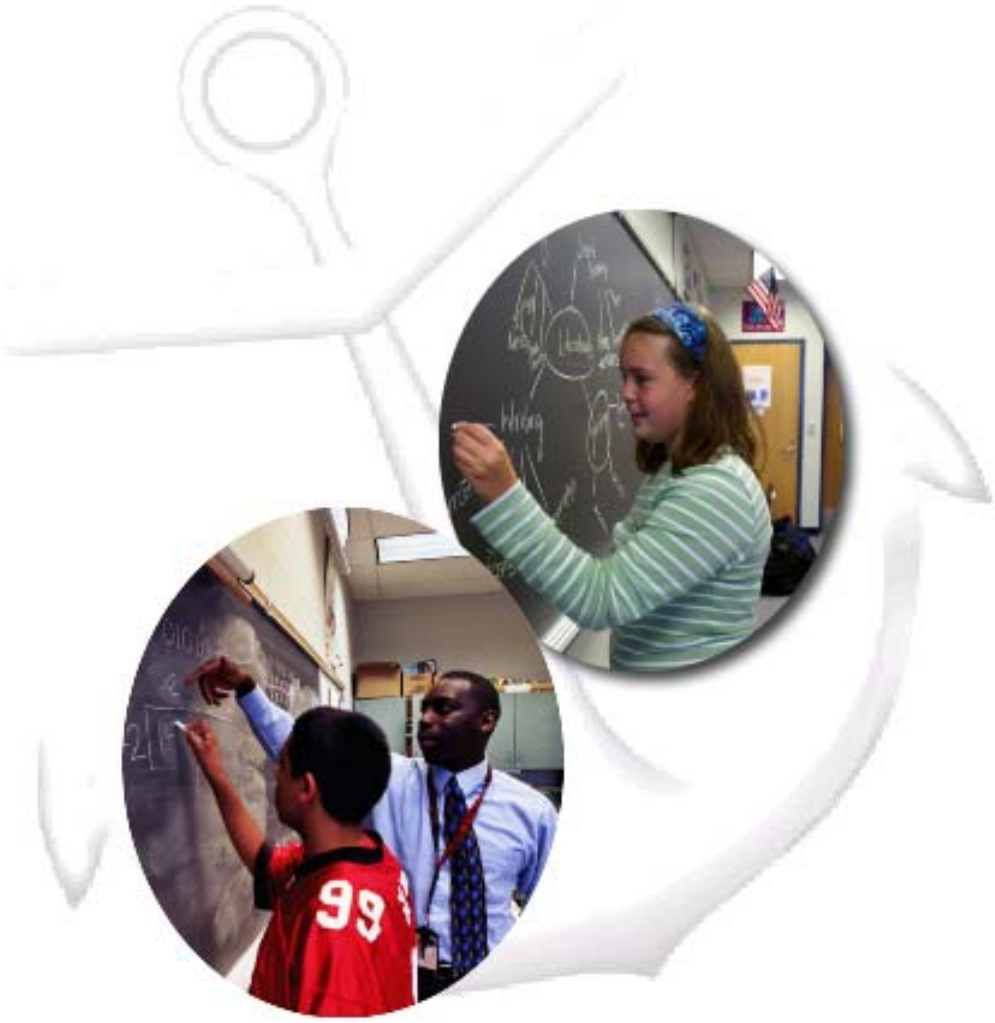
Math Grade 8 Assessment Anchors and Eligible Content



Pennsylvania Department of Education

www.pde.state.pa.us

2007

M8.A Numbers and Operations — Reporting Category

ASSESSMENT ANCHOR

M8.A.1 Demonstrate an understanding of numbers, ways of representing numbers, relationships among numbers and number systems.

	ELIGIBLE CONTENT
M8.A.1.1 Represent numbers in equivalent forms. ***Reference: 2.1.8.A, 2.1.8.B***	**M8.A.1.1.1** Represent numbers using scientific notation and/or exponential forms.
	M8.A.1.1.2 Find the square or cube of a whole number (single digit) and/or the square root of a perfect square (without a calculator) and explain the relationship between the two (i.e. square and square root).

EXAMPLE ITEMS

- The earth is approximately 93,000,000 miles from the sun. What is the distance written in scientific notation?

  A. 9.3×10^6
  B. 93×10^6
  C. 93×10^7
  * D. 9.3×10^7

  (Maryland Department of Education)

- Which number represents 4.5×10^4 written in standard notation?

  A. 0.00045
  B. 0.000045
  * C. 45,000
  D. 450,000

  (Pennsylvania Department of Education)

- The number 5.12×10^8 is written in scientific notation. How would it be written in standard form?

  A. 0.0000000512
  B. 51,200,000
  * C. 512,000,000
  D. 51,200,000,000

  (Pennsylvania Department of Education)

- Liang got an answer of about 3.87 when she entered 15 on her calculator and pressed the ($\sqrt{\ }$) key. As usual, she stopped to think briefly about whether or not her calculator's answer was reasonable. Which of the following statements is the most likely explanation for her to believe that her calculator's answer is or not reasonable?

  A. It is not reasonable, because the answer should be a whole number.
  * B. It is reasonable because 3 squared is 9 while 4 squared is 16.
  C. It is not reasonable, because the answer should be only slightly more than 3.
  D. It is reasonable, because 15 is an odd number.

  (New Jersey Department of Education)

ASSESSMENT ANCHOR

M8.A.2 Understand the meanings of operations, use operations and understand how they relate to each other.

ELIGIBLE CONTENT

M8.A.2.1 Complete calculations by applying the order of operations. ***Reference: 2.2.8.A***	**M8.A.2.1.1** Simplify numeric expressions involving integers, using the order of operations. (May include all types of grouping symbols. No combining negatives with exponents [4^{-3}] or compound exponents.)

EXAMPLE ITEMS

- $3^3 + 4(8 - 5) \div 6 =$

  A. 6.5
  B. 11
  C. 27.5
  * D. 29
  E. 34.16

(NAEP)

- What is the value of the expression:

  $2^3 + (3 \bullet 10^3)\ 82 - 16$?

  A. 7,370
  B. 7,372
  C. 198,008
  * D. 245,992

(Pennsylvania Department of Education)

- Evaluate

  $7 + 5[(3 + 2)^2 - (2^3 + 1)]$

  A. 22
  B. 36
  * C. 87
  D. 97

(Pennsylvania Department of Education)

ASSESSMENT ANCHOR

M8.A.2 Understand the meanings of operations, use operations and understand how they relate to each other.

	ELIGIBLE CONTENT
M8.A.2.2 Represent or solve problems using rates, ratios, proportions and/or percents. ***Reference: 2.1.8.D, 2.3.8.B***	**M8.A.2.2.1** Solve problems involving percents (e.g., tax, discounts, etc) Do not include percent increase or decrease. **M8.A.2.2.2** Represent or solve rate problems (e.g., unit rates, simple interest, distance, etc.) Students may be asked to solve for any term (formulas provided on the reference sheet for distance and interest).

EXAMPLE ITEMS

- A secretary can type 56 words per minute. How much time will she need to type a 4200-word report?

  A. 7 hours 30 minutes
  B. 1 hour 4 minutes
  C. 1 hour 28 minutes
  * D. 1 hour 15 minutes

  (Pennsylvania Department of Education)

- In 1991, an American, Ann Trason, set a world record by running 100 km in

Hours	Minutes	Seconds
7	50	09

  Which is the best estimate of her average speed?

  * A. 12 km per hr
  B. 14 km per hr
  C. 16 km per hr
  D. 18 km per hr

  (New Jersey Department of Education)

- A runner ran 3000 m in exactly 8 minutes. What was his average speed in meters per second?

  A. 3.75
  * B. 6.25
  C. 16.0
  D. 37.5
  E. 62.5

  (TIMSS)

ASSESSMENT ANCHOR

M8.A.3 Compute accurately and fluently and make reasonable estimates.

	ELIGIBLE CONTENT
M8.A.3.1 Determine the appropriateness of overestimating, underestimating or calculating an exact answer in problem-solving situations. ***Reference: 2.2.8.F***	**M8.A.3.1.1** Identify, use and/or explain when it is appropriate to round up or round down. **M8.A.3.1.2** Identify, apply and/or explain when an exact answer is needed or when estimation is appropriate.

EXAMPLE ITEMS

ASSESSMENT ANCHOR

M8.A.3 Compute accurately and fluently and make reasonable estimates.

	ELIGIBLE CONTENT
M8.A.3.2 Use estimation strategies in problem-solving situations. ***Reference: 2.2.8.D***	**M8.A.3.2.1** Estimate answers to problems involving percents (percents will be limited to: 1%, 10%, 15%, 20%, 25%, 50% or 75%).

EXAMPLE ITEMS

- Ken bought a used car for $5,375. He had to pay an additional 15 percent of the purchase price to cover both sales tax and extra fees. Of the following, which is the closest to the total amount Ken paid?

  A. $806
  B. $5,510
  C. $5,760
  D. $5,940
  * E. $6,180

  (NAEP)

- A state law requires that students attend school 180 days out of the 365 days in a year. Approximately what percent of a year must students attend school?

  A. 2%
  * B. 50%
  C. 75%
  D. 200%

  (Pennsylvania Department of Education)

ASSESSMENT ANCHOR

M8.A.3 Compute accurately and fluently and make reasonable estimates.

	ELIGIBLE CONTENT
M8.A.3.3 Compute and/or explain operations with integers, fractions and/or decimals. ***Reference: 2.2.8.B***	**M8.A.3.3.1** Add, subtract, multiply and/or divide integers, fractions and/or decimals with and without a calculator (straight computation or word problems).

EXAMPLE ITEMS

- Subtract (-)

$$\begin{array}{r} 14\frac{5}{8} \\ -\ 6\frac{5}{8} \\ \hline \end{array}$$

A. $8\frac{5}{24}$
B. $21\frac{11}{24}$
* C. 8
D. $7\frac{19}{24}$

(Pennsylvania Department of Education)

- Divide (÷)

$$\frac{3}{0.24}$$

A. 0.08
B. 0.72
* C. 12.5
D. 125.00

(Pennsylvania Department of Education)

- Subtract (-)

$$\begin{array}{r} 11 \\ -\ 1\frac{2}{3} \\ \hline \end{array}$$

* A. $9\frac{1}{3}$
B. $9\frac{2}{3}$
C. $10\frac{1}{3}$
D. $10\frac{2}{3}$

(Pennsylvania Department of Education)

ASSESSMENT ANCHOR

M8.B.1 Demonstrate an understanding of measurable attributes of objects and figures, and the units, systems and processes of measurement.

	ELIGIBLE CONTENT
M8.B.1.1 Convert measurements. ***Reference: 2.3.5.D***	**M8.B.1.1.1** Convert among metric measurements (milli, centi, kilo using meter, liter and gram) (table of equivalency provided on the reference sheet). **M8.B.1.1.2** Convert customary measurements up to 2 units above or below the given unit (e.g., inches to yards, pints to gallons) (table of equivalency provided on the reference sheet). **M8.B.1.1.3** Convert time up to 2 units above or below given unit (e.g., seconds to hours). **M8.B.1.1.4** Convert from Fahrenheit to Celsius or Celsius to Fahrenheit (formulas provided on the reference sheet).

EXAMPLE ITEMS

- 1 mile = 5,280 feet
  How many feet are in 15 miles?

  A. 352
  B. 35,200
  * C. 79,200
  D. 84,480
  E. 89,760

  (NAEP)

- How many yards are equal to 72 inches?

  * A. 2 yards
  B. 3 yards
  C. 6 yards
  D. 36 yards

  (Pennsylvania Department of Education)

- Greg is 150 centimeters tall. How many meters is that?

  A. 0.500
  * B. 1.5
  C. 15
  D. 15,000

  (Connecticut State Department of Education)

ASSESSMENT ANCHOR

M8.B.2 Apply appropriate techniques, tools and formulas to determine measurements.

	ELIGIBLE CONTENT
M8.B.2.1 Determine the measurement of a missing side(s) or angle(s) in a polygon. ***Reference: 2.3.8.C, 2.9.8.D***	**M8.B.2.1.1** Determine the total number of degrees in the interior angles of a polygon in 3 - 8 sided figures (formula provided on the reference sheet). **M8.B.2.1.2** Determine the measurement of one interior angle of a regular polygon (3-8 sided polygons, formula provided on the reference sheet). **M8.B.2.1.3** Determine the number of sides of a polygon given the total number of degrees in the interior angles (3-8 sided polygons, formula provided on the reference sheet).

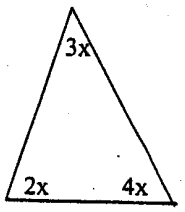
EXAMPLE ITEMS

- In a quadrilateral, each of two angles has a measure of 115°. If the measure of a third angle is 70°, what is the measure of the remaining angle?

* A. 60°
B. 70°
C. 130°
D. 140°

(TIMSS)

- Find the measure in degrees, of the smallest angle in this triangle?



A. 20
* B. 40
C. 60
D. 80

(Pennsylvania Department of Education)

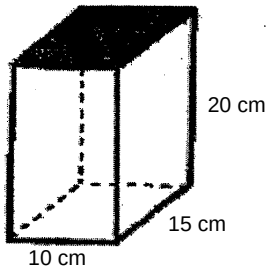
ASSESSMENT ANCHOR

M8.B.2 Apply appropriate techniques, tools and formulas to determine measurements.

	ELIGIBLE CONTENT
M8.B.2.2 Use, describe and/or develop procedures to determine measures of perimeter, circumference, area, surface area and/or volume. ***Reference: 2.3.8.A, 2.3.8.D***	**M8.B.2.2.1** Calculate the surface area of cubes and rectangular prisms (formula provided on the reference sheet). **M8.B.2.2.2** Calculate the volume of cubes and rectangular prisms (formulas provided on the reference sheet). **M8.B.2.2.3** Determine the appropriate type of measurement (circumference, perimeter, area, surface area, volume) for a given situation (e.g., which measurement is needed to determine the amount of carpeting for a room).

EXAMPLE ITEMS

- The box pictured below is open at the top. Find its outside surface area.



A. 45 cm^2
* B. 1150 cm^2
C. 1300 cm^2
D. 3750 cm^2

(Pennsylvania Department of Education)

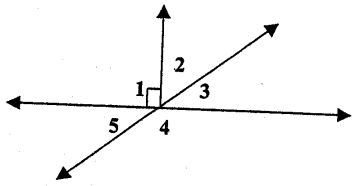
ASSESSMENT ANCHOR

M8.C.1 Analyze characteristics and properties of two- and three- dimensional geometric shapes and demonstrate understanding of geometric relationships.

	ELIGIBLE CONTENT
M8.C.1.1 Identify, use, and/or describe properties of angles, triangles, quadrilaterals, circles, pyramids, cubes, prisms, spheres, cones and/or cylinders. ***Reference: 2.3.8.C, 2.9.8.B, 2.9.8.E, 2.9.8.D***	**M8.C.1.1.1** Match the three-dimensional figure with its net (cube, cylinder, cone, prism, pyramid). Any measurements used should be consistent in the stem and answer choices. **M8.C.1.1.2** Define, identify and/or use properties of angles formed by intersecting lines (complementary, supplementary, adjacent and/or vertical angles). **M8.C.1.1.3** Define, identify and/or use properties of angles formed when two parallel lines are cut by a transversal (alternate interior, alternate exterior, vertical corresponding).

EXAMPLE ITEMS

- Which angles are complementary?



* A. ∠ 2 and ∠ 3
B. ∠ 3 and ∠ 4
C. ∠ 4 and ∠ 5
D. ∠ 1 and ∠ 2

(Pennsylvania Department of Education)

ASSESSMENT ANCHOR

M8.C.1 Analyze characteristics and properties of two- and three- dimensional geometric shapes and demonstrate understanding of geometric relationships.

	ELIGIBLE CONTENT
M8.C.1.2 Compute measures of sides of right triangles using the Pythagorean Theorem. ***Reference: 2.10.8.A***	**M8.C.1.2.1** Use the Pythagorean Theorem to find the measure of a missing side of a right triangle (formula provided on the reference sheet – whole numbers only).

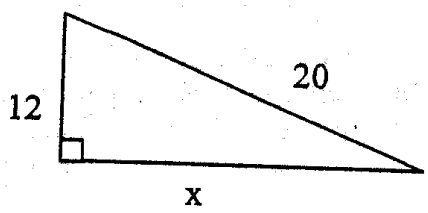
EXAMPLE ITEMS

- Mr. Kyle drives eight miles south and then six miles east. What was the diagonal distance from his starting point?

  A. 2 miles
  * B. 10 miles
  C. 14 miles
  D. 48 miles

(Pennsylvania Department of Education)

- What is the length of the missing side in this triangle?



  A. 14
  B. 15
  * C. 16
  D. 18

(Pennsylvania Department of Education)

ASSESSMENT ANCHOR

M8.C.2 Identify and/or apply concepts of transformations or symmetry.

ELIGIBLE CONTENT

Not assessed at Grade 8.

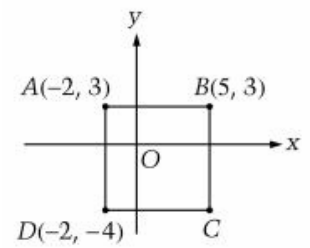
EXAMPLE ITEMS

ASSESSMENT ANCHOR

M8.C.3 Locate points or describe relationships using the coordinate plane.

	ELIGIBLE CONTENT
M8.C.3.1 Plot and/or identify ordered pairs on a coordinate plane. ***Reference: 2.8.5.H***	**M8.C.3.1.1** Plot, locate or identify ordered pairs on a coordinate plane (the point may be a vertex of a polygon).

EXAMPLE ITEMS



- In the figure above, if ABCD is a square, then the coordinates of vertex C are

  A. (4,5)
  B. (3,-4)
  C. (3,-2)
  * D. (5,-4)
  E. (5,-2)

(NAEP)

ASSESSMENT ANCHOR

M8.D.1 Demonstrate an understanding of patterns, relations and functions.

	ELIGIBLE CONTENT
M8.D.1.1 Analyze, extend or develop descriptions of patterns or functions. ***Reference: 2.8.8.B, 2.8.8.G, 2.11.8.C***	**M8.D.1.1.1** Continue a numeric or algebraic pattern (pattern must show 3 repetitions – may include up to 2 operations, squares and square roots). **M8.D.1.1.2** Find missing elements in numeric or geometric patterns and/or functions (may be given a table or rule – pattern must show 3 repetitions). **M8.D.1.1.3** Determine the rule of a function (given elements in an input-output table, chart or list – limit to linear functions).

EXAMPLE ITEMS

- The table shows a relation between x and y.

x	2	3	4	5
y	7	10	13	16

Which of these equations expresses this relation?

A. $y = x + 5$
B. $y = x \pm 5$
C. $y = \frac{1}{3}(x \pm 1)$
* D. $y = 3x + 1$

(Pennsylvania Department of Education)

- What is the next number in the pattern?

4, 13, 28, 49, ...

A. 58
B. 64
* C. 76
D. 98

(Pennsylvania Department of Education)

-

x	y
0	-3
1	-1
2	1

Which of the following equations is true for the three pairs of x and y values in the table above?

A. $3x + 2 = y$
B. $3x – 2 = y$
C. $2x + 3 = y$
* D. $2x – 3 = y$
E. $x – 3 = y$

(NAEP)

- List the next two values in this sequence:

4, 10, 22, __, __

A. 34, 46
B. 34, 48
C. 40, 62
* D. 46, 94

(Pennsylvania Department of Education)

ASSESSMENT ANCHOR

M8.D.2 Represent and/or analyze mathematical situations using numbers, symbols, words, tables and/or graphs.

	ELIGIBLE CONTENT
M8.D.2.1 Select and/or use a strategy to simplify an expression, solve an equation or inequality and/or check the solution for accuracy. ***Reference: 2.8.8.C, 2.8.8.E***	**M8.D.2.1.1** Solve one- or two-step equations and inequalities (should not include absolute values – one variable only). **M8.D.2.1.2** Use substitution to check the accuracy of a given value for an equation or inequality (simple inequalities with one variable). **M8.D.2.1.3** Determine the value of an algebraic expression by simplifying and/or substituting a number for the variable.

EXAMPLE ITEMS

- If 4x – 6 = 14, what is the value of x?

  A. 1
  B. 2
  C. 4
  * D. 5

  (Pennsylvania Department of Education)

- For which equation is (4, 3) a solution?

  A. x – y = 7
  * B. x + y = 7
  C. x = y = 1
  D. x + y = 12

  (Pennsylvania Department of Education)

- If k can be replaced by any number, how many different values can the expression k + 6 have?

  A. None
  B. One
  C. Six
  D. Seven
  * E. Infinitely many

  (NAEP)

- $\frac{x}{2} < 7$ is equivalent to

  A. $x < \frac{7}{2}$
  B. $x < 5$
  * C. $x < 14$
  D. $x > 5$
  E. $x > 14$

  (TIMSS)

ASSESSMENT ANCHOR

M8.D.2 Represent and/or analyze mathematical situations using numbers, symbols, words, tables and/or graphs.

	ELIGIBLE CONTENT
M8.D.2.2 Create and/or interpret expressions, equations or inequalities that model problem situations. ***Reference: 2.8.8.C***	**M8.D.2.2.1** Match a written situation to its numeric and/or algebraic expression, equation or inequality (up to two variables in equations or expressions – one variable with inequalities). **M8.D.2.2.2** Write and/or solve an equation for a given problem situation (one variable only).

EXAMPLE ITEMS

- Which equation shows that the sum of x and 2 is twice as much as 6?

  A. $x = 2 \bullet 2 \bullet 6$
  B. $x + 2 \bullet 2 = 6$
  C. $2(x + 2) = 6$
  * D. $x + 2 = 2 \bullet 6$

(Pennsylvania Department of Education)

- A wooden box with 8 videocassettes inside weighs 4.2 kilograms. The box weighs 0.6 kg when empty. Using w to represent the weight of one videocassette, which of the following describes this situation?

  A. $8w = 4.2$
  * B. $8w + 0.6 = 4.2$
  C. $8w – 0.6 = 4.2$
  D. $8(w + 0.6) = 4.2$

(New Jersey Department of Education)

- Which of the following equations gives the rule for finding the numbers in the column on the right?

x	y
1	7
2	11
3	15

  A. $y = x + 4$
  B. $y = 2x + 5$
  C. $y = x + 6$
  * D. $y = 4x + 3$

(New Jersey Department of Education)

ASSESSMENT ANCHOR

M8.D.3 Analyze change in various contexts.

ELIGIBLE CONTENT

Not assessed at grade 8.

EXAMPLE ITEMS

ASSESSMENT ANCHOR

M8.D.4 Describe or use models to represent quantitative relationships.

	ELIGIBLE CONTENT
M8.D.4.1 Represent relationships with tables or graphs on the coordinate plane. ***Reference: 2.8.8.C, 2.8.8.H***	**M8.D.4.1.1** Graph a linear function based on an x/y table (integers only). **M8.D.4.1.2** Match the graph of a linear function to its x/y table (integers only). **M8.D.4.1.3** Match the linear equation (y = mx + b form) to the x/y table (integers only in the table).

EXAMPLE ITEMS

- Given the function $y = \frac{1}{2}x - 2$, which set of numbers completes the table?

x	y
-4	
-2	
0	

A. { 4, 3, 2}
* B. {-4, -3, -2}
C. {-4, 3, 2}
D. { 4, 3, 2}

(Pennsylvania Department of Education)

ASSESSMENT ANCHOR

M8.E.1 Formulate or answer questions that can be addressed with data and/or organize, display, interpret or analyze data.

ELIGIBLE CONTENT

M8.E.1.1 Choose, display or interpret data (tables, charts, graphs, etc.).

Reference: 2.6.5.A, 2.6.8.E, 2.7.8.D, 2.6.3.B

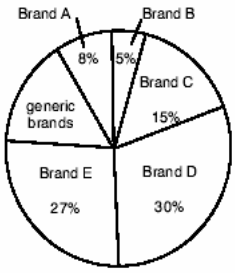
M8.E.1.1.1 Choose and/or explain the correct representation (graph) for a set of data.

M8.E.1.1.2 Analyze data and/or answer questions pertaining to data shown in multiple line graphs, circle graphs or histograms.

M8.E.1.1.3 Interpret data shown in stem-and-leaf or box-and-whisker plots.

EXAMPLE ITEMS

- According to the graph, what percent of the students chose generic brands?



Favorite Sneakers at Sherman High School

* A. 15%
B. 14%
C. 17%
D. 16%

(Pennsylvania Department of Education)

- The table below shows test scores for a class. How many students scored in the 80's?

Stem	Leaf
9	0 1 1 5 7
8	0 0 2 4 6 7 9
7	7 7 8 9
6	9
5	2 3
4	4

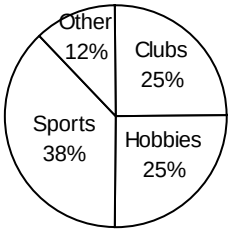
A. 2 students
B. 6 students
* C. 7 students
D. 9 students

(Pennsylvania Department of Education)

- There are 1,200 students enrolled in Adams Middle School. According to the graph, how many of these students participate in sports?

A. 380
*B. 456
C. 760
D. 820
E. 1,162

STUDENT PARTICIPATION IN ACTIVITIES AT ADAMS MIDDLE SCHOOL



(NAEP)

ASSESSMENT ANCHOR

M8.E.2 Select and/or use appropriate statistical methods to analyze data.

ELIGIBLE CONTENT

Not assessed at grade 8.

EXAMPLE ITEMS

ASSESSMENT ANCHOR

M8.E.3 Understand and/or apply basic concepts of probability or outcomes.

	ELIGIBLE CONTENT
M8.E.3.1 Calculate the probability of an event. ***Reference: 2.7.8.E***	**M8.E.3.1.1** Find the probability for a mutually exclusive or an independent event (written as a fraction in simplest form).

EXAMPLE ITEMS

- There are 15 girls and 11 boys in a mathematics class. If a student is selected at random to run an errand, what is the probability that a boy will be selected?

  A. $\frac{4}{26}$ * B. $\frac{11}{26}$ C. $\frac{15}{26}$ D. $\frac{11}{15}$ E. $\frac{15}{11}$

  (NAEP)

- There are 9 packages, 5 red and 4 green. There are calculators inside 4 of the red packages and inside 2 of the green packages. What is the probability of choosing a package containing a calculator from the entire group of packages?

  A. 4/5
  * B. 2/3
  C. 1/2
  D. 4/9

  (Pennsylvania Department of Education)

- Jan entered a drawing for a dirt bike 5 times. Only 150 entries were received. What is the probability that Jan will win the dirt bike?

  A. 1/150
  B. 1/50
  * C. 1/30
  D. 1/5

  (Pennsylvania Department of Education)

ASSESSMENT ANCHOR

M8.E.3 Understand and/or apply basic concepts of probability or outcomes.

	ELIGIBLE CONTENT
M8.E.3.2 Determine the number of combinations and/or permutations for an event. ***Reference: 2.7.8.A***	**M8.E.3.2.1** Determine/show the number of permutations and/or combinations for an event using up to four choices (e.g., organized list, etc.).

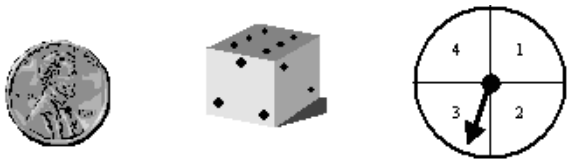
EXAMPLE ITEMS

- Sarah and Tom belong to a soccer league that has 8 teams. Each team will play all of the other teams twice. How many games will be played in all?

  A. 16
  B. 28
  * C. 56
  D. 64

(Colorado Department of Education)

- Edward conducts a simulation using a coin, a number cube, and a spinner as shown below.



What is the number of outcomes for this simulation?

A. 3
B. 8
C. 12
* D. 48

(Maryland State Department of Education)

ASSESSMENT ANCHOR

M8.E.4 Develop and/or evaluate inferences and predictions or draw conclusions based on data or data displays.

	ELIGIBLE CONTENT
M8.E.4.1 Draw conclusions, make inferences and/or evaluate hypotheses based on statistical and data displays. ***Reference: 2.6.8.C, 2.7.8.E***	**M8.E.4.1.1** Fit a line to a scatter plot and/or describe any correlation between the two variables (positive, negative, strong, weak or none). **M8.E.4.1.2** Make predictions based on survey results or graphs (bar, line, circle, scatterplots, etc.).

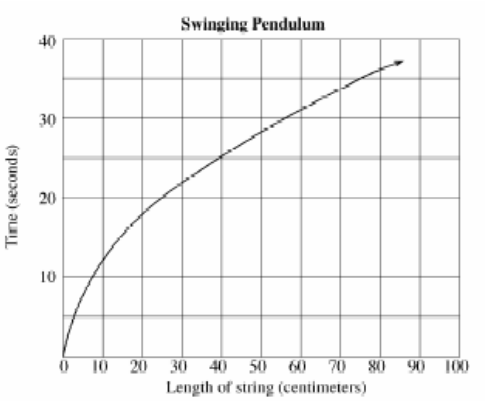
EXAMPLE ITEMS

- From a batch of 3000 light bulbs, 100 were selected at random and tested. If 5 of the light bulbs in the sample were found to be defective, about how many defective light bulbs would be expected in the entire batch?

  A. 15
  B. 60
  * C. 150
  D. 300
  E. 600

(TIMSS)

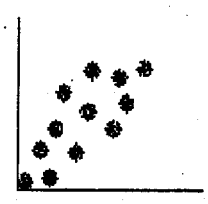
- The graph shows the time taken for a pendulum to swing backwards and forwards 20 times for different lengths of string. The length of a string is 90 cm. About how long would it take for the pendulum to swing backwards and forwards 20 times?



  A. 35 seconds
  * B. 38 seconds
  C. 42 seconds
  D. 45 seconds

(TIMSS)

- Fit a line to the scatter plot of two quantities. Describe any correlation of the variables. The data represented in the scatter plot above can be described as having …



  * A. Positive correlation
  B. Negative correlation
  C. No correlation
  D. Both positive and negative correlation

(Pennsylvania Department of Education)