

Math Grade 11 Assessment Anchors and Eligible Content



Pennsylvania Department of Education

www.pde.state.pa.us

Updated August 2010

M11.A Numbers and Operations
Reporting Category**ASSESSMENT ANCHOR**

M11.A.1 Demonstrate an understanding of numbers, ways of representing numbers, relationships among numbers and number systems.

ELIGIBLE CONTENT

M11.A.1.1 Represent and/or use numbers in equivalent forms (e.g., integers, fractions, decimals, percents, square roots, exponents and scientific notation).

M11.A.1.1.1 Find the square root of an integer to the nearest tenth using either a calculator or estimation.

M11.A.1.1.2 Express numbers and/or simplify expressions using scientific notation (including numbers less than 1).

M11.A.1.1.3 Simplify square roots. (e.g., $\sqrt{24} = 2\sqrt{6}$)

EXAMPLE ITEMS

- The diameter of a red blood cell, in inches, is 3×10^{-4} . This expression is the same as which of the following numbers?

- A. 0.00003
- * B. 0.0003
- C. 0.003
- D. 3,000
- E. 30,000

(NAEP)

- $\frac{6 \times 10^3}{3 \times 10^5} =$

- A. 0.5×10^2
- B. 2×10^2
- C. $2 \times 10^{0.6}$
- D. 0.5×10^{-2}
- * E. 2×10^{-2}

(NAEP)

Reference:

2.1.11.A Model and compare values of **irrational** and **complex numbers**.

2.1.11.D Use **exponential**, **scientific**, and calculator notation to represent any **rational number**.

2.1.8.B Represent and use numbers in **equivalent** forms (e.g., **integers**, fractions, decimals, percents, **exponents**, **scientific notation**, square roots, **absolute values**).

2.1.11.B Use factoring to create **equivalent** forms of **polynomials**.

M11.A Numbers and Operations**Reporting Category**

ASSESSMENT ANCHOR

M11.A.1 Demonstrate an understanding of numbers, ways of representing numbers, relationships among numbers and number systems.

ELIGIBLE CONTENT

M11.A.1.2 Apply number theory concepts to show relationships between real numbers in problem solving settings.

M11.A.1.2.1 Find the Greatest Common Factor (GCF) and/or the Least Common Multiple (LCM) for sets of monomials.

EXAMPLE ITEMS**Reference:**

2.1.11.E Apply the concepts of **prime** and **composite polynomials** to determine GCFs (Greatest Common Factor) and LCMs (Least Common Multiple) of **polynomials**.

M11.A Numbers and Operations**Reporting Category**

ASSESSMENT ANCHOR

M11.A.1 Demonstrate an understanding of numbers, ways of representing numbers, relationships among numbers and number systems.

ELIGIBLE CONTENT

M11.A.1.3 Estimate the value of an irrational number.

M11.A.1.3.1 Locate/identify irrational numbers at the approximate location on a number line.

M11.A.1.3.2 Compare and/or order any real numbers (rational and irrational may be mixed).

EXAMPLE ITEMS**Reference:**

2.1.11.A Model and compare values of **irrational** and **complex numbers**.

M11.A Numbers and Operations
Reporting Category

ASSESSMENT ANCHOR

M11.A.2 Understand the meanings of operations, use operations and understand how they relate to each other.

ELIGIBLE CONTENT

M11.A.2.1 Apply ratio and/or proportion in problem-solving situations.

M11.A.2.1.1 Solve problems using operations with rational numbers including rates and percents (single and multi-step and multiple procedure operations) (e.g., distance, work and mixture problems, etc.).

M11.A.2.1.2 Solve problems using direct and inverse proportions.

M11.A.2.1.3 Identify and/or use proportional relationships in problem solving settings.

EXAMPLE ITEMS

- Mr. Morris is making a dollhouse with toy furniture. He uses 0.5 inches to represent 1 foot. What would be the dimensions of a toy table representing a table 6 feet long, 3 feet wide and 30 inches high?
 - A. 3 inches long, 1.25 inches wide and 1.5 inches high
 - ★ B. 3 inches long, 1.5 inches wide and 1.25 inches high
 - C. 12 inches long, 6 inches wide and 5 inches high
 - D. 3 inches long, 1.5 inches wide and 15 inches high

(Pennsylvania Department of Education)

Reference:

2.1.8.C Use **ratio** and **proportion** to model relationships between quantities.

2.2.8.B Add, subtract, multiply, and divide different kinds and forms of **rational numbers** including **integers**, decimal fractions, percents, and proper and improper fractions.

2.2.11.C Evaluate numerical **expressions** that include the four basic operations and operations of **powers** and **roots**, **reciprocals**, opposites, and **absolute values**.

M11.A Numbers and Operations
Reporting Category

ASSESSMENT ANCHOR

M11.A.2 Understand the meanings of operations, use operations and understand how they relate to each other.

ELIGIBLE CONTENT

M11.A.2.2 Use exponents, roots and/or absolute value to solve problems.

M11.A.2.2.1 Simplify/evaluate expressions involving positive and negative exponents, roots and/or absolute value (may contain all types of real numbers - exponents should not exceed power of 10).

M11.A.2.2.2 Simplify/evaluate expressions involving multiplying with exponents (e.g. $x^6 * x^7 = x^{13}$), powers of powers (e.g., $(x^6)^7 = x^{42}$) and powers of products $(2x^2)^3 = 8x^6$ (positive exponents only).

EXAMPLE ITEMS
Reference:

2.2.11.C Evaluate numerical **expressions** that include the four basic operations and operations of **powers** and **roots, reciprocals**, opposites, and **absolute values**.

2.1.11.D Use **exponential, scientific**, and calculator notation to represent any **rational number**.

2.1.11.F Understand the concepts of **exponential** and **logarithmic** forms and use the **inverse** relationships between **exponential** and **logarithmic expression** to determine unknown quantities in **equations**.

M11.A Numbers and Operations**Reporting Category**

ASSESSMENT ANCHOR**M11.A.3 Compute accurately and fluently and make reasonable estimates.****ELIGIBLE CONTENT****M11.A.3.1** Apply the order of operations in computation and in problem-solving situations.**M11.A.3.1.1** Simplify/evaluate expressions using the order of operations to solve problems (any rational numbers may be used).

EXAMPLE ITEMS**Reference:****2.2.8.C** Use the **order of operations** to evaluate numerical **expressions**.**2.2.11.C** Evaluate numerical **expressions** that include the four basic operations and operations of **powers** and **roots, reciprocals**, opposites, and **absolute values**.

M11.A Numbers and Operations

Reporting Category

ASSESSMENT ANCHOR

M11.A.3 Compute accurately and fluently and make reasonable estimates.

ELIGIBLE CONTENT

M11.A.3.2 Use estimation strategies in problem-solving situations.

M11.A.3.2.1 Use estimation to solve problems.

EXAMPLE ITEMS

- At the start of the month, the counter on the copy machine read 6,583. At the end of the month, it read 82,110. The copies cost $1\frac{1}{3}$ cents a piece. What was the approximate total cost of the copies for this month?

- A. \$10,000.00
- B. \$2,200.00
- * C. \$1,000.00
- D. \$200.00

(Pennsylvania Department of Education)

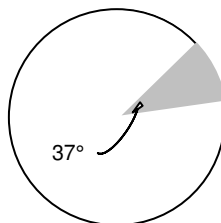
- Mrs. Ditters and her daughter went to lunch. Their bill came to \$27.29. If a fair tip is between 15 and 20 percent, what would be a fair tip to leave their waiter?

- A. \$2.00
- B. \$2.72
- * C. \$5.00
- D. \$20.00

(Pennsylvania Department of Education)

- The entire circle shown below represents a total of 2,675 radios sold. Of the following, which is the best approximation of the number of radios represented by the shaded sector of the circle?

- B. 70
- * C. 275
- D. 985
- E. 25880
- F. 98420

*(NAEP)***Reference:**

2.2.8.D Estimate the values of **irrational numbers** and the results from calculations with basic operations of fractions and percents and check the **reasonableness** of those estimates.

2.2.7.D Estimate solutions of problems involving calculations with basic operations of whole numbers, decimals, fractions, or mixed numbers and check the **reasonableness** of those estimates.

M11.B Measurement

Reporting Category

ASSESSMENT ANCHOR

M11.B.1 Demonstrate an understanding of measurable attributes of objects and figures, and the units, systems and processes of measurement.

ELIGIBLE CONTENT

Not assessed at grade 11.

EXAMPLE ITEMS

M11.B Measurement

Reporting Category

ASSESSMENT ANCHOR

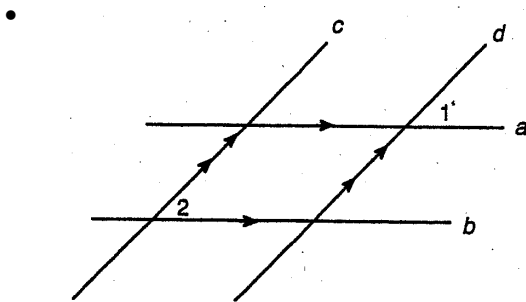
M11.B.2 Apply appropriate techniques, tools and formulas to determine measurements.

ELIGIBLE CONTENT

M11.B.2.1 Use and/or compare measurements of angles.

M11.B.2.1.1 Measure and/or compare angles in degrees (up to 360°) (protractor must be provided or drawn).

EXAMPLE ITEMS

Given: $a \parallel b$, $c \parallel d$ If $m \angle 1 = 2x + 16$ and $m \angle 2 = x + 14$, then what is the value of x ?

- A. -10
- * B. -2
- C. 2
- D. 10

*(Pennsylvania Department of Education)***Reference:**

- 2.3.8.C** Calculate **volume**, surface area, and degrees of angles; calculate circumference and area of circles, and use a measurement formula to solve for a missing quantity.
- 2.3.11.C** Use properties of geometric figures and measurement formulas to solve for a missing quantity (e.g., the measure of a specific angle created by **parallel lines** and a **transversal**).
- 2.3.5.B** Select and use appropriate instruments and units for measuring quantities to a specified level of accuracy.

M11.B Measurement

Reporting Category

ASSESSMENT ANCHOR

M11.B.2 Apply appropriate techniques, tools and formulas to determine measurements.

ELIGIBLE CONTENT

M11.B.2.2 Use and/or develop procedures to determine or describe measures of perimeter, circumference, area, surface area and/or volume. (May require conversions within the same system.)

M11.B.2.2.1 Calculate the surface area of prisms, cylinders, cones, pyramids and/or spheres. Formulas are provided on the reference sheet.

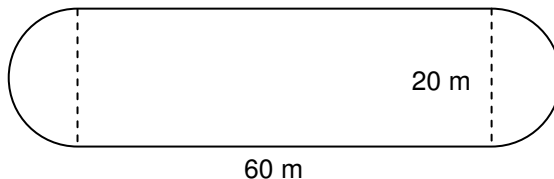
M11.B.2.2.2 Calculate the volume of prisms, cylinders, cones, pyramids and/or spheres. Formulas are provided on the reference sheet.

M11.B.2.2.3 Estimate area, perimeter or circumference of an irregular figure.

M11.B.2.2.4 Find the measurement of a missing length given the perimeter, circumference, area or volume.

EXAMPLE ITEMS

- The inside rail of a running track consists of a rectangle with a semicircle at each end as shown in the figure below. Find the approximate area surrounded by the track rail.



- A. 1200 m^2
- B. 2456 m^2
- * C. 1514 m^2
- D. 160 m^2

(Pennsylvania Department of Education)

Reference:

2.3.8.C Calculate **volume**, surface area, and degrees of angles; calculate circumference and area of circles, and use a measurement formula to solve for a missing quantity.

2.3.11.C Use properties of geometric figures and measurement formulas to solve for a missing quantity (e.g., the measure of a specific angle created by **parallel lines** and a **transversal**).

2.3.5.C Calculate perimeter and area, and sums and differences of measurements.

2.3.7.C Use measurement formulas to calculate **volume**, area, and perimeter and to calculate circumference and area of circles.

2.3.7.F Estimate and verify measurements of length, perimeter, area, **volume**, capacity, temperature, time, weight, and angles.

M11.B Measurement

Reporting Category

ASSESSMENT ANCHOR**M11.B.2 Apply appropriate techniques, tools and formulas to determine measurements.**

M11.B.2.3 Describe how a change in one dimension of a figure (2 or 3 dimensional) affects other measurements of that figure.

ELIGIBLE CONTENT

M11.B.2.3.1 Describe how a change in the linear dimension of a figure affects its perimeter, circumference, area or volume.

- How does changing the length of the radius of a circle affect the circumference of the circle?
- How does changing the length of the edge of a cube affect the volume of the cube?
- How does changing the length of the base of a triangle affect the area of the triangle?

EXAMPLE ITEMS**Reference:**

2.3.11.E Describe how a change in the value of one **variable** in a formula affects the value of the measurement.

M11.D Algebraic Concepts**Reporting Category****ASSESSMENT ANCHOR**

M11.C.1 Analyze characteristics and properties of two- and three- dimensional geometric shapes and demonstrate understanding of geometric relationships.

ELIGIBLE CONTENT

M11.C.1.1 Identify and/or use parts of circles and segments associated with circles.

M11.C.1.1.1 Identify and/or use the properties of a radius, diameter and/or tangent of a circle (given numbers should be whole.)

M11.C.1.1.2 Identify and/or use the properties of arcs, semicircles, inscribed angles and/or central angles.

EXAMPLE ITEMS**Reference:**

2.9.8.A Name, describe and apply geometric relations for 1- dimensional shapes and 2- dimensional shapes and 3- dimensional solids.

2.9.11.A Create justifications for arguments related to geometric relations.

M11.D Algebraic Concepts

Reporting Category

ASSESSMENT ANCHOR

M11.C.1 Analyze characteristics and properties of two- and three- dimensional geometric shapes and demonstrate understanding of geometric relationships.

ELIGIBLE CONTENT

M11.C.1.2 Recognize and/or apply properties of angles, triangles and quadrilaterals.

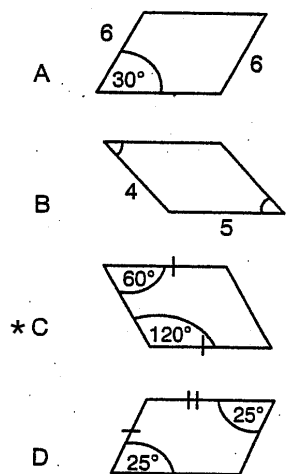
M11.C.1.2.1 Identify and/or use properties of triangles (e.g., medians, altitudes, angle bisectors, side/angle relationships, Triangle Inequality Theorem).

M11.C.1.2.2 Identify and/or use properties of quadrilaterals (e.g., parallel sides, diagonals, bisectors, congruent sides/angles and supplementary angles).

M11.C.1.2.3 Identify and/or use properties of isosceles and equilateral triangles

EXAMPLE ITEMS

- Which picture provides enough information to prove that the figure is a parallelogram?



(Pennsylvania Department of Education)

Reference:

2.9.8.A Name, describe and apply geometric relations for 1- dimensional shapes and 2- dimensional shapes and 3- dimensional solids.

2.9.11.A Create justifications for arguments related to geometric relations.

M11.D Algebraic Concepts

Reporting Category

ASSESSMENT ANCHOR

M11.C.1 Analyze characteristics and properties of two- and three- dimensional geometric shapes and demonstrate understanding of geometric relationships.

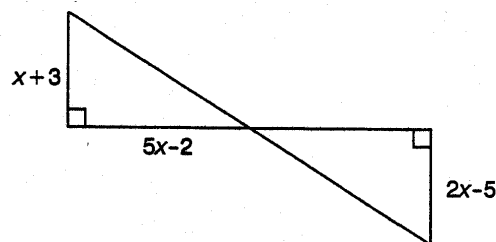
ELIGIBLE CONTENT

M11.C.1.3 Use properties of congruence, correspondence and similarity in problem-solving settings involving two- and three- dimensional figures.

M11.C.1.3.1 Identify and/or use properties of congruent and similar polygons or solids.

EXAMPLE ITEMS

- Given that the triangles shown are congruent, find the value of x .



- A. $\frac{5}{4}$
- B. -1
- * C. 8
- D. $-\frac{3}{2}$

(Pennsylvania Department of Education)

Reference:

2.9.8.A Name, describe and apply geometric relations for 1- dimensional shapes and 2- dimensional shapes and 3- dimensional solids.

2.9.11.B Use arguments based on **transformations** to establish **congruence** or **similarity** of 2- dimensional shapes.

M11.D Algebraic Concepts

Reporting Category

ASSESSMENT ANCHOR

M11.C.1 Analyze characteristics and properties of two- and three- dimensional geometric shapes and demonstrate understanding of geometric relationships.

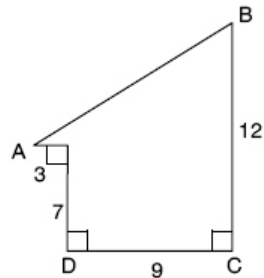
ELIGIBLE CONTENT

M11.C.1.4 Solve problems involving right triangles using the Pythagorean Theorem.

M11.C.1.4.1 Find the measure of a side of a right triangle using the Pythagorean Theorem (Pythagorean Theorem included on the reference sheet).

EXAMPLE ITEMS

- Find the length of segment AB in the figure below.



NOTE: Figure is NOT drawn to scale.

- A. 8
- * B. 13
- C. 14
- D. 15

(Pennsylvania Department of Education)

Reference:

2.10.11.A Identify, create, and solve practical problems involving right triangles using the **trigonometric functions** and the Pythagorean Theorem.

M11.D Algebraic Concepts

Reporting Category

ASSESSMENT ANCHOR

M11.C.2 Identify and/or apply concepts of transformations or symmetry.

ELIGIBLE CONTENT

Not assessed at grade 11.

EXAMPLE ITEMS

M11.D Algebraic Concepts

Reporting Category

ASSESSMENT ANCHOR

M11.C.3 Locate points or describe relationships using the coordinate plane.

ELIGIBLE CONTENT

M11.C.3.1 Solve problems using analytic geometry.

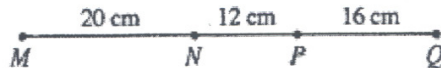
M11.C.3.1.1 Calculate the distance and/or midpoint between 2 points on a number line or on a coordinate plane (formula provided on the reference sheet).

M11.C.3.1.2 Relate slope to perpendicularity and/or parallelism (limit to linear algebraic expressions; slope formula provided on the reference sheet).

EXAMPLE ITEMS

- What is the distance between the points (2,10) and (-4,2) in the xy-plane?
 - A. 6
 - B. 8
 - * C. 10
 - D. 14
 - E. 18

(NAEP)



- What is the distance between the midpoint of MN and the midpoint of PQ shown above?
 - A. 18 cm
 - B. 24 cm
 - C. 26 cm
 - D. 28 cm
 - * E. 30 cm

(NAEP)

Reference:

2.9.8.C Plot ordered pairs and 2-dimensional shapes that satisfy given conditions on a 2-dimensional **coordinate system**.

2.9.7.C Identify on a 2-dimensional **coordinate system** the location of points with **rational number** coordinates; plot in a two-dimensional **coordinate system** a point represented by an ordered pair of **rational numbers**.

2.9.11.C Use techniques from coordinate geometry to establish properties of lines, shapes, and solids.

M11.D Algebraic Concepts

Reporting Category

ASSESSMENT ANCHOR

M11.D.1 Demonstrate an understanding of patterns, relations and functions.

M11.D.1.1 Analyze and/or use patterns or relations.

ELIGIBLE CONTENT

M11.D.1.1.1 Analyze a set of data for the existence of a pattern and represent the pattern algebraically and/or graphically.

M11.D.1.1.2 Determine if a relation is a function given a set of points or a graph.

M11.D.1.1.3 Identify the domain, range or inverse of a relation (may be presented as ordered pairs or a table).

EXAMPLE ITEMS

- Which of the following best describes the pattern 4, 8, 12, ...?

- A. $1 + n, 4 + n, 8 + n, \dots$
- B. n^2, n^3, n^4, \dots
- * C. $n, 2n, 3n, \dots$
- D. $n, \frac{n}{2}, \frac{n}{3}, \dots$

(Pennsylvania Department of Education)

- What is the next term in the sequence below?
1, 8, 27, 64, ...

- A. 5
- B. 25
- C. 96
- * D. 125

(Pennsylvania Department of Education)



- If this pattern of dot-figures is continued, how many dots will be in the 100th figure?

- A. 100
- B. 101
- * C. 199
- D. 200
- E. 201

(NAEP)

Reference:

2.8.11.C Recognize, describe and generalize patterns using sequences and series to predict long-term outcomes.

2.8.8.C Find the missing elements and recognize, describe, and extend **patterns** to include **linear**, **exponential**, and simple **quadratic equations**.

M11.D Algebraic Concepts**Reporting Category**

- 2.8.11.D** Demonstrate an understanding and apply properties of functions (**domain**, range, **inverses**) and characteristics of families of functions (**linear**, **polynomial**, **rational**, **trigonometric**, **exponential**, **logarithmic**).
- 2.8.11.E** Use combinations of symbols and numbers to create **expressions**, **equations**, and **inequalities** in two or more **variables**, **systems of equations** and **inequalities**, and functional relationships that model problem situations.

M11.D Algebraic Concepts

Reporting Category

ASSESSMENT ANCHOR

M11.D.2 Represent and/or analyze mathematical situations using numbers, symbols, words, tables and/or graphs.

M11.D.2.1 Write, solve and/or graph linear equations and inequalities using various methods.

ELIGIBLE CONTENT

M11.D.2.1.1 Solve compound inequalities and/or graph their solution sets on a number line (may include absolute value inequalities).

M11.D.2.1.2 Identify or graph functions, linear equations or linear inequalities on a coordinate plane.

M11.D.2.1.3 Write, solve and/or apply a linear equation (including problem situations).

M11.D.2.1.4 Write and/or solve systems of equations using graphing, substitution and/or elimination (limit systems to 2 equations).

M11.D.2.1.5 Solve quadratic equations using factoring (integers only – not including completing the square or the Quadratic Formula).

EXAMPLE ITEMS

- If $f(x) = 5x - 3$ and $f(x) = 7$,
What is the value of x ?
A. -3
* B. 2
C. 5
D. 7
- If $f(x) = \frac{2x+1}{3}$ and $g(x) = 2x^2 + 2$,
then $f(g(2)) =$
A. 3
B. 5
* C. 7
D. $7\frac{5}{9}$
E. $16\frac{2}{3}$

(Kentucky Department of Education)

Reference:

(NAEP)

2.8.11.B Evaluate and simplify algebraic **expressions** and solve and graph linear, **quadratic**, **exponential**, and **logarithmic equations and inequalities**, and solve and graph **systems of equations and inequalities**.

2.8.8.D Create a table or graph from a functional rule.

2.8.11.E Use combinations of symbols and numbers to create **expressions, equations, and inequalities** in two or more **variables, systems of equations and inequalities**, and functional relationships that model problem situations.

2.8.11.F Interpret the results of solving **equations, inequalities, systems of equations, and inequalities** in the context of the situation that motivated the model.

M11.D Algebraic Concepts**Reporting Category****ASSESSMENT ANCHOR**

M11.D.2 Represent and/or analyze mathematical situations using numbers, symbols, words, tables and/or graphs.

M11.D.2.2 Simplify expressions involving polynomials.

ELIGIBLE CONTENT

M11.D.2.2.1 Add, subtract and/or multiply polynomial expressions (express answers in simplest form – nothing larger than a binomial multiplied by a trinomial).

M11.D.2.2.2 Factor algebraic expressions, including difference of squares and trinomials (trinomials limited to the form ax^2+bx+c where a is not equal to 0).

M11.D.2.2.3 Simplify algebraic fractions.

EXAMPLE ITEMS**Reference:**

2.8.11.B Evaluate and simplify algebraic **expressions** and solve and graph linear, **quadratic**, **exponential**, and **logarithmic equations** and **inequalities**, and solve and graph **systems of equations** and **inequalities**.

M11.D Algebraic Concepts**Reporting Category****ASSESSMENT ANCHOR****M11.D.3 Analyze change in various contexts.****ELIGIBLE CONTENT****M11.D.3.1** Describe and/or determine change.**M11.D.3.1.1** Identify, describe and/or use constant or varying rates of change.**M11.D.3.1.2** Determine how a change in one variable relates to a change in a second variable (e.g., $y=4/x$, if x doubles, what happens to y ?).**EXAMPLE ITEMS**

- Yearly college tuition increased from \$16,000 in 1996 to \$20,000 in the year 2000. What is the **annual** rate of increase?

- A. 2.5%
- *B. 5.7%
- C. 8%
- D. 20%

(Pennsylvania Department of Education)

- A certain culture of 5,000 bacteria triples every 43 minutes. Let B = the number of bacteria t minutes after the start of the count. Which equation models the situation?

- A. $B = 5000 + 43t$
- B. $B = 43t^2 + 5000$
- *C. $B = 5000 \cdot 3^{t/43}$
- D. $B = 5000 + 3 \cdot 43t$

*(Pennsylvania Department of Education)***Reference:****2.11.8.B** Describe the concept of unit rate, **ratio**, and **slope** in the context of rate of change.**2.11.5.B** Describe the relationship between **rates of change** and another **variable** (e.g., time, temperature).**2.8.8.D** Create a table or graph from a functional rule.

M11.D Algebraic Concepts

Reporting Category

ASSESSMENT ANCHOR

M11.D.3 Analyze change in various contexts.

M11.D.3.2 Compute and/or use the slope of a line.

ELIGIBLE CONTENT

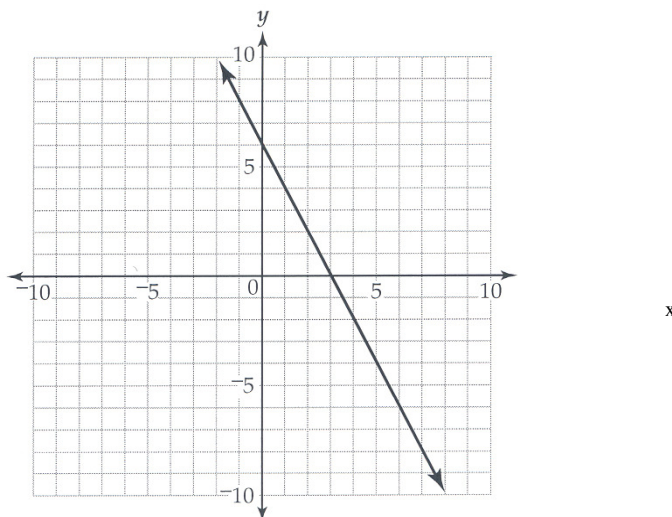
M11.D.3.2.1 Apply the formula for the slope of a line to solve problems (formula given on reference sheet).

M11.D.3.2.2 Given the graph of the line, 2 points on the line, or the slope and a point on a line, write or identify the linear equation in point-slope, standard and/or slope-intercept form.

M11.D.3.2.3 Compute the slope and/or y-intercept represented by a linear equation or graph.

EXAMPLE ITEMS

- Look at the line that is graphed below.



Which of these equations describes the line?

- * A. $y = -2x + 6$
- B. $y = -\frac{1}{2}x + 6$
- C. $y = \frac{1}{2}x + 6$
- D. $y = 2x + 6$

(Massachusetts Department of Education)

Reference:

2.11.8.B Describe the concept of unit rate, **ratio**, and **slope** in the context of rate of change.

2.9.11.A Create justifications for arguments related to geometric relations.

2.8.8.D Create a table or graph from a functional rule.

2.11.8.B Describe the concept of unit rate, **ratio**, and **slope** in the context of rate of change.

M11.D Algebraic Concepts

Reporting Category

ASSESSMENT ANCHOR

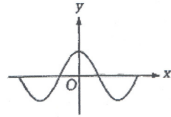
M11.D.4 Describe or use models to represent quantitative relationships.

ELIGIBLE CONTENT

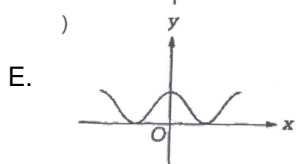
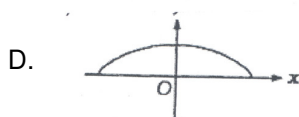
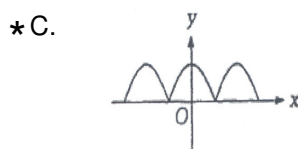
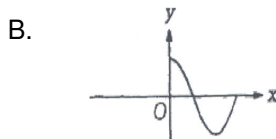
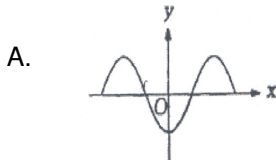
M11.D.4.1 Interpret and/or use linear, quadratic and/or exponential functions and their equations, graphs or tables.

M11.D.4.1.1 Match the graph of a given function to its table or equation.

EXAMPLE ITEMS



- The figure above shows the graph of $y = f(x)$. Which of the following could be the graph of $y = |f(x)|$?

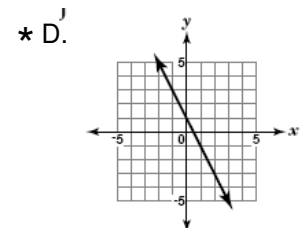
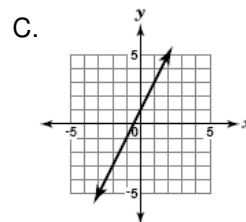
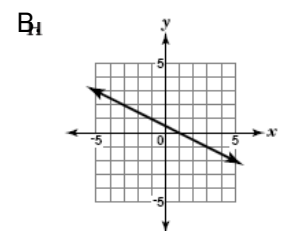
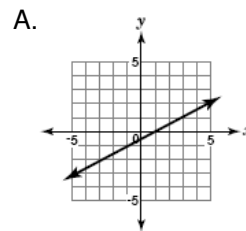


(NAEP)

- The table below shows a linear relationship between x and y .

x	-2	-1	0	1	2
y	5	3	1	-1	-3

Which of these graphs shows this relationship?



(Maryland Department of Education)

Reference:

2.8.5.D Determine a functional rule from a table or graph.

2.8.8.D Create a table or graph from a functional rule.

2.11.8.B Describe the concept of unit rate, **ratio**, and **slope** in the context of rate of change.

2.8.11.E Use combinations of symbols and numbers to create **expressions, equations, and inequalities** in two or more **variables, systems of equations and inequalities**, and functional relationships that model problem situations.

M11.E Data Analysis and Probability
Reporting Category

ASSESSMENT ANCHOR

M11.E.1 Formulate or answer questions that can be addressed with data and/or organize, display, interpret or analyze data.

ELIGIBLE CONTENT

M11.E.1.1 Appropriately display and/or use data in problem-solving settings.

M11.E.1.1.1 Create and/or use appropriate graphical representations of data, including box-and-whisker plots, stem-and-leaf plots or scatter plots.

M11.E.1.1.2 Analyze data and/or answer questions based on displayed data (box-and-whisker plots, stem-and-leaf plots or scatter plots).

EXAMPLE ITEMS

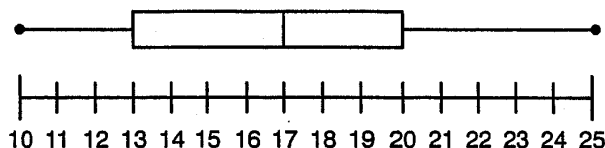
Year	Number of Traffic Deaths in Pennsylvania
1990	205
1991	
1992	191
1993	184

The above relationship is linear. Predict the number of highway deaths in the year 2005.

- A. 93
- *B. 100
- C. 107
- D. 114

(Pennsylvania Department of Education)

- Look at the box-and-whisker plot below. What range of values contains 50% of the data?



- A. 10 – 20
- B. 13 – 25
- *C. 17 – 25
- D. 17 – 20

(Pennsylvania Department of Education)

Reference:

2.6.8.B Organize and display one-**variable** data using appropriate data display, such as **stem-and-leaf** and **box-and-whisker plots**, and two **variable** data with **scatterplots**.

2.6.8.D Compare data sets graphically using double-bar and double-line graphs and numerically using **mean, median, mode, range, and quartiles**.

2.6.5.E Determine the **reasonableness** of a statement based on a comparison to data displayed in a graph and summarized by numerical measures.

2.6.5.D Compare data using multiple categories displayed in a graph.

M11.E Data Analysis and Probability

Reporting Category

2.6.5.B Use pictures, tallies, tables, charts, bar graphs, line graphs, diagrams, and graphs to organize, display, and analyze data.

2.6.11.A Design and conduct an experiment using random sampling.

M11.E Data Analysis and Probability
Reporting Category

ASSESSMENT ANCHOR**M11.E.2 Select and/or use appropriate statistical methods to analyze data.****M11.E.2.1** Use measures of central tendency to describe a set of data.**ELIGIBLE CONTENT****M11.E.2.1.1** Calculate or select the appropriate measure of central tendency (mean, mode or median) of a set of data given or represented on a table, line plot or stem-and-leaf plot.**M11.E.2.1.2** Calculate and/or interpret the range, quartiles and interquartile range of data.**M11.E.2.1.3** Describe how outliers affect measures of central tendency.**EXAMPLE ITEMS**

- | | |
|----|------------------------------------|
| 12 | 9 |
| 13 | 3, 6, 7, 7 |
| 14 | 1, 1, 1, 1, 3, 4, 4, 6, 9, 9 |
| 15 | 0, 0, 0, 1, 2, 4, 6, 7, 8, 8, 8, 9 |
| 16 | 1, 6, 7 |

What is the median of the data recorded on the stem-and-leaf plot?

- A. 149
- * B. 149.5
- C. $149.\overline{6}$
- D. 150

(Pennsylvania Department of Education)

Reference:

2.6.11.C Select or calculate the appropriate measure of **central tendency**, calculate and apply the **interquartile range** for one-**variable** data, and construct a **line of best fit** and calculate its **equation** for two-**variable** data.

2.6.5.C Calculate **mean** and **range**, identify the **median** and the **mode** of a set of data, and use these quantities to describe the data.

2.6.8.E Determine the effect of extreme values on numerical summaries and calculate estimates based on survey results or graphs.

M11.E Data Analysis and Probability

Reporting Category

ASSESSMENT ANCHOR

M11.E.3 Understand and/or apply basic concepts of probability or outcomes.

ELIGIBLE CONTENT

M11.E.3.1 Apply probability and/or odds to practical situations.

M11.E.3.1.1 Find probabilities for independent, dependent or compound events and represent as a fraction, decimal or percent).

M11.E.3.1.2 Find, convert and/or compare the probability and/or odds of a simple event.

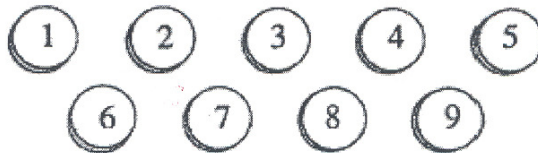
EXAMPLE ITEMS

- If the odds are 3 to 5 that a vehicle randomly selected from a parking lot is a truck, what is the probability that it is not a truck?
 - A. 3 to 5
 - B. 5 to 3
 - C. $\frac{3}{8}$
 - *D. $\frac{5}{8}$

(Pennsylvania Department of Education)

- The chance of rain is $\frac{2}{5}$. What are the odds against rain occurring?
 - A. 2 to 3
 - *B. 3 to 2
 - C. $\frac{3}{8}$
 - D. $\frac{2}{5}$

(Pennsylvania Department of Education)



- The nine chips shown above are placed in a sack and then mixed up. Madeline draws one chip from this sack. What is the probability that Madeline draws a chip with an even number?

- A. $\frac{1}{9}$ B. $\frac{2}{9}$ *C. $\frac{4}{9}$ D. $\frac{1}{2}$ E. $\frac{4}{5}$

(NAEP)

Reference:

2.7.8.A Calculate the **probability** of an event involving “and”, “or” or “not”.

2.7.11.C Compare odds and **probability**.

2.7.11.E Use **probability** to make judgments about the likelihood of various outcomes.

M11.E Data Analysis and Probability**Reporting Category****ASSESSMENT ANCHOR****M11.E.3 Understand and/or apply basic concepts of probability or outcomes.****M11.E.3.2** Apply counting techniques in problem-solving settings.**ELIGIBLE CONTENT****M11.E.3.2.1** Determine the number of permutations and/or combinations or apply the fundamental counting principle. (Formula provided on the reference sheet).**EXAMPLE ITEMS**

- A contractor is building 5 different model homes on 5 adjacent lots on one side of a street. If 1 house is to be built on each lot, how many different arrangements of the 5 houses are possible?
 - * A. 120
 - B. 60
 - C. 25
 - D. 10
 - E. 5

(NAEP)

Reference:**2.7.8.C** Determine the number of **combinations** and **permutations** for an event.

M11.E Data Analysis and Probability
Reporting Category**ASSESSMENT ANCHOR**

M11.E.4 Develop and/or evaluate inferences and predictions or draw conclusions based on data or data displays.

ELIGIBLE CONTENT

M11.E.4.1 Make predictions using data displays and probability.

M11.E.4.1.1 Estimate or calculate to make predictions based on a circle, line, bar graph or given situation.

M11.E.4.1.2 Use probability to predict outcomes.

EXAMPLE ITEMS

- From a shipment of 500 batteries, a sample of 25 was selected at random and tested. If 2 batteries in the sample were found to be dead, how many dead batteries would be expected in the entire shipment?
 - A. 10
 - B. 20
 - C. 30
 - * D. 40
 - E. 50

(NAEP)

Reference:

2.7.11.A Use **probability** to predict the likelihood of an outcome in an experiment.

2.7.11.E Use **probability** to make judgments about the likelihood of various outcomes.

2.6.5.E Determine the **reasonableness** of a statement based on a comparison to data displayed in a graph and summarized by numerical measures.

M11.E Data Analysis and Probability

Reporting Category

ASSESSMENT ANCHOR

M11.E.4 Develop and evaluate inferences and predictions or draw conclusions based on data or data displays.

ELIGIBLE CONTENT

M11.E.4.2 Analyze and/or interpret data on a scatter plot and/or use a scatter plot to make predictions.

M11.E.4.2.1 Draw, find and/or write an equation for a line of best fit for a scatter plot.

M11.E.4.2.2 Make predictions using the equations or graphs of best-fit lines of scatter plots.

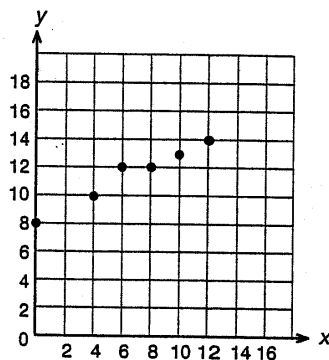
EXAMPLE ITEMS

- The annual maintenance cost of an appliance is given by the regression equation $y = 12.5x + 19.2$, where y represents the total maintenance cost and x represents the age of the appliance in years. Rounded to the nearest dollar, what is the expected maintenance cost of a 14-year-old appliance?

- A. \$ 33
- B. \$156
- * C. \$194
- D. \$281

(Pennsylvania Department of Education)

- Which of the given equations most closely represents the line of best fit for the scatter plot given below?



- A. $y = 2x + 8$
- * B. $y = \frac{1}{2}x + 8$
- C. $y = -\frac{1}{2}x + 8$
- D. $y = -2x + 8$

(Pennsylvania Department of Education)

Reference:

- 2.6.11.E** Make predictions based on **lines of best fit** or draw conclusions on the value of a **variable** in a population based on the results of a sample.
- 2.6.5.B** Use pictures, tallies, tables, charts, bar graphs, line graphs, diagrams, and graphs to organize, display, and analyze data.
- 2.6.5.E** **Determine** the **reasonableness** of a statement based on a comparison to data displayed in a graph and summarized by numerical measures.

M11.E Data Analysis and Probability

Reporting Category
