$  after reflection about the  $y$ -axis.

#### Item Specifications

- Allowable notation:  $J$  and  $J'$  (labels for points before and after transformation)
- Allowable translation notation:  $(x, y) \rightarrow (x + 3, y - 2)$
- Images may be reflected over vertical lines, horizontal lines and the lines  $y=x$  and  $y=-x$
- Vocabulary allowed in items: vocabulary given at previous grades

DOK: 2

Calculator: CL

Answer:

This is a technology-enhanced item. A correct answer is shown. Student must select the correct orientation of triangle  $A'B'C'$  and then place it in the correct location in order to receive 1 point.

Translate  $\triangle ABC$  using the rule  $(x, y) \rightarrow (x - 4, y + 3)$ .

Drag the correct transformation to the correct position on the coordinate plane.

