**Computer-Based Released Items**
**Grade 10 Mathematics**
**Spring 2021**

The spring 2021 grade 10 Mathematics test was administered in two primary formats: a computer-based version and a paper-based version. The vast majority of students took the computer-based test. The paper-based test was offered as an accommodation for students with disabilities who are unable to use a computer, as well as for English learners who are new to the country and are unfamiliar with technology.

The Department of Elementary and Secondary Education is releasing items from both versions of the test to provide information about the knowledge and skills that students are expected to demonstrate.

- Released items from the **computer-based test** are available online at mcas.pearsonsupport.com/released-items. The computer-based released items are collected in a mini test called an ePAT (electronic practice assessment tool). Items in the ePAT are displayed in TestNav 8, the testing platform for the computer-based tests.

- Released items from the **paper-based test** are available in PDF format on the Department's website at www.doe.mass.edu/mcas/testitems.html.

This document provides information about each released item from the *computer-based test*, including: reporting category, standard(s) covered, item type, item description, and correct answer (for selected-response items only). Scoring rubrics are also provided for released constructed-response items.

**A Note about Testing Mode**

Most of the operational items on the grade 10 Mathematics test were the same, regardless of whether a student took the computer-based version or the paper-based version. In places where a technology-enhanced item was used on the computer-based test, an adapted version of the item was created for use on the paper test. These adapted paper items were multiple-choice, multiple-select, or short-answer items that tested the same Mathematics content and assessed the same standard as the technology-enhanced item.

# Grade 10 Mathematics
## Spring 2021 Computer-Based Released Operational Items

| CBT Item No. | Reporting Category | Standard | Item Type* | Item Description | Correct Answer** |
|---|---|---|---|---|---|
| 1 | Geometry | G-SRT.A.1 | SR | Determine which graph shows a triangle and its image after a dilation. | A |
| 2 | Number and Quantity | N-Q.A.2 | SR | Use modeling and estimation techniques to solve a real-world problem. | B |
| 3 | Algebra and Functions | A-REI.D.11 | SR | Select the values that make a given quadratic equation true. | D,E |
| 4 | Statistics and Probability | S-ID.A.1 | SA | Complete a histogram using a given set of data. | *see page 5* |
| 5 | Algebra and Functions | A-REI.C.7 | SR | Solve a system consisting of the equations of a line and a circle. | B,D |
| 6 | Geometry | G-GPE.B.5 | CR | Write equations of lines that are parallel and perpendicular to given lines passing through given points. | *see page 5* |
| 7 | Geometry | G-CO.B.6 | SR | Determine whether various transformations performed on a triangle will result in a congruent image. | *see page 6* |
| 8 | Algebra and Functions | A-REI.C.5 | SR | Choose a system of equations that has the same solution as a given system of linear equations. | C |
| 9 | Statistics and Probability | S-ID.A.3 | SR | Determine the effect on the mean if an outlier is removed from a set of data. | B |
| 10 | Algebra and Functions | F-IF.A.2 | SR | Find a specified term in an arithmetic sequence that is represented by a given function. | A |
| 11 | Number and Quantity | N-RN.B.3 | SR | Solve equations that contain rational and irrational numbers. | *see page 6* |
| 12 | Algebra and Functions | A-APR.A.1 | SR | Multiply a monomial and a binomial to identify an equivalent expression. | D |
| 13 | Number and Quantity | N-RN.A.1 | CR | Translate between radical and exponential representations of different expressions and create a radical expression based on stated parameters. | *see page 7* |

| | | | | | |
|---|---|---|---|---|---|
| 14 | Algebra and Functions | F-LE.A.2 | SR | Use the values of a function in a table to describe an exponential function and determine which equation models the function. | D;B |
| 15 | Algebra and Functions | A-REI.B.4 | SR | Find the solutions of a quadratic equation. | B |
| 16 | Algebra and Functions | F-IF.A.3 | SR | Find a specified term in a geometric sequence, given the value of two other terms in the sequence. | B |
| 17 | Number and Quantity | N-Q.A.2 | SR | Use a mathematical model to estimate a quantity in a real-world situation. | D |
| 18 | Algebra and Functions | A-REI.C.6 | SA | Solve and graph a system of linear equations. | *see page 8* |
| 19 | Statistics and Probability | S-ID.B.6 | SR | Use the line of best fit for data in a scatter plot to predict a value in a real-world situation. | B |
| 20 | Algebra and Functions | A-CED.A.2 | SR | Determine which equation describes the relationship between two variables in a real-world context. | B |
| 21 | Algebra and Functions | F-LE.A.3 | SR | Use the graphs of three different functions to compare how they increase as the independent variable increases. | *see page 8* |
| 22 | Geometry | G-SRT.C.8 | SR | Use the Pythagorean Theorem to determine the missing side length of a triangle in a real-world context. | A |
| 23 | Algebra and Functions | F-BF.A.2 | SR | Analyze an algebraic sequence that represents a real-world situation. | *see page 9* |
| 24 | Geometry | G-SRT.B.5 | SR | Use proportions to find a missing side length in a diagram displaying similar triangles. | B |
| 25 | Geometry | G-GMD.A.3 | SR | Use the volume formula for a cone to solve a real-world problem. | B |
| 26 | Geometry | G-GPE.B.6 | SR | Locate a point on a line segment, graphed on a coordinate plane, that divides the segment in a specified ratio. | A |
| 27 | Statistics and Probability | S-ID.B.5 | CR | Calculate relative frequencies based on data displayed in a two-way table. | *see page 9* |
| 28 | Number and Quantity | N-Q.A.3 | SR | Determine the effects of rounding on measurements in a real-world situation. | *see page 9* |

| 29 | Geometry | G-SRT.C.6 | SR | Use trigonometric ratios to determine a missing side length in a right triangle. | B |
|---|---|---|---|---|---|
| 30 | Geometry | G-CO.A.1 | SR | Match geometric terms with their definitions. | *see page 10* |
| 31 | Geometry | G-CO.A.2 | SR | Determine the coordinates of a vertex of a triangle, graphed on a coordinate plane, after a sequence of transformations. | B |
| 32 | Geometry | G-GMD.A.1 | SA | Determine the volume of a cylinder, and compare the volumes of other cylinders that have similar dimensions. | *see page 10* |
| 33 | Algebra and Functions | A-REI.B.3 | SR | Solve a compound linear inequality that represents a real-world problem. | C |
| 34 | Algebra and Functions | A-CED.A.1 | CR | Write and solve a linear equation and linear inequalities based on a real-world situation. | *see page 11* |
| 35 | Geometry | G-CO.A.3 | SR | Determine the coordinates of a vertex of a parallelogram after a reflection and the sequence of transformations that would map the parallelogram onto itself. | A;B |
| 36 | Geometry | G-CO.A.5 | SA | Graph the image of a point on a coordinate plane after a reflection over a given line. | *see page 11* |
| 37 | Geometry | G-CO.C.9 | SR | Identify the theorem about parallel lines and transversals that proves two pairs of angles in a diagram are congruent. | C |
| 38 | Algebra and Functions | F-IF.B.5 | SR | Identify the domain of a function based on a real-world situation. | B |
| 39 | Statistics and Probability | S-CP.A.4 | SA | Complete a two-way frequency table and use the table to calculate a conditional probability. | 184;B |
| 40 | Geometry | G-C.A.2 | SR | Determine the measure of an angle in a triangle inscribed in a circle. | B |
| 41 | Algebra and Functions | F-IF.B.6 | SR | Calculate the average rate of change of an exponential function over a given interval. | *see page 12* |
| 42 | Geometry | G-GPE.B.7 | SR | Calculate the perimeter of a trapezoid graphed on a coordinate plane. | C |

\* Mathematics item types are selected-response (SR), short-answer (SA), and constructed-response (CR).

\*\*Answers are provided here for selected-response and short-answer items only. Pages 6 through 13 of this document provide correct answers for technology-enhanced (TE) items and scoring rubrics for constructed-response items. Sample responses and scoring guidelines for constructed-response items will be posted to the Department's website later this year.

**Correct Answer for CBT Item #4: Technology-Enhanced Item**



**Customer Satisfaction**

**Rubric for CBT Item #6: Constructed Response**

| Scoring Guide | |
|---|---|
| **Score** | **Description** |
| **4** | The student response demonstrates an exemplary understanding of the Geometry concepts involved in proving the slope criteria for parallel and perpendicular lines and using them to solve geometric problems. The student writes equations of lines that are parallel and perpendicular to given lines passing through given points. |
| **3** | The student response demonstrates a good understanding of the Geometry concepts involved in proving the slope criteria for parallel and perpendicular lines and using them to solve geometric problems. Although there is significant evidence that the student was able to recognize and apply the concepts involved, some aspect of the response is flawed. As a result, the response merits 3 points. |
| **2** | The student response demonstrates a fair understanding of the Geometry concepts involved in proving the slope criteria for parallel and perpendicular lines and using them to solve geometric problems. While some aspects of the task are completed correctly, others are not. The mixed evidence provided by the student merits 2 points. |
| **1** | The student response demonstrates a minimal understanding of the Geometry concepts involved in proving the slope criteria for parallel and perpendicular lines and using them to solve geometric problems. |
| **0** | The student response contains insufficient evidence of an understanding of the Geometry concepts involved in proving the slope criteria for parallel and perpendicular lines and using them to solve geometric problems. As a result, the response does not merit any points. |

**Correct Answer for CBT Item #7: Technology-Enhanced Item**

| Transformation | Congruent to Triangle $RST$ | Not Congruent to Triangle $RST$ |
|---|---|---|
| a dilation by a scale factor of 2 with respect to point $R$ | ○ | ◉ |
| a 540° counterclockwise rotation about point $S$ | ◉ | ○ |
| a reflection over $\overline{ST}$ | ◉ | ○ |

**Correct Answer for CBT Item #11: Technology-Enhanced Item**

Part A:

$$\sqrt{9} + \sqrt{9} = \boxed{6}$$

Part B:

$$2\sqrt{3} \cdot 2\sqrt{4} = \boxed{8}\sqrt{\boxed{3}}$$

**Rubric for CBT Item #13: Constructed Response**

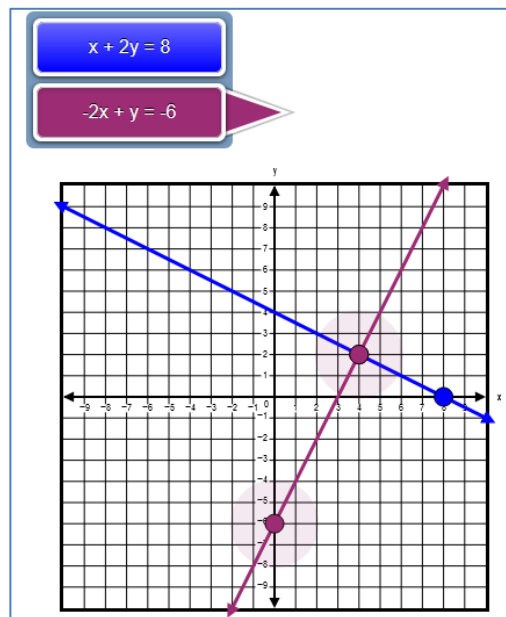| Scoring Guide | |
|---|---|
| Score | Description |
| 4 | The student response demonstrates an exemplary understanding of the Number and Quantity concepts involved in explaining how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. The student constructs and evaluates expressions involving radicals and rational exponents. |
| 3 | The student response demonstrates a good understanding of the Number and Quantity concepts involved in explaining how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. Although there is significant evidence that the student was able to recognize and apply the concepts involved, some aspect of the response is flawed. As a result, the response merits 3 points. |
| 2 | The student response demonstrates a fair understanding of the Number and Quantity concepts involved in explaining how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. While some aspects of the task are completed correctly, others are not. The mixed evidence provided by the student merits 2 points. |
| 1 | The student response demonstrates a minimal understanding of the Number and Quantity concepts involved in explaining how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. |
| 0 | The student response contains insufficient evidence of an understanding of the Number and Quantity concepts involved in explaining how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. As a result, the response does not merit any points. |

**Correct Answer for CBT Item #18: Technology-Enhanced Item**

**Part A:**

$$(4, 2)$$

**Part B:**

x + 2y = 8

-2x + y = -6

**Correct Answer for CBT Item #21: Technology-Enhanced Item**

The function that has the greatest initial value is [ f(x) ▾ ] .

The function that has the greatest value when $x = 50$ is [ h(x) ▾ ] .

**Correct Answer for CBT Item #23: Technology-Enhanced Item**

| | | |
|---|---|---|
| Row 20 has | 79 | flowers. |
| Row 35 has | 139 | flowers. |

**Rubric for CBT Item #27: Constructed Response**

| Scoring Guide | |
|---|---|
| Score | Description |
| 4 | The student response demonstrates an exemplary understanding of the Statistics and Probability concepts involved in summarizing categorical data for two categories in two-way frequency tables and interpreting relative frequencies in the context of the data. The student calculates relative frequencies based on information in a table. |
| 3 | The student response demonstrates a good understanding of the Statistics and Probability concepts involved in summarizing categorical data for two categories in two-way frequency tables and interpreting relative frequencies in the context of the data. Although there is significant evidence that the student was able to recognize and apply the concepts involved, some aspect of the response is flawed. As a result, the response merits 3 points. |
| 2 | The student response demonstrates a fair understanding of the Statistics and Probability concepts involved in summarizing categorical data for two categories in two-way frequency tables and interpreting relative frequencies in the context of the data. While some aspects of the task are completed correctly, others are not. The mixed evidence provided by the student merits 2 points. |
| 1 | The student response demonstrates a minimal understanding of the Statistics and Probability concepts involved in summarizing categorical data for two categories in two-way frequency tables and interpreting relative frequencies in the context of the data. |
| 0 | The student response contains insufficient evidence of an understanding of the Statistics and Probability concepts involved in summarizing categorical data for two categories in two-way frequency tables and interpreting relative frequencies in the context of the data. As a result, the response does not merit any points. |

**Correct Answer for CBT Item #28: Technology-Enhanced Item**

The [ second ˅ ] student's calculation is more accurate by about [ 56 ˅ ] square yards.

**Correct Answer for CBT Item #30: Technology-Enhanced Item**

| Circle | Angle | Line Segment | Parallel Lines |
|---|---|---|---|
| the set of all points equidistant from a point in a plane | two rays that have the same endpoint | part of a line that contains two endpoints and all the points between them | lines in a plane that do not intersect |

**Correct Answer for CBT Item #32: Technology-Enhanced Item**

Part A:

$540\pi$ cubic inches

| ↶ | + | − | × | ÷ | 🔲 | 🔳 |
|---|---|---|---|---|---|---|
| ↷ | $y^x$ | $\sqrt{}$ | $\sqrt[3]{}$ | = | (·) | % |
| 🗑 | | | ▼ | | | |

Part B:

The volume of cylinder Y is [ equal to ⌄ ] the volume of cylinder X, and the

volume of cylinder Z is [ greater than ⌄ ] the volume of cylinder X.

**Rubric for CBT Item #34: Constructed Response**

<table>
<tr><td colspan="2" align="center"><strong>Scoring Guide</strong></td></tr>
<tr><td align="center">Score</td><td align="center">Description</td></tr>
<tr><td align="center">4</td><td>The student response demonstrates an exemplary understanding of the Algebra concepts involved in creating equations and inequalities in one variable and using them to solve problems. The student writes and solves inequalities to model a situation and applies the solutions to the context of the problem.</td></tr>
<tr><td align="center">3</td><td>The student response demonstrates a good understanding of the Algebra concepts involved in creating equations and inequalities in one variable and using them to solve problems. Although there is significant evidence that the student was able to recognize and apply the concepts involved, some aspect of the response is flawed. As a result, the response merits 3 points.</td></tr>
<tr><td align="center">2</td><td>The student response demonstrates a fair understanding of the Algebra concepts involved in creating equations and inequalities in one variable and using them to solve problems. While some aspects of the task are completed correctly, others are not. The mixed evidence provided by the student merits 2 points.</td></tr>
<tr><td align="center">1</td><td>The student response demonstrates a minimal understanding of the Algebra concepts involved in creating equations and inequalities in one variable and using them to solve problems.</td></tr>
<tr><td align="center">0</td><td>The student response contains insufficient evidence of an understanding of the Algebra concepts involved in creating equations and inequalities in one variable and using them to solve problems. As a result, the response does not merit any points.</td></tr>
</table>

**Correct Answer for CBT Item #36: Technology-Enhanced Item**
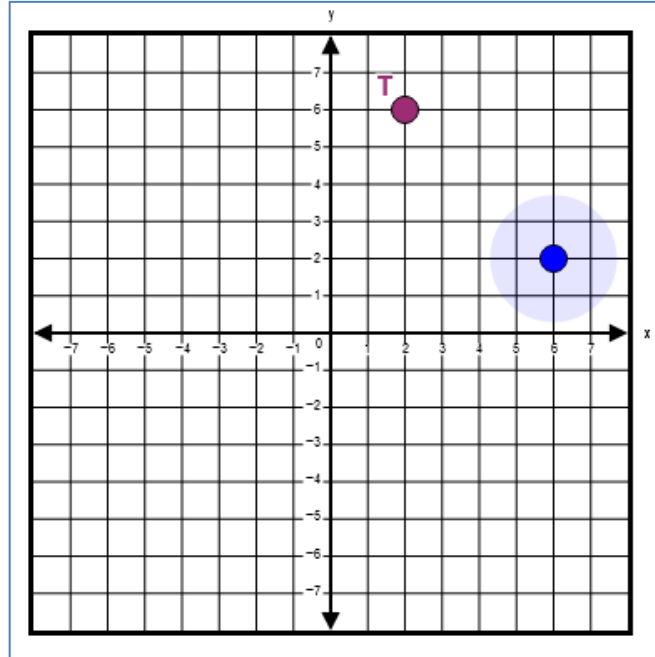
**Correct Answer for CBT Item #41: Technology-Enhanced Item**

On average, $f(x)$ [ decreases ▾ ] by [ 3.6 ▾ ] units as $x$ increases by $1$ unit over the interval $-1 \leq x \leq 2$.